DOCUMENTING PERCEPTIONS ABOUT PESTICIDES AND OTHER ENVIRONMENTAL EXPOSURES WITH PHOTOVOICE: MOTHERS' CONCERNS FOR THEIR CHILDREN

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ABSTRACT

Women of childbearing age and children living in rural agricultural regions are at-risk for pesticide exposure from a variety of pathways including occupational track-in, drift from farming activities, residential usage, and dietary intake. The purpose of this dissertation research is to answer the questions: "What do mothers perceive as pesticide exposure pathways for themselves and their children? How do these perceptions differ between cultural groups?" The study involves a secondary analysis of data collected during the summer of 2007 in the Red River Basin of the North from the University of Minnesota's Regional Sustainable Development Partnerships and the Division of Environmental Health Sciences. Sixteen women from three diverse groups participated: Caucasians enrolled in the Women Infant and Children federally subsidized nutrition program, new American immigrants, and Native Americans. Due to culture, economics, and geography, these groups may experience increased health risks from pesticide exposure. Photovoice was used as a qualitative methodology to document mothers' concerns about pesticide exposure and other health issues for their children, since it enables participants, including those who lack verbal acumen in the language of the dominant culture, to use photographs to address questions like, "Why does this situation exist? Do we want to change it, and, if so, how?" Caucasian and Native American mothers voiced concern about pesticide exposure from drift due to agricultural spraying on the ground and by plane. All participants wanted advanced notice to take precautionary measures before fogging or spraying. Perceptions of pesticide exposure differed according to the cultural lens of each group: Caucasian women saw the necessity of industrial agriculture and pesticide usage as a trade-off; Native American women voiced concerns about pesticide contamination to traditional foods; and new American immigrants expressed a need to learn how to read labels and use pesticides safely. Participants suggested culturally congruent strategies for the delivery of educational information. Consumption of locally grown organic foods was identified as one strategy to reduce pesticide exposure. This research assists public health professionals, extension educators, and primary care providers with the aim of reducing pesticide exposure to children living in rural agricultural regions.

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CHAPTER 1

BACKGROUND AND AIMS

Research Context

This dissertation is a secondary analysis on a public health needs assessment which was part of a larger, one year collaborative planning research project led by Dr. Kathryn Draeger, Ph. D., Principal Investigator, and Statewide Director of the University of Minnesota Regional Sustainable Development Partnerships (UMN Partnerships) and Professor Patricia McGovern from the Division of Environmental Health Sciences, School of Public Health, University of Minnesota. The first year of the project was funded, in part, by the Blue Cross Blue Shield (BCBS) Foundation of Minnesota as part of broader initiative, “Growing Up Healthy: Kids and Communities.” The Foundation’s initiative is a statewide effort to improve the health of Minnesota’s children through a focus on social and environmental health determinants. The goal of the BCBS initiative is to build strong and connected communities where children can grow up healthy by working at the cross-section of health and the physical environment. The mission of UMN Partnerships is to facilitate regional sustainable development projects through citizen-driven participation in collaboration with University of Minnesota faculty.

The public health needs assessment was identified as a priority activity for UMN Partnerships because of community concerns about the findings of a survey and focus group research conducted by the Environmental Resource Council in 2004 that documented that more than 50% of the residents believed that pesticide exposure may cause birth defects and cancer. Additionally, 70% reported they did not have adequate knowledge about risks to their health created by exposure to pesticides. Citizens said the most reliable and trusted sources of information included local county public health professionals and educators from the University of Minnesota. Given the public concerns and the trust voiced in public health professionals and education, Dr. Dragger wanted to identify acceptable community strategies to better understand the nature of pesticide exposure to women of childbearing age and their children in the Red River Valley for the purpose of promoting healthy children and communities.

This research is relevant to the field of occupational and environmental health nursing. The National Institute for Occupational Safety and Health (NIOSH) identifies its research priorities under the framework of the National Occupational Research Agenda (NORA). It is organized by industrial sectors, one of which is agriculture. Within this sector, priorities include vulnerable populations, outreach, agricultural safety and health, all of which relate to this research to address mothers' perceptions of their families' exposures to pesticides (National Institute for Occupational Safety and Health, March 2008). In addition, the National Research Council's report, *Pesticides in the Diets of Infants and Children* called for identification of all pesticide pathways to exposure for use in children's risk assessment (National Research Council, 1993a). Consistent with these recommendations, a needs assessment, using principles of Community Based Participatory Research, called "Photovoice" was implemented.

Collaborative planning among academic researchers and local partners took place between September 2006 and May 2007. Data was collected in Photovoice workshops held between May and July of this same year, and analyzed by Dr. Pat McGovern for major themes to be described in a final report to the funding agency in August 2007.

This dissertation is a secondary analysis of the data obtained from women raising young children in the Red River Valley. The specific aims of this research are to: (1) conduct a secondary analysis of the data to identify deeper meanings and themes collected from the Photovoice needs assessment; (2) to develop culturally appropriate recommendations based on unique preferences of the groups for future outreach, practice, research and policy; and (3) to evaluate the application of principles of Community Based Participatory Research to this use of Photovoice and the effectiveness of the activity from the perspective of the participants and the co-researchers.

The long-term goal of this research is to address the paucity of research on the perception of women, particularly vulnerable women, to their exposures to pesticides. A myriad of studies have been conducted on the association of chronic, low-dose pesticide exposure and adverse health effects. These studies have been quantitative. Inadequate exposure assessment has been a major deficit in these studies. Little if any qualitative research has been conducted related to mothers' perceptions of how their children may become exposed to pesticides. A greater emphasis is placed on traditional gender roles in rural American culture, with women largely responsible for activities related to nurturing and child care. (Bushy, 1993; Leipert & George, 2008; Mulder et al., 1999). This research will provide insights from the perceptions of mothers as to how children's exposure to pesticide may occur, and how best to assist families to reduce exposure.

Specific questions for this research include the following:

1. What do mothers perceive as pesticide exposure pathways for themselves and their children?

2. What are the similarities and differences between the three cultural groups of Photovoice participants in regard to their perceptions of the above issues?

3. What conditions would these mothers like to see changed (if any) to better protect the health and safety of themselves and their children?

4. What differences or similarities exist among the conditions identified by three cultural groups?

CHAPTER 2

REVIEW OF THE LITERATURE: PATHWAYS TO PESTICIDE EXPOSURE

This chapter will examine the existing scientific literature concerning what is known about how people may become exposed to pesticides. Evidence exists for several pathways to pesticide exposure, which include: occupational, drift, residential usage, dietary, and drinking water. Studies will be analyzed for evidence to support the existence of these pathways with an emphasis on children's exposure. The information is relevant to the needs assessment and the identification of future recommendations to reduce pesticide exposure to mothers and children in the Red River Valley Basin of the North.

PART I: PESTICIDE EXPOSURE THROUGH OCCUPATIONAL TRACK-IN, DRIFT AND PROXIMITY

This section will review six studies that provide evidence to support the existence of children's exposure to pesticides from occupational track-in by parents working in agriculture and drift through proximity to treated fields. The research employs a variety of approaches toward measurement of exposures that includes environmental and biological monitoring.

Evidence for a Pathway

Supporting evidence has emerged for the existence of two primary pathways to exposure for children who live with at least one agricultural worker in rural farming areas: occupational track-in and occupational proximity. Simcox et al. (1995) found statistically higher levels of organophosphorus pesticides in the house dust and soil of homes where at least one agricultural worker resided as compared to reference homes. This study was conducted during 1992, in a rural agricultural area of eastern Washington where many small family fruit tree orchards are located. The aims were to assess levels of pesticide concentrations in household dust and in soil located in children's indoor and outdoor play environments, and to ascertain whether children who live in homes with at least one agricultural worker are exposed to higher levels of pesticide concentrations in household dust compared to children of non-agricultural workers. Families of 26 farmers, 22 farm-workers, and 11 reference families participated. Reference families had no residents with direct agricultural pesticide contact and resided more than one-quarter of a mile from an operating orchard. All families had at least one child under age six in residence.

Measurements of pesticide concentrations were targeted to four commonly used organophosphate pesticides (OP) pesticides in this orchard region: Azinphos-methyl (AZM); chlorpyrifos; phosmet; and ethyl parathion. Paired samples consisting of outdoor soil and indoor dust were significantly and positively correlated for all pesticides in the homes of agricultural applicators and workers (AZM: $r = 0.49$; p 0.001; phosmet: $r = 0.67$, $p < 0.0001$; chlorpyrifos: $r = .52$, $p = 0.0003$; ethyl parathion: $r = .35$, $p = 0.02$). The authors concluded that this finding is suggestive of a "common source for pesticide contamination of soil and household dust" (p.1131).

Residues in soil and household dust were found to be predominantly from agricultural and not residential use. Soil levels of pesticides from agricultural families ranged from non-detectable to 930 ng/g, compared to reference homes which ranged from non-detectable to 39 ng/g. Dust residue from agricultural homes ranged from non-detectable to 17,100 ng/g, with 75% (32/48) of these homes having concentrations greater than 1000 ng/g for at least one of the designated substances. In contrast, pesticide residues in household dust from non-agricultural families ranged from non-detectable to 820 ng/g. Median pesticide concentration levels in household dust were 17-100 times higher than soil levels (Wilcoxon signed-Rank test: $p < 0.0001$).

Household dust concentrations were analyzed for agricultural families living less than and greater than 50 feet from an orchard; using the Mann-Whitney U test, mean and median levels were higher for groups living closer than 50 feet for all four compounds, with statistically significant levels seen in median levels of AZM (~ 4,000 ng/g vs. ~ 900 ng/g; $p = 0.04$), and parathion ~ 750 ng/g vs. ~ 90 ng/g; $p = 0.005$). When reference households were included, the trend of increasing concentrations with decreasing distance from a farm was strengthened for AZM ($p = 0.001$), chlorpyrifos ($p = 0.02$), and parathion ($p = 0.001$, using Kruskal Wallis analysis.

No specific pathways to exposure were found from track-in from shoes or pets, or the frequency of vacuuming despite the fact that significantly higher levels of pesticide loading levels were found in the carpeting of applicators compared to farm worker households for median values of chlorpyrifos and parathion (Chlorpyrifos, 2.7 mcg/m2 vs. 1.2 mcg/m^2; p = 0.04; parathion, 2.7 mcg/m^2 vs. 0.05 mcg/m^2; p = 0.002).

Although pesticide concentrations in house dust were much lower in reference families than in agricultural families, since residues from all four OP pesticides were present in reference families, and these families lived between one-quarter and one-half of a mile away from an orchard— the authors suggested that people living in agricultural regions with similar characteristics as this study region may have quantifiable pesticide residues in their homes irrespective of personal pesticide usage.

Having found that children of agricultural families are exposed to higher levels of pesticide residues from soil and household dust, Loewenherz et al. (1997) conducted a cross sectional study in an orchard region of eastern Washington to evaluate whether children of parents working in agriculture have higher urine concentrations of pesticides than children of non-agricultural workers. Participants consisted of 48 volunteer families who had at least one person in the household employed as a pesticide applicator, and 14 reference families with no members working in agriculture who resided more than 200 feet from active farmland.

A total of 88 children between the ages of three and five years participated, including 70 from applicator households and 18 from reference households. Data collections included two "spot urine" samples obtained from participating children within a one-week period of time, and parental interviews to elicit information about the types of pesticides used, household practices, and work practices. Three analytes of organophosphorus pesticide metabolites were measured: (1) dimethylphosphate (DMP);

dimethylthiophosphate (DMPT); and dimethyldithiophosphate (DMDTP). Ultimately, DMTP was selected as the only biomarker or analysis, since it was the most commonly detected metabolite (40% of 117 samples).

Reference children had a two-fold greater frequency of non-detectable samples compared to applicator children (60% vs. 33%), but only on the second visit. Children of applicators had a four times higher median concentration of DMTP when combined for both visits than reference children (0.021 vs. 0.005 micrograms per dilution; Mann Whitney U test, p = 0. 015). Exposures were higher for younger children. At the second visit, median DMTP concentrations in 3-4 year olds children of applicators were significantly greater compared to their first visit samples (0.033 micrograms per dilution[mcg/dl]) 0.009 mcg/dl; Wilcoxon Signed Rank test; p = 0.047), while no comparable difference was seen for children ages 5 to 6 years .

Exposure levels also varied according to proximity to pesticide spraying. Children of applicators living less than 200 feet from spraying showed a marginally significant increase in median concentrations during the second visit (0.015mcg/ml vs. 0.023 mcg/ml; Mann-Whitney U test, p = 0.062). Children living less than 200 feet from spraying had significantly higher frequencies of detectable concentrations, when detectable, trace and non-detectable categories were compared for the second visit, (~ 59% vs. ~25%; Fisher Exact test, p = 0.036).

Differences were found in exposure related to one worker home hygiene practice. Of sibling pairs with detectable metabolites, 70% lived with an applicator that reported wearing work shoes inside the home vs. 33% of sibling pairs with non-detectable metabolites.

Lu, Fenske, Simcox and Kalman (2000) conducted a cross sectional study in an orchard region in Washington to improve characterizations of exposure pathways from household proximity, and occupational take-home as related to children's direct exposure levels. Eligibility included volunteers from agricultural families that had, at least one member working as an orchard pesticide applicator or a farm worker and reference families that had no household members with pesticide contact and resided more than 1/4 of a mile (approximately 400 meters) from an active orchard. Families from both groups had at least one child age six or younger living in the home. Samples were taken from 109 children ages six or younger and 76 homes between May and July of 1995.

Personal and biological measurement was performed through spot urines and children's hand wipes during two interviews at their residences three to seven days apart and analyzed for the presence of the OP pesticides--AZM and phosmet. Environmental samples were taken from the steering wheel of the vehicle used for transportation to and from parents' work, non carpeted floors, and parents' work-boots. Survey questions were asked about practices related to these pathways, which included: the regularity and magnitude of pesticide use, personal hygiene practices, housekeeping practices, the distance of the residence to treated orchards, and the activity of the children.

Pesticide residues were found on the children's hands, parent work boots, and the vehicles' steering wheels of many of the agricultural households. In comparison, no detectable OP target pesticide concentrations were found in hand or environmental samples from reference households. A statistically significant difference in the median level of pesticide concentrations (mcg/g) from house-dust between agricultural families and reference families was found for: AZM: 1.0 vs.0.15, $p<0.001$; phosmet: 0.14 vs.0.09, p = 0. 02; and dimethyl OP pesticides: 1.92 vs. 0.27, $p< 0.001$ (Whitney U Wilcoxon Rank Sum W test)

Proximity from pesticide spraying areas mattered. Median pesticide concentrations in household dust were significantly higher in the homes of agricultural children living 200 feet or less from an orchard compared to children living 200 feet or more from an orchard for AZM (1.3mcg/g vs. 0.49 mcg/g; p= 0.008) and dimethyl OP (2.6 mcg/g vs. 0.87 mcg/g; p= 0.014) (Whitney U-Wilcoxon Rank Sum W test). A trend of decreasing median concentrations of dimethyl OP pesticide concentrations in house dust according to proximity to active orchards was found in four categories: 50 feet or less (~ 3 mcg/g), 50-200 feet (~2 mcg/g), 200 feet to one-quarter mile (~1.4 mcg/g), and one quarter mile or more (box plot: median ~1.0mcg/g); these differences of pesticide residue in house dust were significantly greater than median levels in reference households, which were all located greater than one one-quarter mile from active farm land (~ 0.2 mcg/g) (p = 0. 04). The authors asserted that the elevated house dust levels in agricultural family homes living more than one-quarter mile away from active farmland compared to reference households living more than on-quarter mile away provides evidence for an occupational track-in pathway.

Applicators' children who resided in homes 200 feet or less from an active orchard, compared to those living greater than 200 feet from an active orchard, had significantly higher median urinary metabolite concentrations (DMTP: 0.03 vs. 0.01; p =

0.009; dimethyl OP: 0.07 vs.0.02; $p = 0.01$; Whitney U-Wilcoxon Rank Sum W test). However, only a marginally significant association was found between residues in house dust in agricultural residences and dimethyl OP metabolites of the children ($n = 60$) (Spearman rho 0.35, $p = 0.09$).

Dimethyl OP metabolites were lower in children whose parents removed shoes and contaminated work-clothes before entering the home, but this difference did not reach statistical significance. No association was seen between vacuuming practices and the dimethyl OP metabolite levels of agricultural children. No significant associations were seen between the use of pesticides on lawns, household dust levels, and children's urinary OP metabolite concentrations. In addition, no significant associations were noted in the concentration of urinary metabolites from children living in households (n=16%) who reported treating pets with pesticides.

Koch, Lu, Fisker-Anderson, Jolley, and Fenske (2002) conducted a longitudinal study in this same region to test the premise that a temporal variation exists in children's exposure to OP pesticides and to develop a temporal profile of pesticide exposure in children through the analysis of urinary metabolites. Temporal patterns of exposure were analyzed in relation to age, gender, residential proximity to active farmland, and parental occupation. A total of 52 families with 44 children enrolled in the federal food program for women infants and children (WIC) participated. Four interviews were conducted; biweekly urine specimens were collected for one year and analyzed for six diethylphosphate metabolites (DAPs) found in most OP pesticides Twenty-seven children had parents who were employed as farm workers in field agriculture, while 17 children had parents employed as non-agricultural workers.

Out of 998 samples, 972 were analyzed for DAP and creatinine concentrations. A global positioning system determined that most families lived more than one-quarter mile from active orchards (30/44). Significantly higher mean DAP concentrations were seen in the children's urine samples collected during spray months compared to non-spray months as measured in micromoles per liter (dimethyl spray months- 0.96, SD 2.72 vs. non-spray months- 0.072, SD 2.52, $p = 0.009$; diethyl spray months- 0.049, SD 1.98, vs. non-spray months- 0.035, SD 1.54, $p = 0.018$). No children of pesticide applicators participated in this study and only five children lived in households closer than 200 feet to an orchard. Therefore, these additional factors found in previous research to increase the risk of higher pesticide residues in the home were not present in this study. The results showed temporal variability in the exposure to pesticides for children living in an agricultural region; they are consistent with results from Simcox et al. (1995) and Lu et al. (1995) that found pesticide residues in reference homes without agricultural workers which were located one quarter to one quarter to one half mile away from treated farmland.

McCauley et al (2003) conducted a study in rural Oregon to characterize the relationship between pesticide concentration levels in households of agricultural applicators and their self-reported home hygiene practices. Families from 24 farms who owned orchards or had at least one member working at an orchard, along with four control families who lived in the same area and had no members employed in agriculture were recruited by referral. Both groups had at least one child between the ages of infancy and 7 years.

Four questionnaires were administered to elicit information about demographics, characteristics of the home, pesticide usage, work-practices, household cleaning practices, play locations and precautions taken during pesticide spraying events to keep children away from equipment and exposure. Dust samples were uniformly taken from inside the front entry and in the children's play area of the homes.

The pesticide AZM was detected in approximately 79% (19/24) of the playrooms from the agricultural households (median of .71 parts per million [ppm]); other OP pesticides that were found in these play areas, included phosmet (n= 7, median .38 ppm) chlorpyrifos (n=7, median .14 ppm) and malathion (n=3, median .15 ppm). In contrast, no OP pesticide residues were detected in play areas of the control family homes. Residues from carpet were higher than residues from hard flooring.

The number of workers in the household with high contact job descriptions was significantly associated with the median level of total OP pesticide residues measured in dust samples from play areas ($W = 194$; $p = .007$). Median residue levels for total OP pesticides were 4.44 ppm higher in homes, which reported having two individuals with jobs that required direct contact with pesticides, compared to homes that reported only one adult working with pesticides.

Significantly higher mean levels of total OP pesticides and AZM were found in the households of workers who reported waiting more than two hours before changing out of their work clothes compared to homes with workers who reported changing out of their work clothes within two hours after returning from work (T (21) = -3.3, $p < .01$). These two findings provide evidence to support an occupational track-in pesticide pathway; other findings from this study did not support this pathway.

In 2003, Thompson et al. published the results of a cross sectional study using a blocked randomization design conducted in the lower Yakima Valley of Washington. A telephone survey was administered to 571 agricultural workers that contained 73 questions about home hygiene practices, work practices, and work hygiene facilities available on the job. A response rate of 93 % was conducted among eligible participants for the cross sectional interviews. A sub-sample of 213 workers with 211 children between the ages of two and six years was asked to contribute urine and dust samples.

Two to three voids were pooled to create a urine sample for each parent-worker and child. Concentrations of five metabolites, which are by-products of target OP pesticides used in the region, were quantified: dimethylphosphate [DMP], dimethylthiophosphate [DMTP], dimethylthiophosphate [DMDTP], diethylphosphate [DEP], and dimethylthiophosphate [DETP]. Dust samples were uniformly collected from the area in homes where the children played most frequently and foot-wells in the front and rear of the vehicle used to transport workers to and from their jobs (Curl et al., 2002).

Six OP pesticides were found in house dust samples (n = 156) and vehicles (n = 90). Geometric means and geometric standard deviations of house dust values in mcg/g are as follows: AZM, 0.53, SD 4.3; malathion, 0.05, SD 3.0; chlorpyrifos, 0.05, SD 4.6; m-Parathion 0.03, SD 4.8; phosmet 0.02, SD 0.02; and diazinon 0.01, SD 0.01. Vehicle dust OP pesticide geometric mean and geometric standard deviations include: AZM 0.75, SD 5.3; chlorpyrifos 0.03, SD 4.8; malathion 0.02, SD 5.3; m-Parathion 0.01: phosmet 0.01, SD 20; and diazinon 0.00, SD 7.6. AZM was the most common OP pesticide found in both house dust samples (85%) and in vehicle samples (87%), and had the largest values of the six compounds found. Geometric means and geometric standard deviations for dimethyl and diethyl concentrations in children were 0.09, SD 2.9 and 0.06, SD 1.5 and for adults were 0.9 SD 7.2 and 0.04, SD 2.0, respectively.

Three significant relationships were found using linear regression. First, a significant association existed between vehicle dust and house-dust for AZM ($R^2 = 0.41$; $p < 0.0001$) (Curl et al, 2002; Thompson et al, 2003). Second, a significant relationship was found between concentrations of AZM in house dust from children's play areas and in dimethyl DAP concentrations in children's urine ($R^2 = 0.15$; $p < 0.0001$) (Curl et al, 2002). Third, dimethyl DAP levels were significantly associated with urinary metabolite concentrations from adults and children living in the same house ($R^2 = 0.15$; $p < 0.0001$) (Curl et al, 2002; Thompson et al, 2003).

Summary

This review of the literature supports evidence for the existence of pathways of organophosphorus pesticide exposure to children from occupational track-in, and drift due to proximity to agricultural production, primarily from fruit orchards in Washington. Elevated levels of household dust have been measured in the outdoor soil and in the play areas of agricultural households as compared to non-agricultural households (Loewenherz, Fenske, Simcox, Garland & Kalman, 1997; Lu, Fenske, Simcox, &

Kalman, 2000; Simcox, Fenske, Wolz, Lee, & Kalman, 2000; and Thompson et al., 2003). Pesticide residues have been found on the steering wheel of vehicles used to transport parents to and from work (Lu, 2000) and on the front and rear foot-wells of household vehicles (Thompson, 2003) which may represent dermal, clothing, and shoe contamination, support a vector for the occupational take-home pathway.

Pesticides in the soil, household dust, and on the steering wheels of family vehicles represent the potential for indirect exposure; whereas, pesticide concentrations measured through biomarkers represent direct exposure. Elevated levels of urine metabolites for OP pesticides have been found in children from agricultural households as compared to reference households (Loewenherz, et al., 1997; Lu, et al., 2000). Since biomarkers for pesticide concentration in urine indicate direct biological exposure, this finding provides evidence that exposure to children has actually occurred.

Studies supporting drift by proximity include: Simcox et.al (1995); Loewenherz et al. (1997) and Lu et al. (2000). A trend of increasing indoor levels was seen with decreasing distances from active farmland (< 50 feet vs. >50 feet) for four Organophosphorus (OP) pesticides being measured, with statistical significance reached for azinphosmethyl (AZM) and parathion (Simcox et al., 2000). This same trend was found by Lu et al. (2000), who showed decreasing concentrations in household dust according to proximity categories.

Common limitations in these studies are as follows. While spot urine samples are more economical and easier to produce than 24-hour urine samples since, it is not possible to know at which point the urine was collected during metabolism and excretion of the analytes, increased variability may have been introduced into the results. Several of the studies measuring occupational track-in and drift through proximity used self-report surveys along with environmental and or biological samples (Loewenherz et al., 1997; Lu et al., 2000; McCauley et al., 2003; Simcox et al, 1995; and Thompson et al, 2003). While self-report may not be completely accurate due to incomplete recall, inaccurate knowledge about a subject, or a reluctance to self-disclose, careful collection, processing, and analysis of environmental and or biological sampling through the use of standardized protocols were strengths of these studies same studies.

Several studies failed to show associations between a variety of self-reported home hygiene practices to decrease pesticide exposure and reduced pesticide concentration levels in household dust (Lu et al., 2000; McCauley et al., 2003; Simcox et al, 1995). Possible explanations for these findings include: (1) inaccuracy of self-reported information; (2) error in the method of collecting household dust; or (3) the questions may not have been useful in predicting indoor exposure levels. All of the analytical studies were conducted on small, non-randomized populations (with the exception of Thompson et al., (2003); therefore, the findings may not be representative of their target populations. Lastly, the studies were all conducted in the Pacific Northwest and are not generalizable to other areas since weather patterns, crops and pesticide usage vary between regions.

In spite of these limitations, the findings presented from this literature review of the occupational pathway to pesticide exposure are relevant to the participants in this Photovoice effort, since mothers in the RRV Basin of the North who are married to farmers or living adjacent to family farms may have concerns about pesticide exposure due to drift from proximity and occupational track-in. These women may want knowledge about common sense protective housekeeping practices for the purpose of minimizing exposure. While the evidence for the effectiveness of housekeeping and hygiene practices in minimizing exposures is ambiguous, application of the precautionary principle would suggest the relevance of prevention and protection strategies for farm families and families living proximal to active farms. The precautionary principle asserts that when the potential for harm exists in the midst of scientific uncertainty, it is not necessary to wait for all scientific relationships to become fully established in order to take protective actions that safe guard health (Kriebel et al., 2001).

PART II: PESTICIDE EXPOSURE FROM SPRAY DRIFT

Drift from Bystander Exposure, Aerial Spraying and Truck Application

Spray drift from pesticides is defined by the United States Environmental Protection Agency (U.S. EPA, 1999) as "the physical movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application (p.1).

This phenomenon can occur when nozzles emit tiny droplets that remain temporarily suspended in air until wind current carries them to unintended sites. Both on-the-ground equipment and air craft can release pesticide spray drift (Weppner, Chensheng, Herbert, Yost, & Fenske, 2006). Exposure to pesticides can occur to humans, animals and plants through drift. This review of the literature will discuss five related studies: (1) a descriptive study on bystander exposure to pesticides based on reports to the American Association of Poison Control Center; two studies that analyzed deposition of pesticide residues after routine spraying of fields; one study that analyzed health complaints after an orchestrated spraying campaign in Australia; and a study that evaluated the impact of community truck spraying on emergency room admissions for asthma exacerbation.

Little is known about the characterization of pesticide exposure to bystanders since the type, amount and route of pesticide exposure usually is not known, and surveillance for non-occupational exposures is not mandated (Bryden, McKnight, & Westneat, 2005). The EPA's Office of Pesticide Programs encourages people exposed to pesticides to contact their physician, local poison control center, or health department for assistance (U.S. EPA, 1999). A descriptive study conducted by Bryden, McKnight and Wheat in four southern states, which utilized the narrative notes from phone calls taken by the American Association of Poison Control Center found that 5% of all acute pesticide poisonings resulted from bystander exposure. Complaints were elucidated in the majority of cases and ranged from mild irritation to severe neurological symptoms (Bryden et al, 2001). Bystander exposure was defined as exposure occurring to a person who was not using the substance, and did not have direct control over its use. Cases included in this study consisted of pesticide exposures reported from drift, direct spray, and releases from manufacturing plants and transportation of pesticides. Poison control calls containing codes for chemicals including fertilizers, fungicides, insecticides, fumigants, herbicides and rodenticides were searched from the computer database of the American Association of Poison Control Center (AAPCC) during the year 2001 from

Kentucky, Tennessee, Alabama, and Louisiana. Narrative notes from professionals answering these calls were examined for bystander exposure.

Of 98 pesticide exposure reports, 46 bystander exposures occurred in 32 incidents. Almost two-thirds of those exposed were either referred to or examined in a medical facility. In 74% of cases, symptoms were recorded. Route of exposure for the majority of cases implied both inhalation and dermal (63%) followed by inhalation (28%), and dermal (9%). Fifteen symptoms were reported from 74% of the cases in the following order of frequency: dermal irritation; nausea; headache; neurological; dizziness; diarrhea; irritated throat; shortness of breath; coughing; vomiting; eye irritation; lip stinging or feeling thick; bad taste in mouth; nasal stuffiness; and salivation. The severity of dermal complaints ranged from "sunburn-like redness to whole-body rashes to blistering skin; headaches ranged from mild to migraine, and neurological impairments ranged from malaise, disorientation and confusion to slurred speech, constricted pupils and visual impairments"(p.7). Insecticides were the most common types of pesticide identified, with 17/25 insecticides consisting of organophosphates. Other chemical exposures included herbicides, fertilizers, and defoliants. Nearly five percent of acute pesticide ingestion included bystander exposure, which were captured by narrative notes.

A limitation was the use of symptoms as a proxy since it was not possible to verify the names or doses of chemicals implicated. Second, these cases may represent an underestimation of actual incidents, since all persons who are exposed may not report the events, and even if treatment is sought, an estimated 1/3 of health care providers report these cases to poison control centers (Alarcon et al., 2005).

Richards et al. (2001) evaluated the levels of pesticide concentrations that residents could be exposed to inside and outside of households located near rice fields in Arkansas after aerial spraying with propanil which is used in. 70% of the state's rice crops. Treatment groups lived within 125 meters of an active rice field (n=11), and control groups lived at least one mile from a treated field (n=3). Passive sampling devices were placed inside the homes and between the households and the treated fields of 8 / 11 families 15 minutes before and remained for 1.5 hours after spraying.

Wind patterns differed among the eight household sites with the winds blowing: toward the homes (sites 3, 4, 6 and 8); away from the homes (sites 1, and 7); and multi-directionally (sites 2, and 5). The highest concentration of propanil were found among the group with the wind blowing toward their homes with the greatest concentrations at the edge of the field (12, 390 micrograms [mcg]) and inside the home (6.7 mcg). In comparison, one residence with the wind blowing away from its household had detectable levels of propanil which were 25 times less than levels found from a monitor at a similar distance where the wind was blowing toward the household (18.2 mcg vs. 432.8 mcg). Seventy-five percent of households with the wind blowing toward them had detectable propanil concentrations (site 4, 6.65 mcg; site 8, 3.5mcg; site 6, 3.1 mcg).

Of the four sites which experienced the wind blowing toward their households, the closer the home was to the field, the higher the indoor concentrations of propanil that were measured (46 meters-6.65 mcg; 101 meters-3.5 mcg; 108 meters-3.1 mcg; and 113 meters-non-detectable). Additionally, the closer the measurement was taken to the field, the greater the concentrations that were yielded. Although the authors asserted that wind speed was an influencing factor, mixed results were reported, making this finding ambiguous. No detectable concentrations of propanil were found in the control group. This study provided evidence that drift from aerial spraying can occur both indoors and outdoors of households near treated fields, with primary determinants as wind direction and distance from the residence.

Weppner et al. (2006) initiated the first study to include outdoor and indoor measurements after aerial pesticide application and assess the potential for children's exposure from aerial spraying through both environmental and biological monitoring. Participants consisted of eight families with six children between the ages of 2-12 years who lived in Central Washington and had households within 15 to 200 meters of a farm field treated liquid methamidophos (Monitor[4]) by aircraft flying 10 feet above the crop canopy at 110 miles per hour. Environmental samples taken from the day before, the day of, and the day after spraying included: pesticide residues from community parks and yards; air vapor within the breathing zone of the children in community space, yards, and inside of residences; and wipe samples taken from playground equipment, private yards; and from indoor kitchen surfaces. Spot urine samples were collected at baseline, the evening prior to spraying and the day after spraying, while 24-hour urine specimens were collected on the day after spraying.

An inverse relationship was found between the median values of residues located inside the boundaries of the fields and the distance from the nearest sprayed field ($p = 0.03$). Community air concentrations rose from median pre-application levels of 0.05 to 0.11 micrograms per cubic meter (mcg/m^3) on the morning of application to 0.48 mcg/m^3 on the afternoon of the application day, and then decreased to 0.10 mcg/m^3 on the day after application; significantly higher application and post application values were found compared to pre-application values ($p < 0.05$). Air samplers located outdoors at residences showed a four-fold greater median concentration the day after application compared to the day before application (0.03 mcg/m^3 vs. 0.13mcg/m^3). Indoor concentrations did not exceed 0.03 pg/m^3 and the majority of the samples were less than or near the level of detection. No detectable residue was found on counter surfaces or on apples inside the households.

Significantly higher Monitor[4] concentrations were seen on playground equipment at six hours and eleven hours after spraying began compared to pre-application levels ($p = 0.04$; median concentrations, 0.04,0.57 and 1.04 nanograms per cubic centimeters respectively [ng/cm^3]). While no measurable residues were found on toys at pre-application, four out of six toys had measurable residues ranging from 0.11-0.37 ng/cm^3. Children's hand-wipes contained significantly higher median residues on the day of application compared to baseline and pre-application residues (baseline: <0.02, pre spray: <0.02; spray day: 0.08 mcg/sample; $p = .03$); median levels extracted during the spray day were significantly higher than median levels extracted on the day after application (spray day: 0.08; post spray day: 0.05; p = 0. 05).

On the day of spraying, median concentration levels obtained after 11AM were significantly higher than those obtained before 11AM ($p = 0.06$). Urinary metabolite levels from specimens obtained after 11AM on the day of spraying were moderately correlated with the amount of time the children spent outdoors ($r = 0.68$, $p = 0.09$), hand-wipe levels obtained on the day of spraying ($r = 0.67$, $p = 0.10$); and metabolite levels collected on the day after spraying ($r = 0.66$, $p=0.11$). However, these correlations did not reach statistical significance.

Monitor[4] residues found on deposition plates located within the boundaries of fields in the community park, the yards, and on the outdoor toys of residences lend support to a pesticide exposure pathway from off-target drift due to aerial spraying. In addition, elevated residues on the hands of children and elevated metabolite levels following spraying indicated that the youth were directly exposed.

Both physical symptoms and health care visits were evaluated by Petrie, Thomas and Broadbent (2003) before and after two aerial spray campaigns using a biological insecticide, *Bacillus thuringiensis* (Foray 48B) in New Zealand. While visits to health practitioners did not increase during application times, participants at follow-up compared to baseline reported a statistically significant elevation in symptom complaints.

Using a prospective study design Petrie and colleagues (2003) investigated if complaints of adverse health symptoms and health care visits increased from 10 weeks prior to the conclusion of a 12 week aerial spray campaign that consisted of three pesticide applications. Subjects age 18 and over were recruited door- to door in a community of 13,500 residents. Baseline and follow up surveys were administered that inquired about the following information: demographics, previous diagnosis with asthma, hay fever, or allergies, recent adverse health symptoms, visits to health care providers, changes in medications, and the general perception of the effect that the spraying had on health.

A total of 292/315 residents participated (93%). Of the 62% who responded (181/292) significant elevations in the frequencies of three clustered categories were found in symptoms before and after the spraying campaign: (1) neuropsychiatric responses; (2) local effects on the upper airways; and (3) gastrointestinal responses. Overall, a significant increase was seen in the total number of all symptoms at baseline versus symptoms reported in the follow-up questionnaire; however, the difference between time periods is on average one symptom (mean=3.9, SD=3.56 vs. mean 4.78, SD=4.48, t (156) = -2.99, p=0.003)[1]. Results of ANOVA showed a significant increase in symptoms from baseline to the conclusion of the spray campaign for participants with a diagnosed history of hay fever compared to the reference groups of participants without hay fever (F (1147) =5.30, p = 0.02). No significant elevations were seen after spraying in participants with health histories of asthma or other allergies compared to the reference group. A total of 9.2% of respondents said they discussed the effects of the spraying with their physician, and 6.5% of participants reported that they changed their medication because of the spraying. Most adult participants reported that their own health was not adversely affected by the spraying 58% vs. 42%, but were equally divided about whether or not the spraying had an adverse impact on their children's health.

There is biological plausibility for the majority of the reported systems with the exposure. The authors asserted that increase in upper airway and GI symptoms are plausibly related to the spraying. Foray 48B contains spore associated crystals derived from an endotoxin, named *thuringiensis kurstaki*, several volatile chemicals, and

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[1] Note: The authors did not include degrees of freedom in reporting their results.

“residual components of the medium in which the organism was cultivated” (p.5). Therefore, this pesticide could cause local irritation of the upper airways (presumably from the volatile chemicals, and or the residual medium). GI effects could be due to germinating spores that produce replicating bacilli, since exposure to B. thuringiensis has led to documented human infection with the organism. In contrast, the neuropsychiatric symptoms were posited to be associated with insomnia from the noise of the early morning planes, or anxiety about the spraying.

A well-controlled time-series study by Karpati et al. (2004) used zip codes and dates three days before and after community pesticide spraying by truck fogging to eradicate West Nile Virus showed no increases in admissions to public hospitals due to asthma exacerbations. In the summer of 2000, pyrethroids were applied in New York City to decrease mosquitoes as a preventive measure for West Nile Virus. Human exposure to this insecticide is associated with respiratory irritation, asthma aggravation, and lung inflammatory conditions (Reigart & Roberts, 1999; U.S. EPA, 2006). Karpati et al., 2004, conducted a population level study to determine if elevated levels of asthma-related admissions to public hospitals occurred in association with community spraying by trucks. Using a time series approach with zip codes, the dates of spraying and emergency department (ED) admissions to public hospitals were analyzed from four out of five New York City boroughs during a 14 month period between October 1999 and November 2000. The number of asthma-related visits was compared according to zip code locations during the three days before and three days after spraying with pyrethroids, with the neighborhood communities serving as their own controls. Information was also collected for 14 months about asthma visits in relation to possible confounding factors including: day of the week; season of the year; and daily conditions, such as, particulate, ozone, temperature, and precipitation.

No significant increases in asthma-related admissions to public hospital EDs were associated with neighborhood spraying. Multivariate models using lag times showed no significant association between relative risk (RR) increases in asthma-related ED visits and truck-fogging up to six days after spraying.

Summary

This review of the literature provides supportive evidence for exposure due to drift from aerial spraying. Results from environmental monitoring conducted by Richards et al. (2001) and Weppner et al. (2006) found measurable pesticide residue after aerial application. Richards and colleagues evaluated spraying that was conducted under varied wind directions, wind speeds, and distances of residences from treated fields; his findings showed pesticide residue both outside and inside of family households with wind direction, wind speed, and distance of the homes from the fields influencing the amount of pesticide measured. In comparison, Weppner and colleagues analyzed a well executed spraying conducted under ideal conditions with the wind blowing away from the community, and found pesticide residue confined to outdoors with no pesticide residue inside of households. Richards et al. did not include dermal or urine sampling of family members, so no evidence was provided that direct exposure actually occurred to participants. In contrast, Weppner et al. found that direct exposure occurred to the children of these families, since dermal wipes, and urinary metabolites were positive. Because no residue was found inside of participant households, exposure was thought to have occurred outside with toys and playground equipment as possible vehicles of transmission. Median pesticide metabolites peaked at 170 mcg/l between the hours of 11AM and midnight on the spray day. The reference dose (Rfd) for monitor[4] is 0.005 mg/kg/day (U.S.EPA, 1991). Since the authors did not conduct a risk assessment it is difficult to interpret these findings from a health perspective for the children.

Petrie et al. (2003) found a significant increase in adverse health symptom complaints from baseline to follow-up after two 12-week aerial spray campaigns in New Zealand. Since no control group was present and multiple confounding factors were not controlled, causation cannot be inferred or ruled out from these results. Lastly, Karpati et al. (2004) found no increase in hospital ED admissions related to community truck spraying in New York City, which was conducted while residents were sleeping; the public was pre-warned and instructed to keep their windows closed with air conditioners operating. These results did not include environmental samples to substantiate truck blasting as a pathway to exposure, and did not rule out the presence of less severe symptoms. All of these studies were conducted with unique pesticides that have differing health endpoints and exposure characteristics. In addition, the sample populations were not selected randomly, volunteered for participation, and resided in remarkably different regions. Therefore, generalization both from and between these studies is not possible.

Bryden's research from AAPC records in four southern states showed that adverse health effects from pesticide exposure can occur to bystanders as a result of drift. Results showed that bystanders accounted for 5% of the pesticide exposure calls. Although the article did not capture specific scenarios in which exposure by drift occurred, symptoms ranged from mild to acute, and approximately 75% of those who notified the AAPC were referred for medical treatment.

These studies are relevant to the Photovoice needs assessment in the RRV since aerial spraying with pesticides is common in this region. Additionally, communities in the RRV Basin frequently use truck spraying as a measure to control WNV, since a preponderance of cases in Minnesota during 2007 have occurred in this region (U.S. Geological Survey, 2007). Mothers may be worried about pesticide exposure to their children from drift due to both aerial spraying and truck fogging, and concerned about the potential for toys left outdoors during spraying as a vehicle for pesticide exposure to their children. In addition, the women may be concerned about bystander exposure to drift for themselves and their children when driving on roads adjacent to aerial spraying in progress. As such, these women may be interested in learning about measures they can take to reduce exposure to pesticides to protect their families.

PART III: RESIDENTIAL PATHWAY TO PESTICIDE EXPOSURE

According to a U.S. EPA report, approximately 90% of all households in America use pesticides in and around their homes (Kiely, Donaldson, & Grube, 2004). Common pesticides used in residences include insecticides, termiticides, rodenticides, fungicides and disinfectants to control insects, termites, rodents, fungi, and microbes. Pesticides on family gardens may be blown in through open windows, as well as tracked into homes, where it typically breaks down more slowly than in outdoors. These patterns of pesticide use suggest the potential for children to become exposed in the residential setting. Moreover, estimates from the U.S. EPA National Human Activity Pattern Study document that the average American spends 87% of their time indoors (Klepeis, 2001), heightening the need to examine residential settings as potential exposure pathways.

Evidence for Exposure

Studies by Fenske et al., (1990) and Gurunathan et al. (1998) provide evidence that the potential for pesticide exposure can occur for one to two weeks after indoor home application. In a risk assessment conducted for an infant under conditions that simulated pesticide labeling instructions for re-entry after chlorpyrifos was applied, Fenske et al. (1990), found exposures to chlorpyrifos exceeded the reference dose by 10-50 times. Gurunathan et al. (1998) found that the deposition of chlorpyrifos occurs in two stages, first as a particle and then as a vapor, and maintained that this deposition model had not been considered heretofore in the context of children's exposure to pesticides. These authors maintained that polyurethane foam (PUF) has been used as a collection media for pesticides in ambient air, and that soft toys, which are similar to PUF, acted as reservoirs for pesticides. Moreover, household surfaces, including pillows, bedding and furniture may absorb chlorpyrifos and accumulate high levels over repeated residential applications. Although chlorpyrifos is still widely used in agricultural settings, since the publishing of these articles, the U.S. EPA has banned the use of this pesticide for residential purposes (U.S. EPA, 2002). However, the results of these studies are still salient since they emphasize the importance of considering the unique chemical properties of the pesticide sprayed, the impact of exposure through toys and soft objects, and consideration of dermal and non-dietary pathways in risk assessment for children.

Fenske and colleagues (1990), conducted a study to measure air and surface residues of chlorpyrifos using broadcast application for the purpose of assessing residential exposure levels and risk to infants after re-entry according to manufacturer instructions. Broadcast application consists of hand spraying a solution directly onto intended fixtures such as, furniture, floor, and rugs. No chlorpyrifos was detected from samples taken in the rooms before application. Compared to studies using crack and crevice, baseboard, aerosol, or termiticide methods of applications, chlorpyrifos from broadcast application yielded residues that were 5-10 times higher, and peak air concentrations were roughly one to two orders of magnitude higher. Concentrations in the infant breathing zone of non-ventilated rooms reached 60 micrograms per cubic meter (mcg/m^3) at three to five hours post application, rising to 94 mcg/m^3 at five to seven hours; in comparison, concentrations in adult breathings zones did not exceed 20 mcg / m^3. Time weighted averages for 24-hour post application in the infant versus adult breathing zones were markedly elevated at 41.2 and 66.8 mcg/ m^3 respectively, for ventilated and non-ventilated rooms, compared to 12.3 and 45.7 mcg/m^3 for the adult breathing zones. A human reference dose (RFD) of .003 mg/kg/day for chlorpyrifos set by the U.S. EPA for the adverse health effect of measurable changes in plasma acetyl cholinesterase. A risk assessment for a nine to ten-month old infant playing on the carpet at least one hours after spraying exceeded the human reference dose (RfD) by 10 to 50 times.

Gurunathan et al. (1998) estimated time-related depositional patterns on toys and surfaces after a broadcast application of Dursban containing 41.5 % chlorpyrifos, and resultant exposure levels to children through risk assessment. The study was conducted in two apartments comparable in design and furnishings, under conditions, which emulated directions on the pesticide label. The application occurred for a five to seven minute period by a licensed pesticide applicator; toys were not sprayed directly.

Deposition on toys was compared with results from surface samples taken at multiple post application time intervals. After 72 hours, concentrations on repeat wipe samples from the dresser tops rose to levels that were two times greater than plastic toy surfaces at one and two weeks. While the surfaces of plastic toys peaked at one week, the felt toys showed slower sustained increases over two weeks, with concentrations that were two times greater than those on hard surfaces. The findings were consistent with the behavior of semi-volatile organic compounds, such as chlorpyrifos, which can move between particle and vapor phases; these compounds attach to airborne particles and disperse, and then over time, gradually volatilize and diffuse vapor. The study showed that contamination levels after spraying with semi-volatile chemicals can continue to build on indoor hard surfaces for one to two weeks and that felt toys can serve as sinks, and act as reservoirs for future contamination, because of their sorptive material. Hand to mouth activity in small children increases their risks for exposure.

A risk assessment was determined for a child age three to six years in the home environment based on contact with surfaces and toys one week after application, and included inhalation, dermal, and non-dietary ingestion. The results estimated exposure to a non-dietary dose of 208-mcg/ kg per day, with 39% due to the dermal route and 61% due to oral doses from playing with toys; the estimate exceeded the current reference dose of 3-mcg/ kg per day by a factor of 21.

Children can also be exposed to pesticides by the residential pathway at school and daycare as well as in their family homes. Alarcon and colleagues (2005), conducted a study to estimate the magnitude of and risk factors for acute pesticide induced illnesses at daycare and schools for children and adults during 1998-2002. Cases were identified through the integration of databases from three national surveillance systems: the National Institute for Occupational Safety and Health's Sentinel Event Notification System for Occupational Risks pesticides program (SENSOR); the California Department of Pesticide Regulation (CDPR); and the Toxic Exposure Surveillance System, (TESS). Inclusion criteria involved exposure to pesticides with subsequent adverse health symptoms that were consistent with known toxicological effects of the involved pesticide. Cases across three databases were compared and the findings revealed that 2,593 persons had "acute pesticide-induced illnesses associated with pesticide exposures at schools between 1998-2002. The general incidence rate of pesticide induced illness among children during this time period was 7.4 cases per million. A statistically significant trend of increasing incident rates per million was present for children ages 0-5 years (p <0.001), and ages 6-17 years (p<0.001) between the years of 1998-2002. For younger children, the incidence rates ranged from11.3 in 1998 to 22.5 in 2001. For older children, the incidence rates ranged from 5.0 in 1998 to 6.4 in 2002. In comparison, the incident rate for adult for adult workers was 27.3 per million full-time equivalents, with yearly incident rates decreasing from 44.4 in 1998 to 25.8 in 2002. The odds of severe and moderate illness were lower for children compared to adults (8% vs. 18%; OR 2.6, 95% CI, 1.1-2.2), and higher for females than males in adults and children combined (12% vs. 8%; OR 1.5, 95 CI, 1.2-2.0).

A total of 406 pesticide induced illnesses from children (n=149) and adults (n=254) were reported to SENSOR / CDPR as occurring on school grounds. Of these, 69% of the cases were sustained by pesticide exposure on school grounds, while 31% of cases were sustained by pesticide drift from farms. A higher proportion of children compared to adults were exposed by drift from neighboring farmland vs. on-premise usage (children 66% vs. adults 33%; p=0.001). Pesticides most frequently implicated on school grounds were insecticides (n=156, 56%) and disinfectants (n=99, 35%), and the most common active ingredients were: diazinon (n=64, 23%), sodium hypochlorite (n=47, 17%) chlorpyrifos (n=40, 14%), quaternary ammonium compound (n=38, 14%) and Malathion (n=14, 5%). Of those illnesses sustained from pesticide drift, insecticides, 91% were implicated with insecticides while seven percent were implicated with fumigants; the most common ingredients were: chlorpyrifos (n=28, 22%); methamidophos combined with chlorothalonil and propargite (n=25, 20%), mancozeb combined with glyphosate (n=20, 16%), cyfluthrin combined with dicofol (n=16, 13%), and Malathion (n=13, 10%). The results of this study showed that acute illnesses from pesticide exposure do occur to children in the school environment albeit in low incidence rates.

Summary

Findings from Fenske et al. (1990) and Gurunathan (1998) showed a potential for infant's and children's exposure in the home setting from the organophosphate pesticide, chlorpyrifos, which in both studies were considerably over the RfD in risk assessments. Prior to Gurunathan's research, pesticide exposure after residential usage was thought of as a one stage process; this study documented the unique characteristics of chlorpyrifos as a semi-volatile compound with exposure occurring during two distinct phases over one to two weeks, and the potential for continued future exposure for children through contact with soft toys. A limitation of these studies is that the authors did not identify the structural air infiltration rates in their experimental settings; therefore, it is unknown how this risk assessment would differ with variations in air infiltration among other residential settings (U.S. EPA, 2007).

In the aftermath of the chlorpyrifos ban, one study using national point of sale tracking data has shown that pyrethroids have largely replaced organophosphate pesticides in U.S. homes; however, hundreds of pesticides are currently approved for residential usage (Beckarian, Payne-Sturges, Edmondson, Chism, & Woodruff, 2006). As such, other semi-volatile pesticides with varying degrees of toxicity may be used in American households (Bradman & Whyatt, 2005). Findings from Fenske (1990) and Gurunathan's studies underscore the importance of considering unique characteristics of pesticides as related to exposure and toxicity, and conducting risk assessment that includes exposure routes relevant to children, such as, measurement of air concentrations at children's breathing levels, and dermal and non-dietary contributions.

Alarcon and others (2005) have demonstrated that children are also at risk for acute pesticide induced illnesses in school and Daycare settings. Although, the trend showed that acute cases of pesticide induced illnesses among school employees have been decreasing, the potential for low-dose chronic exposure to children is a concern due to track-in from adult workers who may be involved in mixing, applying, and cleaning spills from pesticides. Also disturbing is the trend for increasing incidents of acute pesticide induced illnesses among children in schools between 1998-2002. Since 40% of these cases were sustained from farmland drift, the authors asserted that these case increases might be occurring due to sprawl, which places new schools at the border of neighboring farms.

These articles are relevant to this Photovoice needs assessment since mothers in the RRV basin may use pesticides in and around the homes and may be concerned about the possibility of exposure to their children. Bruce Bomier, President of the non-profit Environmental Resource Council of Minnesota related that public concern about pesticide exposure from drift due to aerial spraying has increased in the RRV basin. This concern is in part due to recent development that has resulted in more communities encroaching on existing farmland (personal communication, Bruce Bomier, 11/08/2006). Mothers may feel uneasy about the potential for children's pesticide exposure in school settings, which may be related to on the ground usage as well as drift, since it is likely that schools in the RRV basin boarder farmland.

PART IV: DIETARY PATHWAY TO PESTICIDE EXPOSURE

Pesticides in the Diets of Infants and Children (1993) was a landmark report by the National Research Council (NRC) which has shaped research and policy and guided research in the elucidation of multiple pesticide exposure pathways for children during the last 14 years. The document identified several deficits in information that were necessary to conduct more accurate risk assessments and to set standards for protecting children. These recommendations were instrumental in the establishment of new standards for the 1996 Food Quality Protection Act to reduce dietary pesticide exposure to infants and children (Public Law, 1996). The new standards included: a consideration of the health effects of pesticides in the diets of infants and children; the addition of an extra ten-fold margin of safety when setting tolerances in risk assessment for infants and children to account for differences in developmental toxicity; and the conduction of risk assessment that considers cumulative exposure to multiple pesticides with the same mechanism of toxicity. Consistent with the NRC report, three studies have attempted to estimate pesticide consumption through the dietary exposure pathway in children.

Fenske, Kedan, Lu, Fisker-Anderson and Curl (2002) conducted a duplicate diet study to characterize pesticide exposures from 15 OP pesticides to preschool children. Two 24-hour samplings occurred during the summer and fall seasons of 1998. Recruitment consisted of families with children between the ages of 2 and 5 years living in two rural agricultural counties (n = 6) and in two suburban counties from Washington State (n = 7), who had relatively higher combined urinary diaklyphosphate (DAP) levels in previous studies. Duplicate portions of all food that the children consumed in 24 hours were prepared by their parents, and a sample of tap water was collected. Samples were analyzed by gas chromatography and cumulative risk from OP pesticide exposure was performed.

Ten children participated in the study with an average age of 3.9 years. From 88 dietary samples, 6 /15 targeted OP pesticides were detected (AZM, chlorpyrifos, malathion, methidathion, methyl parathion, and phosmet). Fresh produce contained the most pesticide determinations of any category of food. AZM was the most common pesticide detected, with 24% (4/17) fresh fruit and vegetable samples containing this pesticide. AZM was also found in 19% of beverages (4/ 21) and in 44% (4/9) of apple juice samples. The upper bound of the cumulative risk from dietary OP pesticides was estimated in a risk assessment for the child with the highest dietary exposure. This child lived in the suburbs and consumed a serving of 114 grams of cherry tomatoes in the fall, which contained 30 ng/g of AZM and 350 ng/g of chloropyrifos. The total dietary dose of OP pesticides was 2.5 mcg/kg/day, reflecting acute, not chronic, exposure. The acute Population Adjusted Daily reference dose (aPAD) for chlorpyrifos is 1.7mcg/kg/day. Therefore, the exposure exceeded the safety benchmark dose for this pesticide. Concentrations from all other samples were considerably less than the aPAD.

Curl, Fenske, and Elgethan (2003) conducted a study in Seattle, Washington to compare the levels of pesticide OP metabolites in children between those who ate largely organic foods and those who ate largely conventional foods. Recruitment took place in the entries of a food co-op and a large retail grocery store that served clientele of the same socioeconomic strata. Parents with one child between the ages of 2 and 5 years who self-reported serving either primarily organic foods or primarily conventional foods were enrolled. Parents kept food diaries for two days before and the day of 24-hour urine monitoring of their children.

A total of 43 children ages 2-5 participated. Five metabolites of OP pesticides were measured: dimethylphosphate (DMP); dimethylthiophosphate (DMTP); dimethyldithiophosphate (DMDTP); diethylphosphate (DEP); and diethylthiophosphate (DETP). DMTP was found significantly more frequently than the other four compounds (87% of all samples, $p < 0.0001$); thus, the analysis was conducted solely on this compound. Children who consumed organic foods had significantly lower levels of total urinary dimethyl metabolites compared to children who consumed conventional foods (medians, 0.03 vs. 0.17, $p = 0.0003$). Under the premise that all exposure was from oxydemeton-methyl, 88% of the children who ate organics and 100% of the children who ate conventional foods would have exceeded the US EPA chronic reference dose or cRfD. If AZM were the only source of exposure, one child (6%) that ate organic food would have gone beyond the cRfD, and 11 children (52%) who ate conventional food would have exceeded the cRfD. If 100% of the exposure were from malathion or phosmet, no child in either group would have exceeded the cRfD.

Lu et al. (2006) conducted a longitudinal study in the summer of 2003 to assess daily dietary OP pesticide intake in the context of overall pesticide exposure. Children between the ages of 3-11 years who ate conventional foods (n=23) were recruited through a flyer sent home from schools in suburban Washington. Children consumed conventional foods during days 1-5; organic foods were supplied and substituted during days 4-8; and conventional foods were eaten during days 9-15. Organic foods were substituted for all foods reported by the USDA to contain OP pesticides in the child's *usual* diet. Dietary intake was recorded in a diary by parents during the study period. Urine samples were collected from the children at bedtime and upon awakening the next morning. Metabolites were measured for specific OP pesticides, herbicides, and pyrethroid insecticides.

Metabolites for chlorpyrifos (TCPY) and malathion (MDA) were present in all 23 samples. The median urinary TCPY and median urinary MDA dropped directly after introducing organic foods into the children's diets, and rose again immediately after conventional foods were re-introduced. Daily Volume-Weighted Averages (DVWAs) for both metabolites were significantly lower in the organic food consumption phase compared to conventional foods phase ($p < 0.01$).

The researchers asserted that the organic diet provided a "dramatic" and "immediate" and "protective effect" in preventing exposure to chlorpyrifos and malathion in the diets of children who regularly consumed foods containing OP pesticides, such as, conventional fresh fruits and vegetables, juices, and wheat products.

Summary

Conventional wisdom is that diet is the most common pathway to pesticide exposure, since virtually all people are exposed to pesticide residues through consumption of conventional foods. The USDA Pesticide Data Program (PDP) and the U.S. Food and Drug Administration (US FDA) Total Dietary Study program both routinely sample foods for pesticide residues (US DA, 2007; US FDA, 2007). While the PDP targets foods for testing that are commonly consumed by children and reports them to the US EPA for risk assessment, Fenske et al. (2002) provided a real world example of the actual diets of a small group of children, a daily pesticide intake that accounts for food production, storage and preparation, and a risk assessment that shows how these intakes relate to the RfD. The results of this study provide insight into the nature of exposure that children may experience through diet. However study findings are based on the assumption that 100% of the pesticide was absorbed across the gastrointestinal tract. Without actual biomonitoring, it is not possible to know how much of this pesticide was actually ingested.

Curl et al. (2003) and Lu et al. (2006) both employed direct biomonitoring to determine the doses of pesticide absorbed by the intake of conventional foods compared to organic foods. All three studies by Curl et al. (2003), Lu et al. (2006) and Fenske et al. (2002) employed risk assessment to determine if eating organic vs. conventional foods shifted these children under or over the RfD. As in any risk assessment, uncertainties were present in the assumptions that were modeled; these researchers clearly articulated those assumptions and resultant uncertainties. Probably the largest uncertainty in the study by Curl and colleagues (2002) was the fact that the exact pesticides implicated in exposure could not be isolated. However, their approach of constructing dosages from the least and most toxic pesticides is consistent with the process of risk assessment, which includes the construction of both upper bound and lower bound exposures. Several children exceeded the RfD from the intake of conventional foods. Since the health effects of exceeding RfDs is not known, a diet of conventional foods was associated with a domain of uncertain risk. In the case of the moderately toxic chemical, AZM, eating organic foods would have shifted these children below the RfD. Study findings showed that eating organic foods can shift risk from uncertain domain of risk to a certain negligible domain of risk that is protective of children's health.

Chensheng and colleagues showed a dramatic decrease in pesticide metabolites with the initiation of organic foods that rose again when conventional foods were reintroduced. No pesticides were detected in the organic foods served to the children before and during the study. Since the USDA organic standard requires that foods be 95% free of synthetic pesticides, not all organic foods may be totally free of pesticides (USDA, 2007). In addition, pesticides may unintentionally get into organic food due to mistakes in labeling and food processing (Baker, Benbrook, Groth, & Lutz, 2002). Therefore, the results of this intervention may not consistently be as dramatic as these study findings. In spite of these uncertainties, all three studies supported the premise that dietary exposure can be an important pathway for children's pesticide exposure, and suggested that the consumption of organic foods may decrease pesticide exposure. The strength of these studies is that they relied on direct measurement, instead of self-report. A weakness is that they all employed small voluntary populations, and as such, the results cannot be generalized; nonetheless, these findings could be viewed as a pilot to develop larger studies involving probability samples of young children in the future.

This review of the literature is relevant to participants in this Photovoice needs assessment since it provides evidence of a dietary pathway to pesticide exposure along with a simple, and relatively effective means to reduce exposure. The literature is consistent with the premise that a chronic low-level of background pesticide exposure occurs through diet, which may be characterized by events of pesticide exposure from other pathways. Since these families live in an intensive agricultural region, which also has an abundant mosquito population, mothers may be concerned about their children becoming exposed to pesticide drift from agricultural sources as well as community truck spraying to decrease the risk of West Nile Virus. As such, they may want to increase the consumption of locally grown organic foods as one approach toward reducing pesticide exposure.

PART V: DRINKING WATER PATHWAY TO PESTICIDE EXPOSURE

According to the report, Pesticides in the Diets of Infants and Children, water could be a potentially significant pathway to pesticide exposure for infants and children (National Research Council, 1993b). Estimates of water intake by tap water added to food in production, and in total food moisture were developed by Ershow and Cantor (1989) for the National Cancer Institute using data from the 1978-1979 Nationwide Food Consumption Survey (NFCS), using a nationally representative sample.

Findings revealed that the highest water intake estimates in grams per kilograms of body weight per day (g/kg/bw/day) were for infants during the first 6 months of life, with intake declining steadily up to the age of 75 years or older (6 or less months: females, 205 vs. males 170; 7-12 months: females, 145 vs. males, 140; 1-3 years: females, 99 vs. males, 104; 4-6 years; females, 72 vs. males, 73; 7-10 years: females, 59 vs. males, 60; 11-14 years: females, 40 vs. males, 45; 15-19 years: females 35, vs. males 40; 20-75+ years, approximately 35 for both male and female).

In the population of infants less than 1 year of age, the percentage of total fluid intake was as follows: formula, 32.7%; milk and milk drinks, 24.7%; and drinking water 16.1%. Of the tap water intakes from infants less than 1 year, 69% were derived from drinking water, while 11.9 % were ingested through formula. By ages 1-10 years, since formula was no longer consumed, the percentage of total water intake from drinking water rose to 30.3 %, while 25% consisted of milk or milk products, and 13.6% was ingested from fruit juice, tomato juice and non-carbonated drinks. Consistent with these findings that newborn infants consume the greatest amount of water per body weight of any age category, the American Academy of Pediatrics asserted in their text, Pediatric Environmental Health, that the average newborn consumes five ounces of formula or breast milk per kilogram of body weight a day, which is the equivalent of an average adult male drinking 30, 12-ounce cans of soda per day (American Academy of Pediatrics Committee on Environmental Health, 2003a).

Infant Formula and Pesticide Residues

Formula is the only source of food for infants during the first three months of life. Thus the quality of infant formula and water are important considerations in safeguarding newborn health. Intensive analytical testing of infant formulas has not detected pesticide residues (National Research Council, 1993c). Formula production is regulated by the U.S. Food and Drug Administration through the Infant Formula Act. Ingredients are subjected to stringent physical processes in the form of raw agricultural commodities (RACs) before they are converted into infant formula.

Water is the largest ingredient of ready to feed formula and has the potential to be the most significant source of pesticide residues. Water used in formula is subjected to a purification process that includes general filtration and carbon column filtration at several junctures. Gelardi and Mountford analyzed 35 pesticide compounds in U. S. manufactured milk-based samples (n=2043) and soy-based formula samples (n=1141) using gas chromatograpy; these pesticide residues included chlorpyrifos, alachlor, aldicarb, atrazine, diazinon, malathion, and methyl and ethyl parathion. No samples were found that contained detectable pesticide residues.

Sources of Water: Ground Water and Surface Water

Ground water is located under the surface of the earth and comes from rain and melting snow. It is thought to be less vulnerable to contamination than surface water, since it percolates down between the soil and rocks which act as a filter for contaminants (Nadakavukaren, 2000). While most groundwater is safe, contamination has been found in groundwater from all 50 states. Water flowing underground through rocks may pick up natural contaminants such as calcium, magnesium and chlorides; it may also contain dissolved elements, including arsenic, selenium, or radon. In addition, ground water may be contaminated by human activities conducted in watershed areas, such as, mining, farming and the use of chemicals (United States Environmental Protection Agency, 2006a),

Surface water consists of sources, which include streams, rivers, and lakes. An estimated 80% of municipal drinking water systems across the nation use ground water as their source. However, 66% of the American public is served by a community water system that uses surface water, since most urban areas use water from this source (United States Environmental Protection Agency, 2006b; United States Environmental Protection Agency, 2007b) (United States Environmental Protection Agency, 2007b)(United States Environmental Protection Agency, 2007b)(United States Environmental Protection Agency, 2007b). Another 10-20% of people living in America utilize ground water through private wells (United States Environmental Protection Agency, 2007c).

Pesticide Usage in the Red River Valley Basin of the North

A collaborative survey was conducted by the Minnesota Department of Agriculture, the United States Department of Agriculture, the National Agriculture Statistics Service, and the Minnesota Field Office to summarize crop production and pesticide usage from 4000 farmers in Minnesota during the year 2005 (Minnesota Department of Agriculture, United States Department of Agriculture, National Agriculture Statistics Service, & Minnesota Field Office, 2007). Corn, soybeans, wheat, and hay were targeted from 76 of the most intensive agricultural counties in Minnesota; pesticide information was collected from farmers of 13% of wheat acres and 9-10% of corn, soybean and hay acres, which represented over one million acres of Minnesota cropland. Counties were clustered into ten pesticide management areas (PMAs) according to similarities in geology, soils, and crops, which also conformed to the general boundaries of the monitoring areas for water resources by the MDA. Counties in the RRV basin are designated in PMA-1 (Table 1).

According to respondents, the top crops in the RRV basin during 2005 by total number of acres in production were (1) soybeans (227,542); (2) wheat (192,930); (3) corn (81,263); and (4) hay (37,719). In comparison, the most common crops by total number of acres in production from the State of Minnesota consisted of (1) soybeans (722,491); (2) corn (672,146); (3) wheat (229,097); and hay (171,154). The highest ten pesticides used by respondents included: (1) glyphosate; (2) MCPA; (3) bromoxynil; (4) acetochlor; (5) two, 4-D; (6) atrazine; (7) trifluralin; (8) methyl parathion; (9) bentazon; and (10) chlorpyrifos (Table 2). Dozens more pesticides were reportedly in use.

Drinking Water Regulations and Monitoring in the Red River Valley of Minnesota

Although drinking water has the potential to represent a significant pathway for pesticide ingestion, due to "limited information on pesticide residues in water and the lack of monitoring data on water intake by infants and children," a quantitative risk assessment for pesticide exposure via this source was not conducted for the report, *Pesticides in the Diet of Infants and Children* (National Research Council, 1993c). Drinking water in the U.S. is regulated under the Safe Drinking Water Act (SDWA). All public water systems in the U.S. are regulated by the SDWA (United States Environmental Protection Agency, 2007b; United States Environmental Protections Agency, 2004). Approximately 170,000 public water systems exist in the nation. Public water systems are defined as water that has at least 15 service connections, and serves at least 25 people for a minimum of 60 days per year. Public water systems include community water systems (public system that serves the same people throughout the year, such as private homes); and non-community water systems (public water systems that do not serve the same people for more than six months).

The SDWA requires numerous activities to protect drinking water. The original Act focused on treatment, while the 1996 amendments focused on protecting source water, operator training, public information, and providing funds for improving water systems. Under the SWDA, National Primary Drinking Regulations (NPDWR) have included the establishment of maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) by the U.S. EPA to limit the amount of natural and man made substances in drinking water that could pose health hazards. MCLGs signify the "level of a contaminant in drinking water below which there is no known or expected risk to health" and allows for a margin of safety (United States Environmental Protections Agency, 2004); this health-based goal is set according to assessment of risk and includes risk to the most sensitive populations, such as infants, children, the elderly and the immune-compromised. MCLs are enforceable permissible levels of contaminants that can be present in drinking water, and are set as close to the MCLGs as is technologically feasible. In cases where it is not technically or economically feasible to set a level, the U.S. EPA instead specifies a required water treatment. Under the NPDWR, MCLs have been set by the U.S. EPA for 87 contaminants, which include 21 pesticides that are organic chemicals (Code of Federal Regulations, 2008; United States Environmental Protection Agency, 2007a; United States Environmental Protection Agency, 2007a).

All states except the District of Columbia and Wyoming have adopted standards at least as stringent as the U.S. EPA and therefore, have received the primacy to regulate the SWDA. The Minnesota Department of Health has set Health Risk Limits (HRLs) for groundwater. According to the MDH, a Health Risk Limit is an "exposure value for a concentration of a groundwater contaminant, expressed in micrograms per liter (ug/L), which can be safely consumed daily for a lifetime. The toxicologic endpoint indicates the organ or organ system that is most sensitive to the contaminant. For carcinogens the endpoint is cancer" (Minnesota Department of Health, 2007a).

During the year 2006, the MDH tested 7,343 public water systems for MCLs. The MDH tests substances mandated under the MPDWR, which include: (1) microorganisms; (2) inorganic chemicals; (3) organic chemicals, such as, industrial solvents and pesticides; and (4) radionuclides. Specifically, 21 pesticides are tested each year, which are mandated by the SDWA (Table 3). According to the MDH community water report, no pesticide levels were above the MCLs in 2006 (Minnesota Department of Health, 2007b). However, only three of the top ten pesticides reported to be in use by the MDA's pesticide survey are monitored under the SWDA: atrazine, glyphosate, and two, 4-D. Under the SDWA, private wells that serve less than 25 people are exempt from regulation. It is the responsibility of well-water owners to ensure that their wells are working properly and to test their drinking water quality.

Mothers who participated in this Photovoice needs assessment reside in seven counties in the RRV. This author located public drinking water reports of those seven counties from the MDH website; all counties receive their water exclusively from ground water sources with the exception of two municipalities: Thief River Falls in Pennington County (surface water source) and Moorhead, in Clay County (surface and ground sources) (Minnesota Department of Health). It is not known whether the participants in this needs assessment consume community water or water from private wells which would influence the relevance of drinking water as a potential pesticide exposure pathway for their families

Pesticide Contamination of Water from Residential Lawn Practices

The U. S. Geological Service asserts that in addition to agricultural activities, pesticide use on residential lawns, golf courses and parks can also contribute to ground and surface water contamination (Christensen, 2007). Eitzer and Chevalier (1999) conducted a survey of water on 53 residential drinking wells from a 19 square mile town in South-Central Connecticut (population 8,000). The town had two farms, and most people had private drinking wells. Sixty-six percent of the residents reported using pesticides in lawn care. A total of 53 private wells were analyzed for 19 pesticides. Of the 53 wells sampled, six (11%) were found to contain at least one pesticide residue. Pesticides recovered included: diazinon; dacthal (DCPA); trifluralin; lindane; chlorpyrifos; and chlordane. Although none reached the reference dose, the findings show that pesticides used in lawn care can reach deep groundwater and contaminate private water wells. These findings support the institution of practices to prevent the migration of pesticides into drinking water wells.

Summary

Extensive analysis has not found pesticide residue in infant formula. No evidence exists that infants and children in the RRV basin are in an area of health concern related to pesticide exposure from drinking water. The majority of public water services in the RRV derive their drinking water from ground water sources, with the exception of Thief River Falls in Pennington County, which has a surface water source and the city of Moorhead, in Clay County, which uses a combination of surface and ground water. No

MCL violations for pesticides have been found in public drinking water systems in the state of Minnesota for the year 2006.

With that said, only three of the top ten pesticides that were reported as used by farmers in the RRV counties were tested under the SDWA; dozens of other pesticides found to be used in the year 2006 by an MDA survey were not tested by public drinking water services. The MCL was not exceeded for glyphosate, the highest pesticide active ingredient applied in 2006. In addition, no MCL violations were found for the fifth and sixth largest active ingredients reportedly applied in the RRV during 2006—two, 4-D and atrazine. Private water wells may be vulnerable to pesticide contamination from human activities, including agricultural or lawn care practices. The U.S. EPA recommends that owners of private wells perform regular maintenance activities and test their water annually for nitrate, coliform bacteria, and pesticides if they are located near intensive agriculture. However, this is a voluntary activity (United States Environmental Protection Agency, 2006a).

All mothers who apply for WIC are asked if they use private well water, and if their well water has been tested. If not, the mother is given a one month supply of ready-to-feed formula and referred to local county services for well-water testing (Patrician Faulkner, Nutrition Supervisor, Minnesota Department of Health, electronic communication, 02/15 and 02/20/08). It is unknown how many families may derive their water from private wells. While it is likely that coliform (bacteria), nitrates, and lead are tested in these wells, it is not known if pesticides are also routinely tested in the wells of families living adjacent to or on farms in the RRV, or how frequently these tests are updated. Inconclusive evidence exists related to whether or not infants and children of families with private drinking water wells are at risk from pesticide contamination through this exposure pathway.

Conclusion

This review of the literature supported the possibility of exposure to pesticides for children from the following pathways: occupational track-in from parents who are farmers or agricultural workers, drift by proximity for houses living closer than 200 feet from actively treated fields, with a temporal pattern of exposure among children in high production agricultural regions who have higher levels of exposure during intensive times of spraying (Koch et al, 2002). However, because these studies relied upon small convenience samples these findings cannot be generalized to dissimilar groups (Loewenherz, 1997; Lu, 2000; McCauley, 2003; Simcox, 1995). Although Koch et al. 2002 employed a larger sample of 52 children, these participants were volunteers from a local WIC clinic and thus were not representative of the target population.

Weppner and colleagues (2006) provided evidence that children can become exposed outdoors from aerial spraying under controlled conditions. However, a risk assessment was not conducted so it is difficult to interpret the levels of exposure related to possible adverse health effects. In addition, Bryden et al. (2005) provided evidence from the American Association of Poison Control Centers that exposure can occur at large in the community due to bystanders located where spraying is taking place. While Alarcon (2007) provides evidence from national surveillance registries of children and workers who have experienced acute pesticide induced illnesses from exposure at school resulting from indoor usage and drift from nearby farm fields.

Since the usual diets of children were analyzed, Fenske et al. (2002, Curl et al., (2003) and Lu et al, (2006) provided evidence which supported the premise that pesticide intake from conventional food may be a constant low level of pesticide exposure that may be a background for events of exposure from other pathways. Consumption of organic foods was shown to be a relatively simple and effective means to reduce exposure. A risk assessment by Curl et al. (2003) showed that it is possible for organic foods to shift children from over the RfD, an area of uncertain risks, to under the RfD, an area of certain negligible risk. However, a major limitation of all three children's dietary studies is that they were selected from small voluntary convenience sampling and cannot be generalized to different groups of children.

Lastly, while drinking water could potentially be an exposure route for infants and children, the 21 pesticides tested annually from public drinking water facilities in Minnesota have shown no violations of maximum contaminant levels. Testing of private drinking water wells is voluntary; it is not known how many mothers participating in this Photovoice project have private wells and how often they are tested for pesticide residues.

The results of this literature review is relevant to the Photovoice needs assessment in the Red River Valley since it provides scientific evidence about the existence of pesticide exposure pathways for children and offers a public health context for concerns these mothers may have for their children related to this topic. Although none of these studies that conducted risk assessments indicated danger of acute toxic exposure, consistent with the precautionary principle, it would be prudent to employ practical measures to reduce pesticide exposure to children whenever possible.

TABLE 2.1

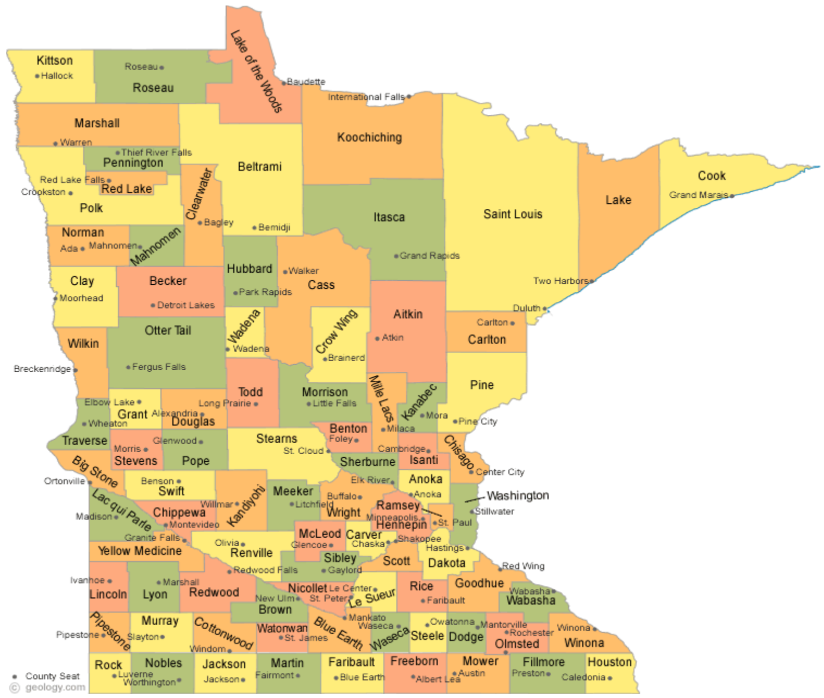
Pesticides Tested Annually in Public Drinking Water Systems According to the National Primary Drinking Water Regulations (NPDWR) Under the Safe Drinking Water Act (SDWA)

Pesticide	Classification	MCL(mg/L)	Adverse Effects	Sources
Alachlor	Herbicide	0.002	Eye, liver, kidney, spleen, anemia, increased cancer risk	Run-off from row crops
Atrazine	**Herbicide**	**0.003**	**Cardiovascular, and reproductive systems**	**Run-off from row crops**
Carbofuran	Fumigant	0.04	Blood, nervous system, reproductive system	Leaching of soil fumigant
Chlordane	Termiticide	0.002	Liver, nervous system, increased risk of cancer	Banned, but residue may be found in soil
2,4-D	**Herbicide**	**0.07**	**Kidney, liver, or adrenal gland**	**Run-off from row crops**
Dalapon	Herbicide	0.2	Kidney (minor changes)	Run-off from use on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	0.0002	Reproductive “difficulties”, increased cancer risk	Run-off, leaching from soil
Dinoseb	Herbicide	0.007	Reproductive	Run-off
Diquat	Herbicide	0.02	Cataracts	Run-off
Endothall	Herbicide	0.1	Gastrointestinal	Run-off
Endrin	Insecticide	0.1	Liver	Banned, but residue may be present
Glyphosate	**Herbicide**	**0.7**	**Kidney, reproductive difficulties**	**Run-off from use**
Heptachlor	Termiticide	0.0004	Liver damage, increased risk of cancer	Banned, but residue may be present
Heptachlor Epoxide	Termiticide	0.0002	Liver damage, increased cancer risk	Break-down of Heptachlor
Lindane	Insecticide	0.0002	Liver, kidney	Run-off,
Methoxychlor	Insecticide	0.04	Reproductive	Run-off/leaching
Oxamyl (Vydate)	Insecticide	0.2	Minor nervous system effects	Run-off/leaching
Picloram	Herbicide	0.5	Liver	Run-off

Pesticide	Classification	MCL(mg/L)	Adverse Effects	Sources
Simazine	Herbicide	0.004	Blood	Run-off
Toxaphene	Insecticide	0.003	Kidney, Liver, or thyroid; increased risk of cancer	Run-off/leaching
2,4,5-TP (Silvex)	Herbicide	0.05	Liver	Banned, but reside may be present

* United States Environmental Protection Agency (2007). National Primary Drinking Water Regulations. URL: http://www.epa.gov/safewater/contaminants/index.

TABLE 2.2
Minnesota Counties with Listing of Counties in the Red River Valley of Minnesota



Counties in the Red River Valley of Minnesota, Pesticide Management (PMA)-1:

Kittson	Red Lake	Traverse
Roseau	Norman	
Marshall	Mahnomen	
Polk	Clay	
Pennington	Wilkington	

*Graphic from: http://geology.com/county-map/minnesota.shtm

Minnesota Department of Agriculture, United States Department of Agriculture, National Statistics Service, & Minnesota Field Office (May 2007). 2005 Pesticide Usage on Four Major Crops in Minnesota. Accessed 2/12/2008: http:www.mda.state.mn.us/news/publications/chemfert/2005pesticidesuse.pdf

TABLE 2.3

Red River Valley- Pesticide Management-1 (PMA-1):
Total pounds of active ingredient applied by survey respondents in crop year 2005

Pesticide Active Ingredient	Crop	Total Pounds of Active Ingredient Applied to Crop
Glyphosate	Soybeans Corn Wheat	200,089 34,511 3,685
MCPA	Wheat	30,282
Bromoxynil	Wheat	24,266
Acetochlor	Corn	10,204
Two,4-D	Wheat	9,861
Atrazine	Corn	6,958
Trifluralin	soybeans	3,780
Methyl parathion	Wheat	3,639
Bentazon	Soybeans	3,058
Chlorpyrifos	Soybeans	2,688

Minnesota Department of Agriculture Pesticide Management Unit, Pesticide and Fertilizer Management Division (January 7, 2008). Summary of Pesticide Detections in Groundwater and Surface Water Resources: MDA 2006 Annual Monitoring Report & Related Information.

*Data in this survey was not statistically weighted; therefore, these figures may over or underestimate the actual number of total pounds used.

CHAPTER 3

GEOGRAPIC AND CULTURAL CHARACTERISTICS

PART I: THE RED RIVER OF THE NORTH BASIN

A primary objective of this dissertation is to answer the research question: *What are the similarities and differences between the three cultural groups of Photovoice participants in regard to their perceptions of pesticide exposure and other health and safety issues for themselves and their children?* In an attempt to address this inquiry, the topographical and environmental conditions of the Red River Valley Basin of the North as well as the cultural background of each group of women participating in this Photovoice project will be described.

According to renowned anthropologist, E. Adamson Hoebel, (1972) culture is the cognitive view of life and the environment which members of a group hold. As such, culture is the perceptual filter through which one's environment is perceived. For the purposes of this dissertation, the definition of environment as derived from the World Health Organization consists of "chemical, physical, and biological agents as well as the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry, and agriculture" (United States Department of Health and Human Services, 2000a).

The women participating in this Photovoice effort live in a common geographic region; this region has unique topographical features which give rise to certain environmental characteristics that favor agricultural activities along with the proliferation of insects; both agricultural activities and an abundant insect population may contribute to the use of pesticides as an adaptive strategy. As such, the cultural orientation of each group may form a unique lens that shapes the perception of agriculture and the use of pesticides. Therefore, a prelude to subsequent data analysis of the Photovoice results will include a discussion of the geographical characteristics of the landscape and the cultural backgrounds of each group.

Topographical and Environmental Conditions

The Red River of the North Basin in Minnesota is bounded to the south by west Central Minnesota, to the west by northeastern South Dakota and eastern North Dakota, and to the north by Southern Ontario and southern Manitoba where it empties into the south end of Lake Winnipeg. (Minnesota Pollution Control Agency, August 6, 2007) [MPCA]. Red River is 550 miles long, of which approximately 394 miles is in the United States tributary, while 155 is located within Canada (Minnesota Department of Natural Resources, 2008) [MDNR]. In the center of the surrounding Red River Basin lies the Red River Valley, both of which were formed by the ancient Glacial Lake Agassiz. Lake Agassiz was formed between 12,000-14,000 years ago during the last ice age when glaciers began to recede northward through Canada and drain southward through the Minnesota River Valley (Minnesota Pollution Control Agency, August 6, 2007). The lake was massive, with an area of 110,000 square miles and a length of approximately 700 miles (Upham, 1999). As the glaciers retreated in this period, they created millions of topographical depressions known as wetlands or prairie potholes, giving rise to the Prairie Pothole Region of North America. The North American Prairie

Pothole Region (PPR) spans an estimated 300,000 miles and includes most of the Red River Basin of North Dakota and Minnesota (Ducks Unlimited, n.d.; Ducks Unlimited, n.d.; United States Fish & Wildlife Service, 2008).

Potholes were formed when chunks of ice trapped under gravel for centuries melted away, leaving sagging depressions in the landscape. While many of these prairie potholes have been drained for the production of modern agriculture, existing potholes, ponds, and marshes fill with snowmelt and precipitation in the spring and are ideal environments for the breeding and proliferation of mosquitoes (National Biological Information Infrastructure of the United States Geological Service, 2008; Savage, 2004a; United States Environmental Protection Agency, 2006c). In addition, the River Basin of the North is located in the Tall Grass Prairie Segment of the northern Great Plains, which receives the largest amount of rainfall, since precipitation increases generally from west to east (Christensen, 2007; Savage, 2004b). Mean annual precipitation in the Red River of the North Basin is approximately 21 inches, which primarily occurs between the months of April through September. These wet conditions further contribute to an abundant mosquito population (Christensen, 2007).

PART II: CULTURAL CHARACTERISTICS

Caucasian Women from the Upper Northwest Red River Basin of the North

Mothers raising young children who participate in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) live in the rural Minnesota agricultural counties of Kitzen, Roseau, Marshal, Pennington and Red Lake[2]. While no universal definition of rural exists, based on the definition adopted by the United States Office of Management Budget, these participants reside in rural areas[3] (Table 3.1). Rural North American women are not homogenous in relation to geography, demographics, and economics. However, a review of the existing literature (while sparse) has identified common experiences and traits. These include: (1) geographic and built environment features, such as, low population density, geographic barriers, long distances to metropolitan areas, and isolation; and (2) socio-cultural features, such as, dense social networks depicted by shared life experiences within long-term social relationships, neighborliness and reciprocity, self-sufficiency, traditional values, and a patriarchal social structure (Hartley, 2004; Hartley, 2004; Mulder et al., 1999).

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[2] WIC is a federal grant program authorized by the U. S. Congress to provide funding to agencies for nutritious foods, nutrition education, and referrals to health and social services for pregnant, postpartum and breastfeeding women, and infants and children up to age five who are at nutrition risk. Eligibility is at or below 185% of the federal poverty guideline, and those who are eligible for food support (food stamps), Medicaid, or temporary assistance for the Needy Families automatically meet income eligibility. The 2007 federal poverty guideline for a family of four is $20,650;http://www.cdf-mn.org/kidscount.

[3] Rural areas are considered as regions outside of counties or county clusters that contain core based statistical areas (CBAs) of 10,000 or more people; outlying counties are included if at least 50% of the population resides within the CBA or 25% are employed within the CBA (Slifkin, Randolph, and Ricketts, 2004) (U.S. Census Bureau, 2005)(Vanderboon & Madigan, 2007).

Rural women are more likely than their urban peers to be married, have more children and complete their childbearing earlier (Bushy, 1993; Mulder et al., 1999). A greater emphasis is placed on traditional gender roles that consist of women at the helm of nurturing and domestic activities. Thickly entwined social networks stem from the smaller number of people in rural towns, with families frequently tracing their ancestry back for generations. Due to close proximity, residents are well acquainted and interact frequently in school, church, local businesses, and community organizations (Bushy, 1993). A qualitative study conducted in rural southwest Ontario consisting of nine focus groups and three narrative interviews (n=65) identified themes of rural culture and rural pride as determinants of rural women's health. A primary component of rural culture involved the presence of traditional, circumscribed gender roles; participants perceived these roles as upheld and fostered by religious doctrine in the church. Rural pride was seen in the ability to solve problems with ingenuity, and raise children with limited material resources. Participants also expressed a sense of satisfaction about their socio-cultural norms of helping others without expectations for self-recognition (Leipert & George, 2008).

A random digit dial qualitative telephone survey (n=242) was administered in states which contain urban, suburban, and rural areas located across all regions in the U.S.A to determine commonly held views of rural American life (W.K. Kellogg Foundation, 2001). Perceptions coalesced around several major themes. The rural environment was seen as serene, lush, pastoral, and populated with farms, giving rise to a slow pace of life. However, at the same time this setting was perceived as fostering hardships, including harsh elements along with a lack of resources that are available to urban and suburban counterparts. Farming was envisioned as the primary subsistence of rural life, with farmers sacrificing to feed the world by toiling under extreme weather conditions, earning low pay, and struggling economically; yet, farming and agricultural activities only consists of 11.7% of all jobs in rural America. These conditions were perceived to promote the cultivation of personal characteristics, known as traditional American values of hard work, self-reliance, extensive social networking among family and community members, and strong religious ties with activities revolving around church functions. Rural American life was believed to be a virtuous lifestyle freer from distractions, and embodying the Puritan Ethic (W.K. Kellogg Foundation, 2001). Given these religious convictions, along with generations of family history- rural people have a strong sense of place and will endure considerable hardship to perpetuate this way of life (Shenk, Peacock, & Moore, 2002).

Characteristics of the women participating in the Photovoice workshop held in Hallock are consistent with depictions of rural American culture. All of the mothers were Caucasian and raising between three and six children each; five out of six of the mothers were between the ages of 23-34. All were receiving supplementary food assistance through the WIC program. They spoke of their responsibilities for creating meals and expressed gratitude for WIC since it allowed them to stretch their food budgets. Traditional gender roles related to the division of labor in the community were acknowledged by the mothers in a discussion about the use of personal protective equipment in pesticide handling as a measure to reduce exposure. One woman related that pesticides are viewed according to job responsibilities; the men apply pesticides and think about this task as a job that needs to get done, whereas, when women see pesticides being applied they think about the potential of exposure to their children.

New American Immigrants from Fargo, North Dakota and Moorhead, Minnesota

A total of 83% of participants (5/6) recruited from the cities of Fargo, North Dakota (2006 population: 90,056) and Moorhead, Minnesota (2006 population: 34,749) emigrated from East Africa (Somalia, Egypt, Ethiopia) while one participant emigrated from Bosnia (U.S. Census Bureau, 2008a; U.S. Census Bureau, 2008c). The self-reported length of U.S. residency among these women ranged between 3-11 years. Several waves of immigration have occurred in the U.S. from 1983-2004 (Singer & Wilson, 2008). Bosnian citizens were admitted to America from 1992 onward when Yugoslavia began to break-up. Refugees from East Africa, including Somalia, Ethiopia, Sudan, and Liberia entered the U.S. beginning in the late 1990s due to civil conflict. Refugee programs first strived to unite immigrants with their relatives, and second, sought to disperse refugees across the country to avoid placing a burden on individual localities. An estimated 73% of immigrants settled in metropolitan areas that have large foreign-born populations. Minneapolis-St. Paul has the largest population of East African immigrants in the nation (Minneapolis Foundation, 2008; Singer & Wilson, 2008); among these refugees, almost 50% of those from Somalia have settled in five metropolitan areas: (1) the Twin Cities (14%); Washington, D.C. (10%); Atlanta and Chicago (9% each); and Seattle (4%). Resettlement has occurred in several medium sized and small metropolitan areas, with refugees dominating foreign born populations in the communities of: Fargo, North Dakota; Erie, Pennsylvania; Sioux Falls, South Dakota;

and Binghamton, New York (Singer & Wilson, 2008). A total of 4% of Fargo's population of 9,599 consists of foreign born residents (U.S. Census Bureau, 2008a). Refugee immigrants are provided with local services designed to assist them to succeed in relocation to the U.S, such as, affordable housing, literacy and job training.

The primary religion of East Africa is Muslim; all of the participants in this Photovoice study self-reported as Muslim. Islam means "submission to Allah, the supreme and only God," and people who practice this belief are called Muslims. Community participation is an essential value of Muslims, which emphasizes equality, justice, cooperation, empathy, and social support. Individuality coalesces around community since community protects and empowers the individual. Family is the central unit of Islam and it includes the extended family, such as relatives or even the whole community. The extended family is the major unit of socialization among Muslims. Arranged marriages are common and are seen as the joining of two extended families instead of the joining of two individuals. Husbands and wives are considered to be equal in the eyes of God; however, their roles are complimentary (Hodge, 2005).

Men are permitted (though not recommended) to have up to four wives and the wives must be treated equally. Women maintain the home and raise the children and men provide materially; while women may work outside of the home, they must perform these traditional duties in the home alongside employment. Large families are encouraged. Since sexual commodification is perceived as the cause of family and social breakdown, modesty is an important value; as such, traditional Islamic dress for women frequently includes veils, and or head scarves, along with long sleeved, full length robes and only exposes the eyes, hands, and feet (hijab) (Hodge, 2005; Login & Areas, 2008).

Islamic people participate in modern western medicine practices; as such, it is recommended that health care professionals become aware of basic Muslim tenets, such as, the need for modesty, hygiene before prayer or handling the Quran, and specific dietary practices, so that these needs can be honored in caring for members of this population (Islamic Council of Queensland, 1996).

One-half of the participants from this Photovoice group are from Somalia; all of the women from East Africa (5/6) dressed in accordance with hijab, which involved wearing head scarves and long robes (no one wore a veil). People of Somalia participate in modern western health care practices; however, they typically only visit a physician for a health problem and do not engage in preventive health care. They may also engage in traditional healing practices alongside modern medicine regimens (Plaisted, 2002).

Mothers and Grandmothers raising Children at White Earth Reservation

White Earth Reservation was established in 1867 and is located in Becker, Clearwater and Mahnomen counties in Northwestern, Minnesota. Participants from this Photovoice project were recruited from Mahnomen County. Mahnomen County has a population of 5,072. The two predominant ethnicities of citizens living in this county are Caucasian (60.3%) and American Indian or Alaska Native (29.9%). The land area of Mahnomen is 2,000 square miles with 9.3 persons per square mile of land (U.S. Census Bureau, 2008b).

Native Americans from the White Earth Reservation are Ojibwe, also known as *Anishanaabeg,* an Ojibwe word meaning "the people," and *Chippewa*. Their "creation stories, culture, and way of life, are entirely based on the forest, source of medicinal plants and food, forest animals, and birch-bark baskets" (LaDuke, 1999a). As originally established, White Earth Reservation consisted of 1300 square miles containing 47 lakes, which were intersected by prairie, maple-basswood forest and boreal pine forest. Small camps and villages on traditional hunts moved through forests, rivers and lakes by snowshoe, dogsled or canoe, filling their birch-bark baskets with wild rice, maple sugar, berries, dried corn, and squash. The harvesting of wild rice by Natives on this land can be traced back over a history of 1000 years. The land was named White Earth for the white clay that lies under part of it; due to an abundantly diverse ecosystem, this land was considered the medicine chest of the Ojibwe.

LaDuke describes this, as a way of life not circumscribed by constructs of modern civilization such as, clocks, fences, or roads but instead by "natural law," the Creator's law. While White man has long considered land to be a symbol of wealth and power, to indigenous Ojibwe people, land is a traditional and spiritual way of life for which a price tag cannot be exacted. Between the years 1784-1894, the federal government made approximately 720 land seizures through 371 treaties; many of these acquisitions were a deferral to economic interests for natural resources such as, minerals (iron, ore, and copper) and timber. By 1898, more than 76 million board-feet of timber were cut annually. Minnesota alone took .25 million acres of White Earth land as tax payments. By 1914, only 14% of the original White Earth land was in Native American hands. The clear-cutting of the White Earth forests had a devastating impact on the Ojibwe traditional ways of living, since traditional Anishinaabeg forest culture is dependent upon the forest (LaDuke, 1999b).

The White Earth Land Recovery Project has been established to restore the forests, recover the land, and restore the traditional Ojibwe culture. These activities involve restoring language, cultural practices, and environmental resources. Greater than one-third of the reservation is cultivated using intensive industrial agricultural chemicals such as, pesticides, fertilizers, herbicides, and fungicides, and more than 12,000 acres of reservation land are being farmed by the largest potato manufacturer in the world (RDO Offutt). An estimated 50% of the wetlands on the reservation have been destroyed since 1858 "largely due to ill-founded agricultural practices" (LaDuke, 1999b). Mahnomen County has lost 60% of its wetlands (30,000 acres) between 1955 and1975. To recover self-reliance, the White Earth Tribe has began the community project, "Native Harvest" to restore native foods and obtain fair market price for traditional and organically grown foods, such as, hominy corn, organic raspberries, wild rice, maple candy, buffalo sausage, and maple syrup (LaDuke, 1999b).

Four women from White Earth Reservation participated in this Photovoice project Two were grandmothers ages 47 and 48 years, while a third woman was age 28. Although, demographic information was not available for a fourth mother, she appeared to be in her 20s. Consistent with the Ojibwe cultural depiction, mothers in this group spoke about the importance of eating traditional foods and participating in subsistence activities, such as, gathering nuts and berries, cultivating wild rice, and fishing in their community. In addition, differences in the perception of land use related to food production between modern agricultural practices and traditional native practices were highlighted by one grandmother during the second Photovoice workshop.

TABLE 3.1

Women from the Upper Northwest Segment of the Red River Basin of the North: County Demographics[4]

County	Population	Land Area (Square Miles)	Persons per Square Mile	Primary Ethnicity
Clay	51,229	1,045.24	49.0	White: 95.1%[5]
Kittson	5,285	1,097.08	4.8	White: 98.1%
Mahnomen	5,190	556.14	9.3	White: 60.3%[6]
Marshal	10,155	1,772.24	5.7	White: 98.5%
Pennington	13,584	616.54	22	White: 96.4%
Red Lake	4,299	432.43	10	White: 97.5%
Roseau	16,338	1,662.51	9.8	White: 95.2%

[4] Information derived from U.S. Census Bureau State & County QuickFacts (2008); statistics for population, land area and person per square mile are 2000 data, while statistics for ethnicity are from 2006 data. Accessed September 14, 2008 from: http://www.quickfacts.census.gov/qfd/states/27/27125.html

[5] While Whites represent the primary ethnicity, foreign born persons represent 2.6% of the population in Clay County.

[6] While Whites represent the primary ethnicity, Native Americans are the second greatest ethnicity in Mahnomen County at 29.9%.

CHAPTER 4

RESEARCH METHODS

PART I: METHODS FOR PHOTOVOICE AND DATA ANALYSIS

Photovoice

The methodology of Photovoice was developed by Dr. Carolyn Wang of the University of Michigan, Ann Arbor. Photovoice is an innovative community participatory research technique that allows vulnerable populations to document the reality of their daily lives. The method serves as a community building activity among children, families, and civic leaders. Key questions emerge from the images, which enable participants to ask: "Why does this situation exist? Do we want to change it, and if so, how?" Policy makers are included in ensuing dialogue as a means to promote grass roots social change.

Photovoice can be adapted for multiple purposes, including participatory needs assessment, participatory evaluation, and as an empowering intervention to reach civic leaders for policy change to improve community health (C. Wang, Morrel-Samuels, Hutchison, Bell, & Pestronk, 2004; C. Wang, 2005). The methodology has been successfully used by public health departments, educators, and community organizers throughout the United States in diverse populations that include, homeless people living in shelters (C. Wang, Cash, & Powers, 2000), adolescents living in high crime rates (C. Wang et al., 2004), and low income women in a diverse community with poor perinatal outcomes (C. Wang & Pies, 2004). For example, Photovoice was used in a group of youth, adults, and community leaders to communicate their concerns about violence through images. Along with community building, the intervention promoted community capacity, since it was instrumental in securing funding for violence prevention (C. Wang et al., 2004).

Community-Based Participatory Research

A community-based participatory research approach serves as the supporting framework for this public health needs assessment (CBPR). The W. K. Kellogg Foundation's Community Scholars program has adopted a definition of CBPR as "A collaborative approach to research that equitably involves all partners in the research process with the aim of combining knowledge and action to improve community health and eliminate disparities" (Minkler, M. & Wallerstein, N., 2003). Several principles distinguish CBPR from other research approaches. CBPR calls for active collaboration by participants as equal partners in all phases of the research process, which includes: development of the idea and design, implementation of the process, analysis and interpretation of the findings, and development of future interventions. The method utilizes personal experiences and non-scientific ways of knowing, emphasizes "consciousness raising" through increasing awareness and knowledge, encourages critical dialogue of social conditions, and promotes political action (G. Gibson, 2000; N. Gibson, Gibson, & McCaulay, 2001). Photovoice is a CBPR approach, since its methodology incorporates these tenets.

Theoretical Foundation

Social Critical Theory

The underpinnings of CBPR are rooted in the tenets of critical social theory. Several assumptions form the foundation of critical social theory. Social critical theory is grounded in a post-modernist, interpretive paradigm. In contrast to empiricism, post-modernist theory does not embrace the existence of pure, objective knowledge, but instead holds that the "criteria that scientists use to separate knowledge from belief are based on social conventions [which are] a negotiated agreement… [that] changes, historically forming what some call paradigms'" (Allen, Benner, & Diekelmann, 1986). Based on this premise, rationality is of paramount importance, since it is integral to negotiating standards of truth in a community. Autonomy and responsibility, in turn, promote rationality, since people must be free from coercion or retribution to express their opinion in order for society to base its decisions on the best arguments; at the same time, citizens are responsible for creating social conditions where others can speak their minds as freely as they themselves can.

Social critical theory holds that the patterns and regularities which structure human activity are often negotiated by powerful social structures in a one-sided manner and are not distributed equally through classes, gender, or races, and as such, result in domination. This negotiation of power takes place through language, which is a tool for interpreting and defining knowledge, and setting socially constructed agendas. The theory purports that through understanding these patterns or regularities which structure social activity, underlying meaning can be comprehended; by making these meanings explicit, it is possible to promote autonomy and responsibility. As such, critical social theory focuses on liberation through creating conditions that promote autonomy and responsibility (Allen et al., 1986) and uses discourse as a means for both identification of the meaning underlying oppressive social structures and subsequent action for emancipation.

Polit and Beck define critical theory as "an approach to viewing the world that involves a critique of society with the goal of envisioning social change" (Polit & Beck, 2004). Critical theory does not consist of any one single theory; rather it consists of multiple theories arising from different traditions (Stevens & Hall, 1992; N. Wallerstein & Duran, 2003). It is a framework for research that combines theory with action, which arises from a dialectical process. Through group dialogue, members of vulnerable populations reflect upon and critically analyze social conditions that inhibit or enhance the status of their health for the purpose of promoting positive social change.

Critical theory originated in Germany during the 1930's. There are two camps of critical theory, the southern tradition of emancipation, which originated in the developing countries of Asia, South America and Africa and the northern tradition of "action research" used in organizations to translate research into practice.[1] (Wallerstein & Doran). The southern tradition of critical theory has been used as a basis for several theories, such as, feminist theory, gay, lesbian, bisexual, and transgender liberation studies, and racial theories. By utilizing the tenets of critical theory, disadvantaged social groups can become empowered to take constructive action to remove barriers within social systems for the purpose of promoting their collective well-being (Stevens & Hall, 1992). Specifically, Photovoice has been credited by Dr. Carolyn Wang as rooted in

Brazilian philosopher, Paulo Freire's empowerment education, feminist theory, and documentary photography.

Paulo Freire: Education for Critical Consciousness

Freire's education for critical consciousness is based on "praxis", which he defined as "reflection and action upon the world in order to transform it" (Freire, 1970, p.33, Preface). The approach uses a dialogical process through sharing from experience, whereby, people become conscious of their own representations of reality, and their participation in the social forces that influence their lives. Once this awareness is achieved, they are liberated to initiate grass roots change. Freire's methodology involves the selection and use of photographs and sketches by trained facilitators to encourage dialogue (Freire, 1970). Photovoice builds on Freire's commitment of fostering social change through dialogue; however, it utilizes images that the participants select themselves and thereby, allows them to directly express the reality of their everyday lives (C. Wang, 2003).

Feminist Theory

Feminist theory is one theoretical type of Social Critical Theory. It originated in the 1960s due to a perception that women were systematically excluded from the dominant power structure of American society (Stevens & Hall, 1992). The theory asserts that power accrues to those who have voice, set the terms of the discourse, and participate in decision making (Smith, D.E.1987); feminist scholars have urged women to recognize and respect their own voices to create inclusive change in their workplaces and communities. While feminist theory originated in its concern for the status of women, feminist values are not limited to females, but apply to all people who are concerned with equality and human rights (Backer, Costello-Nickitas, Mason, McBride, & Vance, 1998). Photovoice is grounded in feminist theory since it gives voice to those who typically do not have access to policymakers in an effort to promote inclusive dialogue for the purpose of promoting positive social change (C. Wang & Burris, 1997; C. Wang & Redwood-Jones, 2001).

While documentary photography has been used in many ways, a recent tradition exists within this genre among community photographers to encourage disadvantaged citizens to depict their reality through visual images for the purpose of catalyzing social change (C. Wang & Redwood-Jones, 2001; C. Wang & Burris, 1997). However, unlike Photovoice the approach does not contain an explicit methodology to promote critical dialogue between participants and stakeholders for the purpose of translating reflection into social action. The work of Jim Hubbard is one example of community documentary photography; in “Shooting Back from the Reservation.” Hubbard places cameras in the hands of Native American children, enabling them to document the experiences of their everyday life through visual images with narratives (Hubbard, 1994).

Emergence of the Partnership

This Photovoice study involved the emergence of three types of partnerships: academics from the University of Minnesota, local stakeholders, and women raising young children in the RRV. The University of Minnesota Regional Sustainable Partnerships (UMRSP) has executive directors located in each major geographical region of Minnesota who perform community outreach related to issues of sustainability. Linda Kingery, M.S., is the Executive Director of the Northwest Regional Partnership, which encompasses the RRV Basin of the North territory. Dr. Kathryn Draeger, Ph.D., Executive Director of UMN Partnerships and Ms. Kingery collaboratively identified local stakeholders who work in the RRV Basin. Professor McGovern was invited by Dr. Draeger to provide academic input to the research team, and subsequently Professor McGovern invited this author to join the team. In June, 2007, prior to the second set of Photovoice workshops, health educators from the University of Minnesota, Centers for Public Health Education and Outreach (CPHEO) also joined this team to explore future outreach for communities in the RRV related to reducing pesticide exposure to workers and families (Table 4.1).

Study Population

This intervention engaged three groups of diverse women (n=16) who were not included in previous surveys or focus groups that were held in the RRV, and was conducted during the late spring and summer of the 2007 growing season when pesticides are in high usage. These women were mothers or grandmothers who were actively involved in caring for at least one child from the following populations: (1) White mothers enrolled in the federally subsidized, Women Infant and Children (WIC) nutrition program administered through Quin County Health Services living in the Minnesota rural farm communities of Kittson, Marshal, Roseau, Pennington, and Red Lake counties; (2) new American immigrant mothers from Somalia, Bosnia, and Liberia who live in the Fargo, Moorhead area and have participated in gardening classes for food security held by the Immigrant Development Center; and (3) Native American mothers from the White Earth Reservation.

Due to economic and cultural characteristics, these groups of women and children were hypothesized to be at increased health risks from pesticide exposure. Low income mothers receiving support from WIC who are wives of farmers, or are living near farms may be at an increased risk of exposure to pesticides due to a lack of separation between their home and the farming occupational setting (National Institute for Occupational Safety and Health [NIOSH], 1995). Little is known about pesticide exposure to immigrant women, especially those using gardening as a source of food production; these immigrants and their families may be at increased risk for exposure to pesticides due to a lower level of English literacy and an inability to read pesticide labels. Native American families on White Earth Reservation live adjacent to large potato farms where pesticides are used; they may be at heightened risk from exposure due to chronic health disparities among American Indians living in Minnesota (Minnesota Department of Health, 2003). In addition, evidence exists to support the existence of persistent health disparities in rural populations compared to urban populations, based on exposure to higher risk factors, and higher morbidity and mortality rates (Hartley, 2004; Leight, 2003; United States Department of Health and Human Services, 2000d).

Recruitment

Recruitment and ongoing support occurred through local professionals in the RRV who have established relationships with the participants. Recruitment by stakeholders was based on selecting mothers who would be both interested in the issue of pesticide exposure to children, and able to articulate their personal concerns. Flyers were distributed to participants and a reminder card was mailed before each session (Appendixes E, F, and G). Photovoice as a method is tailored to the needs and purpose of the research project in which it is being incorporated. As such the number of sessions and degree of group participation can vary (Baker & Wang, 2006a; C. Wang & Pies, 2004; C. Wang et al., 2004). Professor McGovern created the design of the Photovoice intervention in consultation with the research team. Local partners in the RRV, this graduate student, and Dr. Kathryn Draeger participated in planning during a nine month period for all aspects of the project through group conference calls, which were used concurrently with Breeze technology. Breeze is a secured, password-protected virtual meeting place over the Internet, which permits a visual review of documents as well as the use of white boards in group discussions. Occasional face-to- face meetings were held in the Twin Cities. For example, in September 2006, a get-acquainted and brainstorming meeting was held over breakfast, and in November 2006, a meeting was held on the University of Minnesota, St. Paul Campus with Bruce Bomier and Joan Nephews, President and Executive Director of the non-profit Environmental Resource Council to discuss citizen perceptions related to pesticide exposure from the findings of focus groups and surveys conducted in the Red River Valley of Minnesota. Electronic communications through email facilitated planning between conference calls. Face-to-face meetings occurred with the research team immediately after final Photovoice workshops over meals to discuss impressions and to explore future partnerships to meet the needs of participants.

Data Collection

Workshop I

The Photovoice effort consisted of two workshops lasting three hours each. At the first workshop, women received information about health effects from pesticide exposure and how families may be exposed to pesticides from Professor Bruce Alexander, Environmental Epidemiologist, at the Division of Environmental Health Sciences, University of Minnesota School of Public Health. Professor McGovern presented an introduction to Photovoice and the purpose of this research. This author gave a presentation about the ethics of using the camera in Photovoice, followed by a presentation on how to take well-composed photos. Ethical principles of using the camera included the following tenets (C. Wang & Redwood-Jones, 2001):

1. Always ask for permission before taking a person's picture

2. Explain why you want to take a person's picture and if needed, give them a copy of a Photovoice flyer.

3. Never take a picture that puts an identifiable person in a negative circumstance

4. Never take a picture of an identifiable property that is cast unfavorably

5. Give back a print to someone who let you take their picture to thank them.

The mothers were given new 35 mm-digital cameras as a benefit of participating. A hands-on instruction session occurred in which participants practiced taking pictures with the assistance of local partners, Professor McGovern, and this author. The women were instructed to take photos in response to the following questions:

1. How do you get exposed to pesticides?

2. Does your family get exposed to pesticides? How?

3. What prevention strategies do you now practice for yourself and for your family?

4. Does your family have access to locally grown foods through gardening or purchasing?

   If yes, where do your find such food? If no, what barriers prevent you from getting such foods?

5. Do you worry about any other important health or safety issues for your children?

Workshop II

Workshop II occurred during the second and third weeks of July. At this time, the women individually showed and discussed the meaning of their photos in the context of their lives. The goals of this session were (1) to encourage conversation about issues through photographs and group discussion; and (2) to document and reflect on community strengths and weaknesses. Probing questions were explored based on this framework while participants narrated the meaning of their photos:

1. Why did you select this photograph?

2. What do you see here?

3. What if anything would you like to change about this situation?

4. Which photos are most important to you and why?

Professor McGovern facilitated group discussion, through the following questions:

1. What themes did we see across everyone's photos?

2. What do they really mean for your lives?

3. Why does this problem or strength exist?

4. What can we do about it?

5. Are there issues or problems that you think call for community change?

6. If so, what? How would you like to change it?

7. Would you like help with this effort?

8. What would you like help with?

9. Who would you like to help you?

Data Analysis

Transcription Verification

The second workshops were tape recorded and transcribed by a professional transcriptionist. Tapes were listened to by this author and checked against the transcripts; gaps in transcription were manually filled in where conversation from the tapes could be ascertained. Field notes were written during and after the conclusion of all workshops by this author. Field notes are subjective impressions recorded by the researcher related to participation and observation during data collection (Mulhall, 2003). Field notes during the workshops consisted of environmental descriptions, a narrative summary that included overall impressions of each session, as well as multiple verbatim quotes from each participant. Field notes were used to fill in text where lapses in the transcripts occurred that could not be audibly deciphered.

Memos

First, transcripts from each group were read to derive an overall impression of the data. Next the transcripts for each group were re-read and memos were written in the margins. Memos are reflective notes that qualitative researchers write to themselves in the margin of the transcript when they have ideas and insights about the data. Glazer defines a memo as, "the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding" (Glazar, 1978). Miles and Huberman explain that memos " help the analyst move easily from empirical data to a conceptual level, refining and expanding codes, developing key categories and showing their relationships, building toward a more integrative understanding of events, processes and interactions" (1994). Memos can link units of data to demonstrate how they are a related concept, and they can pertain to any aspect of the study, including personal, methodological, or substantive issues. The memos were created in a separate word document classified by each group where they were titled by concept, and tagged with a page and paragraph number for easy location.

Codes

Coding is a process that begins through microanalysis which consists of reading the transcribed data line by line to identify analytical units of meaning. Through this process, patterns are perceived which give rise to larger categories that represent phenomena (A. L. Strauss & Corbin, 1998). After memos were written, transcripts for each group were re-read and further analyzed; codes were identified, synthesized, and organized by color in a word document. Memos were made during this process as needed to describe methodological issues pertaining to categorizations as they arose.

Categories

Categories[7] are patterns that depict relationships among two or more units of meaning or codes; they describe a cluster of codes, which constitute an emergent configuration or explanation. Codes and memos were analyzed for threads that tied together relationships among two or more units of meaning, creating larger patterns of categorical meaning or themes within the context of the needs assessment. Axial coding was conducted according to methods by Strauss & Corbin. Categories were analyzed on a finer level to ascertain sub-categories that further explain and clarify the perceived phenomenon. Sub-categories explain the properties (characteristics) and the dimensions (range) of an experience. Analytical tools used involved the use of questioning who, what, where, when, why and under, under what conditions does the category hold true (A. Strauss & Corbin, 1998), and looking for evidence that both confirms and disconfirm patterns (M. B. Miles & Huberman, 1994).

Cross Case Analysis

Transcripts were analyzed for deeper themes across the groups using cross case analysis by Miles and Huberman (B. Miles & Huberman, 1994). Cross case analysis examines patterns of similarities and differences between cases to facilitate a depth and breadth of understanding from the data. The approach was well suited to this research, since the data was collected from three unique cultural groups living in one single, albeit, large rural agricultural area, the Red River Valley Basin of the North. Cross case analysis is typically used to deepen understanding and explanation. This method reconciles the uniqueness of each case with a more general understanding of generic processes that occur across cases.

Data analysis within the groups occurred as explained according to methods by Strauss & Corbin (1998), which involved the use of memos and the techniques of axial coding to identify codes and categories. Themes within the groups that were generated using analytic techniques from Straus & Corbin (1998) were analyzed for similarities and differences across the groups using the methods of cross case analysis. Data analysis between groups was conducted iteratively within three streams of analysis: (1) data analysis; (2) data display; and (3) conclusion drawing and verification. Displays of data were created by depicting theme categories in matrices. The assembled displays organized information into an immediately accessible compact form to allow for a

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[7] While Strauss and Corbin refer to patterns of meaning as categories, other qualitative researchers refer to patterns of meaning as "themes." DeSantis & Ugariza (2000). The concept of theme as used in qualitative nursing research. Western Journal of Nursing Research, 22(3), 351-372.

systematic and clear perception of overarching patterns for the purpose of discussing similarities and differences between the groups. These displays were created as an integral part of the process of data analysis, which facilitated conclusion drawing and verification (M. Miles & Huberman, 1994; M. B. Miles & and Huberman, 1994). Data conclusion drawing and verification is the process of reconstructing the data with an insightful understanding or explanation. The researcher explores ideas about understanding the meaning of the analysis from a new perspective as the analysis goes beyond descriptive summation and reaches explanation. Data conclusion drawing and verification was conducted in analysis that was conducted separately within each group and jointly across cases. The conceptual importance of the conclusions was evaluated by triangulating the findings with existing research and theories.

Validity and Reliability

Coherence

Validity answers the question: Does the research measure what it is intended to measure? Reliability answers the question: Are the findings of the research able to be replicated? Several strategies were employed to promote reliability and validity of the findings from this data analysis. First, validity was promoted by employing a method that was methodologically coherent. Method coherence was demonstrated since the method was compatible with the nature of the data, and the data was compatible with the analytic procedure. As previously described, cross case analysis was an appropriate methodology for this data since it was collected from three distinct cultural groups who live in one rural agricultural region. Therefore, this method allowed for similarities and contrasts within and across cases to be highlighted. Additional measures to promote validity included member checks, peer review, and data triangulation. Reliability was promoted through documentation of data analysis decisions in memos, creating an audit trail that enables replication of the methods.

Audit Trail

A journal was kept in a word document to record the ongoing process of writing memos, and ascertaining codes and themes from the data; this documentation included insights, choices and subjective interpretations during the process of data analysis and not after the conclusion. The journal suffices as an audit trail so that another researcher could trace how the results were attained.

Member Check

Member checks involve checking the coding between two or more researchers or group members both during and after analysis. The codes were checked by Professor McGovern during and after analysis. Dr. McGovern was a member of the Photovoice research team; her findings of this data were verified by co-researchers of the Photovoice team.

Peer Review

Peer review consists of discussing findings with another researcher not directly involved with the research project both during and after conclusion. Codes, themes, and findings were discussed with Professor Cindy Peden-McAlpine both during and after the analysis was conducted. Dr. Peden-McAlpine is an Associate Professor at the University of Minnesota School of Nursing; she is an expert in qualitative research and was not a member of the original Photovoice team.

Data Triangulation

Triangulation involves crosschecking and comparing the conclusions of this data analysis with existing literature; where conclusions are consistent, triangulation has been corroborated. Existing literature on pathways to pesticide exposure were compared with the results of this qualitative data analysis for research, practice, and policy recommendations.

Risks and Benefits

This research has been approved by and conducted in accordance with the University Of Minnesota Institute Of Review Board for the Protection of Human Subjects in Research (Appendix H). The IRB waived the requirement for participants to sign an informed consent. This decision was made to promote cultural sensitivity, since it was hypothesized that Native American and new American Immigrants may not be uncomfortable signing these documents. As such, local recruiters provided participants with assent forms; recruiters discussed and read the assent forms to the women at the time of recruitment, and any questions from potential participants were answered during that time (Appendixes I, J, and K). However, the co-researchers responsible for recruiting wanted signed releases to use photos in exhibits and publications. As such, photo releases were signed from the University of Minnesota, and Blue Cross and Blue Shield of Minnesota even though they were not required by the IRB (Appendixes L and M). The risks of participating were minimal and included a hesitancy to share photos and tell stories; however, the women selected their photos and choose the extent to which they shared their thoughts and feelings. Benefits included receiving an honorarium of $100 [women recruited through WIC were awarded $125 since they traveled longer distances for the workshops], a new 35mm digital camera, and instruction in how to take well-composed photos and how to use the camera.

Limitations

The CBPR Approach

Limitations of this needs assessment arise from both the use of a community participative approach as well as the specific method of Photovoice. Several limitations exist related to development and maintenance of the partnerships required in CBPR. First, a lack of trust has historically existed between educators and community members; a perception is present that academics conduct research “upon” vulnerable citizens, taking their time and energy, collecting their data and providing no benefits to their community (N. Gibson, Gibson, & Macaulay, 2001; Hagey, 1997; Israel, Schulz, Parker, & Becker, 1998; Stoecker, 1999). As such, developing trust is an integral process of moving forward in CBPR and requires awareness, skill, and commitment on by the researcher. Once trust has been gained, it must be continually reinforced through communication and action. Reflexivity is the ability to reflect upon and situate ones own values, experiences, and beliefs for the purpose of identifying how these assumptions interact with both social processes, and the generation of knowledge (Hutchinson & Wilson, 1994; Sword, 1999). Since CBPR involves collaborating with participants while emphasizing their inclusion in the generation of knowledge, it requires sophistication in many skills that go beyond traditional academic preparation, such as, an understanding of group processes, adept interpersonal communication, and reflexivity (Hagey, 1997; Israel et al., 1998; Milio, 1970; Stoecker, 1999). Group processes involve setting healthy norms for dealing with conflict and making decisions. Conflict may occur between members over multiple issues, including differences in agendas, the emphasis of time spent on group processes vs. tasks, and the distribution of funds (Becker, Israel, & Allen, 2005).

Depending upon the purpose and circumstances of the effort, various academic roles have been identified. An academic as consultant may carry out the intervention while consulting with members at each stage of the project. Whereas, an academic as a participant researcher collaborates with members, which may involve facilitating learning and affirming others, while performing research functions, such as, creating a research process, designing surveys, and finding references (Stoecker, 1999). Acting as a professional researcher, while collaborating as an equal member may require the flexibility to listen to participants and incorporate non-traditional ways of knowing in such a manner that does not compromise scientific research, as well as nuanced judgment in balancing the role of a leader with the role of community member. Development of group cohesiveness, making decisions and moving forward with the project can be both time and energy consuming. Researchers are typically rewarded for their time and may factor the project into their academic load, while community members may be participating in addition to their usual responsibilities (Stoecker, 1999).

When applied to this research, there were challenges in implementing a CBPR method. First, the UMN Partners representatives had relatively little experience with research and even though it is a University-supported entity their staff and board members were initially very distrustful and negative about working with University researchers. In the early months of the project Professor McGovern worked hard with these team members to counter negative emotions and build trust. Subsequently, after some trust had been established there were ongoing issues in coordination and communications because the team was very decentralized

Limitations of Photovoice

A major limitation specific to Photovoice as a method is that it takes considerable motivation on the part of the researchers, local stakeholders, and community citizens to perform. Several meetings are required for planning and designing adaptations in the method, which are tailored to the context and purpose of a given project. Local stakeholders may encounter challenges in recruiting and need to follow-up to support citizen participants related to the use of the camera, developing photos, and attending workshops. Attrition may occur due to unforeseen circumstances. For example, at White Earth Reservation only four members participated in the second workshop−of these four, one participant did not attend but sent her pictures and quotes electronically, while another participant attended with narratives, however, she forgot her photos. The method can be expensive since all participating citizens and co-researchers may need financial or organizational rewards for their efforts. Additional expenses include the cost of room rental, cameras, film, development of film, flyers and consents, transportation, childcare, and refreshments. Additionally there is a need for substantial logistical support such as bringing audiovisual equipment and research supplies to meetings and managing the digital images and recordings from initial receipt and recording through editing to a final product.

Strengths

CBPR

A significant strength of CBPR as an approach is that it involves the community in all phases of planning and implementation, and as such, the identification of problems and solutions are grounded in relevance. Other assessments that do not include community members may miss issues of importance that are critical to developing future interventions aimed at mitigating health disparities. CBPR builds community capacity through fostering the development of new skills and knowledge, and promoting the solidarity of participants during the process of carrying out the project (N. Gibson, Gibson, & Macaulay, 2001; Israel et al., 1998; N. B. Wallerstein & Duran, 2006). Since CBPR occurs at the boundaries of traditional academia and non-traditional ways of knowing, it can expand the generation of knowledge and inform public health practice and policy. Due to the emphasis of inclusion, and a commitment to benefit the community and address disparities in power and knowledge, CBPR as a method has a chance to overcome lack of trust, and to make a difference in ameliorating health disparities (Satcher, 2005). As such, CBPR has been identified by the Institute of Medicine as one of eight core competencies in educating the public health workforce for the 21st century (Committee on Educating Public Health Professionals for the 21st Century, 2003). As applied to this project there was one major distinction with the principles of CBPR, which was that the purpose of Photovoice---assessing exposures to pesticides—was identified by UMN Partnerships and not by the communities of women participants.

Photovoice

A major strength of Photovoice as a tool is that it incorporates the voices of citizens in assessment or evaluation; therefore, it facilitates the meaningful development of programs and services (C. Wang & Pies, 2004). Since images can convey poignant meaning, the method does not require participants to have acumen in a given dominant language. Although this Photovoice project employed digital cameras with color-images, previous Photovoice projects have incorporated simple black and white cameras, which have allowed for simplicity in use, so that taking pictures can be easily navigated; as such, Photovoice has been by people with little education in various places throughout the world. Since participants take pictures of the reality of their everyday lives, the method allows researchers to gain entrance into places and activities that would otherwise be inaccessible. Therefore, insight can be derived in a manner that would not be possible from traditional surveys which are framed by the limited knowledge and understanding of researchers.

The photos can be a source of individual pride and self-expression that builds the self-esteem of participants (C. Wang & Burris, 1997; C. Wang, 2003). The process of taking photos can build relationships among community members through the act of giving back copies of photos, which have been taken. Lastly, Photovoice balances the generation of knowledge through research with the action to create positive change, since it is predicated upon promoting dialogue with community stakeholders who have the resources to improve conditions.

Adaptation of Photovoice for this Needs Assessment and Dissertation Research

First, most Photovoice interventions consist of multiple workshops, which allow more time to explore issues and build solidarity between participants. For example, a minimum of six workshops were conducted in a Flint, Michigan intervention (C. Wang et al., 2004). Due to constraints on time, travel, and resources, we have adapted this project to only two workshops. With that said, Wang has used flexible adaptation in a recent Photovoice study which explored the meaning of chronic pain in older adults (Baker & Wang, 2006b). In this assessment, one group attended three sessions, while a second group took photos and wrote narrative captions in solo; the researchers explained that this adaptation was made to accommodate scheduling and problems of mobility among these participants.

Typically, analysis of Photovoice data for themes, and photography exhibits are conducted by the group during workshops, with the lead researcher as a facilitator (C. Wang, 2003; C. Wang ET al., 2004). However, in this project, analysis of themes was conducted in group discussion immediately after each individual shared their pictures and narratives. Since only two workshops were held, the analysis was synthesized within and across groups and a poster with photos and quotes and final report for the funding agency was created by Professor McGovern after the conclusion of the workshops. The draft poster and report were uploaded on an interactive website, and co-researchers and citizen participants were invited to log onto the site and offer their feedback. Consistent with the purpose of Photovoice to create positive social change, this information was used as a needs assessment for the development of a larger, three-year intervention project to reduce pesticide exposure to children, and was selected for funding by the Blue Cross and Blue Shield Foundation of Minnesota for 2008-2011.

This dissertation involves a secondary analysis of the data for deeper themes both within and across the groups. Positivistic research often involves randomized selection of participants and control of conditions for a certain hypothesized outcome. In contrast, qualitative research methods employ small convenience sampling for the purpose of gaining in-depth insight and understanding into a certain phenomenon. While the findings of qualitative research cannot be empirically generalized to larger populations, overarching theoretical concepts can be *transferred* to other environments according to how well the context of the research *fits* other situations being considered (Morse, 1999). Lincoln and Guba (1989) assert that the degree of transferability is determined by the receiver according to the transparency and rigor in which the procedures, methods, and analysis of the study have been conducted. Lastly, since these groups of mothers were not included in past surveys and focus groups in the RRV, it is possible that they may not have worries about pesticide exposure. As such, we have broadened our dialogue to include concerns about general health and well being.

PART II: METHODS FOR FORMATIVE AND SUMMATIVE EVALUATION OF PHOTOVOICE

Objectives

Objectives for mothers participating in this Photovoice needs assessment were developed by Dr. McGovern and distributed to the women during workshop I:

1. To learn about health effects pesticides and how families may become exposed
2. To discuss how what you learn may apply to your family's life
3. To discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. To receive guidance on digital camera operation and selection of quality photographs
5. To receive a digital camera to take pictures that express concerns, if any, related to pesticide exposures and how to prevent them
6. To select four photos that are most important, show these to the group and tell us why they are important
7. To work with the team to prepare a poster of photographs.

Two levels of partners participated in this CBPR project: local stakeholders and academic professionals considered as co-researchers, and women raising small children in the region. Evaluation was conducted from the perspectives of the participants and the co-researchers and considered the process of participation and short-term outcomes. Surveys that elicited participant perception about demographics, research objectives, and satisfaction were developed collaboratively by Professor McGovern and this author; they were distributed to participants at the end of the second Photovoice workshops and given to co-researchers by individual interviews over the phone during the summer of 2008 (Appendixes L and M).

Instruments were developed for validity of the constructs measured in the survey questions, which contained the following information: (1) the survey question; (2) the principle(s) of CBPR that the question was designed to measure; and (3) the rationale for question inclusion (Tables 4.2 and 4.3). Descriptive statistics, including numbers, percents, means, and medians were used via Excel (2007) software to capture demographic information and satisfaction. Open-ended questions were analyzed and summarized by major themes. Qualitative information was categorized by each open-ended question and ranges of themes were identified; matrices were created to display this information as part of the process of analysis. The matrices allowed for a systematic approach to thematic identification and facilitated ease in discussion.

TABLE 4.1

The Research Team

Team Member	Organization	Role on Research
Fowzia Adde, Director	Immigrant Development Center, Moorhead, Minnesota	Co-researcher; facilitate the inclusion of study participants from Fargo-Moorhead
Kathyrn J. Draeger, Ph.D.; Executive Director	University of Minnesota Regional Sustainability Partnerships, St. Paul, Minnesota	Principal Investigator, "Reducing Children's Exposures to Pesticides in the Red River Valley" funding: Blue Cross Blue Shield Foundation of Minnesota
Kristin Eggerling, Administrator	Quin Community Health Services, New Folden, Minnesota	Co-researcher; facilitate the inclusion of study participants receiving supplemental food support through WIC
Dr. Abby Gold, Ph.D. R.D. Assistant Professor	Moorhead State University, Moorhead, Minnesota	Co-researcher; facilitate the inclusion of study participants from the Immigrant Development Center and the White Earth Tribal college
Linda Kingery, M.S. Executive Director	Northwest Regional sustainable Development Partnership, Crookston, Minnesota	Co-investigator
Patricia McGovern, Ph.D., M.P.H., R.N. Professor	Professor, University of Minnesota, School of Public Health, Division of Environmental Health Sciences	Principle Investigator: "Using Photovoice to Document Perceived Routes of Pesticide Exposures and Health Concerns among Mothers from Minnesota's Red River Valley" funded by the Program in Health Disparities Research, Medical School, University of Minnesota.
Ruth Rassmasen, M.P.H., M.S., R.N.	Education Specialist, Centers for Public Health Education and Outreach, University of Minnesota School of Public Health	Co-researcher

Team Member	**Organization**	**Role on Research**
Maggie Stedman-Smith, M.P.H., M.S., R.N.	Division of Environmental Health Sciences, University of Minnesota School of Public Health	Doctoral Student in Environmental Health; participant in planning, implementing and disseminating findings
Stephanie Williams Extension Education Coordinator	White Earth Tribal College	Co-researcher; facilitate the inclusion of study participants from White Earth Reservation.

TABLE 4.2
Construct Validity of Partners' Evaluation Questionnaire

Question	Construct: CBPR Principle(s)	Rationale
1. The team of co-researchers worked effectively in the phases of planning **2.** The team of co-researchers worked effectively in the phases of implementation **3.** The team of co-researchers worked effectively in the phase of disseminating knowledge	* CBPR aims for equitable collaboration in all aspects of the research project among partners; as such, evaluation of process is as important as is evaluation of outcome CBPR aims for open communication, resolution of conflict and trust between members to foster effective collaboration	* This question evaluates participants' perceptions of the group process used in this CBPR research project * Healthy group dynamics are important to the effectiveness of the group; unresolved conflict, lack of trust, or lack of open communication among members can undermine the success of the group process. As such, responses to this question reflect members' perceptions of healthy group dynamics
4. Through my participation in this Photovoice effort, I have made a meaningful contribution to families in the Red River Valley of Minnesota and North Dakota	* CBPR seeks to empower members to create positive change to promote citizen well-being that is relevant to their community	* This question evaluates members' perceptions of their efforts to produce positive, relevant change in their communities
5. I have learned new knowledge and skills that will enhance my future work in my community as a result of my participation in this Photovoice project	* CBPR builds on strengths among community members, which include learning new knowledge and skills to enrich future community work by members	* This question evaluates members' perceptions of new talent development as a result of participating in this Photovoice needs assessment
6. My personal goal(s) for participating in this Photovoice project were met through my participation.	* CBPR theory holds that all members have personal objectives for participating in addition to major project goals; attaining personal objectives promotes the member's ability to create meaningful change and enhances satisfaction with the process and outcome of the group effort	* This question evaluates members' perceptions that their personal goals were reached
7. I would recommend Photovoice to others as a tool for	* CBPR unifies knowledge and skills to promote health and well-	* This question evaluates participants' perceptions of

Question	Construct: CBPR Principle(s)	Rationale
community needs assessment	being along with the action of social change; the process and outcome of CBPR benefit member participants and citizens in the community	effectiveness and satisfaction, which may be related to personal and community benefits of this Photovoice project

References for Table 4.2

Becker, A., Israel, B., & Allen, A. (2005). Strategies and techniques for effective group process in CBPR partnerships. In: Methods for Community-Based Participatory Research for Health, pp.52-72. Jossey-Bass: San Francisco, California.

Gibson, N., Gibson, G., & Macaulay, A. (2001). Community-based research: Negotiating research agendas and evaluating outcomes. In: The Nature of Qualitative Evidence. Eds. J. Morse, J. Swanson, & A. Kuzel, pp. 161-182. Sage: Thousand Oakes.

Israel, B., Schulz, A., Parker, E., & Becker, A. (1998). Review of community-based research: Assessing partnership approaches to improve public health. Annual Review of Public Health, 19: 173-202.

TABLE 4.3
Construct Validity for Mothers' Evaluation Questionnaire

Question	Workshop Objective / CBPR Principle	Rationale
1. My participation in this Photovoice project has helped me become more aware of possible heath problems associated with pesticide exposures	**Objective:** To learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives **Principle:** CBPR promotes learning new awareness, knowledge and skills, which are relevant to the lives of participants.	This question measures the participants' perceptions of learning that is relevant to promoting family and community health
2. My participation in this project has helped me become more aware of how my family and I can get exposed to pesticides	**Objective:** To become aware of pathways to pesticide exposure with targeted awareness of which pathways are relevant to one's own children and family members **Principle:** CBPR promotes learning new awareness, knowledge, and skills which are relevant to the lives of participants	This question measures the participants' perceptions of learning that is relevant to promoting family health and community health
3. Will your participation in Photovoice change your home practices to prevent pesticide exposure? If yes, how will you change your home practices to prevent pesticide exposure?	**Objective:** To discuss how what one learns may apply to one's own family's life **Principle:** CBPR facilitates participant development of relevant knowledge, skills, and action to promote health and well-being	Question 1 and 2 evaluate the participants' perception of increased learning that is relevant to promoting family health and community health Question 3 is open-ended to allow for greater information on how the knowledge and skills gained through this project will promote health in the participants' families
As a result of my participation in this Photovoice project, I have become more aware of the health benefits of eating locally and organically grown, fresh fruits and vegetables	**Objective:** To become aware of eating organic, locally grown foods as one strategy to reduce family exposure to pesticide residue through ingestion. **Principle:** CBPR facilitates participant development of knowledge and skills which are relevant to the lives of participants	This question measures the participants' perceptions of learning that is relevant to promoting family health and community health
Participating in this project has been	**Objective:** To empower others to make positive changes that benefit	This question evaluates participants' perceptions of satisfaction, which

Question	Workshop Objective / CBPR Principle	Rationale
valuable to me	their lives **Principle:** CBPR promotes the development of knowledge, skills, and action to promote positive change	may be related to personal and community benefits of this Photovoice project
If there was an opportunity to work with the University of Minnesota Regional Sustainable Development Partnership and your local project recruiter again on a project related to sustainable agriculture or gardening, would you be interested in being contacted about possible participation?	**Objective**: To bring about benefits from this Photovoice project, which may empower mothers to try additional efforts that promote the health and wellness of their families **Principle:** CBPR promotes the development of knowledge, skills, and action to promote positive change	This question evaluates participants' perceptions of satisfaction, which may be related to personal and community benefits of this Photovoice project

CHAPTER 5

FINDINGS: MOTHERS FROM THE UPPER RED RIVER VALLEY Of MINNESOTA PESTICIDE USAGE— A "BITTERSWEET" TRADE-OFF

"As farming has become more commercialized they farm more acres than they ever used to and everything is now sprayed and treated. And they're spraying for bugs and fungus and weeds and so many different things. You know that concerns me a lot—about what's in our environment. When you look back 50 years ago... farmers grew smaller amounts of acres and so they could manage their crops without large aerial applications…. The cost of living has changed so much [and] farmers [need] to keep up…. And there's a need to feed the world's people. We have to be able to mass-produce these foods to feed everyone—you don't want weeds, you don't want things that are going to reduce your yield. And so it's just a hard balance" (Mother of three children).

Overview

Pesticide usage was perceived by mothers as an imperfect, yet necessary strategy for personal protection against insect transmitted disease and for the successful production of crops in this agriculturally based community. Insect repellents and insecticides were employed by the mothers to prevent exposure from an abundant population of insects. Approaches included the application of repellents directly on children for the prevention of tick and mosquito bites, and the use of insecticides both inside and around the outside foundation of the home to prevent ants, flies and mosquitoes from coming indoors. Communities routinely conducted truck blasting to reduce the risk of West Nile Virus. This was also coupled by fogging from participants' family members and from neighbors. Farmers applied pesticides by airplane and tractor to enhance crop yield. Mothers worried about children's pesticide exposure from aerial drift, which included dermal contact from contaminated toys that were left outdoors. As a protective strategy, the mothers kept their children indoors while the spraying occurred.

However, consensus existed that they would like advanced warning before community truck blasting and agricultural spraying to allow time for getting their children to come indoors and to remove children's toys from the yard as a further measure of protection.

Other environmental health concerns included the: (1) potential for methamphetamine use-related problems aided by easily accessible, stored anhydrous ammonia tanks, and abandoned farms; (2) potential for rat proliferation from vacant property and the possibility of children being bitten; (3) lack of availability of locally grown, organic produce; and (4) potential for children's unintentional poisoning in the home from toxic cleaning chemicals and pesticides.

Assets for these mothers included the use of Community Supported Agriculture (CSA), and access to local health professionals who provide maternal and child health services. The CSA program was seen as an asset which mothers would like to build upon as a strategy to reduce their children's exposure to pesticide residue and enhance family nutrition by buying fresh, locally produced foods. Additionally, mothers identified existing relationships with area health professionals including family physicians, nurses staffing Women, Infant and Children (WIC) Clinics, public health nurses, and local county public health department officials. They discussed a need for maternal education related to safe usage and storage of pesticides beginning in the first few months of infancy onward and suggested using these existing community resources for dissemination of educational materials.

Participation

A total of six women were recruited from the following counties in the upper Red River Valley of Minnesota: Kitzen; Pennington, Marshall, Norman and Roseau. Participants were mothers raising young children who were living in close proximity to actively treated farmland and enrolled in local county WIC programs. The mean age of the women was 31.5 years. The mothers had on average, four children, with a minimum number of 3 children and a maximum number of seven children. The ages of the children ranged in aged from infancy to 12 years. Fifty percent of the mothers had jobs outside of the home.

PART I: ADAPTIVE STRATEGIES TO CONTROL INSECTS

Strategies to Prevent Insect Bites Outdoors

Direct Use of Insect Repellents on Children and Insecticides on Animals

Mothers acknowledge concerns related to the potential of their children contracting insect acquired disease and used repellents for prevention; their frequency of usage is adapted to climate and soil topography conditions in the region which impact the population of insects in a given season. One mother expresses concern about tick bites and wants to find an effective repellant for her son. Another mother reports that this year the mosquitoes are especially thick due to a higher than average rainfall and wetter conditions in the Red River Valley Basin. Direct spraying of her children with a repellent is a strategy conducted daily to protect them from mosquito bites and West Nile Virus. Yet another other describes spraying her ponies with “fly spray”; she identifies dermal contact with the treated ponies as a pathway to exposure for her children and mentions that she does not know the ingredients in the spray.

Ticks

"That is the first wood tick that I found after we started [taking] the pictures…. They just get such big welts this year it seems like when they have a wood tick. It just seems to really give them a big welt. And I don't know how to really keep the wood ticks off. We can spray for the mosquitoes and what do you do for wood ticks? …Like DEET?" (Figure 1, Sara H. ©).

Figure 1

Mosquitoes

"We were out playing with the kids. We had company and, of course, the mosquitoes were so bad that we had to get out the mosquito spray and—pretty typical. You know, I've really worried about West Nile Virus this year probably more than ever being it's so wet and the mosquitoes are so [thick]…and we do this almost everyday" (Figure 2, Pam H. ©).

Figure 2

Use of "Fly Spray" on Ponies: Exposure to Children by Dermal Contact

"And now we have ponies and the flies are horrendous so they're everywhere…. and so we sprayed them with this horse spray, fly spray. But there they've got spray on and you're riding them and petting them…. I don't even know what's in the bottle" (Figure 3, Sara H. ©).

Figure 3

Strategies to Control Insects in the Home—Concerns about Insecticide Exposure

Use of Traps and Insecticides—Alleviating the Problem

Insecticides were used as a strategy to reduce insect populations and prevent them from entering the home. One mother conveys concern about the use of indoor fly traps, since they are located within reach of her children and are aesthetically repelling. In addition, she finds no alternatives toward curbing this problem and is constrained by a low income. A second mother describes a sense of recurrent emotional agitation when flies enter her home and the selection of an automatic insecticide dispenser between her kitchen and garage to lessen this problem.

"Bumping Our Hair on that Fly-Trap"

"… Cause my kids can reach those. But there's no other way that I've been able to find that's cost wise efficient for us…. But it's like, me and my sister my sister were bumping our hair on that fly trap. It's so gross, 'cause you space it out and you know the kids could climb up on a chair and pull on it. They haven't yet— but I know they can" (Figure 4, Elizabeth M. ©).

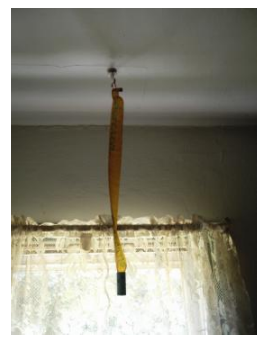

Figure 4

"The Flies Are Coming In!"

"I'm super anal about bugs in my house and my husband finally was so sick and tired of hearing me… 'Shut the door! The flies are coming in! Shut the door!'…. He went and bought me one of these. It sprays every 15 minutes or something… a spray for bugs right in front of my door to enter from the garage…. This is in our garage. My husband bought it [Country Vet] at the hardware store in town and then he carries the refill containers. And then in the winter time we put air freshener in there…. I think it is probably like Raid. It does mosquitoes too" (Figure 5, Stephanie H. ©).

Figure 5

Indoor Ant Invasion: Approaches toward Solving the Problem

Household ant invasion was identified as a problem by the participants. One mother expressed worry about the use of on-the-floor ant traps, since her baby has picked them up while crawling on the floor. The participant expresses that she wishes there were a different approach to alleviate this problem; however, she is constrained by limited financial resources. A second mother felt sickened by the magnitude of the problem of in-home ant invasion and frustrated by her efforts to control it; she describes the process of her decision-making to arrive at a viable solution. She tried home remedies to control the ants through the use of non-toxic methods; however, this was not effective. Her final solution was to spray the cracks and crevices around the foundation of her home. The pesticide usage was conducted under circumscribed conditions, which were aimed at protecting her children's exposure, and included only annual usage and targeted outdoor spraying in an area where the children would not be crawling.

Ant Traps on the Floor—Protecting a Crawling

"And then the white ones for the ants-- you have to have those on the floor and on flat surfaces so my baby can just, crawls in the kitchen. I've had to take it away from him before and put it up for a while. So that's stuff that they can get" (Figure 6, Elizabeth M. ©).

Figure 6

[Ants] in My Cupboard"

"We used to just live in the basement of our house and they [ants] would come into the basement and they would literally even be in my dishwasher. They were everywhere—like all over your plates in your cupboard…. And when you pull a cup out and there's ants in your cup to drink out of, it's just disturbing. I couldn't…."

Natural Home Remedies

"And I tried some of the home remedies. I looked online to see because there are different herbs you can put out. You can draw a line of chalk they said but I didn't know how I could draw chalk on my carpet. It was just too hard to keep them out. I did buy a spray that was an herbal type spray that was supposed to be non-harmful, but it doesn't work as well."

Targeted Outdoor Pesticide Spraying

"And this is my, for ants—I just spray once a year and it keeps the ants out.…Just along **the** edge of every outside wall of my basement. We don't live in the basement so I feel even a little better about that. Inside and out… along the edge of my whole foundation. We have a split bi-level so the windows are above the ground. So I would go along the edge of every baseboard on an outside wall on the inside and then along the house. And I just, I don't know, but it was not in areas where my kids would be crawling when they were little, because it was just on the edge, exactly. And it dries relatively quickly. So I don't know how much residue would be left" (Figure 7, Leanne T. ©).

Figure 7

Exposure to Control West Nile Virus: Exposure to Insecticides through Drift

These passages depict concerns about pesticide exposure to children from drift through two sources: community spraying for West Nile Virus (WNV) from truck fogging with insecticides in neighborhoods, and from neighbors who fog their yards. A major theme includes the dilemma of preventing exposure to mosquitoes carrying WNV vs. preventing exposure to insecticides. Specific concerns were voiced related to the potential for children's dermal exposure to pesticides through toys, and the safety of children fogging for mosquitoes without wearing personal protection, such as, long sleeved shirts and slacks, respiratory protection, and eye protection. This mother explains the story surrounding a specific instance of truck fogging down her street; she describes the proximity of the fog from her home as well as strategies she uses to prevent insecticide exposure to her children.

Community Truck Fogging to Control West Nile Virus

Figure 8

"This is just in my driveway. The spray for the city had come around. It's out of the back of a pickup and so he was spraying. It was about 7:00 at night. And that's the mist that is left after he's gone by. It lingers, for mosquitoes. We pay for this on our monthly water bill…. Maybe, it could be a couple times a week, I'd say, but probably any night that it's calm in the evening" (Figure 8, Leanne T. ©).

Strategy to Prevent Exposure—"I Put My Kids into the House"

"That's me standing in my driveway. That's across the street. We own that lot and then it's a building. So it's just the width of your house lot, I guess…. Just go into the house. I put my kids into the house and I went out and took the picture. …

Navigating a Dilemma: West Nile Virus vs. Repellent vs. Insecticide Fogging

Mothers expressed a strong concern about the potential for contracting West NileVirus (WNV) through mosquito bites, yet they were also wary about the potential health effects of frequently exposing their children to insect repellents (if directly applied) or insecticides (if fogging). One participant described her options from three different choices which all have drawbacks (keeping her children inside all day, spraying them with an insect repellent or risking WNV) and selected the use of repellents as the best option to protect her children. Participants also discussed their concerns about her children's risks of contracting West Nile Virus from infected mosquitoes compared to the risks of exposure to insecticide from community fogging. In balancing the risks, this mother believed that community truck blasting is the most protective action for her children's health. However, she identified insecticide contamination on toys as a vehicle for dermal exposure and specifically cited a need for advanced warning to give her time to take the toys inside before fogging.

Weighing the Options

"I'm concerned [about direct spraying of the children with repellents] because it's an every day occurrence, but without it you have the alternative of West Nile Virus and I don't want to have to keep them inside all the time either."

"Umm ya-know - it's so hard because the mosquito spraying, I'm worried about West Nile virus too. Up to 35%- my mom told me- of the mosquitoes are the actual type of mosquito that carries the West Nile virus in Grand Forks. So I assume that's up here too. So that concerns me.…Because I'm really worried about the insecticide exposure for my children, but I'm also worried about West Nile virus…."

Balancing the Risks: Truck Fogging With Advanced Warning

"….And I just wish that there was some way short of just seeing the truck come by to know that they're going to spray, just to get my kids and my toys. If your yard is full of toys and they're all of a sudden coming down the block, you don't have time to pick up all your toys…. Just the fact that our yard then is full of insecticide and we're out there. It's hard 'cause I don't know how they ever could call everyone in town…If they could do, like a little siren…like a tornado siren. Blow a whistle three times or something."

Community Aerial Spray to Control West Nile Virus

This woman describes community spraying by plane to limit mosquitoes in preparation for a public festival in Grand Forks, North Dakota. She conveyed a concern that people ingesting pesticides through the water they drink or the air they breathe could develop cancer as a result of their exposure. She wonders if the cancers diagnosed in middle-aged women who reside in a nearby community were caused by pesticide exposure; in this instance, the participant is referring to pesticide exposure in totality, which includes insecticides applied by aerial spray for the prevention of West Nile Virus.

Worries about Cancer from Pesticides in the Air and Drinking Water

"My sister and I went to Grand Forks on Monday night and Drayton is a town not that far from here and they are aerial spraying for mosquitoes because they have River-Fest Days coming up. this weekend. And we were on the Interstate coming up the exit and we could smell it. And I know that Grand Forks, they get a lot of flack about using aerial spraying, but then they say that the small, small, small traces or whatever get to you are very safe… but that's something that worries me because we have like right now [five] women in Kennedy that have cancer and we only have 250 people in our town. And I always worry about the chemicals leaking into the drinking water. Cause like my dad says, it's got to be-- what's the common denominator? It's either the air they breathe or the water they drink. … Five out of 250; that's a lot. And if, I would say 45-55 is the age range... 40-55 maybe."

Individual Fogging by Children and Adults to Reduce Mosquitoes

This mother showed a photo of a young boy who was fogging across the street to limit mosquito exposure. She was concerned about the insecticide exposure directly to the child and wondered if this was safe for him, or for adults who engage in this activity also. Upon analysis of the photo, it was noted that the boy was standing in the middle of a cloud of insecticide, wearing a short sleeve T-shirt, shorts, and no mask or eye protection.

Lack of Personal Protective Equipment

"That's my neighbor. He was fogging for mosquitoes. My neighbor's son, actually. He's probably about 12. Is that healthy? I don't know. But that's very common to see people in their backyards. Like my brother-in-law has the same thing too and he does that" (Figure 9, Leanne T. ©).

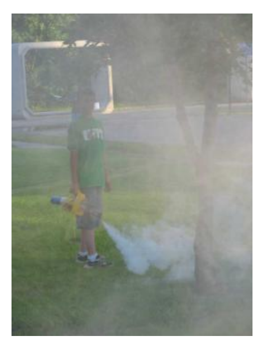

Figure 9

Mixing Home-Made Insecticides for Fogging

One mother told the story of her father-in-law creating a self-manufactured mix of chemicals for the purpose of killing mosquitoes. He creates this mixture as a strategy to save money. The substance has a noxious odor that varies from batch to batch; she does not know all of the ingredients he puts in the pesticide, except for diesel. She worries about this exposure.

A Strategy to Save Money

"And that is my father-in-law's fogger that we used. And the different thing about this is he mixes his own chemicals. He doesn't use the store stuff. I don't know what he uses. I do know he uses diesel fuel as part of it and then he adds some other stuff. I don't even know what it is. It's cheaper. It doesn't work nearly as good, but we're very short on money so we get by with it. Normally you can get that Tempo or whatever and you can at least read what's in it. Where it's like he's using diesel fuel. It's *disgusting!* And then he's mixing all this other stuff and he mixes it different every time because he doesn't have a formula"(Figure 10, Elizabeth M. ©).

Figure 10

PART II: CONCERNS ABOUT EXPOSURE TO AGRICULTURAL PESTICIDES THROUGH DRIFT FROM AERIAL SPRAYING BY FARMERS

Aerial Spraying on Farmland Adjacent to the Family Home

This mother lives adjacent to actively treated farmland. She identifies drift from aerial spraying of pesticides as a potential exposure pathway for her children. Sleep disturbance and anxiety are identified as additional health effects beyond the possibility of exposure from drift. The mother describes her strategy to limit pesticide exposure by not allowing her children to go outside during the spraying.

Impacts on the Children: Sleep Disturbance and Anxiety

"And there he's flying over my house. That's the shed. My house is just to the left. Yep, [he's] right there. Under those trees... and they come early in the morning and wake the kids up. They'll just zoom right, 'cause they go right over the house. Zoom…. And the kids will come down and Ben will say, 'It's scared— It's scared'" (Figure 11, Sara H. ©).

Figure 11

Strategy to Reduce Pesticide Exposure: Keeping the Children Indoors

"It's the airplane and sometimes he'll want to go out and watch the airplane because he wants to see the airplane- but he can't go out there."

Aerial Spraying: Potential for Exposure While Driving on Roads

This same mom tells the story of being out in her community one day with multiple planes spraying in the areas she frequented. Another mother who is pregnant portrays driving in the community about three miles from her home when she came upon a farmer applying pesticides by aerial spray; her sense of smell was overpowered with an offensive odor emitted from the chemical being discharged. She describes an aerial spraying technique that is not targeted exclusively to the crops. Analysis of the photo shows this farmer spraying directly over the road. The participant did not know the type of spray that was being emitted.

"I Couldn't Get Away"

"That is another plane. I just saw them all over. They're just…. It didn't matter where I went, there they were spraying. *I couldn't get away.* We went to look at some horses, some ponies and we were, that's right by where we were looking at the ponies. I was not far... I was just standing right there…."

Untargeted Aerial Spraying

"And we were driving along and… I'm pregnant and I can smell things, and we had the air conditioning going and I'm like—'What's that smell?' We got around the corner and on the one side of the road was a farm, and then there was the road, and then the field right across… *"….And he was swooping right over the road, right over the cows and spraying*…." (Figure 12, Misty B. ©).

Offensive Odor: "I was Literally Almost Holding My Nose"

"…and we stopped and I got out of the van, and it smelled *so terrible*. I was literally almost holding my nose 'cause it was so thick."

Figure 12

Concerns about Exposure to Pesticides through Drift from Tractor Application

The women recognized the potential for pesticide exposure to families living adjacent to agricultural farms from spraying by large tractors, or to community members while driving on roads adjacent to where spraying is being conducted. One mother lives next to actively treated farmland with her husband and six children and describes large-scale agricultural spraying that occurs while she and her children are outside playing in their yard. The two properties are separated by a barrier of trees, which has become sparse due to damage from weather. She expresses apprehension about exposure to her children through drift. In addition, this mother is pregnant and concerned about possible pesticide exposure to her unborn baby from drift; she implies that her awareness of this potential exposure has increased after participating in the Photovoice needs assessment, and she is limiting her exposure to the drift as a protective measure. Another mother describes the close proximity of treated farmland next to her home where her children play. She was not able to photograph the actual pesticide spraying, yet knows her children could be exposed to it when they are outside. A third mother points out the potential for pesticide exposure by drift to citizens driving on roads near the edge of land that is being treated with the use of large tractors. She explains that although she and her husband own a field adjacent to their home, it has not been recently sprayed. This same participant is married to a farmer who works on 600 acres of land that the family owns, located 25 miles away from the home. The mother does not discuss the potential for exposure to pesticides through occupational track-in from her husband's clothes, work-boots, and tools. She is knowledgeable about the type of crop he is spraying and the pesticide he is using. Since the farm is a long distance from her home, her family is at lower risk for exposure by drift compared to other family farms which are not set apart from their residences.

Family Activities Outside During Agricultural Spraying

"…Every time there was a sprayer, we were outside. *Every time!* And we didn't know if it was a tractor. We had to actually go out and see what was on the tractor. We have a barrier of trees which we had a tornado or whatever come through and take out a lot of our trees so now we can see through so a lot more comes through our trees-- so it's a little bit more scary….And this is actually when we were outside. The grass you can see is the edge of our property, and that's the truck or the tractor spraying and it was at 5:30 at night. That is soybean. (Figure 13, Misty B. ©).

Figure 13

Concerns about Possible Pesticide Exposure from Drift to Unborn Baby: Avoiding Direct Exposure

"My husband actually took that picture, ′cause I told him I didn't want to go out there after going to these things. It was one of our first pictures and he goes, you should go out there and take it. *I don't want to*. *I'm pregnant*! *You* go do it. So he did it."

Playing on the Edge of the Farm Field

"That is the closest field. …they play like right on that edge there so it's like, they could walk into the field if they wanted to and actually the machines will have to take our driveway once in a while to get into their own field. I've seen equipment in all the fields before and spraying and stuff. I just couldn't catch them" (Figure 14, Elizabeth M. ©).

Figure 14

Treating Land on the Edge of the Road

"This is just a neighbor out spraying his sugar beets and I was just driving around one night and he was right along side the road-- like the grass right there is the ditch and then the gravel road where I was parked. [This is] 7 miles [from my home]. But typically, there's a field across the road from us that's my husband's that would be sprayed with the exact same thing. It's just, he hadn't been spraying around the farm lately" (Figure 15, Stephanie H. ©).

Figure 15

Family Farm Separated from Home

"This is my husband. I drove up to where he was spraying. But you can actually see the spray coming down a little bit, that white haze under the booms… it's haze from the spray. This is a piece, we farm 600 acres, it's about 25 miles from our house. This is soybeans. [He's spraying with] Round- Up probably, ´cause it's Round-Up Ready Beans"

(Figure 16, Stephanie H. ©).

Figure 16

No Warning Prior to Agricultural Spraying and Fogging: Lack of Time to Take Precautions for Reducing Exposure

A major concern voiced by the mothers was that they did not have warning before the release of pesticides in their community. As such, they were limited in their ability to protect their children from exposure to drift. Toys contaminated with pesticide residue were identified as a potential vehicle for exposing their children through dermal contact. Prior warning was perceived by the mothers as an important strategy that would allow them to remove their children's toys before spraying occurred to prevent pesticide exposure from this pathway. In addition to concerns about warning before truck fogging for West Nile Virus, these mothers voiced concerns about lack of prior warning from farmers and neighbors before they sprayed as well. One mother discusses the lack of warning she typically receives before her neighbor when he conducts aerial spraying. Another mother whose home boarders a large agricultural farm describes the proximity of the field to her home and conveys concern about the lack of time she has without warning to get her children and her pets indoors before the onset of spraying. A third mother conveys that her greatest concern is the contamination of toys from fogging carried out by neighbors who live nearby.

Lack of Warning: Aerial Spraying

"So this is right at— I'm parked at the end of my driveway taking this picture and he's [farmer / neighbor] coming, he has just come over my house and that's him spraying. He did even call one time this year and say he was going to spray. He's never done that before (Figure 11).

Lack of Warning: "The Tractor Closest to Our House"

"….The tractor closest to our house [is my greatest concern], because that one just, they don't let us know. It's right behind me. It wasn't very far from our house at all and we have central air going all the time and the kids are outside playing and we have two dogs. And there'd be no way of even warning that we could get all of our toys in— but just our animals and our kids inside and turn off the air conditioning or whatever" (Figure 13).

Lack of Warning: Neighbor Fogger

"This is just, this is right in my driveway and it shows— I had put my kids in the house and then that was from him. That's the mist that he got from his fogging next door and then those are my kids' toys right there (Leanne T., Figure 17 ©)."

Figure 17

PART III: CONCERNS ABOUT GENERAL ENVIRONMENTAL HEALTH ISSUES

Potential for Methamphetamine Laboratories in the Community

This mother conveys concerns that anhydrous ammonia tanks, used for a nitrogen-based fertilizer could be tampered with and stolen for the purpose of manufacturing and distributing the illegal drug, methamphetamine. She conveys concerns about easy accessibility to the tanks and expresses apprehension about the potential misuse of this substance and associated dangers, such as, unsavory persons making the drug, and the risk of an explosion or environmental contamination. She sarcastically remarks that the tanks are well-secured. A second concern voiced by this mother was the potential for an abandoned property in her community to become a methamphetamine lab. As two protective strategies, she maintains the lawn to camouflage the vacancy and her family keeps a presence on the property.

Insecure Anhydrous Ammonia Tanks

"You see tanks all over but probably one of my biggest fears with raising kids [is] with methamphetamine … *and you see how securely they are put away.* And generally, we see a tank or two parked out in the fields here and there. I didn't see so much of that this year because of the wetness, but I did run across this" (Figure 18, Pam H. ©).

Figure 18

Abandoned Property

"I have a neighbor farm-yard that just vacated about a year and a half ago and periodically my kids like to go for a four-wheeler ride. We just tool through there just ´cause I have thought of that that there could be a meth lab just right down the road from me. I mow it occasionally and I know our other neighbors keep it mowed so there's constant traffic kind of going through this place ´cause I have thought of that. And what do you about the places that are empty because we have two just less than a mile from our house?"

Rodents on Abandoned Property

This mother also raised the worry of rats proliferating in vacated farms where old grain is left, and the potential for her children to be bitten.

"And there's nobody, and the one property has this grain from the 60s and the bins are rotted so the rats are everywhere. And actually we were outside the other day, it's been a while now… and my six year old turned around and said "Hey daddy there's [a] rat behind you." He is like whatever. And he turned around, and there was a rat behind him-- a big rat! They leave these farm places abandoned so there's some concerns besides the meth. There's rats. And that's a health concern."

Concerns about Unintentional Poisoning: Approaches toward Prevention

Mother's identified the potential for unintentional poisoning as a concern and discussed their strategies for prevention. In the captions below, two participants express confidence in their approaches of placing household chemicals in cabinets out of their children's reach. A third mother expresses her sentiments that no perfect strategy exists to protect her children from access to household chemicals. She explains that although she put her chemicals away, her toddler still managed to get exposed. She is resigned that her children will still be able to reach her chemicals despite placing them in what she thinks is the safest place for storage. A second prevention strategy shared was to reduce or eliminate the presence of toxic household cleaners in the home by substitution with non-toxic wiping cloths and solutions.

Establishing a Place for Safe Storage: "It's Up High" and Keeping Chemicals "Out of Reach"

"Yeah. And that's where I keep my ant and my mosquito spray so my kids don't get it. That's in my garage. That's my prevention strategy" (Figure 19, Leanne.T. ©).

Figure 19

"This is just a picture of all my household chemicals. It's hard to tell from the cabinet, but the bottom is where I keep my vacuum cleaners. It's up about this far off the ground and then the vacuum cleaners are in there and brooms and mops. So it's up high. But, I keep all of my household cleaners and stuff out of reach of my kids" (Figure 20, Stephanie H,. ©)."

Figure 20

Illusively Safe Storage: "The Kids Find It No Matter Where You Put It"

"I have tons of cleaning supplies which I've had to move up because my one-year-old will go into the cupboards and spread everything - and I thought I put all my bug sprays away and my 2 ½-year-old sprayed "Off" in his eyes. And so he had it right into his face. You know they say 15-20 minutes rinsing their eyes. I'm like, I've got half a bottle of water in his eyes. I called it good enough. There's no way they're going to hold still for that. But yet it's just like you think you have something put away… I think the kids find it no matter where you put it. That's a big thing."

Concerns about Lack of Access to Fresh Organic Produce and Locally Grown Foods

A discussion took place among the women about the relative scarcity of locally grown organic fresh produce in their community and how they currently access these foods. One mother noted that the organic food section in the grocery stores is limited to boxed food and does not include produce.

Lack of Availability of Organic Foods in Local Grocery Stores

"Well, and in a smaller community you don't tend to have like a bigger organic crop in the stores even as like in the cities they have bigger sections that offer a lot more organic stuff. I noticed that the stores around where we live, there's like one small- not even any produce. It's just all boxed stuff of organic stuff."

PART IV: COMMUNITY AND INDIVIDUAL ASSETS

Community Supported Agriculture

Community Supported Agriculture (CSA) is a partnership between local farmers and the members of a community, whereby, citizens provide advanced economic support to farmers in exchange for receiving a weekly share of the bounty throughout the growing season. In this manner, community members share in the risks and benefits of crop yield. One mother who is a member of a local CSA conveys the following advantages of belonging. CSA participation is an enjoyable family event that she and her children share. CSA benefits pertaining to time, labor, expense and yield outweigh the difficulties of growing a private garden. CSA participation is also a shared experience among community members which can build cohesion. Families take turns driving to Crookston for pick-up and food delivery to neighbors; each family's supply is parceled and ready upon arrival. CSA benefits provide an increased diversity of fruits and vegetables in diet, which enhances family nutrition. Lastly, participation in CSA encourages developing knowledge and familiarity with new foods, as well as learning new recipes; this mom describes a sense of motivation to learn new recipes along with a sense of mastery related to her newly acquired skills.

CSA—A Fun Family Event

"Now this is the guy from the CSA and he had just run down to grab those cucumbers because they didn't put enough in our bags. So he had just picked them over in the garden… and so we joined this, it's the Community Supported Agriculture in Crookston and it was just fun because he ran out and picked them. He gave one to each of the kids and then filled up our bags" (Figure 21, Sara H. ©)

Figure 21

Benefits of CSA over Growing a Garden

"Well… I've tried to have my own garden and it seemed like it would freeze in June and the one year it froze in August and then all the corn blew over and it seemed like I was doing all that work and getting nothing for it…. And weeding. And so really this turns out to be about $15 a week, which I can handle that - and I figure I'd pay somebody $15 a week just to weed my garden."

CSA as a Shared Experience among Neighbors

"It's just, the only thing with this is that we do have to drive down to Crookston, but there's five of us or six of us that are doing it so then we only have to go once every six weeks and they guarantee fifteen weeks - but last year they went 24 weeks."

CSA: Diversity in the Family Diet— Gaining a Sense of Creative Culinary Mastery

"They bag it up for you. Its new things that you would never go to the store and buy, but once you get it, you can look up a recipe online. I just Google it-- and the other night I made pea soup and it was just peas and potatoes and you put in whole milk and a couple onions and it was very good. But normally I wouldn't say, 'Well what can I do with these shelled peas?' [The CSA] is not only organic, but it's food that is healthy - that we should be eating and that I probably wouldn't be buying if I wasn't involved in it. Like I've never eaten kale before and we had it and we all loved it. Kale. It was fabulous! We just sautéed it in a little butter and garlic. I used it like spinach. It's just really fun to experiment with all the different, the new things."

Community Availability of Locally Grown Fresh Produce and Meat

It was discussed that specialty farms for certain foods exist in the area for community members willing to drive to them for access. One mother talks about a local strawberry farm and shares her perception that locally grown, organic produce is better tasting and safer than conventional produce, since they are free of added chemicals. Another mother lives on a hobby farm where she and her husband raise elk. This is an asset for the community which her family is contributing, since they are making available a supply of federally inspected, locally grown fresh meat to citizens.

Locally Grown, Fresh Strawberries

"That's my son, Christopher. We went and picked strawberries out at the strawberry farm and there is such a huge difference between those strawberries and the ones you buy in the store…. It's *crazy!*....These don't have fertilizer on them. They don't put anything on them at all and the ones in the store - they're shipped in a truck and they throw the chemical in the back to burn off the mold and the fuzz that grows on them and it's - half the time they're not really ripe, they're just, that's chemical to make them just turn red or whatever. It's just, they're so much *better tasting* …and *safer"* (Figure 22, Sara H. ©).

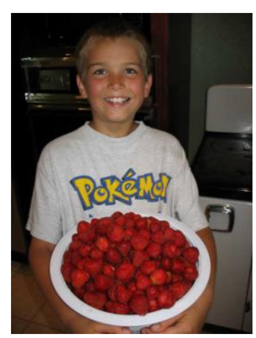

Figure 22

Availability of Locally Produced Elk Meat

"This is an elk. We have about 55 or 60 head of elk and we sell to the Caribou [restaurant, Hallock, Minnesota and we have it butchered in a federally inspected place in Barnesville, Minnesota, which is a little bit of a distance for us. We have quite a few of the local bars sell our, they're called beer sticks - it's jerky. And then the fair, the kids in county fair usually sells our burger patties at one of the stands there, and then the Caribou in the past. I don't know if since the changeover they have done it, but they run specials on the steaks and the burgers (Figure 23, Stephanie H., ©).

Figure 23

Home Gardening as a Family Asset and a Strategy to Promote Dietary Diversity for Children

Another mother conveys that she has a large organic garden of her own, which by canning and freezing serves as a source of year round pesticide-free produce for her family. A second mother describes teaching her children how to garden as a motivational strategy for increased consumption of fresh fruits and vegetables while helping them to develop good nutritional habits; she explains that the sense of satisfaction her children feel through their contribution instills their appreciation for the fresh food that is produced.

Family Organic Garden as a Year-Round Food

"I mean, I'm not part of this CSA, but we have a humongous garden and it's all organic. There's nobody around there that sprays. I garden with my in-laws and so I can as much as I can and I freeze as much as I can."

Gardening with Children—Teaching the Children their Connection with Food

"Locally grown…. And my kids help plant the garden so they think it's kind of cool. But when it's part of their effort they appreciate it… They like to dig the potatoes and pick the tomatoes. I think sometimes they're more likely to try a food and be more willing to say, "Yes I like this tomato," just because they grew it. Whereas, if you brought it home from the store or the CSA it's more like 'I don't want to eat that…I don't like that.' But if they worked to get it, if they helped plant it…. Like peas for instance. Kids generally don't like peas but if you let them shell them out in the garden and eat them just like that, they think that's pretty cool.

PART V: IDENTIFICTION OF COMMUNITY NEEDS: APPROACHES TO REDUCE PESTICIDE EXPOSURE TO CHILDREN

Protection from Exposure to Agricultural Drift by Advanced Warning

Advanced Warning from Farmers —Mother's Weigh-In

Mothers voiced a need for advanced warning before the application of pesticides through aerial spraying or tractors from nearby farmers. An in-depth discussion took place related to the feasibility of farmers providing prior warning; opinions differed as to whether or not this would be practical for several reasons. Some mothers felt it may not be attainable, since there could be many neighbors to notify who may be difficult to reach. Another mother believes that pre-warning may be feasible since only a few homes border the farms. An idea was suggested to place educational information in packets handed out to moms at medical clinics that is aimed at encouraging them to call their neighbors and request advance notice before large-scale pesticide application is conducted. Yet another mother gives farmers the benefit of the doubt in their intentions to be considerate of others; she suggests public service announcements would be a more gentle approach to notify neighbors before spraying.

Advanced Warning from Farmers: Too Much Work for the Farmer

"I think it would be a lot of work [for the farmers]."

Advanced Warning from Farmers: Spraying is based on Weather Conditions

"The spraying is based upon wind speed, weather, whether or not it's going to rain in the next ten hours. So if they're going to sit down and start calling people before they decide to go spray…."

Advanced Warning from Farmers: Notify Only Adjacent Households

"In farming community there's not many… I know where I live there's not that many houses to call. Maybe three or four would be right around the field."

Advanced Warning from Farmers: Feasibility Dependent on Number of Residences to Contact

"It would depend on how big of an area they're going to have sprayed. If they had to call, even if they had to call ten places and if they got people or kids or-- who knows who you're going to get on the phone. It would be one thing if you were going to call and leave a message on the answering machine and leave ten messages. It wouldn't be that bad."

Encouraging Mothers to Request Advanced Notice from Neighbors: Education from Clinic Brochures

"I think maybe in part of the information packet, if you put in like a disclaimer or whatever —if you live next to a farm, don't be hesitant to call your local farmer or whatever and ask them to let you know because maybe if there's just a couple people who are concerned, they might just call a couple people."

Public Service Announcements

"…. A public service announcement just taking that into account and when possible, how considerate that would be to your neighbors. Because I do think farmers, if you told them they had to - I can imagine what their attitude might be because it is difficult. But just making them aware of it, ´cause I think they would be considerate enough if they have a neighbor who has children. I think they would make an effort."

Concerns Related to Inadequate Education for Farmers who Apply Pesticides

Personal Protective Equipment

Some mothers voiced perceptions that the farmers who apply pesticides in their communities are not adequately trained about safe pesticide usage and health implications; this belief is based on witnessing farmers applying pesticides without using personal protective equipment (PPE). One mother who is married to a previous farmer discusses his lack of protective glove use on the job. Another mother who is married to a current farmer also conveys concerns about farmers practicing sound safety practices while applying pesticides.

Inadequate Glove Use Seen Among Farmers Applying Pesticides

"And I always wonder how much of the farmers are educated on the chemical they're using. My husband never wore gloves in the four years he farmed. Maybe if you're an aerial applicator you maybe would be more in tune with something like that."

"I drove by on the highway but I couldn't get a picture of the two guys putting chemical into the sprayer and starting to go spray the fields - neither one had gloves on."

Infrequent Changing of Gloves among Farmers Applying Pesticides

"But I know neighbors like, neither one of them were agronomists before, and they buy a case of this certain glove every spring that's real thick and I was just talking to one of their wives and she said her concern was that he wasn't throwing them away enough. They're reusable. And they're using like really thick rubbery gloves…. She was concerned that they weren't throwing them away enough and taking a new pair."

Perception of Risk and the Use of PPE

A hypothesis was made that if farmers were more educated about issues related to the health effects and safe usage of pesticides, they may be more likely to notify neighbors before large-scale spraying. Another participant asserted that not using PPE may instead be due to a perception by farmers that their exposure on the job would not be harmful. Yet another mother asserted that perception of risk may differ according to a perspective related to the type of job that is being performed; she explains that in this community the perception of risk by pesticide exposure is also related to gender, since farmers are predominantly male, while child care-givers are predominantly female.

Hypothesis: Improved Farmers Education Leads to Increased Awareness

"But maybe if you educated the farmer… because then if they knew kids and pets shouldn't be exposed to this maybe then they would think - like maybe I should let these people know if I can."

Perception of Exposure Risk and the Use of PPE

"But if you would talk to them, like I talk to my husband and the agronomist are both standing there. Both of them are like, it's so safe. You don't have to worry about it and as long as you're not mixing the chemical and standing right underneath the spray of it, he said it's not going to harm you."

Differing Perceptions of Risk Based on Job Tasks / Gender

"I think a lot of times a guy's perspective is almost different than ours. We will think first of the kids—where they just want a field done. They're not going to be thinking the same as we are, so a lot of times the guys are more likely to say it's fine. I think that's a big thing too."

Lack of Information

The mothers conveyed that they lacked clear information about the risks of adverse health effects from long-term exposure to small amounts of insecticides vs. the risks of disease carried by insects. In addition they expressed a desire for knowledge about the safe usage of insecticides in a manner that minimizes exposure to the chemicals; all agreed in a show of hands that they wanted more information.

Taking for Granted that Exposure is Safe

"I wonder how many people who don't have the opportunity to be in a meeting like this - just take it for granted, you know, that their exposure is safe. All the stuff that they're spraying in their house to kill the bugs. But they're spreading germs, stopping germs and stopping bugs and stuff like that, but they're almost doing just as much harm if not worse with all the chemicals and stuff that they're using."

A "Bitter-Sweet Trade-Off —Finding the Happy Medium

"I noticed too when I was going through all the research and the questions and stuff, it's kind of a bittersweet thing. You almost, you have to repel the bugs and the weeds for crops and stuff— you almost have to do it— but it's harmful for you. You know, where is the happy medium?

Safe Usage of Pesticides to Reduce Exposure to Children

"We moved from where we are living now before and the mosquitoes were horrible and we were spraying Raid constantly almost every day, because the mosquitoes were so thick. They'd come in every crevice. You'd walk outside and you were breathing them, they were so thick. And nobody ever told me you probably shouldn't be there when you're actually spraying- but the exposure on their stuffed animals and their clothes and the furniture… all that inside and nobody ever told me that was bad. I wonder how many people actually still do that kind of stuff and spray and spray and spray and spray…."

Identification of Existing Health Resources as Vehicles for Providing Information

In a group discussion, several women identified existing community resources, which provide educational information and services that assist mothers in raising their children. These assets included: (1) the family physician; (2) public health immunization clinics; (3) the Women Infant and Children (WIC) federal nutrition program clinic; (4) the county public health department; and (5) in-home public health nurse visits. The mothers freely and creatively offered solutions related to how education about pesticide safety could be disseminated by using existing services. Some mother's suggested providing written information about pesticide safety in pre-assembled education packets distributed at well-baby appointments and at the time of annual pediatric examination visits. Another mother suggested disseminating information at the public health immunization clinic. Providing information at the local WIC clinics was also proposed. Another suggestion was to include information about pesticides in mailings from the local county public health department, which conducts home visits. Another mother, who is a local county public health nurse, suggested the public health home visits for new babies would be an avenue for education about safe pesticides. In addition, parenting magazines were seen as an additional source of information about pesticides.

Physician Clinic Appointments

"When you have a baby or whatever, they give you tons of information on car safety seats and all these things…. They give you packets when you go into the doctor of different things to [do] or safety things. They could put it in there. Or at least educate you a little bit more, because you could start your prevention then when you first have a baby and just choose better healthy things in life from then on."

"At my doctor's appointment with every first prenatal appointment they give you a folder of handouts for this, that, and the other thing. And I went through mine to see if there was anything on pesticide exposure, bug spray…. I mean- all that different stuff."

Public Health Immunization Clinic

"Or I mean you have those immunizations. We often went to the public health immunization clinics."

Local WIC Clinic

"But they could even have it at WIC. They could have information there. They always have some papers, a newsletter - different things. Well, at every check-up they have like a bulletin board of different information, healthy ways."

Local County Public Health Department Mailings

"I think the things they mail out from the home health has for the different age groups - it says, your child is 4 so they're interested in, this is how they like to play and things to do for them, and one was to put up your chemicals to make sure they're not where they can reach them."

Public Health Nurses Making Home Visits after the Delivery of a Baby

"And it's kind of a tough spot to catch these because you can't wait until your kids are in school - they're already 5 and not everyone has a primary health care provider. Like you see this - catch these kids birth to 5. And every county is different, it's hit and miss. Marshall is fortunate to offer all of their kids the follow along program kind of what you're talking about, communities caring for children, but not all counties can…. If you're coming home from the hospital and you say, I'd like to have a nurse come out and check the height and weight of my baby, that's me. I'm more of the educator versus the health care provider."

Parenting Magazines

"I don't know. I learned a lot of tips and stuff from parenting magazines or Parents. There's both. If they print articles, or even just little blurbs in a magazine like that. A lot of parents get those magazines to look at and get tips out of them and stuff like that. They could learn things out of a magazine like that."

CHAPTER 6

FINDINGS: GRANDMOTHERS AND MOTHERS FROM WHITE EARTH RESERVATION: PESTICIDE EXPOSURE – "IT'S THE WHOLE PICTURE"

"Native American teachings describe their relations all around—animals, fish, trees, and rocks—as our brothers, sisters, uncles, and grandpas. Our relations to each other, our prayers whispered across generations to our relatives, are what bind our cultures together. The protection, teachings, and gifts of our relatives have for generations preserved our families. These relations are honored in ceremony, song, story, and life that keep relations close – to buffalo, sturgeon, salmon, turtles, bears, wolves, and panthers. These are our older relatives—the ones who came before and taught us how to live. Their obliteration… is an immense loss to Native families and cultures. It is the struggle to preserve that which remains and the struggle to recover that characterizes much of Native environmentalism. It is these relationships that industrialism seeks to disrupt. Native communities will resist with great determination"

Winona LaDuke in *All Our Relations: Native Struggles for Land and Life*.

Overview

The grandmothers and mothers from White Earth Reservation recognized that they are surrounded by large-scale farming and pesticide exposure through drift and run-off. Community exposure to children from pesticide drift generated by aerial and tractor spraying was reported to have occurred in multiple places, such as, in cars, schools and daycare. One day care facility is located adjacent to a farm where pesticide spraying is conducted; since these children play outside three to four times a day, concern was raised about dermal contact with pesticide residue from toys. Photos were taken of a farmer spraying pesticides by plane directly over the highway, as well as puddles of pesticides on the pavement that splashes on to traveling cars. The Pine Point School is located across the street from a farm, which reportedly sprays while school is in session.

Other concerns for pesticide exposure included community fogging as a strategy to prevent West Nile Virus, and the use of insecticide spray at public gardening stores while shoppers are present. Direct application of repellents was used by mothers as “the lesser of two evils” to prevent West Nile Virus. The impact of pesticide exposure on cultural activities and the consumption of traditional foods were a major concern and included, run-off from adjacent farms into the rice beds and the Pine Lake River and spraying for mosquitoes in an area where tribal members hunt and gather berries.

Community assets included the availability of locally grown foods to promote nutrition and reduce pesticide exposure, such as, native wild rice, organic apples, and fresh organic strawberries, as well as the accessibility of locally grown, fresh produce at a nearby grocery store. General health concerns were raised by participants, such as, playground safety and children’s exposures to ultraviolet (UV) rays. Mothers suggested testing public water for pesticides and identified a need for education about safe pesticide usage and strategies to prevent exposure to children through existing social services such as the Women, Infants and Children’s Program (WIC), the Indian Health Service, Head Start, and the local county nurses who administer the Life Program.

Participation

Four women participated in this Photovoice project. However, one evaluation is missing from a participant who did not attend in person, yet sent her photos and captions to the workshop electronically. Therefore, demographic analysis will occur with the three existing evaluation surveys. The mean age of the women was 41 years. Women were raising an average of four children. Mothers and grandmothers reported having children and grandchildren between the ages of five months and 28 years. Thirty-three percent of the participants worked outside of the home.

PART I: IMPACTS OF PESTICIDE EXPOSURE ON TRADITIONAL ACTIVITIES AND NATIVE FOODS

World-View toward Large-Scale Agricultural Practices

Two grandmothers discuss their perceptions of the modern agriculture orientation, which use pesticides for the purpose of killing unwanted vegetation and insects on the land. One grandmother who is raising two small children that live with her describes the basic modern agricultural approach of pesticide application, along with concerns for human exposure. She mentions her husband's recent employment as a farm worker and affectionately calls him a "traitor"; her choice of wording conveys disdain toward large-scale conventional agricultural practices. Another grandmother explains that only 11% of the land on the reservation are tribally owned. She asserts that the tribe has to recover the health of the land from many years of pesticide use and fertilizer application. Her choice of the word "heal" belies an anthropomorphic world-view of the Earth as a live entity, and a perception that modern agricultural techniques have desecrated it.

Working for one of 'those' farmers

"My husband works for one of '*those*' farmers…. This picture is driving down the highway and this was right after I learned, my husband works for one of those farmers. He works for a commodity farmer and I had just found out that they spray everything so, they spray Round Up on everything so it kills it all at once for harvesting purposes…. I guess I just lived in my little woods bubble and didn't realize that's what they did. And just the thought of that-- of how many people are getting exposed to this and don't …. Well, he just started-- he was a farmer a long time ago so now he's kind of semi-retired and so that's what he loves to do is work outside…. That's why I was calling him a 'traitor'" (Figure 24, Stephanie W. ©).

Figure 24

Recovering and Healing the Land

"But now the tribe is starting to take that land back which is good. They're getting a lot stricter on that kind of thing. But we have to heal it from all of the years and years of chemical use that were on it."

Concerns about Pesticide Contamination of Rice Beds from Agricultural Run-off

This grandmother introduces us to the rice beds and mentions that the rice beds played an important role in their cultural heritage. Another participant voices community concerns about wastes from pesticides, fertilizers, and bacteria running off from a chicken farmer upstream and contaminating the rice beds which are grown by citizens on the reservation. This grandmother describes the difference between rice beds and rice paddies. Rice paddies are located upstream from the rice beds. Rice beds are the term used to describe native grown rice, while paddy rice is used to describe genetically engineered, commercially grown rice; she explains that the two types of rice differ in appearance, and conveys a sense of protectiveness by the tribal members toward the rice beds.

Concerns about Possible Agricultural Contamination of the Rice Beds

"[This is near] the bridge further down the river going into Rice Lake. There's rice in the middle [which is] a big part of the history and culture here…. A long, long time ago… they said they'd have whole families come and camping out there to rice…. There's quite a few fields surrounding it. [There are] concerns about the run-off from the farms with pesticides that farmers use getting into the rice" (Figure 25, Celeste C. ©).

Figure 25

Protecting Mahnomen Rice

"Mahnomen rice is hand harvested rice the Anishinabe sell. Lake rice is hand harvested by the Anishinabe. The other stuff is genetically modified…. Even the construction of the bridge on Rice Lake was controversial. Underneath there's planks and you can control the water levels."

Concerns about Agricultural Run-Off of Pesticides into the River and Contamination of Fish

This participant talks about concerns of agricultural wastes running off into the Rice Lake, and into Rice Lake River at Pine Bend to Bolleo. Subsistence on fish in the diet and the traditional tribal activities of fishing may be impacted by this pollution.

"By the time the river gets to Pine Bend it's Disgusting"

"It's like that river that Celeste took pictures of. It starts out on the lake where most of our water is gross and then it comes down and it goes through Rice Lake and down around through Pine Bend to Bolleo and then I don't know how far it goes from there but by the time the river gets to Pine Bend it's disgusting…. It's slimy. Most of that river's right there on crop lands and things got run down in to the river and stuff like that."

Pesticide Exposure through Hunting, Gathering, and Eating Wild Berries and Nuts

This grandmother spoke about community concerns of pesticide exposure from spraying pesticides in a wooded area which community members frequent. The area contains nuts and berries which citizens hunt and gather as a traditional activity. Exposure may occur through dermal contact from walking in the terrain, and from dietary consumption of these contaminated foods.

“This right here is in the south end. I think they call it Auginaush Road. They used to call it Foxes Trail before. We’re looking north right now and some of the people had mentioned this too, is that along the high line I think they call it, they kill the vegetation around those utility poles. Well, from talking to different people who live in Rice Lake that’s always been a concern about the spraying and things like that. ‘Cause I know a lot of them, they all hunt and pick the berries and gathering - hunting and gathering” (Figure 26, Celeste C. ©).

Figure 26

PART II: EXPOSURE TO DRIFT AND RUN-OFF FROM PESTICIDES USED IN THE COMMUNITY

The participants expressed apprehension about children’s exposure to pesticides through drift in public places. Pathways of exposure included farmers using tractors and planes to spray pesticides on land adjacent to highways, schools and daycare centers, employees applying pesticides at public garden and nurseries during open store hours, and community truck fogging for prevention of West Nile Virus. In addition, other pathways of exposure included the potential for pesticide contamination of locally grown, organic foods with pesticide residue due to drift and drinking water supplies from land run-off.

Agricultural Spray by Tractors: Exposure while Driving on Public Roads

One grandmother expresses apprehension about pesticide exposure from agricultural drift from tractor spray for community members and specifically for her grandchildren when she drives on the reservation. Another grandmother voices concern about the same exposure pathway.

"You Really Can't Get Away From It"

"…Just driving down the road and getting exposed to it 'cause they're spraying…. Just from the overspray of everything. This happens a lot…. He just happened to be the one that I took a picture of because since this program I've really been paying attention and especially since I've usually got my babies on board. Just the exposure. How I try to stay away from that stuff, but its there. You really can't get away from it" (Figure 27, Stephanie W. ©).

Figure 27

"Spraying off of a Tractor"

"I stopped and I talked to the other farmers that were out there with them and they were doing something with one of the tractors and spraying something else with the tractors…. And then I took another image of a farmer that's out in Pine Bend that he had one of the tractors, spraying off of a tractor and that was soybeans down there also. It's actually the farmer that lives right across the road from my mom."

Drift from Commercial Spraying at a Garden Store

This grandmother describes being exposed to pesticide drift at a garden and nursery store while shopping; as a strategy to avoid exposure to her babies, she leaves the facility.

"Because I Don't Want the Babies Exposed"

"Even going to the store where they have landscaping. I've been places where they're spraying it, you know, so I just kind of turn around and head back out. Because I don't want the babies exposed to that… Weed B gone-Round-Up or something."

Exposure to Pesticide Drift by Agricultural Spray from Helicopters and Planes

Aerial Spraying of Crops: Exposure to Drift while Driving

A mother tells the story of driving on a public road while watching a farmer spraying pesticides by plane on land adjacent to the highway and directly over the pavement. On a different day, she notes puddles of pesticides, which had accumulated on the same road from aerial spraying. As a strategy to reduce exposure from pesticides splashing up into her car, she explains she shuts her car window. She points out that this is a common experience. One grandmother described getting caught in a fog of pesticide while driving, which was emitted from aerial spraying; she identified the drift by a distinctive odor, and did not know the type of pesticide being used. Another grandmother conveys the familiar experience of detecting the odor of pesticides when she drives through the area, denoting the commonness of this exposure.

Concerns of Exposure to Drift from Untargeted Spraying Near the Road

"On this day I was driving from my home to Park Rapids which is about a half hour away. After I went through Pine Point, I saw this guy spraying the fields on the side of the road. He would spray one side then jump across the road and spray the other. I don't think that's very healthy to spray so close to the road and directly over the road" (Figure 28, Waseyabin L. ©).

Figure 28

Concerns of Exposure to Pesticides from Splashes on the Road: Strategy to Limit Exposure

“In this picture between Pine Point and Osage there are always puddles like this on the road from the overspray. Last weekend, I was driving through the same area on my way home from the cities. The puddle was all the way across the road and it was spraying our car. I know that this chemical burns. I know that you can get chemical burns from this stuff and so I shut my car window but still that spray shouldn’t be sprayed on the road or near me or my car” (Figure 29, Waseyabin L. ©).

Figure 29

“Caught” in a Pesticide Fog on [Highway] 200

“Driving…. I got caught in the one [a fog of pesticide] on 200 and that’s what made me stop and take the picture of it is because it sprayed -- we smelled it inside the car. It’s just out east on Highway 200. A farmer was spraying his crop …with the airplane… some kind of pesticide so it wouldn’t ruin his crops-- I can’t remember the name of it.”

Concerns about Exposure of Pesticide Drift to Children at School from Aerial Agricultural Application

This mother explains that Pine Point School is directly across the street from a potato farm and aerial spraying is conducted while the children are in school. She says that her mother takes her little brother out of school on days that the field is sprayed due to concerns of exposure from drift. The participant does not think justice is served by having parents and children choose between safeguarding their health or interrupting their learning. She describes the close proximity of the potato farm to the schoolyard where the children are playing outdoors while spraying is carried out.

Protecting Children from Pesticide Exposure at School

"I couldn't get these kids to slow down for a picture. I went to their summer school program. They're planting flowers around their school sign. The Pine Point School is located across the road from a potato field. My little brother goes to school there and my mom pulls him out of school on the days that they spray the field. I don't think that it's fair that the parents have to protect their kids from getting contaminated while at school. Or that the option that the parent has is, [to] pull the child out of school to keep them from being exposed" (Figure 30, Waseyabin L. ©)

Figure 30

Locating Proximity

"I turned around to take a picture of the fields that they spray just to show how close they are to spraying the school." So standing in the same place-- here's the kids planting flowers. Turn around-- they're at the fields" (Figure 31, Waseyabin L.©)

Figure 31

A Common Occurrence

"In this picture you can actually see the chemicals being sprayed. My camera would sometimes die during good photo ops and it's pretty tricky to get the plane in the picture and get it spraying. But I got this one. There are lots of planes flying around doing this" (Figure 32, Waseyabin L. ©).

Figure 32

Concerns about Agricultural Pesticide Drift at Day Care and Strategies for Preventing Exposure to Children

This grandmother conveys concerns about exposure to pesticide drift to children while at day care from a farm located adjacent to the facility. She detects the pesticides by an odor. It is not known whether this drift has been applied by tractor or aerial methods. She suggests preventive strategies to protect the children, such as getting the children inside and cleaning playground equipment before children play outside.

Get the Children "Inside"

"That's another big thing-- there's a field right on the other side of their daycare and when we went to go pick them up you could just smell that and that's what the day care lady asked. Should they be out here? I would get them inside."

Clean Contaminated Toys

"And in our apartment building-- I haven't seen anybody come up and put any pesticides on those two fields but there's one right behind the day care, right behind our apartment building and there's one right across the road from our apartment building. That's a big concern because the day care has the kids out three or four times a day…. And I'm sure they don't clean that playground equipment."

Exposure to Children at Day Care by Drift from Mosquito Fogging

This mother of four children, ages 14 years to 6 months just moved to Mahnomen County. She describes an experience she had after the city sprayed for mosquitoes without prior warning to residents.

"We Could Smell the Pesticides Coming in the Screens"

"They sprayed the whole city for mosquitoes and we could smell the pesticides coming in the screens. And there's a Head Start and a Day Care in our building and it's a 48-unit apartment building not including how many people live here in town and how many kids are outside playing…. It was like 4:00 in the afternoon. …Yep, [the toys were outside] 'cause they have the playground equipment for the Head Start and day care right out in back of the apartment building."

Drift from Agricultural Pesticide Residue on Locally Grown Organic Foods--Wild Rice and Apples

This grandmother talks about feeling a lack of control over the contamination of the organic food they grow, including run-off of agricultural wastes on their wild rice beds and pesticide drift that may land on their organic apple trees.

"I think it was the effects of the pesticide use by the farmers and its effect on our children, on our produce. I think there's kind of like an underlying issue of what can we do about it. We're pretty much helpless….Like for example the wild rice, the runoff from the different fields. Even if I do grow an apple tree and I don't put pesticides on it, from what everyone else is saying is that it's kind of blowing in the air. You can't really say that it's completely pesticide free."

Concerns about Exposure from Agricultural Pesticides Contaminating Water

Participants report a sense of reluctance by members of the community to consume drinking water, with many of the citizens drinking only bottled water even though the water is tested and the results are safe. Reasons for not drinking community water include, distrust of the chemicals added for sanitation, an objectionable odor or taste, and the presence of rust in the water. In addition, one grandmother suggests that a major influence in the distrust of water purity may be due to the fact that the availability of running tap water is relatively new to the reservation, since the1960s. She describes that her well water is 95 feet deep and it has always been safe when it has been tested; as such she drinks only well water. The participants convey that although the drinking water has been tested for microorganisms and heavy metals, it has not been tested for the presence of pesticides from run-off.

“Most Everyone Drinks Bottled Water”

“I will not drink out of anybody that’s got a public water system. I’ll only drink well-water…. They call it Bagwa. Most everyone drinks bottled water actually. A lot of people drink bottled water.”

Chemicals in the Water for Sanitation: “I think it turned Pink Once”

“In each one of the communities they have water towers but even the guys that have to go around and put those chemicals in there, they won’t drink the water because they know what they put in there…. I think it turned pink once…. They have to [put chemicals in the water to make it safe] because it sits up in the water tower and then the lines that go everywhere. They have to put that stuff in there.”

Drinking Water that “Smells Like Rotten Eggs”

“You can go into the old projects of Rice Lake and their water tastes fine. You go into the new projects of Rice Lake and like the houses that are down by the lagoon-- that water is horrible. The water in Shannon’s house-- it smells like rotten eggs. It stinks and it’s just unbearable to even try to swallow it. I don’t see how her and her kids drink that water. Anytime I go to Rice Lake I bring bottled water with me.”

Rusty Water

“That’s like Pine Bend. It’s just well-water down there and they come out and test that once a year just to make sure and I think the biggest reason why I don’t drink the water down there is because it’s rusty. That’s the biggest reason why I don’t drink it.”

Running Water: New to the Reservation

“…. And I think a big thing of that is because running water, tap water is new really to the reservation…. the early to mid-60s…‘Cause when I was a kid there was no running water. I don’t think hardly anybody had it.”

Water Testing Only for Heavy Metals and Micro-organisms

“But they don’t test the water for pesticides or anything like that. It’s just the regular, germy things….Yeah [they test the water for heavy metals]. The arsenic and I can’t remember the other one.”

Sense of Helplessness over Exposure to Pesticides: "It all Ends up in the Water—It's the Whole Picture"

This grandmother expresses that her greatest concern about pesticide exposure is the loss of control over being constantly exposed to pesticides in her environment, which all ends up in the water. Upon clarification, she attributes her health condition primarily to pesticide exposure.

"Just being exposed constantly [to pesticides] with no control over it. And it all ends up in the water, and it's the whole picture. As much as I try and I'm exposed, I'm sick because of it. Nearly all my life I've grown and eaten most of my food and now I've got lupus…. I'm almost positive it is because-- it's just-- especially they were painting in here and I walked through here and I got sick. I think it's-- a part of it could be because I'm, I don't have a tolerance because I don't expose myself, now that my body's killing itself because of environmental exposure that I have no control over….[pesticide exposure is] a big part of it."

PART III: ADAPTIVE STRATEGIES: USE OF REPELLENTS AND PESTICIDES IN THE COMMUNITY—CONCERNS & APPROACHES TO LIMIT HUMAN EXPOSURE

Repellents were used to prevent West Nile Virus from mosquito bites while pesticides were used in a variety of situations as strategies to limit insects and weeds. Insecticides and herbicides were used indoors, in gardens, on fruits and vegetables, and on pets. In several instances, concerns were voiced about the need to learn methods related to safe usage and storage of pesticides. Yet in others, specific precautions were identified as being taken, such as, washing fruits and vegetables before consumption, and laundering work clothes of a farm-worker husband in a manner that reduces exposure.

Direct Use of Repellents to Prevent West Nile Virus: Reconciling the Dilemma

This grandmother has taken a picture of her property. She states that she and her family typically apply "Off" to repel mosquitoes, which they spray on themselves and their grandchildren. She considers the possible effects of West Nile Virus from mosquitoes compared to the risks of adverse health effects from exposure to repellents; the risk of West Nile Virus is perceived as greater than the risk of repellent exposure. She refers to the mosquito repellent as a pesticide. One mother of four children describes her reconciliation of the use of repellents on her children to prevent mosquito-bites that could result in West Nile Virus; she compares the options of not using repellents vs. keeping her children indoors. As a method to resolve the dilemma, she chooses to spray her pre-school child before going outside, while she keeps her infant indoors to avoid the use of repellents.

"Pick[ing] the Lesser of two Evils"

"That day we didn't but usually we do. We use *Off*…. Yeah, we are [concerned about the exposure]. I guess it's more like you have to pick the lesser of two evils. You either have to go without the pesticide use or use the pesticide. Go without the pesticide use and that'll expose you to different kinds of diseases and things like that or you can use the pesticides and expose your small children. You have to pick the lesser of two evils."

"I Won't Spray My Infant at All"

"I took a picture of me spraying my kids down with *Off* because of how bad the mosquitoes are out in Pine Bend at my mother's house. Its seven miles south of Lengby [on the reservation]…. I hate spraying them. I won't spray my infant at all. I just keep him in the house, 'cause I won't spray him. My four-year-old, he hates to be sprayed with mosquito spray because he says he can taste it."

Pesticides Used Indoors to Limit Incoming Ants

This grandmother identifies the use of Raid indoors by her mother as a strategy to prevent indoor ants in her home.

"I took pictures at my mom's house of, she's got ants really bad in her house so I took a picture of her spraying the Raid on her window sills to keep the ants away from there so they can't get in the house. She uses Weed B Gone in the front of her house for the big thorn bushes and things like that."

Use of Pesticides in Gardens: Concerns about Pesticide Storage at Daycare Facilities

Another grandmother shows us a photo of a pesticide container sitting at the edge of her day-care provider's driveway all summer. The day-care provider uses the pesticides as a strategy to prevent weeds for her flower gardens. Implicit is a concern about safe storage of pesticides at day care facilities.

…. That's at my baby's daycare. She has got a beautiful--everything is flowers, but that has been sitting out [a container of pesticide solution]. The children aren't anywhere near this 'cause that's right in the driveway, right by the road, but that's been sitting out there like all summer…But I'm sure she uses that everywhere and a lot of people do and again she just happened to be up"(Figure 33, Stephanie W. ©).

Figure 33

Use of Pesticides on Produce: Washing fruit to remove pesticide Residue to Limit Human Exposure through Diet

Pesticides are used as a strategy to promote crop yield by farmers. This grandmother of three young children acknowledges that she purchases conventional fresh fruits and vegetables for consumption. As a strategy to reduce dietary exposure, she washes the fruit to remove pesticide residue.

Figure 34

Rinsing Produce Prior to Consumption

"Remember to wash your fruit to rinse off the chemicals…. Especially the plums" (Figure 34, Celeste C. ©).

Use of Pesticides on Pets and Concerns about Pesticide Exposure to Children from Dermal Contact

This grandmother discusses the use of pesticides on a dog with subsequent dermal exposure to children through expressions of affection.

"The Kids are Always Hugging Him"

"This right here is a dog. They're training him to fetch for duck. Getting him ready for duck season. And I kind of thought that would tie in. I thought about the pesticide use to kill all the pests on the dogs and then the kids are always hugging him and stuff like that."(Figure 35, Celeste C. ©)

Figure 35

Strategy to Limit Family Exposure to Pesticides Contamination on Work Clothes

This grandmother is married to a farm-worker. She says that she launders his work-clothes separately and then cleans the machine to prevent pesticide contamination in the washer and on the clothes of family members. Although, she does not wear chemically resistant gloves or other personal protective equipment when handling the clothes, she limits her exposure by not going through the pockets or straightening them.

"I Just Barely Touch Them"

"…Yeah [I launder my husband's work-clothes], but separate from everything else and his gets washed last, and then I clean out my washing machine…. "Actually I make him do it. I tell him, however he has his clothes I'm just throwing them in the washer that way. So I don't go through his pockets or straighten anything out or anything. I just barely touch them."

PART IV: EXISTING COMMUNITY ASSETS--PROMOTING NUTRITION AND REDUCING DIETARY PESTICIDE EXPOSURE

Participants described the availability of several types of locally grown fresh foods, both organic and conventional, as assets in their community. These foods included, organic apples from nearby trees, organic strawberries from a farm in the community, a variety of locally grown produce at a neighborhood grocery market, and locally harvested wild rice.

Locally Grown Organic and Conventional Fresh Produce

One grandmother shows us a nearby tree, which yields organic apples as a strategy to promote nutrition while reducing pesticide exposure. A second grandmother depicts locally grown organic food from a farm in the community as an asset. The strawberry patch is convenient, as well a source of fresh, locally grown strawberries; this grandmother relates that for her, the fact that they are grown without pesticides is secondary and not primary to the rationale of purchasing produce at this establishment. Yet, she still sees eating these berries as a strategy to reduce pesticide exposure. At the strawberry farm, consumers pick their own fruit. The people in the photo are bent over, low to the ground, picking berries in the bright sun. As such, this appears to be a labor-intensive activity; however, this grandmother describes that the fruit they purchased fed many people and was very economical. The same grandmother shows a picture of fruit that she purchased at a neighborhood grocery store and explains that the store lets consumers know when the fruits and vegetables are locally grown.

Local Organic Apple Trees

"Then they had planted fruit trees around where I live at and they planted another apple tree on the other side of my yard and it's got 15 apples on it. It's small. It's only like this big. They're getting redder every day" (Figure 36, Celeste C. ©).

Figure 36

Locally Grown, Organic Strawberry Farm

"This is the berry farm. We went to pick strawberries. It was the day before my daughter's birthday and they don't use pesticides or anything. The reason why we go there is it's close to our house. And I asked him if they used pesticides. He said no, we don't use pesticides at all"…. "That's Betsy. That's the little boy's mother and that's my daughter and her boyfriend. Those are strawberries. And they're picking them. We fed about 50 people…. and we went up there because the $16 was to pay for the strawberries." (Figure 37, Celeste C. ©).

Figure 37

Availability of Fresh and Locally Grown Produce at a Nearby Grocery Store

"I think I bought the fruit just at a grocery store…. in Bagley. I think they usually try to get a lot of locally grown produce. "

Availability of Locally Grown Wild Rice

This participant describes her most important concern about pesticide exposure is the contamination of wild rice; although she has acknowledged the cultural significance related to this rice, she explains that she personally eats the locally grown wild rice instead of the commercial rice because she likes it and not because of cultural tradition.

"I think the effects of the agricultural use on the wild rice….It's more not the purity or tradition but more the safety and the quality of the wild rice. 'Cause I know that we eat wild rice quite a bit and it's not meant to be culturally or to say that I'm Native or anything. It's because my family likes it. I never buy wild rice in the store. I buy it from the different people."

Tribal Activities to Reduce Pesticide Exposure from Large-Scale Agricultural Practices

This grandmother explains that the tribe is surrounded by farmers who grow sunflowers, beets, potatoes, and hay. The tribe takes measures to reduce pesticide drift when its members launch complaints. In addition, through the Land Recovery Project, tribal members are monitoring the amount of air pollutants entering the Pine Point School.

Responding to Complaints of Drift by Tribal Members

"They're trying to cut it down on the reservation [drift from pesticide usage]. Like if you complain that the spray is getting into your yard, then they'll make the farmer stop. We've got [an expert] who is in charge of the pesticide use on the reservation and he works for the tribal biology…. I'm not exactly sure how they do it but I know I have called…. and it helps."

Research on Indoor School Air Exposure from Surrounding Indoor Monitoring in the School

"It'll be interesting. The land recovery has got some kind of device by the clean air vent up on the room that's collecting, and they change it every day to see how much pollution is going into the building."

PART V: CHILDREN'S GENERAL HEALTH & SAFETY-- EXISTING COMMUNITY ASSETS, STRATEGIES AND NEEDS TO PROMOTE CHILDHOOD WELL-BEING

Concerns about Falls from Uneven Ground

One grandmother identifies concerns around safety in a local children's playground as her greatest concern. She tells a story about how the play area came into creation, and how the adults in the community have come together to take actions to keep it safe. The participant shows a photo of a playground on the reservation with children swinging on a swing-set and explains that the playground was made possible from a grant. Initially, the ground surface was uneven and contained large rocks; these conditions posed a risk for potential falls and injuries by the children (Figure 38, Celeste C. ©).

Figure 38

Collective Action as a Community Asset

The same grandmother describes that one month later, the males from the community got together and filled the sand in the playground by digging and laying it themselves (Figure 39, Celeste C. ©).

Figure 39

Concerns about Skin Cuts from Exposure to Broken Glass

This same grandmother explains that she recently found broken glass on the playground; as a strategy to prevent injury to the children, she takes her children to the play area and stays with them while they play, and she picks up the glass.

"There was Broken Glass"

"…The thing that sticks out in my mind is the playground safety. Mostly because since they built it, I noticed myself as taking my grandsons or my granddaughter over there. I know I went over there just yesterday and there was broken glass. When I go there I try to pick stuff up and put it away or try to clean up a little bit. Just things like that."

Concerns of Sunburn and Skin Damage from Exposure to Ultraviolet Rays from the Sun

This participant identified exposure to ultraviolet rays from the sun as a concern for her grandchildren and great nephew; as a strategy for prevention of skin damage, she shows a picture of the children applying sun lotion to protect themselves from the sun on a bright day outdoors (Figure 40, Celeste C. ©).

Figure 40

PART VI: TAKING CONSTRUCTIVE ACTION—IDENTIFICATION OF NEEDS AND SOLUTIONS TO PROMOTE CHILDREN'S HEALTH

Identification of Existing Community Assets—Dissemination of Information

The participants identified needs in the community that included information about how to prevent pesticide exposure, as well as safe usage and storage of pesticides. They identified several existing community services in place that deliver services to the tribe and suggested those services as a venue for delivering this information. Social and medical agencies included: (1) the Indian Health Service; (2) the WIC federal nutrition program; (3) the Head Start childhood education program; and (4) the Life Program administered by local registered nurses.

"Getting the Word Out to People"

This grandmother thinks an important strategy may be to provide information to mothers about how to prevent pesticide exposure for their children through distributing educational handouts at existing agencies which are resources to the tribe, such as, WIC and Head Start.

"I think it's more just getting the word out there to people….Like maybe making handouts or getting in touch with WIC for the young moms or Head Start and informing them about the pesticide use and ways to avoid it."

Face-to-Face Presentation along with Informational Brochures

Another grandmother said she thought a more effective means of disseminating information would be through a face-to-face presentation, along with informational pamphlets that people could reference at a later time.

Outreach in the Community

The grandmothers discussed the best places to reach people in the community with information. The women suggested reaching community members through existing programs in which they already participate. Locations included the local WIC Clinic, and the Indian Health Services through registered nurses administering the Life Program. The main WIC office is located at the Indian Health Service; however, WIC professionals conduct outreach in all the neighboring communities. The Head Start Program is also located in White Earth.

“Doing it at things like ….wherever they’re serving food”

“The Life program, because a lot of the young moms rely on the Life program because the Life program provided walkers and things like that to the young moms that they need. High chairs, bouncy chairs, toys for the kids. They’re registered nurses out of IHS. They deal with children…. They deal with infants until a year old. They’re supposed to go to three.”

At the WIC Office

“At Riverland they do it right there in the community. When we bring our kids up to WIC, the Life nurse is right there in the community room along with WIC.”

At Head Start

“And then they got, like Head Start’s in every community. Rice Lake has one and then Head Start is right there in my apartment building.”

Promoting Trust through Testing the Drinking Water for Pesticide Contamination

One grandmother discussed that although the community drinking water on the Reservation is tested routinely for heavy metals, and microbes, it is not tested for pesticide contamination. She asserts that citizens would like to get the water tested for pesticides residues.

“Definitely [an interest exists to test drinking water for pesticide contamination]. Especially out by the Point area cause that’s all RDO territory out there. RDO is the name of the potato company….It’s huge. Thousands of acres in Minnesota and North Dakota and Washington, Oregon.”

CHAPTER 7

FINDINGS: MOTHERS WHO ARE NEW AMERICAN IMMIGRANTS FROM FARGO, NORTH DAKOTA AND MOORHEAD, MINNESOTA - PESTICIDES IN A NEW LAND

Overview

New American immigrant mothers living in the area of Fargo, North Dakota and Moorhead, Minnesota expressed concerns about the potential for pesticide exposure and a lack of knowledge about this topic. The women identified several possible pathways to children's pesticide exposures, which included walking barefoot and playing on lawns after chemical treatment, drift from agricultural run-off, and community truck fogging for West Nile Virus. Information deficits were voiced about potential health effects from pesticide exposure, such as miscarriage and childhood asthma. The women described questions about environmental concerns, such as the safe usage and storage of cleaning solutions. These concerns and knowledge deficits were voiced within a context of cultural assimilation in a complex and foreign land. Coping strategies included: (1) maintaining extended family relationships; (2) spending time in scenic places that are reminiscent of their homeland; (2) embracing diversity; and (3) affiliating with networks at the local Immigrant Development Center. The mothers identified a need for health education through a train-the-trainer approach, with members of their individual communities delivering this information in their homes.

Participation

A total of six women participated, five of who are new American immigrants and one former immigrant who was granted U.S. citizenship in 2006. Five mothers and grandmothers were from East Africa while another was from Bosnia. The mean length of time in the U.S. was 8 years. On average participants were raising four children, with a range between two to six children. The children ranged in age from 1 and ½ to 18 years. Sixty six percent (4/6) of the participants worked outside of the home.

PART I: CONCERNS ABOUT PESTICIDE EXPOSURE FROM COMMUNITY AND RESIDENTIAL USAGE

Participants expressed concerns about the possibility of pesticide exposure from several sources in the community, which included drift or run-off from nearby farms, and chemical exposure to children while playing, eating, or walking barefoot after professional lawn treatment. In addition, the mothers were worried about exposure to pesticides used to control West Nile Virus by city officials through community truck blasting, even though they are relieved that this spraying is being conducted. One mother expressed concern about the possibility of her son's asthma being triggered by pesticide spraying in a wooded area adjacent to her home. The same participant discusses her dilemma of using "chemicals" to repel or kill mosquitoes vs. the possibility of contracting West Nile Virus; she conveys frustration as she describes her decision to limit the time she and her son spend outdoors.

Concern about Pesticide Exposure from Use on Agricultural Crops

Although, this mother enjoys the landscape because of its familiarity to her home, she expresses concern about run-off or drift in her environment from agricultural pesticides.

"That's a farm close to where I [am] living and I go over there and take the pictures. I'm worried about this too, you know, the chemicals everywhere around us" (Figure 41, Merja S., ©)

Figure 41

Concerns about Possible Exposure to Pesticides on Professionally Treated Lawns

Several mothers expressed apprehension about the possibility of their children being exposed to chemicals from playing or walking on the grass after the lawn has been treated by a professional lawn service. A mother of six children who immigrated from Egypt shows a picture of a sign advising humans and pets to stay off of the lawn for 24 hours after spraying. The participant explains that she has teenagers and small children who play on the lawn and she does not believe that the chemicals dissolve within 24 hours. As such, she is worried about dermal and non-dietary exposure to pesticides for her children from lying and eating while on the lawn. Another mother of four children who immigrated from Somalia shows a picture with a patch of dead grass; she thinks that the grass may have been killed from city workers applying a higher than recommended amount of chemicals, and she worries for the potential of her children to become exposed to those substances while walking barefoot on the lawn. The participant conveys that the city arranges to have her lawn sprayed and instructs her to keep her children off of the lawn for one hour.

Playing on the Grass after Treatment

"This picture is a sign in the street - he say 'don't play in the grass because the grass have allot of chemicals.' The reason I want it really [is] because in the summer people like to stay in the grass and especially kids and teenagers. I tell my kids, please don't sit in the grass and my two girls, nobody listen to me. 'Mom everywhere is chemicals,' you know. I tell him don't sit in this area. This area [is] close to my house and the front of my house. Even if she take 24 hours– after the 24 hours I am very sure the chemical still stay in the ground" (Figure 42,Suna O. ©).

Figure 42

Eating Food While on the Lawn: Non-dietary Ingestion from Contaminated Hands

"But you can't control the kids; every time the kids are playing out– come clean the hands! Sometimes you take some food out and the kids take it right away, and this really is important thing."

Concerns about Exposure to Insecticide from Community Truck Fogging

A mother of five children who emigrated from Somalia took a photo of a city truck that emits insecticide fog to kill mosquitoes as a community strategy to reduce the risk of West Nile Virus. She describes the circumstances of the fogging: the truck comes in the evening while her children's toys are outside in the yard. Although, the spraying usually occurs once a month, she has seen the truck twice this month. Another mother raises concerns that her two children may have developed asthma from exposure to the fogging. Her son has told her that he can smell the insecticide in their home. She wonders if this is possible.

“He Stops, Sprays, and Goes”

“It’s the truck that comes in our area. I have the truck driving away and the truck close to my house. I live in the corner of the street so he always parks close to my house. And when he was leaving, I took the picture…. I live in the corner of the street so he comes by me, stops and sprays and goes…. And this is the truck leaving. I was just chasing him….This was close to like 7:30 or so in the evening…. I have toys [outside]. I have a playground. It’s close to the truck; there is sand for my children to play. They have a playground toy there” (Figure 43, Fowzia A. ©)

Figure 43

Concern about Asthma Triggered by Insecticide Spraying for Mosquitoes

“I see them every week, every Wednesday in the week, once and I see him spray at night because they think you need the kids inside, you need the people inside. My son - he never have asthma. The time he come to America have very bad asthma - my son and my daughter. And the time inside the house my son tell me, ‘Mom I swear to God… I smell the spray of the mosquitoes.’ I tell him*,* how? You inside the house.”

Concerns about Disease Transmitted by Mosquitoes and Insecticide Exposure: Navigating the Dilemma

This participant conveys that she does not enjoy the summer in Minnesota due to the presence of mosquitoes and the use of chemicals. It is not known whether the chemicals to which she is referring are repellants sprayed on clothes, community fogging, or the use of insecticides. She explains that even with the use of the chemicals, there are still a lot of mosquitoes in her community. As a personal strategy to reduce the risk of contracting West Nile Virus, she stays inside of her home, and she only allows her son to play outside for 10 minutes at a time. Another mother discusses truck fogging in her neighborhood by the city; although, she is concerned about insecticide exposure and lacks information about the composition of the spray or the potential health effects from exposure–she welcomes truck fogging as a strategy to prevent West Nile Virus. Implicit in this stance is the understanding that the exposure to insecticides is safer for her family than the risks of contracting West Nile Virus.

“No Happy Summer in the United States”: Limiting Time Outdoors

“And this reason - no happy summer in United States! Because, first the mosquito. Second, the chemical. Even if the mosquito–a lot of chemicals… but it’s still a lot of mosquito. I don’t have a chance to get even 10 minutes with my son outside. Like no happy summer…. But I hear about West Nile virus…. All the times, whole summer I stay inside the house and is not fun…. “This [picture] really is very nice– kids have fun out to play– but I take my son for 10 minutes exactly. Because I am adult and mosquito bite me and I can make the choice to get inside the house. But kids play and nobody like to go inside. But a lot of mosquito, and my son doesn’t like to go inside” (Figure 44, Suna S. ©).

Figure 44

“You Want Them to Come Anyway”

“Actually my neighbor calls for him even, and one time myself and the neighbor, we were having a conversation and they talked about ‘we are calling for the mosquito spray’ and I asked him, ‘do they know what was the mix of the spray, if it was any pesticide? We don’t know, but you want them to come anyway….”

PART II: LACK OF KNOWLEDGE AND UNDERSTANDING ABOUT HEALTH EFFECTS OF PESTICIDE EXPOSURE AND MOSQUITO INDUCED DISEASE IN RESIDENTIAL AND COMMUNITY SETTINGS

The mothers expressed concerns about the potential health effects of pesticide exposure in their environment, as well as mosquito-born disease and conveyed that they lacked information to gauge these risks. Specific worries and identified needs pesticide exposure included: (1) the potential for miscarriage; (2) the possibility of adverse health effects on growing children from the insecticides used in community fogging; and (3) the potential to contract fevers, and West Nile Virus from mosquitoes.

Concerns about Miscarriage Related to Pesticide Exposure

This participant who emigrated from Somalia shows a picture of members from her family who live in North Dakota. The mother explains that her sister had several miscarriages and she lives in an area that is heavily sprayed with pesticides. She also conveys that she has also had two miscarriages. The mother questions if the miscarriages were caused by pesticide exposure, and conveys that knowledge about pesticide usage and exposure is new to her.

Family History of Miscarriage: "So What is this about Pesticide?"

" And my sister actually lost lots of children. She had a lot of miscarriage that we don't know what was the cause. She have two children and she have two miscarriage. So – 'What is this about the pesticide'? She used to live in Pelican Rapids, wide open area and it was so sprayed around. What was the cause, I don't know but this is a family picture."

Personal History of Miscarriage: "What's the Cause of Pesticides?"

"This one is Juanita and Saide. My first Juanita. Between Juanita and Noreny, I myself miscarried one child. And then between Noreny and Saide, I miscarried a baby. So I had miscarriage in my time of having children and the youngest is my sister's oldest daughter. So there is a lot of miscarriage in our family. Not only myself but myself, my sister and my other sister. The third one also have been losing a lot. But between North Dakota and Pelican Rapids I don't know where is that coming from? On our family it's new really. And in this project I noticed what's pesticide and what's the cause of pesticides?" (Figure 45, Fowzia A., ©).

Figure 45

Lack of Information about Pesticide Ingredients and How to Limit Exposure to Drift from Community Truck Fogging

The same mother explains that the most important issue to her is lack of information about what the city trucks are spraying and how to limit exposure to the insecticide. She conveys that she is worried about her children being exposed and wants to know how to limit exposure to them, especially since they are still growing. She would like to make this information available to other mothers at the immigrant center in the Fargo-Moorhead area.

"You know, I didn't know pesticide issue. I didn't know the cost of the pesticide so now I am more curious. Now I know, now I care, now I want to know what he's spraying….And my daughter who's growing now and all my children…."

Concerns about Disease Transmitted by Mosquitoes

This mother discusses her concerns about mosquito bites causing disease in her children. She believes her son contracted a virus from a mosquito bite. In her homeland, she contracted malaria, which heightens her concern about West Nile Virus. The same participant alludes to Avian Flu; although she recognizes that this virus is not yet transmitted between humans, she thinks that mosquitoes transmit this virus.

Mosquito Induced Virus

One day my son gets sick and I am very worried. I tell myself for 100% that mosquito bite him and give him some kind of disease. And I take him to hospital and he tell me he have some infection. He have a virus and can't give him any antibiotic. But for me the time I get my son out— next day my son have a fever. And from my experience I have [had] malaria. The mosquito bring it.

Avian Influenza

"And another virus is very dangerous for the chicken. I don't know what's the name but I hear it in the TV - another stuff the mosquito bring it."

Lack of Pesticide Education for Family Members

This mother of five children between the ages of three to eight years shows a photo of her mother, her eldest daughter, and her sister's youngest daughter and explains that she would like them to learn more about pesticides so that they can learn how to take precautions to reduce exposure and thereby, protect their health.

"It's my mom at home and she was playing with the kids but I took this picture just for the moment and my family actually needing more in learning about pesticides. They don't have any idea what's pesticide" (Figure 46, Fowzia A., ©)

Figure 46

PART III: LACK OF KNOWLEDGE AND UNDERSTANGING ABOUT ENVIRONMENTAL AGENTS

Pesticide Usage and Exposure

This mother explains that she rents her home from the Public Housing Authority. She says that the city sprays on the premises of her home during the summer and she does not know what they are spraying for, or what chemicals they are using. She is instructed to stay off of the lawn for one hour after spraying.

Pesticide Spraying by the Housing Authority

They spray all the time [the city]….Once a year or twice a year. I don't know what they're spraying. Maybe mosquitoes. Sometimes mosquitoes. Sometimes I don't know what it is. They just say chemical spray...stay away for one hour."

Lack of Knowledge about Pesticide Usage in Family Garden

Upon further exploration, this mother says that she uses fertilizer and pesticides on her garden; however, she does not know the name of the fertilizer or the pesticides that she applies.

"Yeah. I buy some spray. I don't know the name. I use the spray because of the bugs, they grow fast…. I don't know. I got a huge bag. I buy it and some spray too and put something in the water and spray."

Concerns about General Environmental Exposures

Safe Storage of Household Cleaning Agents

This participant who cares for her cousins shows two pictures of a shelf filled with cleaning supplies; the first photo contains candy hidden behind the supplies while the second photo contains an open box of crackers above them. The mother places these foods here as a strategy to keep them away from the children. It is explained that the children (ages 1 ½, 4, 7, and 9 years) know the treats are stored on the cleaning supply shelf and they climb up on a chair to reach them; as such, a potential hazard for unintentional poisoning and falls exists.

"Sometimes they Jump All the Way Up…."

"This one as you can see there's a lot of chemicals left there. Sometimes kids whenever they are looking for candies, we normally put them behind those… So they don't see it. Yeah, so, I normally worry about those chemicals. Sometimes they can spread and sometimes they jump up there to look for it…. They jump up, all the way up" (Figure 47, Fowzia D, ©).

Figure 47

"So they Don't Eat Too Much of These"

"You can see there's a lot of chemicals and on top of them there's that thing. The mom did it so they don't eat too much of those…. She just put it that morning. I look around [and] I see 'oh the crackers.' So I just open that and saw and I just took it. I say what was it? And she say 'they wanted to eat and I just put it by there.'" (Figure 48, Fouziya D. ©)

Figure 48

Household Cleaning Chemicals: "I Don't Have Enough Knowledge about the Chemical I'm Using"

This mother of four describes using cleaning solutions on the rug in her home to wipe up spills; she is concerned that her children may become exposed to the spot removers when they play on the floor and worries about non-dietary exposure from hand to mouth activity. Her greatest concern is that she does not know what ingredients are in the cleaners and if they are safe for her children.

I have children. Whenever they spill milk or juice, I have to spray and clean it, but after I clean they come and play there. So I don't know - how strong is the chemical I'm using? How strong is it? If they touch and put their hand in their mouth, what's going to happen? I don't have enough knowledge about the chemical I'm using. So it worries me all the time. Sometimes I wish they were out when I'm cleaning. They should come back while it's dry. But it doesn't happen. So whenever I'm cleaning– and I can't leave it because if it's milk, it will smell bad later so I have to clean it. I know I have to do it but I don't know how strong is that chemical. So it worries me… I don't pick one... I always buy different one" (Figure 49, Koos S., ©)

Figure 49

PART IV: STRIVING TO ASSIMILATE: A NEW LIFE IN A NEW LAND

The mothers talked at length about issues related to assimilation into American communities. Several approaches were mentioned toward making this adjustment in a new land which involved: (1) the inclusion of an extended family network in their daily lives; (2) spending time in places that remind them of home; and (3) embracing the American ideal of diversity through friendships. Problems they discussed that were related to their immigrant status included: (1) a lack of control of their home environment due to renting, and associated tensions due to differences in expectations about fair property use and maintenance, and (2) cultural norms between the mothers and the public housing authority from whom most of the women rented.

Extended Family Network: A System of Support

Several women from East Africa took family photos, which included their children as well as other relatives, such as, grandmothers, siblings, nephews, and aunts. Common themes included the close proximity and inclusion of these relatives in day to day life. One mother who immigrated from Somalia conveyed a sense of belonging and family identity as she introduced her family members through the photos. A college student described her close daily contact with her cousins. Another mother of four children, ages 1 ½ to 7 years, attends college; she chose to live in public housing with her mother so that her mother can take care of her children while she goes to school. A mother of four children ages 9-16 showed a photo of a new baby. She explained that her sister's daughter (her niece) came from Atlanta, Georgia to deliver her baby in Fargo, North Dakota. Her niece had a history of several miscarriages; the participant expressed happiness and relief that her niece's baby had been safely born. She selected this picture as the most important to her of all of the photos she took. The same mother has taken a photo of three small children, her daughter, and her two nephews and explained that they all live in the same apartment building.

"But We Were Together"

"This picture is my mother, my aunt, son, [and] my daughter Saide. Sophia is my sister's daughter. She's looking down to her daughter and Juanita and Fatima. Actually we have my sister there and two children of hers and this is our family picture who are all together in North Dakota. My mom she doesn't even know Dakota but we were together…." (Figure 50, Fowzia A., ©).

Figure 50

"Whenever I'm Off I Hang Out With Them"

"I live with a cousin. She has four kids at home. I don't live with them but I live next to them so I normally stay with them daytimes, whenever I'm off I hang out with them."

"I Live Close to My Mom"

"It subsidized housing but it's not subsidized for me because my income's high. I can go to different buildings with a cheaper price and have better people as management, but I live close to my mom. I go to school so she can stay home with my children."

"My Family had [a] Baby"

"My family had baby. This is the first child she [my niece] had but she had three miscarriages before that…. I'm glad she had finally a baby. She struggled. She lost too many–three miscarriages and this is the lucky one…. She will go back to where she came from which is Atlanta" (Figure 51, Habiba A., ©).

Figure 51

We Live in the Same Building"

Figure 52

"The youngest is my son's daughter. The two oldest are my sister's kids. We live in the same building." (Figure 52, Habiba A. ©).

Finding a Place Like Home

Participants took photos of places they are fond of in their community because these sites remind them of their homeland. A participant took a picture of a farm that is 15 minutes from her present home and explains that she was surrounded by farms in her native land and she misses this daily scenery. This same mother shows another picture taken of a vegetable garden from someone in her community whom she does not know; she says it reminds her of home and describes that she has only a small garden at her present residence. An Egyptian mother of six children describes an affinity and appreciation for the Red River; she conveys that the Red River is reminiscent of the Nile River in her home land.

Farmland Scenery: "I'm Missing This Here"

Figure 53

" That's a farm close to where I living and I go over there and take the pictures and I like this and I'm missing this here" (Figure 53, Merja S., ©).

I Like That [Garden]"

"That's, I like that. She got everything inside…Yeah [this reminds me of home]… I got just a little bit. I can't [have a garden like this] because of the kids and I don't have a fence around my house. Everybody's running and playing. But I got some [vegetables] in the front of my house

The Red River

"…. The one I like really for the river….Really I love this area because I have the river Nile in my country and this area, [the Red River] reminds me."

Blending into Rural American Culture: Reflections on Racial Discrimination and Acceptance of Immigrants into the Social Mainstream

Mothers shared mixed perceptions about racial acceptance and discrimination in the Fargo-Moorhead community where they reside. Stories were told in which they encountered both racial inclusiveness, as well as hostility from residents. One mother asserts that on the whole, the community accepts people regardless of their race or beliefs, and she has embraced cultural diversity as a value in her home; she discusses the friendship between her son, Abdul and his best friend, Chris, as an example of mutual respect that transcends national origins. The friendship goes beyond respect to inclusion into the fabric of this family system. In contrast, the same mother also describes a very different scenario when she encountered racism in a grocery store and conveys that the exchange made her feel like she is 'nobody'; however, she responded to this stranger in a manner that exercised her rights as a citizen. Another immigrant mother reflected on the situation in the grocery store and responded that racial intolerance was due to a lack of education, and that this woman at the market needed education about cultural diversity.

Abdul and Chris: "All People Live Together"

"A lot of peoples coming [from] my country [with] different beliefs, really have such hard time. I want to tell people no difference between black and white. Is a healthy community. All people live together….For no different between black and white. No different between this person coming Africa and this person live in America. All live together: He come to my house, he sleep in my house, he eat my food. My son go to him house, he sleep with him, eat him food - almost now close to five years. My son with this boy, close, close - he tell him 'I never love anybody like you Abdul.' And really I want to put this picture in the big poster to show people the new generation, he doesn't have this kind of problem between White and Black, because he have a different language, because he's Muslim and this is Christian–no. Because it is really love. He doesn't need anything with my son and my son he doesn't need anything" (Figure 54, Suna O., ©).

Figure 54

Racial Discrimination in the Grocery Store: "Because We Are Nobody Here."

"Because we are nobody here. … I am walking in the store buying groceries and the lady she come, [and asked] 'Where are you from'? I tell her, 'that's not your problem where I'm from.' She keeps going and ask me and walking by me, 'You have to tell me.' And I said, 'no I don't have to.' 'You have to go where you're from–your country.' And I tell her, 'If you tell me one more time something like that I'm going to call the cops. Leave me alone. I am in the store. I don't tell you nothing. I don't care where you from.' I never ask her. 'I know who you are, and I don't care. You are in the store, whatever. Just leave me alone!'"

Lack of Education about Cultural Diversity

"So, if you see that lady, she just need a little education about people's right and what her rights are."

Lack of Control of Environmental Conditions: Renting

These new American immigrants expressed a sense of powerlessness over their living conditions since most rent their homes from the Public Housing Authority. One mother says she would like to see the city fix a slope on her rental property which causes water to puddle near her house; however, she does not think this will occur. Another mother is concerned about environmental conditions adjacent to her back yard; she voices a sense of resignation about change occurring, since she thinks that the city already knows about the problem. In addition, the participant feels that she does not have a right to complain to her local government because she does not own her property. Yet another participant who lives in a house owned by public housing discusses their rules for fixing property: tenants pay to have items that break inside of the unit repaired, while the housing authority pays to restore items located outside. One woman who is helping to raise her cousin's children explains she was sitting in the kitchen at her cousin's home when a man knocked on the door and said he was from the Health Department; he walked into the kitchen and left an open container of roach bait on the counter next to a hot pancake and a glass of milk. He then added that he wanted to see if there were pests in the unit. The participant was worried that the insecticides could contaminate the fresh food, or could have been a source of unintentional poisoning for the children if they had not just left for school. This man left and came back, explaining that he had entered the wrong apartment.

Property Repair

"The only way I think they can fix it is to make that land elevated so that the water doesn't sit there… it drains…. I did talk to someone [about fixing this] but I don't think they will do it. It's federally funded housing, although I'm not considered low income family - but I don’t think they will do anything. I pay full rent for that house…. and I don’t think they will spend too much money, just fixing that…. That’s what I would like.”

“ I Don’t Have the Right to Talk”

“And the people in the city know and nobody care. And I don’t have a house. I am rent[ing] and I don’t have the right to talk because all the people live before me like 20 years in this area - nobody talks about that.”

Repairing Property: Knowing the Rules

“….Inside- you got to pay; outside grounds they fix grasses- anything that does not include the leaves.”

Lack of Privacy

“I was at home one morning and there was a guy from pesticide, insect - something. He came. He just left the [container] and he said he wanted to look around [to see] if we have pests. So you can see next to it there’s a [breakfast pancake] and milk. I was worried about it; whatever he’s doing could contaminate whatever’s like [on the counter]. [My cousin] wasn’t at home so he just knocked on the door. He said he’s from pesticide and he was sent by the department [of Health]. It’s an open package. It was open already….He left it and he went to get something. You can see there’s a note. He left something. He went outside. He came back and I say, ‘Can I take a photo? He say ‘Yeah sure’. But what he was doing was a little scary…. He was just looking to see if we had roaches or something like that and I told him we don’t have it and you can see the note to see the number of the apartment so he left and he came back so and he just picked it up and left” (Figure 55, Fouziya D., ©).

Figure 55

Tension with the Housing Authority and Cultural Dissonance: Reflections

The mothers described tension in the relationship between Public Housing Authority officials and the new American immigrant community. This mother who rents from the public housing authority explains that she has complained one time about a rental condition; however, she feels wary about complaining more than once due to the potential for possible retaliation. Another participant told the story of a specific official making decisions to evict the tenants. Yet another mother asserts that the problem lies just with one housing authority official, and the rest of the public housing workers are polite. One mother explains that although she wants and respects rules for her safety, from a cultural perspective, it is difficult to adhere to the rules set down by the Housing Authority. The rules involve following practices that are different from her traditional customs. For example, sometimes she wants to lock herself in her room for privacy, and the rules include no locks on the doors. The immigrant mother from Somalia who is the director of the local Immigrant Center explains that there could be many reasons for an eviction by the housing authority. The rules for both the case workers and the immigrants are clear. Yet in circumstances where eviction occurs, one party is in the wrong, and no consistent pattern exists regarding who this may be.

Concerns about Possible Future Eviction for Making Property Complaints

“ But I know if I complain I know my complaint will go no where. If I complain too much−Jeopardy for me, I know for sure!”

Fear of Eviction and Homelessness by a Housing Authority Official

“ This woman we are talking about from authority, she made a lot of mothers homeless. It’s not only Merja [that] lost her house. Merja was lucky enough to find quickly another house. She was working at the time. There was this mother with seven children who became homeless because of her decision. [She] had a sneakiness and she jumps into the house without permission. She comes into your house.”

Tensions with Housing Authority Related to Differing Cultural Norms

“This is the Rules”

“This is the first thing they say [is that] she doesn’t give anybody a choice….normal life people need some choices. But they don’t understand. If they got a problem−they got to help them. But all she does is like pick up the paper and [say] 'This is the rules.'

"Problem with Misunderstanding the Rules"

"Like every day the housing people come at the door. Everybody like the rules, everybody like to keep themselves safe but the rules of the housing people especially if you have kids, small kids around you…. All women coming in Africa have problem with misunderstanding the rules.

"A lot of Rules Coming Against the Culture"

"You need more people to be together. Face to face people stay together. Somebody teaching you the rules because everybody loves rules. Rules make the person [safe]. A lot rules coming against the culture. Because back home everything open – it's tough life, you don't have food − you don't have…but nobody bother you either. I don't want to say it's [a] problem but this is the deal. Every time I have the manager come to my house he say, 'Suna'− he complain about what I do. You know, I have my own room. [Sometimes] I want to stay inside my room. But the manager, he comes, [and] complains about the lock. 'Don't lock this because this is the rules in America'….The rules of the culture. Tomorrow he tells me if I come see this lock here I charge you."

"We Just Need to Work Together"

"Both sides understand their rules. Somebody's doing wrong. Exactly. Both sides. Because when you are going to get the house you're going to go through training. You know it's translated in your language. If you are a case worker yourself, you know the rules of how to treat somebody who is low income. Both sides know the rules and just we need to work together."

PART V: COMMUNITY AND FAMILY ASSETS

Several community assets are identified by the immigrant mothers. These assets include the creation and maintenance of a public flower garden which one participant says she enjoys visiting. Another community asset is described as a city government that works toward promoting an understanding of the cultural background of the immigrants for the purpose of integrating them into the social fabric of the area. However, perhaps the strongest direct source of support for new American citizens is the Immigrant Development Center, since it offers several services to assist the immigrants to adapt to a new way of living in a new land.

North Dakota State University-Fargo Garden

This mother has taken two pictures of a public garden at North Dakota State University in Fargo. She explains that she enjoys the beauty of the flowers at this public garden…"I like this picture….And the other one, I like it. It's so many flowers…." (Figure 56, Merja S. ©).

Figure 56

City Government: Openness to Changing Attitudes and Cultural Inclusion

This immigrant mother describes a municipal government that has consciously worked toward increased cultural understanding and acceptance of the beliefs and practices of new immigrants.

"Most people understand the culture, even the cops, even the court place… But now because a lot of meeting, a lot of person working in the community, the community understands. Even the cops, something happens, it doesn't take your child away. You stay together."

The Immigrant Center as a Community Resource

The Immigrant Community Center in the Fargo-Moorhead area provides instructions about organic gardening for immigrants who want to learn how to practice organic gardening and have access to locally grown organic food through their endeavors; twenty plots of land are available for the immigrant women to garden together. In addition to providing an opportunity to learn about and grow organic produce, the women describe this activity as a way for them to get together to discuss the challenges of adapting to American life. Immigrants are grouped collectively by similar ethnicities; one woman talks about the strength of the group in helping members to overcome obstacles, especially related to balancing schedules in order to meet at a given time. Other services provided by the Immigrant Development Center include community outreach to expand services and promote inclusion of immigrants into mainstream society, and advocating for individuals on the job, and protecting housing rights through legal action.

Community Building

"Some kind of setting like this will give us the opportunity to come together…So we kind of have to strategize around how can we come together and express what's most important in our community."

"Any problem– people will stay together and fix it. A lot of people have trouble but if you stay with group close to you and stay in what's going on – for sure, 100% help you."

Outreach for Opportunity and Social Inclusion

"We are working with them to work with us about the market plaza for the Fargo housing could become the developer of market plaza."

Promoting Policy Change

Two of the greatest assets in the community for these immigrant mothers are the Immigrant Center in Fargo-Moorhead, and the women themselves who are members. The director of the Immigrant Center who is a mother from Somalia suggests rallying together to facilitate change, specifically pertaining to the behavior of one official at the housing authority who has intimidated and evicted immigrant parents and their children.

"….We need to kind of come together and see what is the big issue in the community and have the guts to go to the authority or to whoever is leading that program and say, listen, this is something that's affecting us if we are from Somalia or Bosnia or from Sudan. It doesn't matter. This is affected by the community and we think something is wrong here. So maybe we have to find a way of connecting to each other and going back and taking some action together. Like the bread on the table for the children. But to be honest there is so many little things that can make our community stronger to stay in this area….We have that kind of relationship already but we don't have a relationship of say[ing], well the community- this is what they are saying."

Advocating for Individuals on the Job

This mother from Somalia shares that she is leaving her job due to isolation by her co-workers for wearing traditional attire; she went to the director of the immigrant center who intervened on her behalf by speaking with her co-workers. The director of the immigrant acted as a mediator between the immigrant and her peers.

"I actually went with her to talk to the janitor manager there and it's not the management but it's the team who works with her Coworkers…."

Protecting Housing Rights

This mother who immigrated from Somalia and is the director of the Immigrant Center conveys that the center obtained legal council to prevent an eviction of a mother and her children.

"But sometimes it's the housing authority wanting to send a message to the community that they help, and somebody will be an example for them. And the last case - we went after it because we found the law clinic who are willing to take this case and we proved to the housing that they didn't have enough proof to make that family homeless. Somebody's coming and somebody's catching them in their house. So many things that happen that they are not allowed to do."

PART VI: IDENTIFICATION OF COMMUNITY NEEDS

The mothers identified a need for information about the types of pesticides used, their health effects, safe usage and storage of pesticides, and strategies to reduce pesticide exposure. They want the community to continue to spray as a prevention approach toward West Nile Virus; however, they would like information about the type and amount of insecticides used as well as the potential health effects of those substances.

Pesticide Education: Health Effects of Pesticide

"More Education to What's the Effects of Pesticides"

"You know what I would like to kind of see happening is get more education to what's the effects of pesticides. If you use it more than enough, what's going to happen to you, to your children? What's the health effect and then that way we know and we can talk about it in the community so that we can say, well, this is what can happen to your children…. And so more in the education side."

"What Kind of Chemicals?"

"For me I don't think really you can say you don't spend chemicals in the [community] to kill the mosquitoes. You cannot stop that because if you stop that, the mosquito he [will] eat all your body. The Moorhead public safety, he do a lot of the stuff good for [us]. But, like me, for example, I don't know what kind of chemicals, how much chemical it was."

Need for Increased Opportunity and Knowledge about Growing Organic Produce

All of the women identified a need to learn more about how to grow organic fruits and vegetables. This mother conveys that the more she listens to and understands the news, the more she worries about the food she eats as a potential cause of disease. Growing organic food is seen as a method to eat healthy produce while reducing pesticide exposure. The same mother discusses that although she would like to consume an organic diet, people of low income do not have an opportunity to purchase organic food because of increased cost.

"…Low Income People−You Can't Buy the Food in the Section of No Chemicals"

It's important because if you eat a lot of foods and vegetables with chemicals you tell yourself, 'I don't want to eat meat, I don't want to eat eggs, I don't want to eat vegetables, I don't want to eat fruits!' I am really, all the times I don't want to hear the news. I don't want to understand because any time I understand I get worse....Because no chance for low income people. You can't buy the food in the section of no chemicals….And this is really, very worry. You eat all this food it's not healthy. You try to eat the healthy food, no oil, not a lot of colors, but the foods has a lot of chemicals. The meat have a lot of chemicals. The eggs, even the milk…. I like to buy milk. I like to buy a gallon. But the organic is expensive. It is over $5".

Promoting Participating in Community Gardening - Need for Childcare

Due to busy schedules and lack of childcare, the women identify obstacles in their ability to come together at a given time and garden. The women conveyed a need to find better solutions for childcare. Identified problems include, finding a convenient time when people can together, children who need supervision while the mothers are gardening.

Finding a Convenient Time to Meet: "It's Not Easy"

"Most of the young women, they work in the weekend. That's the time they actually work so their husband can watch the kids. It's not easy - like today when we came together. It's really tough to bring six, seven women in the same table to express …. I'm glad you guys are here and it's very, it takes a lot of hard work to do this."

"Working in the Garden with Kids Running Around"

"It's hard to work in the garden with my kids running around because they run in the garden too and they step on all the plants."

“Don’t Kill the Plants!”

“I have beautiful pictures this year. Yesterday we had a Kurzikstan woman and her children. My children, five of them, and then we had Liberian five children and then we had another five children from Somalian woman and it was all children. I took the pictures yesterday. All children and I was saying ‘Don’t kill the plants, don’t kill the plants!’ because they are taking the beans out and they are cutting the whole plant.

PART VII : IDENTIFICATION OF SOLUTIONS −TAKING ACTION TO SATISFY COMMUNITY NEED FOR PESTICIDE EDUCATION

In a reflective dialogue, the mothers discuss what they think would be the most effective manner to educate new American immigrants about pesticides, including safe usage, actions to reduce exposure, and possible health effects. A verbal approach is identified as culturally acceptable, since East African immigrants come from an oral tradition, and may have difficulty reading brochures. The director of the Immigrant Development Center in Fargo-Moorhead conveys that she would like to conduct training about this topic in conjunction with the center. She also says that in the past she has used videotapes as a successful educational tool and suggests this as one method. For effectiveness, it is asserted that the training needs to be brought to the people; one suggestion is to bring the information to immigrants at a community meeting or after church. These mothers meet together in specific groups that are composed of members of their ethnicity for social support. Another mother conveys that the trainers should be inside members of the specific immigrant group to whom they are speaking; this was preferred over information delivered by American professionals or members from other nationalities. As a culmination of these suggestions, the same mother suggests a train-the-trainer program, whereby, a member from each group receives training and delivers the information face-to-face inside of the homes of the immigrants. This approach was supported by the entire group of mothers.

Education at the Immigrant Development Center

"…And I think this is something that we can actually have it [at the Immigrant Development Center] as an educational tool…. For the community that I really come from, this pesticide is new education to us. We didn't know what it is. We [were] told 'yes the city's coming to spray, to protect us for the mosquito and all that."

"Going to Where the People's at"−Community Gathering

"Going to where the people's at, where they have gathering… We have some kind of community meeting, church meeting where they pray or where they have community gathering. Women sitting together. Sometimes they come together in the coffee time area for women and men…."

"Listening Will Be the Best Choice

"You know listening will be the best choice…. Because our reading literacy-- it's the youngster can read very well-- and all have a problem of reading English or their own language. So in our area it's kind of listening more."

Delivery by Videos

"What we use in a mentoring project we do kind of put together videos, something like that and then send it out to the community…. rather than having a brochure."

Conversation: Face-to-Face

"But for me I think it's a conversation face to face. "

Instruction from a Community Insider

"If you bring special woman in the community teaching with different language [this] is the best because everybody is comfortable with the language, with the culture. Like if for example if I go to my community he understand me better. If Fouziya and Habiba goes to his community, he understand better. I know the best way to bring him together [is] to tell him what's going on exactly."

Face to Face Instruction by a Community Member in the Homes

"….And inside the house because many woman can't go out the house because a lot of kids and children and a lot of responsibility. And you know America there no time. Every people rush. No time for anything. Even the weekend you don't have time to get out because a lot of responsibility. This reason people go inside your house to let the community and you know what's going on, what's the bad with the good with this conversation. Face to face the best. Because video, some video, some people hate the TV. Some people hate to read. If you go to him, this means that you interested– you patient, you come to [the] house and teaching him what's going on. That's the thing like different languages- like the English and Russians- where they can teach the community like train [the] people [and] they can go to houses. So they speak different languages. They didn't come from a country like America where English is the only language.

CHAPTER 8

COMPARISON OF FINDINGS ACROSS GROUPS AND EVALUATION

Overview

In this chapter, similarities and differences related to concerns between the three groups of mothers will be analyzed; overarching themes include: (1) pesticide usage and possible pathways to exposure for children (2) health effects of pesticides, repellents, and insect transmitted diseases; (3) general environmental exposures; (4) actions for solutions; and (5) the cultural lens that each group has brought to their perception of pesticides. For the purposes of this research, culture is defined as the cognitive view of life and the environment which members of a group hold (Hoebel, 1972). Additionally, an evaluation of this Photovoice needs assessment will be analyzed from the perspective of process and outcome from the mothers and grandmothers and the co-researchers who participated.

PART I: SIMILARITIES AND DIFFERENCES RELATED TO CONCERNS ABOUT PESTICIDES AND OTHER ENVIRONMENTAL EXPOSURES BETWEEN THE GROUPS

Concerns about Pesticide Exposure from Drift

All three groups voiced concerns about pesticide exposure to their children from the drift of agricultural pesticides and insecticides used in community truck fogging (Table 8.1). Mothers from Hallock identified sources of drift from both tractors and planes; these exposures were reported as both occurring while traveling on roads as well as at home while playing in their yards. In comparison, participants from White Earth Reservation expressed concern about their children being exposed to agricultural drift while: traveling on public roads; attending day care; attending Pine Ridge School; and shopping at a public garden store. Participants from both Hallock and White Earth Reservation voiced concerns about pesticide applicators spraying pesticides on public roads instead of on targeted fields.

In contrast, the new American immigrants from Fargo-Moorhead expressed general concerns about exposure to agricultural drift; however, they did not identify planes or tractors as vehicles for exposure. This may be due to the fact that Fargo and Moorhead are metropolitan instead of rural areas. Mothers from both Hallock and Fargo-Moorhead expressed concerns about pesticide exposure to drift during pregnancy. One mother from Hallock reported that she was limiting her exposure to a neighboring farm that utilized spraying by tractor, because she is pregnant. While another mother from Fargo-Moorhead wondered if general exposure to pesticides could have caused miscarriages for her, and for family members living in other rural Minnesota agricultural regions.

Mothers and grandmothers from all three groups wondered about possible adverse health effects from exposure to insecticide fogging released from trucks as part of a community strategy for eradicating West Nile Virus. All reported a process of contemplating the pros and cons of insecticide exposure from community truck fogging to reduce the mosquito population versus the risks of their children contracting West Nile Virus. They said they want their communities to spray by truck; however, they would like advanced notice of this schedule so that they have time to remove their children's toys and take their children indoors before the fogging occurs, as protective measures to reduce exposure. Another new immigrant mother wondered if the drift from truck fogging could be entering her home and affecting her son's asthma.

Concerns about Pesticide Exposure from Dietary Ingestion

Women from all three groups recognized dietary ingestion as one possible pathway for exposure to pesticide residues, and discussed community assets and needs related to their access to fresh, locally grown organic produce (Table 8.2). The women from Hallock identified participating in Community Supported Agriculture (CSA) as a community strength, which allows them to consume fresh organic produce to reduce the intake of pesticide residue and increase the variety of fruits and vegetables in their family diet. Nonetheless, they reported a need for improved access to fresh produce and organic foods in their community and wanted a wider availability of locally grown, organic produce, along with a more diverse selection of general organic foods in their local grocery stores.

One woman from White Earth Reservation raised concerns about pesticide drift contaminating nearby organic apple trees. This group did not identify a need to increase the availability of locally grown, fresh produce and instead focused on existing community assets in this domain, such as having access to locally grown, organic produce on privately owned farms where citizens can pick fresh berries at an economical cost. Additionally, they reported the availability of locally grown, conventional fruits and vegetables sold at a nearby grocery store, and the ability to purchase native wild rice.

While the new American immigrants from Fargo-Moorhead acknowledged the accessibility of organic foods in local supermarkets, they said that the elevated price of these goods relative to conventionally grown food was not affordable. They identified a need for the availability of organic produce and foods, including milk, at a cost they could afford.

Concerns about Adverse Health Effects from the Use of Repellents versus the Risks of Insecticide Induced Disease

Mothers from all groups used repellents on their children to repel mosquitoes and ticks. However, one mother from White Earth said that although she reluctantly uses repellents on her four-year old child, she will not use them on her baby, while another new American immigrant identified her strategy as limiting the time both she and her son (age 2 years) spend outside. The women expressed an aversion toward using the repellents, yet knew that it would decrease the risk of insect induced disease, suggesting a need for information on the relative risks of their options (Table 8.1; Table 8.2).

Concerns about Exposure from the Use of Insecticides Indoors in Residential Settings

Of the three groups, mothers from Hallock placed the strongest emphasis on the use of insecticides both indoors and outdoors. They used insecticides indoors, yet were concerned about exposure to their children from this usage. One mother discussed using ant traps on the floor, and no-pest strips hanging from her ceiling to catch flies and ants in her home; she was concerned about potential exposure to her children since they could reach these traps. Another mother installed an automatic insecticide dispenser between her kitchen and the door from the garage to eliminate flies as they enter her home. One grandmother at White Earth noted Raid was used by her mother, while a woman from

Fargo-Moorhead noted a housing authority official who temporarily placed a bag of roach bait on her cousin's kitchen counter. Although, the indoor use of pesticides was not discussed as a direct strategy used by participating mothers at White Earth and Fargo-Moorhead to reduce pests.

Concerns about the Use of Insecticides in Outdoors Residential Settings

Insecticides were used by participants from Hallock in their yards that were mixed as a fog to kill mosquitoes. One mother spoke about her father-in-law creating a concoction with home ingredients, including diesel fuel, as a way to save money and reduce mosquitoes. Another mother discussed the use of fogging by a 12-year old neighbor who wore no personal protection while dispersing the insecticide; she wondered if this was a safe activity for the child and said it was a common occurrence. Two mothers discussed the application of insecticide around the outside foundation of their homes as a strategy to prevent ants from entering.

Fogging on outdoor lawns was not identified as a strategy or a possible exposure concern by participants from White Earth or Fargo-Moorhead. Instead, participants from Fargo-Moorhead who rented from the Public Housing Authority discussed concerns about possible pesticide exposure to their children while walking barefoot, eating, and playing on lawns after professional treatment; they wondered how long the chemicals would stay on the grass as a source for possible contamination. Only one participant at Fargo-Moorhead said she used pesticides on her garden; she did not know the name of the substance, and it was not clear if she was able to follow the instructions on the label.

The Potential for Unintentional Poisoning for Children from Pesticides and Household Chemicals

Mothers from all three groups expressed concern about storage of pesticides and household chemicals in areas where children cannot access them; although two women from Hallock conveyed confidence that their sons and daughters could not reach them, another mother said that no matter where she stores them, she thinks her children will be able to access them. While both of these concerns were about finding safe indoor storage places in the home, a grandmother from White Earth expressed worry about finding a safe place for storing pesticides that are used outdoors in the garden at a daycare facility.

Concerns about Water Contamination and Long-Term Adverse Health Effects from Pesticide Exposure

Participants from all three groups expressed concerns about possible long-term adverse health effects from exposure to pesticide drift, and run-off into ground water with the potential for drinking water contamination (Table 8.2). Another mother from Hallock described what she thought was a cluster of breast cancer cases among middle aged women in a nearby town and wondered if this occurrence could be caused by exposure to pesticides from drift, or run-off into the water system. While the women from White-Earth Reservation expressed a reluctance to drink community water due to concerns about potential adverse health effects from pesticide run-off and disinfectant chemical contamination, they did not identify a specific disease endpoint. One grandmother was suspicious that she had contracted lupus, in part because of general pesticide exposure in her environment.

Concerns about Abandoned Farms and Farm Houses

In addition to concerns about pesticide exposure, several concerns about general environmental health exposures were voiced (Table 8.3). The most important issue from a public health perspective involved the potential for methamphetamine laboratories to be established in local abandoned farmhouses. The mothers from Hallock voiced concern about the possibility of methamphetamine laboratories becoming established in their communities with resultant crime and environmental degradation. Specific environmental conditions mothers identified that support this illicit activity included the presence of both anhydrous ammonia storage tanks and abandoned farm houses. Drug manufacturers create methamphetamine with the use of anhydrous ammonia, while abandoned farmhouses are ideal places in which to “cook” this substance. A second problem noted by a mother from Hallock was the proliferation of rats in abandoned farms due to rotting grain and other organic materials, which serve as food for rodents. An increased presence of rodents may pose a potential for human bites or the transmission of disease. Women from Fargo-Moorhead or White Earth Reservation did not voice concern about these issues.

PART II: ACTIONS FOR SOLUTIONS DEVISED BY PARTICIPANTS

Targeted Health Information and Delivery Format

Women from each cultural group showed considerable ingenuity in identifying both needs and specific strategies to support them in reducing pesticide and general environmental exposures for their children (Tables 8.1, 8.2, 8 4 and 8 5). Participants from all three groups wanted information about: (1) the health effects of pesticides from drift, dietary and residential usage; (2) safe usage and storage in residential settings; (3) the risks and benefits of exposure to drift from community fogging vs. living with elevated risks of contracting West Nile Virus; (4) insect related diseases and tips to reduce exposure; (5) the use of insect repellent, and instructions about correct usage; (6) the correct usage of insecticide dispenser units, and (7) information about non-toxic ant control in their homes. The groups differed in the manner of which they wanted this information delivered. Mothers from Hallock wanted written material in the form of brochures and pamphlets distributed by primary caregivers, WIC clinic providers, and public health nurses at well-baby home visits. There was an interest in learning through in-person visits and printed materials. Women from White Earth Reservation wanted face to face instruction along with written materials provided by WIC providers, Head Start, public health nurses and at gatherings where food is served. In comparison, new American immigrants from Fargo-Moorhead wanted verbal information from members of their community; ideas were to go to where the people are, such as, the Immigrant Development Center or at church meetings. Another idea voiced was to mail audio-visual tapes to people’s homes; however, the strategy that garnered the most support was a train-the-trainer approach in which members of the community who are trained in pesticide education come into the homes and discuss this information (Table 8.5).

PART III: CULTURAL VIEW OF PESTICIDES

Views of Members from Each Cultural Group

The unique conceptualization of mothers and grandmothers from each cultural group is depicted in a single phrase (Table 8.6). Mothers participating in the WIC program who are raising young children in rural counties of upper northwestern Minnesota who met in Hallock for their Photovoice workshops expressed respect and deference to farmer neighbors in their community. Although concern was voiced about pesticide exposure to drift from agricultural applications, the mothers conveyed respect for farmers; they considered the constraints associated with farming and gave farmers the benefit of the doubt when discussing the feasibility for advanced notification of aerial spraying. One mother clearly articulated a predominant mainstream American perception about farming (W. K. Kellogg Foundation, 2003); although she worries about the exposure to pesticides, she sees them as needed so that farmers can accomplish their job of "feeding the world" and earn competitive wages within the context of large-scale industrial agricultural practices. Participants voiced a desire to work with their neighbor-farmers to provide advanced notice prior to spraying so that mothers could take measures to protect their children from exposure. As such, the world-view of the mothers toward pesticide use is depicted in the key phrase: "negotiating our way".

Mothers and grandmothers raising young children from White Earth were concerned with pesticide exposure from run-off and drift to people within the community at large and on traditional foods, such as, wild rice, fish, and wild berries and nuts. They spoke about the historical significance of cultural activities connected with harvesting, picking, and gathering these foods. Participants described the degradation of the land occurring from industrial farming practices and how this is counter to traditional native approaches to working with the Earth. The Land Recovery Project was referred to as a project that is allowing the tribe to reclaim their land. The cultural view of participants from White Earth Reservation toward pesticide usage and industrial agricultural practices is depicted in the key phrase of: "recovering and preserving our ways".

Mothers and grandmothers raising young children who are new immigrants in the Fargo-Moorhead area voiced multiple concerns, with most of these in the form of questions asking for information. Women from East Africa renting from the Public Housing Authority had questions about what chemicals were applied to their lawns and how long the children had to refrain from playing on the grounds to avoid dermal contamination. They also expressed concerns about what ingredients are in household cleaning agents, and their safety for exposure to children playing in the home. One mother expressed concerns about mosquito-induced diseases and the likelihood of contracting them. Questions also were voiced about the potential for miscarriages from exposure to pesticide drift and childhood asthma exacerbation from community truck fogging. The mothers wanted knowledge related to the health effects of pesticide exposure, safe pesticide usage and storage, and approaches to reduce exposure for themselves and extended family. As such, the cultural view of participants from this group is depicted in the key phrase: "finding our way," since the new American immigrants are in the midst of establishing a new lifestyle in a land that includes the unfamiliar use of pesticides.

PART IV: LIMITATIONS AND STRENGTHS

Several limitations are present in this Photovoice needs assessment. First, as qualitative research, this information cannot be generalized to all mothers raising children in the three respective ethnicities and communities. These were small groups of six or less participants who were recruited by convenience sampling. Consistent with the purpose of qualitative research, these findings provide insight into the needs of mothers related to reducing pesticide exposure and promoting general health and safety for their children, and are considered hypothesis-generating.

However, Photovoice provided the opportunity to hear the voices and see the images of the mother's everyday lives related to their direct concerns about pesticide exposure and other environmental health issues. Although a plethora of epidemiological literature has been conducted over the past few decades about the health effects of pesticide exposure, few if any qualitative research has been conducted to incorporate the perspectives of mothers raising children related to their concerns about children's exposure. A search in the *Proquest Digital Dissertation Database*, which includes dissertations from over 1000 American and European Universities, revealed 29 dissertations using Photovoice and none were about this topic. In a search of Ovid Medline, Cinahl, and Agricola databases by this author, a small number of journal articles were found that employed focus group surveys to elicit perceptions of risk about pesticide exposure to adolescent farm workers (Salazar, Napolitano, Scherer, &

McCauley, 2004), migrant workers (Napolitano, McCauley, Beltran, & Philips, 2002) and parental concerns about exposure to radon for their children (Hill, W., Butterfield, P., & Larsson, L., 2006). However, no qualitative research was found that targeted mothers' perceptions about pathways to pesticide exposure for their children. The strength of this Photovoice project is that it recognizes these mothers as experts in their own lives and empowers them to be an integral part of the solutions to improve their health and environmental conditions, while producing a community needs assessment grounded in real-world experience.

These findings will serve to fill a gap in the literature since they document mothers' perceived pathways of pesticide exposure for their children a well as other rural health related concerns from three diverse populations. To the extent that the results are transferable, they will provide valuable insights to occupational and environmental health nurses who serve agricultural workers and may be used to develop strategies toward preventing exposure to pregnant women and children living on family farms. In addition, these findings may be used by professionals from county extension and non-profit organizations as well as academics to target educational research and policy interventions aimed at reducing pesticide exposure to rural families.

A second limitation of this Photovoice project is that the data generated through photographs and self-report are limited in their technical and scientific precision. In many instances, when mothers expressed concern about the safety of pesticide exposure for their children, it was not known what substances were being used. Examples of concerns expressed by women related to unidentified chemicals included those used: on lawns, in community truck fogging, on pets, in drift from agricultural spraying, by individual foggers, and in outdoor pesticide treatments. Since pesticides have unique characteristics related to mechanisms of action, human toxicity, environmental breakdown, and fate–determining chemical-specific risks is not possible without more information (Reigart & Roberts, 1999; The Extension Toxicology Network, 1998). In addition, one immigrant mother wanted more information about the safe use and the health effects from exposure to a specific household cleaner, although it was not known what ingredients were in the agent she used. However, with over 900 pesticides registered for use (American Academy of Pediatrics Committee on Environmental Health, 2003b) and an undetermined number of potential chemicals which could be found in a residential setting, it may not be practical to focus training on the names and actions of a given substance. As such, the best approach to training may be to advocate the Precautionary Principle to reduce exposure.

Health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (United States Department of Health and Human Services, 2000c). It involves a complex of skills that allow people to read, understand, make decisions, and act on information to promote their health (National Network of Libraries of Medicine, 2008; Parker et al., 1999). Even those with adequate literacy may be low in health literacy.

Health literacy can impact health knowledge, health status and health access. Those with low functional literacy have decreased ability to care for chronic conditions and use more health services. They report worse health status, have less understanding about their medical conditions and treatment, and have more hospital visits with longer stays. Low health literacy results in additional health care expenditures that have been estimated at $73 billion in 1998 health care dollars (National Network of Libraries of Medicine, 2008; Parker et al., 1999). Those at risk for low health literacy include the elderly, low income, minority, and immigrant populations. Both private medicine and public health have compelling interests to promote health literacy, since narrowing the gap of low health literacy is essential to reducing health disparities. As such, Healthy People 2010 goal 11-2 is to "improve the health literacy of persons with inadequate or marginal literacy skills" (United States Department of Health and Human Services, 2000b). This Photovoice project is a first step in improving environmental health literacy related to reducing pesticide exposure. Because the mothers themselves voiced their needs for both information and the manner in which they want it presented, the results of this project hold promise for the future delivery of culturally tailored information resulting in a successful intervention to promote environmental health literacy and thereby, reduce health disparities.

A third limitation of these findings is that heterogeneity may exist within cultural groups. As such, mothers and community members can differ in regard to beliefs and the way they view their surroundings. For example, while one participant from White Earth Reservation spoke about the cultural significance of eating wild rice among community members, it was explained that she personally does not eat the rice for this reason, but instead because she likes its taste better than non-native varieties.

With that said, cultural competency involves being aware of the traditions and historical events of a group while not stereotyping or assuming adherence to specific practices among individuals. In delivering culturally acceptable measures, it is the responsibility of health professionals to respectfully inquire about unique cultural activities, which may impact the promotion of health (Buehler, 1993; Buehler, 1993). Cultural competence education is a systematic process with a goal of increasing "public health professionals' cultural awareness, knowledge of self and others, communication skills, attitudes and behaviors," while confronting stereotypes. Education in cultural competence is carried out through exposure to a knowledge base integrated with practice methods that include as one strategy, "assessment techniques adapted to community cultural diversity" (Committee on Educating Public Health Professionals for the 21st Century, 2003). The use of Photovoice as an approach to assessment is a culturally appropriate method that lends itself to cultural diversity since visual image can depict multiple interpretations of reality. The technique is an "emic"[8] or insiders approach to community needs assessment, which allows for relevant and effective future interventions geared toward alleviating health disparities.

The National Institute of Environmental Health is a leading biomedical research institution in the United States that supports research striving to understand the impact of

[8] "Emic" is defined as "the perception of a phenomena as seen and felt by an inside participant." (Hoebel, E. A. [1972]. Anthropology: The Study of Man, McGraw-Hill, New York, p.62).

environmental exposures on health[9]. NIEHS's translational research program advocates for culturally appropriate innovative CBPR methods as holding the greatest chance for success, since they engage the community as participants in an attempt to meet their needs. Therefore, this Photovoice project is consistent with the mission and approaches advocated by the NIEH (O'Fallon & Dearry, 2002).

PART V: ANALYSIS OF EVALUATION FROM PARTICIPANTS AND CO-RESEARCHERS

This section will analyze the results of surveys completed by the women raising young children in the Red River Valley Basin who participated in this Photovoice project and the co-researchers who participated in planning, implementation, and dissemination of these findings.

Participant Evaluations

Responses from five questions constructed along a four- point Likert scale ranging from strongly disagreed (1 point) to strongly agreed (4 points) were analyzed (Table 8.7). Participants from all three groups (100%) either agreed or strongly agreed that their participation in this project helped them become more aware of possible health problems associated with pesticide exposure. In addition, mothers and grandmothers from all three groups agreed or strongly agreed (100%) that as a result of this project, they have become more aware of how they and their family may become exposed to

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[9] The mission of NIEH is "to reduce the burden of human illness and disability by understanding how the environment influences the development of disease" (http://www.niehs.nih.gov).

pesticides. All participants, except one woman from White Earth Reservation, agreed or strongly agreed that they had become more aware of the benefits of eating locally and organically grown produce. Every woman agreed or strongly agreed from all three groups that their participation in this project was valuable to them. In response to the question asking if participation in this project will change their home practices, 100% from Hallock and White Earth Reservation answered yes. In comparison, a total of 66.7% (4/6) women from Fargo-Moorhead answered yes, with the remaining two participants indicating they were “unsure”.

Two open-ended questions elicited information about how the women will change their practices and what was most valuable to them about participating in this Photovoice project. Themes that described changed home practices included: (1) washing produce (White Earth Reservation); (2) bringing children indoors and keeping them inside for longer periods of time when spraying is occurring nearby, and using less harmful chemicals (Hallock); and reading labels, learning more about the health effects of pesticides and “making better decisions” (Fargo-Moorhead) (Table 8.8).

Themes that expressed the benefits of participation included: (1) learning about and becoming more aware of how exposure to pesticides can occur (all three groups); (2) learning how household chemicals could be harmful (Hallock); (3) learning where and how to access natural foods (Hallock); and meeting new people, talking with participants and listening to their stories (Fargo-Moorhead) (Table 8.9).

Lastly, comments about the value of participating in the Photovoice project were made during the second workshop at Hallock and at Fargo-Moorhead. Statements made at Hallock were off-tape and captured in field notes by this author, while one remark was made while tape recording at Fargo-Moorhead.

"I didn't know. I could have spent my life not knowing (about pesticide exposure) −Now I know! *Thank you*! (Pregnant mother of six children, Hallock)

"It feels good to talk to someone who can do something about this…to be a part of the solutions, for a change" (mother of three children, Hallock)

"Like this training is not just only for now. It's not just for fun, but it let you learn more importantly life, more and more and more. [For] this reason, anytime everybody tell me, 'you can come to this meeting'…I am interested to go−because each time I meet−people teach me. More stuff important in life; and it's good to have a conversation between different level of mind and different level of skills…"(new American immigrant mother of six children)

Co-Researcher Evaluations

Of the ten co-researchers, 100% either agreed or strongly agreed that the team worked effectively in the phases of planning, and implementation. Furthermore 100% agreed or strongly agreed that: through their participation they had made a contribution to the families in the Red River Valley Basin; they had met their personal or professional goals; and they would recommend Photovoice as a tool for community needs assessment in the future. Ninety percent of the co-researchers agreed or strongly agreed that they had learned new knowledge and skills to enhance their future work (Table 8.10).

Several themes were identified from open-ended questions (Appendix P). The themes included strengths and weaknesses within the process and the outcome of this Photovoice project. Process oriented strengths included: overcoming challenges in long distance communication through technology; working respectfully in utilizing multiple talents; an effective partnership with field staff and academics, which included sharing data so that it could be brought back to the community, developing a strong sense of group cohesion.

"There were challenges in communication because of distance. We were able to overcome some communication issues-we used technology. The collaboration was inspiring, but challenging."

"The communication was great—even though were spread apart, everything just clicked perfectly."

"All voices worked well together, there was mutual respect among everyone and everyone brought their talents to the table and put them to good use."

"I think that between community members, field staff, and the graduate student, there was a high degree of mutual respect. The Photovoice project was the best combination of grassroots generated knowledge and university academic based knowledge and I think we brought this together in a good way."

"I was just amazed with how generous [Maggie] and Pat were with allowing Linda and I to share the data. First you taught me about Photovoice, then you embraced the intent of Photovoice by keeping it situated in the community− bringing the data back to the community so we can take these photos and share the exhibit with the people."

"A strong sense of enthusiasm and group cohesiveness was evident in the debriefing sessions after the second Photovoice workshops; in Hallock and Fargo-Moorhead, these meetings also felt like a celebration, since they occurred in restaurants over meals. In White Earth, socializing took place when the group took a walk to look at a local garden in town."

Outcome strengths included: learning a new methodology for research and health promotion outreach; building partnerships to bring more resources to the Red River Valley; empowering members of the community, and building community capacity.

"I learned a new methodology that empowered others "

"We use a lot more pictures now—at health conferences if you have those photos up, people understand what you're talking about… the words don't mean much but the pictures do."

"Part of my goal was to build stronger community/university partnerships; we were successful in bringing more university resources to the Red River Valley."

“I have seen first hand the empowerment that Photovoice creates among participants and felt the energy that advocacy around a topic of community interest can initiate.”

“We did really well given the time constraints and resource constraints. And the women just stepped up with those photo’s−I look at them and think, ‘*wow,* they did a great job!’

“I now have an area that I am passionate about. It gives me a focus area on how I want to educate the community.”

“It really opened my eyes…. The daily exposure that I wasn’t aware really aware of…. Like I was driving down the road and the sprayer along side of me –and just being aware and knowing how I needed to take a picture of that−it was like, ‘hey’! And just to take steps—my husband works part-time for a farmer in the neighborhood. They are good people—they had no intention of harming anyone. They were just doing a job, so they did not even think about this. But this opened their eyes so they are letting people know before they spray. It was just through casual conversation. There wasn’t any big town meeting where people got defensive—it was just a conversation, where they said, ‘hey, they didn’t think about it before’”.

Weaknesses identified included: a need for more thorough planning and discussion concerning implementation that included a need for greater discussion and follow-up related to budgeting; obtaining informed consents in a consistent manner; preventing drop-offs from participants at White Earth Reservation, managing budget issues; and disseminating results on a long-term scale. In addition it was noted that the abbreviated methods for this project which involved only holding two workshops did not lend itself to building community relationships within the participants.

“There was a need for more comprehensive planning on budgeting since the initial grant did not fully cover the cost of implementing the project.”

“There was a need for more discussion and planning about implementing the informed consent protocol in a consistent manner.”

“I wish we could have followed through with the White Earth group more. That group has more drop-offs. I think it’s normal anytime there’s a group of people that meeting once and several weeks later gets together again−they’re going to miss that second meeting. I don’t know that there’s a way to fix that unless you start with eight [participants] when you want six”

“The process of dissemination is still on-going, we are continuing to take the Photovoice exhibit to different audiences around the region and the state. Maybe our team hasn’t updated each other about dissemination. There’s a question of team cohesion and information sharing that we can improve…because we are no longer a team.”

“….There was not a plan developed to address co-authorship of scholarly products from the research. There will be a need for this as we go forward when the doctoral student and her advisor prepare presentations and publications for dissemination.”

“I do think we truncated the Photovoice effort and if we had had a little more time, the groups would have been more cohesive in each of the three groups. In some of the applications of this method people may meet five or six times over the process and there’s more of a jelling of the community feeling.”

TABLE 8.1

Concerns about Possible Pesticide Exposure Pathways: Similarities and Differences

Pathway	Location		
Concerns about Pesticide Exposure	**Hallock**	**White Earth**	**Fargo-Moorhead**
Drift	yes	yes	yes
1. Farm tractors	yes	yes	*not identified
2. Airplanes	yes	yes	*not identified
3. Trucks (Fogging)	yes	yes	yes
Dietary Exposure	yes	yes	yes
1. Community Assets	yes	yes	Yes
2. Community Needs	Yes	No	Yes
Residential Exposure	yes	yes	yes
2. Indoor	yes	no	no
3. Lawns	no	no	yes
3. Pets	yes	yes	yes
4. Safe storage	yes	yes	no

*"Not identified": Participants expressed concern about the possibility of adverse health effects from drift created by the use of agricultural pesticides, yet did not identify specific exposure pathways, such as airplane, or tractor application.

TABLE 8.2

Concerns about Adverse Health Effects from Pesticides: Similarities and Differences

Health Concern	Location of Participants		
	Hallock	**White Earth**	**Fargo-Moorhead**
Pesticide Drift and Run-Off into Water	yes	yes	yes
A. Miscarriage	yes	no	yes
B. Breast cancer	yes	no	no
C. Lupus	no	yes	no
D. Childhood Asthma	no	no	yes
Concerns about Zoonotic Disease	yes	yes	yes
A. West Nile Virus (WNV)	yes	yes	yes
B. Tick induced Disease	yes	no	yes
C. Avian Influenza	no	no	yes
Concerns about possible adverse health effects in children from exposure to insect repellents	yes	Yes	Yes

TABLE 8.3

General Environmental Health Concerns: Similarities and Differences

Environmental Health Concern	Location Of Participants		
	Hallock	**White Earth**	**Fargo-Moorhead**
Abandoned Farmhouses A. Methamphetamine labs B. Rodent proliferation	yes yes	no no	no no
	yes	no	no
Unsafe playgrounds: A. Injury from falls B. Cuts from broken glass	no	yes yes yes	no
Excess ultraviolet sun exposure and skin-burns	no	yes	no

TABLE 8.4

Approaches Desired by Participants for the Delivery of Information to Reduce Pesticide Exposure and Promote the Health and Safety for their Children: Similarities and Differences

Approach	**Location Of Participants**		
Method of Communication	**Hallock**	**White Earth**	**Fargo-Moorhead**
1. Oral communication	no	no	yes
2. Written communication	yes	no	no
3. Both−written and oral communication	no	yes	no
Method of Dissemination			
1. Use of existing agencies	yes	yes	no
2. "Going to where the people are" [in the general community]	yes	no	no
3. Education in homes	yes	no	yes
A. Oral train the trainer	no	no	yes
B. Audio-video tape	no	no	yes

TABLE 8.5

Approaches Desired by Participants to Reduce Pesticide Exposure and Promote the Health and Safety of their Children: Similarities and Differences

Location of Participants	Mothers' Suggestions for Community Approaches to Action
Hallock	**Written health information: Dissemination through existing programs**
	1. Primary care practitioner at prenatal health care visits
	2. Local county public health department at immunization clinics
	3. WIC Professionals at local WIC clinics A. Flyers on bulletin boards B. Newsletters
	4. Public health nurses at well-baby home visits
	5. Journal articles in popular parenting magazines
	Oral communication between families and neighboring farmers for advanced warning before agricultural spraying 1. Individual conversations with neighbors 2. Public service announcements to increase awareness
White Earth	**Oral communication, through face-to-face training with written information: Dissemination through existing programs**
	1. Local WIC program
	2. Indian Health Service
	3. Head Start program
	4. Events where food is served
Fargo-Moorhead	**Oral communication through face- to- face training: Dissemination– "Going to where the people are at [in the community]"**
	1. Immigrant Development Center
	2. Community gathering places, such as, at church meetings
	3. Face-to-face instruction inside homes by community members trained in pesticide education and general health and safety
	4. Oral and visual communication conveyed through audio-visual tapes mailed to the homes of community members

TABLE 8.6

Cultural Group Lens Related to Pesticide Usage in the Community: Similarities and Differences

Location of Participants	**Cultural Lens of Each Group**	**Key Phrase Toward Pesticides**
Hallock	Rural Midwestern Caucasians	Negotiating Our Way
White Earth	Native American Ojibwe	Preserving & Recovering Our Ways
Fargo-Moorhead	New American Immigrants	Finding Our Way

TABLE 8.7

Photovoice Evaluation by Participants

(Scale: strongly disagree = 1; disagree = 2; agree = 3; strongly agree = 4)

Question & Group	Strongly Disagree		Disagree		Agree		Strongly Agree	
1. My participation in the Photovoice project has helped me become more aware of possible health problems associated with pesticide exposure	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Hallock	0	0%	0	0%	0	0%	6	100%
White Earth Reservation	1	33.3%	0	0%	0	0%	2	66.7%
Fargo-Moorhead	0	0%	0	0%	3	50%	3	50%
2. My participation in this project has helped me become more aware of how myself and my family are exposed to pesticides								
Hallock	0	0%	0	0%	1	16.7%	5	83.3%
White Earth Reservation	0	0%	0	0%	0	0%	3	100%
Fargo-Moorhead	0	0%	0	0%	2	33.3%	4	.67%
3. As a result of my participation in this Photovoice project, I have become more aware of the health benefits of eating locally and organically grown, fresh fruits and vegetables								
Hallock	0	0%	0	0%	0	0%	6	100%
White Earth Reservation	0	0%	1	3.67%	1	3.67%	1	3.67%
Fargo-Moorhead	0	0%	0	0%	0	0%	6	100%
4. Participating in this project has been valuable to me								
Hallock	0	0%	0	0%	0	0%	6	100%
White Earth Reservation	0	0%	0	0%	2	.67%	1	33%
Fargo-Moorhead	0	0%	0	0%	1	16.7%	5	83.3%

Question & Group	Yes		No		Unsure	
5. Will your participation in Photovoice change your home practices	**N**	**%**	**N**	**%**	**N**	**%**
Hallock	6	100%	0	0%	0	0%
White Earth Reservation	3	100%	0	0%	0	0%
Fargo-Moorhead	4	66.7%	0	0%	2	33%

TABLE 8.8

Intended Changes in Home Practices: Open-Ended Responses from Participants

QUESTION: How will your participation in Photovoice change your home practices to prevent pesticide exposure?		
GROUP	**Practice Theme**	**RESPONSES**
Hallock	Prevent Exposure from Drift	"Get my kids inside longer when spraying outside." "Putting the kids inside when aerial spraying [is] going on."
	Reduce Exposure to Household Chemicals	"Use less harmful [chemicals], try not to spray around cloth stuff" "Be more aware of the things I use in the house and around the kids." "Make sure my kids aren't in contact with any chemical that could even leave a residue."
	Improve Nutrition & Reduce dietary pesticide exposure	"Joining the CSA has already made a big difference in our home−as far as the food is healthy−green veggies−fresh and organic and relatively economical."
White Earth Reservation	Improve Nutrition & Reduce dietary pesticide exposure	"Be more aware of cleaning fruit and vegetables." " Buy more local produce, wash fruit more"
	Reduce Exposure to Drift	"Pay more attention to announcements about pesticide spraying
Fargo-Moorhead	Improve Pesticide Literacy	"Want to read about chemicals/pesticides for family and community" "Read the label carefully" "Now my family [will] have the information to read the label" "Help me make better decisions."

TABLE 8.9

Most Valuable Aspect of Participating in Photovoice: Open-Ended Responses from Participants

QUESTION: What was most valuable to you about participating in this Photovoice project?		
GROUP	**Theme**	**RESPONSES**
Hallock	Increased awareness	"Just my overall awareness of pesticide use." "Raising awareness about pesticide exposure for me and my family."
	Increased Information	"I think the information on where and how to get more natural food." "Information on how and how much we are exposed, in the long run to pesticides." "Learning about how certain chemicals that I use in my home could be harmful."
White Earth Reservation	Increased awareness	"Becoming more aware of pesticide use and its effect on family and myself."
	Increased Information	"Learning more about exposure and what are exposures, and what all exposes you and how."
Fargo-Moorhead	Learning through interaction with other community participants	"Listening [to] stories of people." "Talking to people to see the pictures and they explain to everybody." "See importance of photos when seeing everyone's photos."
	Increased Information	"Bruce teaching things [I] did not know." "Got knowledge on how to prevent pesticide exposure."
	Community Networking	"Met new people."

TABLE 8.10

Photovoice Evaluation by Co-Researchers
(Scale: strongly disagree=1; disagree=2; agree=3; strongly agree=4)

Question & Group	Strongly Disagree		Disagree		Agree		Strongly Agree	
	N	%	N	%	N	%	N	%
1. The team of co-researchers worked effectively in planning this project.	0	0	0	0	5	50%	5	50%
2. The team of co-researchers worked effectively in implementing this project.	0	0	0	0	3	30%	7	70%
3.[10]The team of co-researchers worked effectively in disseminating knowledge generated from this project	0	0	0	0	6	60%	3	30%
4. I have made a contribution to families in the Red River Valley of Minnesota and north Dakota through my participation in Photo- voice.	0	0	0	0	8	80%	2	20%
5. As result of my participation in Photo-voice, I have learned new knowledge and skills that will enhance my future work.	0	0	1	10 %	2	20%	7	70%
6. My personal and or professional goals for participating in this Photovoice effort were met through my participation in this needs assessment.	0	0	0	0	2	20%	8	80%
7. I would recommend Photovoice to others as a tool for community needs assessment in the future.	0	0	0	0	4	40%	6	60%

[10] One co-researcher indicated she could not respond to this question since she entered the project nine months after it began.

CHAPTER 9

DISCUSSION OF CONCERNS ABOUT PESTICIDE EXPOSURE AND EVALUATION OF THE PARTNERSHIP

This chapter will discuss both the findings from the scientific literature related to major concerns voiced by participants and the evaluation of this Photovoice project by participants and co-researchers. Lastly, interventions based on a response to the needs of the mothers through a three year grant funded by Blue Cross and Blue Shield Foundation of Minnesota will be presented as well as recommendations for public health practice, future research, and policy.

PART I: DISCUSSION OF CONCERNS ABOUT PESTICIDE EXPOSURE

Major Findings

Primary research questions in this dissertation analysis are, "What do mothers perceive as pesticide exposure pathways for their children? How do these exposure pathways differ between cultural groups?" Women from all three groups expressed concerned about exposure to drift from community truck fogging. In addition, participants from Hallock and White Earth Reservation voiced apprehension about exposure to pesticide drift from agricultural spraying on the ground and by airplane. All groups wanted advanced notice before spraying. Concerns were congruent with the immediate characteristics of their environment, since the common prairie pothole region typical of the Red River Valley Basin creates breeding conditions for an abundant population of mosquitoes that necessitates community spraying to reduce the risk of West Nile Virus. The new American immigrants were not concerned about exposure to agricultural drift in their neighborhoods, since they live in a metropolitan area. All groups identified the consumption of organic foods as one strategy to reduce pesticide exposure. Unique perceptions related to the use of pesticides and concerns about exposure varied with the cultural lens of each group. Consistent with traditional rural American views, Caucasian mothers from Hallock perceived industrial agricultural practices and the need for pesticide usage as a necessary yet bitter sweet trade-off, while one grandmother from White Earth expressed the opinion consistent with traditional Native American views that modern agricultural activities are harmful to the land and the land needs to be healed from these practices. In addition, Native American women voiced concern about pesticide exposure to traditional foods, such as rice, nuts and berries, and fish. New American Immigrants, who are still developing English language skills, articulated a need to learn information about the health effects of pesticides, how to read and interpret labels, and how to use pesticides and household chemicals safely. Each group identified culturally appropriate formats for the delivery of the education they requested.

Pesticide Exposure from Drift

The concerns of participants raise questions about the potential for acute pesticide induced illnesses from exposure to drift. Findings from three national surveillance systems (SENSOR, TESS, CDPR) reveal 2,593 cases of acute pesticide induced illnesses were sustained in the school setting between the years 1998-2002 (Alarcon et al., 2005). Of these cases, 76.4% (n=1980) were children, compared to 20.4% (528) adults.

Detailed exposure histories available for 406 pediatric and adult cases indicated that 69% were related to pesticides used at schools, while 31% were related to agricultural drift. A statistically significant higher proportion of children than adults were exposed to drift from neighboring farms (40% vs. 25%).

Prevention strategies include education and compliance with regulatory measures. Minnesota adopted the Janet B. Johnson Right to Know Act in 2000, which mandates that schools K-12 create an Integrated Pesticide Management (IPM) strategy as well as a mandatory written notification policy which requires parents to be notified at the beginning of the academic year with the following information: (1) the names of all pesticides that will be used during the school year; (2) a statement that the long term-health effects may not be fully understood; and the right to sign up to be notified at a reasonable time before each application (Minnesota Office of the Revisor of Statutes, 2007). However, this mandate does not include advanced warning for potential exposure to children while at school from pesticides drift due to aerial spraying by adjacent farmers.

A review of the literature puts the mothers' fears in context as the evidence of a relationship between pesticide exposure and health outcomes is ambiguous with inadequate epidemiological evidence to support associations with reproductive and developmental outcomes (Weselak, Arbuckle, & Foster, 2006), and childhood cancer (Daniels, Olshan, & Savitz, 1997; Zahm & Ward, 1998). In a more recent review of the literature between 1998 and 2006, Infante-Rivard and Weichenthal (2006) found a positive association between exposure to pesticides and childhood cancer; however, they asserted that causation cannot be inferred from these findings, since a need exists for refined exposure assessments and the consideration of other factors which may need to be present for the development of cancer, such as genetics.

Risks of Exposure to Fogging vs. the Risks of West Nile

The women's concerns raise the issue of the relative risk of pesticides used in fogging versus contracting insect-borne disease such as West Nile Virus. Risk assessment data provides a basis for evaluating the relative risks of West Nile Virus versus the risks of exposure to insecticides used to control adult mosquitoes. Peterson, Macedo, & Davis (2006) assessed both acute and sub-chronic exposure to insecticides registered by the U.S. Environmental Protection Agency among adults, children, toddlers, and infants. All risk quotients (total potential exposure divided by the reference dose for each pesticide) were considerably less than 1.0 (typically below regulatory levels of concern); as such, the authors concluded that evidence does not support risks of exposure as greater than the risks of West Nile Virus. Additionally, two recent studies found no statistically significant increases in acute asthma exacerbation cases admitted to local emergency departments coinciding with mosquito spraying programs (Karpati et al., 2004; O'Sullivan, Lafleur, Fridal, Hormozdi, & Belt, M., et al., 2005). Subtler symptoms not requiring medical treatment or long term effects from chronic low level exposure were not ascertained.

Potential community education interventions include education about and compliance with Minnesota statute MS18B.07 which mandates that communities provide a minimum of 24 hours notice before truck blasting to reduce mosquito populations (electronic communication, June 23, 2008, John Peckman, Minnesota Department of Agriculture, Supervisor Pesticide and Fertilizer Management).

Dietary Exposure Pathway

Women identified the ingestion of conventional produce as one pathway for exposure to pesticide residues and expressed a desire for increased availability of locally grown, organic fruits and vegetables. Studies based on measurement of pesticide residue in the actual diets of youth (R. A. Fenske, Kedan, Lu, Fisker-Andersen, & Curl, 2002) and direct biomonitoring of pesticide analytes in the urine of children (Curl, Fenske, & Elgethun, 2003) have shown that dietary intake can be an important pathway to pesticide exposure (Lu et al., 2006). Two of these studies showed that it is possible for children to exceed acute (R. A. Fenske et al., 2002) and chronic reference doses (Curl et al., 2003). A diet consisting of organic foods resulted in a dramatic and abrupt decrease in the amount of pesticide metabolites in children's urine in one study (Lu et al., 2006). While these studies cannot be generalized due to the use of small convenience samples, they nonetheless support the premise that consuming organic produce may be one strategy to reduce pesticide exposure.

Use of Repellents vs. the Risks of West Virus

Women from Hallock and White Earth reported using repellents on their children to prevent mosquito and tick bites; however, they saw this strategy as a trade-off and expressed a sense of uneasiness about applying these substances. West Nile Virus has been reported in the Red River Valley of Minnesota and North Dakota (United States Geological Survey, 2007). N-N-diethyl-3-methylbenzamide (DEET) is a repellent that is effective against mosquitoes, ticks and other insects and is marketed in lotions, sprays, and liquids. It is recommended for use to prevent West Nile Virus and tick induced disease in the United States by the American Academy of Pediatrics, the United States

Centers for Disease Control and Prevention, and the Agency for Toxic Substances and Disease Registry. Although there have been case reports of neurological affects from the use of DEET, after extensive investigation the chemical has been found to be safe when used according to instructions (Agency for Toxic Substances and Disease Registry, 2007; American Academy of Pediatrics, 2003; Department of Health and Human Services Centers for Disease Control and Prevention, 2005; Gideon, Matsui, & Benoit, 2003).

Insecticide Exposure in Residential Settings

Concerns of participants raised questions related to the potential for pesticide induced illness from indoor and outdoor exposures in residential settings. A total of 97 cases of acute toxic reactions from automatic insecticide dispenser units were reported between the years of 1986-1999. Insecticides used in these units typically consisted of pyrethrins / piperonyl butoxide, or Resmethrin, a pyrethroid insecticide. Symptoms of acute exposure involved: eyes; skin; nose and throat, and neurologic, respiratory, gastrointestinal systems (United States Centers for Disease Control, 2000). Data on cases of acute reactions were reported to the Toxic Exposure Surveillance System (TESS) which is maintained by the American Association of Poison Control Centers, and the California Department of Pesticide Regulation (CDPR). Most incidents occurred due to placement of the dispenser too close to food handling, dining, work areas, or supplied air ducts, or due to changing cartridges without personal protective equipment; these problems could potentially be remedied through education and labeling.

Preventive strategies for concerns about the potential for children's exposure to pesticide residues from professional lawn treatments include education about the breakdown of pesticides outdoors. Pesticides dissolve more quickly when used outdoors than indoors, since breakdown can be catalyzed by sunlight, reaction with oxygen, and microbial activity in sediment. Each pesticide has individual properties, which determine this rate of dissipation (The Extension Toxicology Network, 1998). Therefore, knowledge of the substance applied is needed to determine the length of time needed to keep people and pets off of lawns.

Integrative Pest Management is a comprehensive approach to pest management that incorporates information on the life cycle of pests and their interaction with the environment for the purpose of implementing common sense solutions as a means to reduce insects. It is a process of steps that utilizes multiple strategies, to decrease the amount of pesticides applied. IPM is recommended by the U.S. Environmental Protection Agency and the Minnesota Department of Agriculture and can be implemented in home, school, work, and farm settings IPM is an approach to decrease residential pesticide usage both indoors and outdoors in rural environments and has relevance to the concerns about pesticide in residential settings from the participants (Minnesota Department of Agriculture, 2007b; United States Environmental Protection Agency, 2008)

Unintentional Residential Childhood Poisoning

Women from all three groups expressed concerns about the safe usage and storage of pesticides and other household chemicals. Children are vulnerable to unintentional poisoning from household chemicals, medicines, indoor plants, vitamins, lead and carbon monoxide. While the rate of unintentional childhood poisoning has decreased in the U.S. since 1981, more than 1.1 million unintentional poisonings among children ages five and under are reported to the U.S. Poison Control Centers annually. An Australian study found that 94% of children accessed poisons in their own homes. In 38% of cases, a parent was in the immediate vicinity, yet engaged in a separate activity. A total of 79.5% of cases occurred in a duration of only five unsupervised minutes (Ozanne-Smith, Day, Parsons, Tibballs, & Dobbin, 2001). Therefore, it is important for caretakers to be educated in identifying potential sources of household poisoning and in instituting precautionary safety guidelines that include proper storage to keep children from accessing toxic agents (American Academy of Pediatrics: TIPP-The Injury Prevention Program, n.d.; United States Centers for Disease Control Injury Center, 2008).

Concerns of Possible Drinking Water Contamination by Pesticides

Participants from White Earth Reservation said they would like to see their community drinking water tested for the presence of pesticides. Under the SDWA, public water systems are tested for 21 pesticides annually. According to surveys from farmers in Mahnomen County, the top five pesticides applied in pound per crop year (2005) were the herbicides: (1) glyphosate (14,973 pounds); (2) bromoxynil (1200 pounds); (3) MCPA (1,108 pounds); (4) 2-4, D (521 pounds); and (5) fenoxaprop (154 pounds)[11]. Of these herbicides, only glyphosate and 2-4, D are tested yearly under the SWDA, neither of which has shown a violation in maximum contaminant levels (Minnesota Department of Agriculture et al., 2007).

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[11] Since this survey was not statistically weighted in any manner, over or underestimations may exist in estimating the amount of pesticides applied.

The Minnesota Department of Agriculture Laboratory has the capability to test for bromoxynil, MCPA and fenoxaprop. Bromoxynil and MCPA could be tested together, while fenoxaprop would require a separate test. Each test would cost $300; therefore, testing of all three chemicals would cost $600 (electronic communication, Paul Swedenborg, Organic Chemistry Unit Supervisor, Minnesota Department of Health, 09/ 17 2008).

Methamphetamine Laboratories

Mothers from Hallock voiced concerns about the potential establishment of methamphetamine laboratories in their communities and identified unsecured anhydrous ammonia tanks and abandoned farmhouses as risk factors. Concerns about methamphetamine usage in abandoned farm houses, and the use of anhydrous ammonia taken from stored tanks on farmland have been reported in scientific journals from diverse professions, and policy makers are grappling with this issue and its unique ramifications to rural communities (Donnermeyer & Tunnell, 2007; Institute of Medicine, 2006; Kraman, 2004; Kraman, 2004; Shutske, 2004; Wermuth, 2000). Proliferation of rats in abandoned farmland have been reported as a potential problem in rural America (Institute of Medicine, 2006), with over 35 diseases spread worldwide by rodents (United States Centers for Disease Control and Prevention, 2006).

In 2005, Minnesota enacted a policy that has been instrumental in curbing methamphetamine abuse. The law requires ephedrine and pseudoephedrine containing drugs to be placed behind pharmacy counters. A licensed pharmacist, pharmacy technician or pharmacy clerk can offer these substances for sale only after patrons present photo identification and sign a document that contains the their name, date of birth, and the amount of the drug sold (Minnesota Department of Health, 2008a; Minnesota Department of Health, 2008a). This legislation has been largely responsible for a significant decrease in reported methamphetamine laboratories and other methamphetamine events such as meth chemical dumps, and anhydrous ammonia thefts. In 2003 there were 500 recorded events. By 2006, the number of occurrences decreased to 73 events (Minnesota Department of Health, 2008b). Every meth recipe begins with over-the-counter medication that contains ephedrine. Due to the success of this law, it has been mandated by the United States Congress in 2007. Although pseudoephedrine could be smuggled from other countries, the legislation has been effective in deterring potential new users since it is difficult to obtain the product (personal communication, Larry Souther, Methamphetamine Laboratory Coordinator, Minnesota Department of Health, 09/ 17/ 2008).

PART II: DISCUSSION OF PARTNERSHIP EVALUATION

The goals of Photovoice as a CBPR approach include: (1) enabling citizens to record and reflect on community strengths and weaknesses; (2) promoting dialogue by giving voice to those who are vulnerable and typically do not have access to influential community stakeholders; (3) reaching policymakers, donors, researchers and other stakeholders who have the wherewithal to promote positive social change. The objectives of this Photovoice project (as stated in the methods section of this dissertation) are consistent with these methodological goals[12].

A primary tenet of CBPR is empowerment of both participants and local stakeholders; through the process of egalitarian participation new awareness, skills, and relationships are build to increase community capacity. As such, evaluation of this Photovoice project focused on meeting both process and outcome goals for both citizen participants, and co-researchers who consisted of local stakeholders in the region as well as university academics (Cook, 2008; Israel et al., 1998). This Photovoice project was successful from a process and outcome perspective from participants and co-researchers. All participants reported gaining new awareness, and information related to pesticide health effects, exposure pathways. Individual statements by the women reflected gratitude and a sense of empowerment from the process of participation. As an outcome indicator, all participants except for two said that they planned to use this knowledge to make changes in their family life.

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[12] Objectives: (1) create awareness among pregnant women and mothers in the RRV about the potential health effects of pesticides and exposure pathways; (2) enable mothers to record their concerns related to environmental pesticide exposure and health for themselves and their children in photographs;(3) discuss with women their awareness of and access to locally grown foods as one strategy to decrease consumption of pesticides; (4) foster dialogue about these issues with mothers through group discussion of photographs; and (5) engage policy makers and decision makers in the results of these discussions by displaying participant photos in a visual exhibit.

Despite all of the positive feedback, some concerns exist about using Photovoice for this needs assessment. The possibility exists that the information and exercises created or heightened unnecessarily mothers' fears about pesticide exposures that involved trace amounts likely to have negligible effects on human health. However, without a before and after assessment of anxiety or health concerns related to pesticide exposures it is unknown to what extent this phenomenon may have occurred. Another concern is that Photovoice typically addresses community expressed needs or concerns, but the focus of this research was defined by the UMN Partnerships in response to their mission, concerns, and a targeted opportunity for external funding. It is likely that these mothers and grandmothers had more pressing problems than pesticide exposures.

All co-researchers indicated that the team worked effectively in the phases of planning, implementation and dissemination. As an outcome, 100% reported they had met their personal goals for participation in this Photovoice project. A unique element of this project is that two co-researchers also participated as citizens raising young children from White Earth Reservation and the new American Immigrant community. Both of these stakeholders reported gaining new awareness and skills to bring back to the community as a means for building capacity. The co-researcher from White Earth said she had used this Photovoice project to initiate conversation between herself and farmers, and that as a result they will provide her with advanced warning before spraying. In addition, she is using photos as a means to promote health promotion in her community. The co-researcher from Fargo-Moorhead said she has a new focus now and will be discussing pesticide education in the homes of community members. Other stakeholder reported increasing community resources and expanding their influence in the basin as change agents though the development of new partnerships. Despite resounded positive feed back, weaknesses were identified within planning the implementation and dissemination phases of this project. In retrospect, when embarking on a CBPR project with a relatively short timeline and partners who live several hundred miles apart, careful in-depth planning of consistency of consent forms and the dissemination phase of the project could have averted these shortcomings. Additionally, more time and resources were needed to support the relationship building needed to develop trust among members of the research team and for coordination of communications and project management activities.

Specific outcomes from this Photovoice needs assessment are still ongoing and consist of numerous activities to promote community dialogue through the voices and images of participants including: (1) a poster showing at a major meeting with community leaders at the university of Minnesota Morris; (2) a successful grant award from Blue Cross and Blue Shield Foundation of Minnesota for a three year intervention to reduce pesticide exposure among children in the region; (3) a virtual art exhibit over the Internet held during lunch-time with the Minnesota Association of Rural Health; (3) a traveling art exhibit most recently shown at the Atomic Coffee Shop in downtown Fargo along with a round table discussion led by the League of Women Voters(4) several small presentations at the University of Minnesota in graduate courses, and (5) an article in Minnesota Medicine involving an interview with Professor McGovern by an editor and selected photos from the project (Peota, 2008).

Most evaluation literature of CBPR efforts has focused on processes and not outcomes (Israel et al., 1998; Israel et al., 2005; McCauley, Beltran, Phillips, Lasarev, & Sticker, 2001; Ndirangu, Yadrick, Bogle, & Graham-Kresge, 2008). Overall, the results of this evaluation indicate that this Photovoice project successfully fulfilled the objectives of both CBPR and the method of Photovoice from a process and outcome level. However, a limitation is that these objectives represent short-term objectives and not long-term change. As such, a need exists in the future to measure the long-term effectiveness of these measures to result in community change that goes beyond efforts to alter individual level-behavior. The extent to which CBPR approaches lead to action that translates into community change is an important component of its effectiveness as a research methodology. (Cook, W., 2008).

PART III: RECOMMENDATIONS FOR PUBLIC HEALTH PRACITICE, RESEARCH, AND POLICY

A 1998 consensus statement describing the precautionary principle asserts that: "when an activity raises threats of harm to human health and the environment, precautionary measures should be taken even though some cause and effect relationships are not fully established scientifically" (Kriebel & Tickner, 2001). Four aspects of the principle include "taking preventive action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; exploring a wide range of alternatives to possible harmful actions; and increasing public participation in decision making" (Kriebel & Tickner, 2001). Although inconclusive evidence exists linking low dose chronic exposures of pesticides to adverse effects related to reproductive and developmental impacts and childhood cancer, the precautionary principle suggests limiting exposure to these vulnerable populations.

Women from each cultural group showed considerable ingenuity in identifying both needs and specific strategies to support them in reducing pesticide and general environmental exposures for their children. The recommendations for public health practice in this chapter are culturally informed since they arose as preferences for action from participants in each distinct group. A three-year intervention grant has been awarded to several members of this research team by Blue Cross and Blue Shield Foundation of Minnesota to address the needs of women in reducing pesticide exposure to their children; the approaches used in this intervention project will be included in the described recommendations.

Health Effects and Safe Usage of Pesticides: Public Health Practice

One strategy identified by all groups of women was a desire to learn information detailed above from primary caregivers, public health nurses, and WIC and Head Start providers. There was an interest in learning through in-person visits and printed materials. Further research is needed to identify what existing curricula exist for health provider education and what printed materials might be available for mothers and child care-givers, and if customization is needed for these communities. For example, a tool kit for providers is available from the American Academy of Pediatrics for the purpose of providing parent education on reducing pesticide and other environmental exposures to children.

As part of a three year intervention grant funded by Blue Cross & Blue Shield (BCBS) Foundation of Minnesota, select members of this Photovoice project conducted a workshop for primary care professionals to present materials created by the American Academy of Pediatrics toolkit and other government agencies to promote client education aimed at reducing pesticide exposure to children. Web-based training modules for health care professionals will be made available for public health and community health programs at White Earth Tribal College, Minnesota State University, Moorhead and the Area Health Education Center in Crookston, Minnesota. In addition, a workshop was held in the summer of 2008 to train new American Immigrants to provide information in the homes of mothers from their respective communities about safe usage of pesticides and reducing pesticide exposure.

Reducing Exposure to Pesticide Drift in the Community at Large: Public Health Practice

Public health professionals in the farming community could work with state pesticide educators to encourage dialogue with farmers about how best to approach the topic of providing advanced warning to neighbors before conducting agricultural pesticide spraying, and how best to promote adherence to current regulations regarding applications to fields. Pesticide applicators are required to be licensed to apply restricted pesticides, and this license must be renewed every one to three years depending upon the type of license. Renewal can occur by attending a re-certification educational workshop (Minnesota Department of Agriculture, 2008b).

In these workshops, Dr. Dean Herzfeld, pesticide educator for the State of Minnesota, provides training about the mechanics of drift and how to avoid creating drift. In addition, Dr. Herzfeld facilitates in-depth discussions, including: avoiding drift as a professional responsibility and as a good neighbor in the community; drift concerns related to organic production in Minnesota; and complying with regulations. Lastly, he promotes ways to report drift to the Minnesota Department of Agriculture. Dr. Herzfeld perceives an increased receptivity to this topic by applicators attending training over the past 15 years; he asserts that 15 years ago, farmers did not receive this discussion openly; however, in the past few years, this information has been "well received by almost all applicators" (electronic communication, Dr. Dean Herzfeld, Coordinator, Pesticide Safety & Environmental Education, University of Minnesota Extension, 09/19/2008). While this approach is pragmatic and feasible, testing the effectiveness of this measure is needed to determine if this training is associated with a significantly lower number of drift complaints.

More accessible advanced notice of truck spraying is needed. Families could have an opportunity to register for advance notice using push technology through automatic telephone recordings or automatic emails prior to spraying. The city of Minneapolis uses multilingual push technology for advanced warning regarding snow plowing and street sweeping. The technology is cost effective at approximately $3,500 per campaign with 120,000 phone numbers dialed, and is offered in four languages. A total of 12,000 citizens have signed up on the city website to be called on their cell phones and notification by text messaging is gaining in popularity. While no formal evaluation of the effectiveness of this approach has been conducted, anecdotally, citizens have provided positive feedback, and city officials “believe this is the right thing to do” (personal communication, Mike Kennedy, Director of Transportation and Bridge Repair, City of Minneapolis, 9/24/2008).

Alternatively, a post card mailing was successful in getting smokers to call the New York State Smokers Quitline (O'Connor et al., 2008). A second recommendation consists of a post card mailing that explains that the pesticide truck fogging schedule will be listed on a given URL at a city website. Evaluation of the effectiveness of these approaches used specifically in advanced notification for pesticide warnings needs to be initiated through future studies.

Reducing Pesticides in Residential Settings: Public Health Practice

Workshops that teach the public how to implement IPM have been developed and are delivered to communities by the Minnesota Department of Agriculture (MDA). The MDA could work collaboratively with community organizations in the Red River Valley Basin to provide workshops to families about IPM for the purpose of reducing insects and pesticide use indoors and outdoors in residential settings (Minnesota Department of Agriculture, 2008a). In addition, a book is available free of charge to the public through the Minnesota Department of Agriculture that explains how to use IPM in residential settings. This book could be translated into various languages for immigrants living in Minnesota (Minnesota Department of Agriculture, 2007a). IPM workshops could also incorporate information about safe pesticide practices, including the use of personal protection equipment for automatic pesticide dispensers, individual fogging, and pesticide application.

Increasing the Availability of Locally Grown Organic Foods: Public Health Practice

Two strategies developed by the team on the BCBS intervention grant to respond to the needs of mothers for an expansion of variety and affordable access to locally grown organic produce involve supporting organic community gardening for new American immigrants and mentoring farmers to teach them how to adapt from organic home gardens to market gardens. A part-time organizer was hired at the Immigrant Development Center to arrange childcare and transportation to promote participation. An extension educator from the University of Minnesota at Fergus Falls has educated two farmers in skills to transform their farms into Community Supported Agriculture businesses. A goal for 2009 among team members of this intervention is to create materials for WIC clinics and local farmers markets that assist families to find organic farms throughout the region (personal communication, Linda Kingery, Executive Director, Northwest Regional Partnerships, 09/ 17/2008).

In addition, the 2008 Farm Bill has included provisions of $33 million over five years to help establish and promote farmers' markets and implement market development projects and $5 million over 10 years to connect low-income people with fresh foods directly from the local community. New alliances including advocates in local food, conservation, environment and public health interests formed partnerships which were instrumental in the formation and passage of the new 2008 Farm Bill (American Farmland Trust, 2008; House Committee on Agriculture, 2008).

Recommendations to Reduce Pesticide Exposure to Children: Research for Public Health Practice

Research for public health practice is needed to determine evidence-based practices related to the optimal length of time for children to remain indoors after agricultural spraying and community truck fogging for the purpose of reducing pesticide exposure. For example, a study conducted on spray drift after an aerial spraying application of methamidophos found deposition on playground equipment, toys, children's hand wipes and metabolites in children's urine; the results support the premise that drift did occur and the children were exposed. Playground equipment samples were significantly higher than baseline at six and eleven hours post spraying and no significant difference was found between the sample levels at six and eleven hours. However, no samples were taken beyond eleven hours (Weppner et al., 2006), and a risk assessment was not conducted. Mothers in this Photovoice project did not know the amount of time to keep their children indoors after spraying. A limitation with this type of research is that numerous pesticides may be in use in a given locality; since each pesticide may breakdown at different rates, generalization of such studies may be difficult.

Research for Associations of low-level Chronic Pesticide Exposure with Adverse Health Effects

The National Children's Study (NCS) holds the best promise to clarify the relationship between pesticide exposure and adverse maternal and child health outcomes. The NCS is a national multi-staged probability study that will follow over 100,000 children from before birth to 21 years to evaluate the contribution of environmental exposures on children's health outcomes (United States Department of Health and Human Services, 2007).

The research will be conducted on ethnically and regionally diverse populations and views "environment" as including biological, physical, genetic, social, and cultural which can affect health and development. Biological samples from parents and children as well as samples of air, water, soil and dust from residential and school environments will be collected and analyzed. These exposures, along with psychosocial impacts will be measured, tracked and analyzed over time in relationship to health outcomes, stages of child development, and medical occurrences. Sponsors of the study include: the U.S. Centers for Disease Control and Prevention; the National Institutes of Health; and the U.S. Environmental Protection Agency. While much research measuring pathways to pesticide exposure has relied on small convenience sampling in agricultural areas and therefore, cannot be generalized to larger populations, the NCS is designed to yield generalizable knowledge. Diseases as endpoints for pesticide exposure will go beyond childhood cancer and include autism, childhood asthma, and cognitive and developmental outcomes.

Recommendations for Policy

Advance Notification of Commercial Pesticide Usage

Women participating in this Photovoice project that resided near Hallock, Minnesota and on White Earth Reservation want advanced warning before agricultural pesticide spraying is conducted by neighbors and before community truck fogging. New

American immigrants want information about the type of pesticides used on lawns of rental property and how long their children need to stay off of the property. Since 1993, Wisconsin has had a policy that mandates the right to register for advanced notification of pesticide use by commercial lawn companies; these entities must notify citizens who are registered, by phone at least 12 hours before application by phone, or a minimum of 48 hours by mail before applying pesticides to nearby lawns. A sign must be posted which lists the name of the company, a contact phone number, and a date that the sign can be removed and people and pets can play on the lawn. The purpose of the law is to provide advanced warning of commercial pesticide usage so that people can take precautions to minimize exposure, such as, closing windows, bringing in children, pets and toys, and not hanging laundry outdoors; however, the policy does not include pesticide application by neighboring farms (Wisconsin Department of Agriculture, Trade and Consumer Protection, 2008). This policy could be used as a model to develop a similar advanced warning law in Minnesota, which could also include pesticide applications on neighboring farms.

Advanced Notice from Commercial and Non-Commercial Applicators

Minnesota House Representative Ken Tschumper (DFL-Huston, Fillmore) introduced a bill called the Pesticide Right to Know Act in 2008, House file no. 2459. It required all commercial or non-commercial applicators to post pending applications on a public website developed by the commissioner of agriculture 48 hours in advance; information in the posting included the brand name and registration of the pesticide, the location of the site, and the name of the applicator. Red flags would have been required to be placed on six foot poles around the perimeter of the property to be sprayed 48 hours in advance (Minnesota House of Representatives, 2008).

Representative Tschumper asserts “it is absolutely imperative that the public knows in advance what pesticides will be applied.” He explained that the bill was introduced in 2008 and would have promoted increased accountability among applicators, however, it did not get passed; Representative Tschumper related that he would like to modify the bill by tightening up the language and reintroduce it in 2009 (personal communication, Minnesota State Representative, Ken Tschumper, 10/01/ 2008). By providing advanced notification, a bill such as HF no. 2459 would allow families to take precautions by keeping children and pets indoors and removing toys for the purpose of reducing pesticide exposure. In addition, it would allow the public to have immediate access to the names of pesticides to which they may have become exposed.

Agricultural Buffer Zones around Schools

Concerns about children’s exposure to pesticide drift in the school setting could be remedied by mandating agricultural buffer zones around schools. As of 2002, seven states have passed legislation to restrict aerial and or ground spraying in areas nearby schools, ranging from 300 feet to 2 .5 miles[13] (Owens & Feldman, 2002). Restricted spray buffer zones as a policy adopted during school and commuting hours would increase the protection of children from exposure to pesticide drift in this setting.

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[13] States that have mandated agricultural buffer zones around schools for aerial or ground spraying include: Alabama; Arizona; Louisiana; Massachusetts; New Hampshire; New Jersey; and North Carolina.

Evaluation of the policy could be carried out after implementation to determine if it is associated with decreased reports of acute pesticide induced illnesses in schools from drift. Since Minnesota is part of the TESS system, one could evaluate and compare these reports before and after the policy was enacted.

Conclusion

A community health needs assessment was conducted to ascertain the concerns of women raising children from three culturally distinct groups in the rural agricultural region of the Red River Valley Basin of the North. Through a CBPR approach using Photovoice (originally developed by Dr. Carolyn Wang), mothers and grandmothers depicted visual images of pathways to pesticide exposure for their children, and other environmental health and safety concerns for their children. Although several similar themes were noted between the women, each group voiced unique concerns related to their cultural lens through which they viewed pesticides. Participants wanted information about pesticides that included: health effects of exposure, safe usage and storage; and measures to reduce exposure. They wanted advanced notice before agricultural spraying by neighbors and truck fogging by their municipalities so they could take precautions to reduce exposure. In addition, a need for increased availability of locally grown organic produce was voiced.

Although similarities were noted, each group perceived pesticides through a unique lens and voiced distinct concerns that were in consonance with their cultural backgrounds. As such, the needs and actions for solutions identified by the women provide insight into culturally targeted approaches toward promoting the health of children, and can be useful to public health professionals, primary health providers, county extension educators, research scientists, and policy makers.

Evaluations of this CBPR project were favorable; participants, local co-researchers, and academics indicated that their process and outcome objectives were met. All of the mothers and grandmothers said they would be willing to participate in future efforts launched by this partnership. One of the most important outcomes is the award of a grant by the Blue Cross and Blue Shield Foundation for a three-year intervention project to reduce children's pesticide exposure in this region. While dissemination of the results is on going, a need exists to associate long-term change with the findings of this CBPR Photovoice project.

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APPENDIXES

APPENDIX A

OCCUPATIONAL PATHWAY TO PESTICIDE EXPOSURE

Occupational Pathway to Pesticide Exposure

Authors	Aims	Methods	Results & Discussion	Limitations
	"To evaluate the potential for chronic exposures of children to pesticides in and around the homes of farmers and agricultural workers." AIMS: (1) "To determine to what extent household dust and surface soil from children's play areas contain agricultural pesticides; (2) To determine if children of agricultural families live in homes that contain higher levels of pesticides than homes of non-farm children" (p. 1127).	The study was conducted in the greater Wenatchee area in eastern Washington state (small family farms & production of tree fruit: pears, cherries and apples). A cross sectional sampling was implemented during the 1992 pesticide spraying season. Three groups of families were recruited from social service organizations: families who had at least one orchard applicator residing in the household; families with at least one orchard worker residing in the household; and reference families with no resident working in the farm industry or having direct contact with agricultural pesticides, who resided more than 1/4 mile from an operating orchard. Eligibility requirements for all three populations included having at least one child under age six living in residence. ***Soil samples*** were taken from five children's play locations, such as, sand-boxes, front and back-lawns, and driveways.	<u>Sample</u> The study sample included 26 farming families, 22 farm-worker families, and 11 reference families. Most farmers were Caucasian, while most farm- workers were Hispanic. <u>Pesticides</u> Four OP pesticides commonly used in this region were targeted: azinphosmethyl (AZM); chlorpyrifos; parathion; and phosmet. 91% of the agricultural workers reported using at least one of these pesticides, while 65% reported using more > 1/4 pesticides. Azinphosmethyl (83%, 19/23,) chlorpyrifos (57%, 5/23), phosmet (22%, 5/23), and parathion (4%, 1/23). <u>Agricultural workers vs. reference groups</u> Statistically significant higher concentrations of OP pesticides were found in the household dust of those participants who had at least one family member working in agriculture, as compared to reference families. <u>Household dust vs. soil</u>	Since recruitment was voluntary, this study has potential for selection bias. The author's state that they have no evidence that this is not a representative population of the region evaluated. Even though the study demonstrated significant accumulated pesticides in agricultural homes, precise exposure pathways such as, track in by shoes or pets were not identified. Pathway identification may have been confounded via recall bias of self-reported information, and through the composition of the dust. The more powerful suction of the HVS-3 may have increased the possibility of confounding by the age of the carpet and the frequency of cleaning. In addition, the loading values obtained from the vacuum may not have been representative of pesticide residues accessible to young

Authors	Aims	Methods	Results & Discussion	Limitations
		Household dust was collected via an HS-3V vacuum from carpeted areas inside each residence from 3 feet inside the main doorway, and a common children's play area. This vacuum was created for the U.S. EPA to accumulate fine particles < 5 micrometers in size. Pesticide concentrations from both mediums were extracted through a process that involved solvent extraction, and sonication, followed by gas chromatography. Participants were interviewed about their use of pesticides at work, and the regularity of residential and agricultural pesticide use in/ around the household in the most recent 6 months, and the closeness of their homes to orchards. Those who reported using pesticides were asked about home hygiene practices, including vacuum frequency, laundering work clothes, removal of shoes at the door, use of door mats, the presence of an indoor-outdoor pet, & use of personal protective equipment. Surveys were adapted from EPA's Non-occupational Pesticide Exposure Study and the National Cancer Institute /EPA Farm Occupational Exposure Study. Four pesticides were	Pesticide levels were significantly higher in household dust than in the soil for all pesticides in the homes of agricultural applicators and workers. Note: The higher levels of pesticide residue found in household dust than in soil was expected since pesticide is degraded more quickly in outdoor environmental conditions, such as, sun, rain and soil microbial activity. Using Spearman's rank correlation, paired samples consisting of outdoor soil and indoor dust were significantly positively correlated (AZM : $r = 0.49$; p 0.001; phosmet: $r = 0.67$, $p < 0.0001$; chlorpyrifos: $r = .52$, $p = 0.0003$; ethyl parathion: $r = .35$, $p = 0.02$). Median pesticide concentrations in the house dust of agricultural homes for AZM, phosmet, and chlorpyrifos were 3-5 times greater, and parathion was ~ 14 times greater. Results (Mann-Whitney U test): AZM (1100 nanograms per gram [ng/g] vs. 283 ng/g; p=0.001); chlorpyrifos (267 ng/g vs. 53 ng/g; p=0.01) and ethyl parathion (154 ng/g vs. <11 ng/g; p=0.02), with elevated levels of phosmet (519 ng/g vs. 185 ng/g; p=0.07). Results also showed that households of applicators vs. non-applicators had significantly higher median dust concentrations for chlorpyrifos and parathion (395 ng/g vs. 156 ng/g, p = 0.02; and 273 ng/g vs. <11 ng/g,	children. [NOTE: Since carpets are virtual sinks for pollution which accumulate over their lifetime of use, the more powerful vacuum could have pulled up pesticide concentrations in dust particles that were lying deeper in the carpet than a young child could normally become exposed to from walking or crawling on the carpet.] (p.1132)

Authors	Aims	Methods	Results & Discussion	Limitations
		targeted: azinphosmethy (AZM); phosmet; chlorpyrifos; and ethyl parathion [Parathion was canceled for use by the US EPA, but continued use of existing stock was allowed through the 1992 spray season.] [These were the most common pesticides used in apple production at the time of this study.] Active ingredients were verified by pesticide registration numbers, when possible. Statistical analysis: Residue data was skewed to the right with median values lower than means; since log transformation resulted in log-normal distributions in some but not all groups, non-parametric statistical tests were used, such as, Wilcoxon Signed-Rank, Man-Whitney U, Kruskal-Wallice, and Spearman -Rank Correlation. ANOVA was conducted on a portion of the data that yielded a log normal distribution. Concentrations below the detectable limit (MLOQ) were assigned a value of .5 of MLOQ.	p=0.0003). <u>Agricultural v. residential use of pesticides</u> Residues in soil and household dust were found to be predominantly from agricultural and not residential use. Soil levels of the 4 pesticides from agricultural families were higher (non-detectable to 930 ng/g) relative to reference homes (non-detectable to 39 ng/g). Household dust residues from agricultural homes (non-detectable to 17,100 ng/g) were higher than that for non-agricultural families (non-detectable to 820 ng/g). <u>Proximity</u> Mean and median levels of household dust concentrations were statistically higher for agricultural families living closer than 50 feet for all four compounds, with statistically significant levels seen in AZM (box plot diagram- median levels ~ 4,000 ng/g vs. ~ 900 ng/g; p = 0.04), and parathion (box plot diagram- median levels ~ 750 ng/g vs. ~ 90 ng/g; p = 0.005). Significant differences in surface loading levels of carpeting were found between applicator and non-applicator (farm	

Authors	Aims	Methods	Results & Discussion	Limitations
			worker) households for chlorpyrifos (median- 2.7mcg/m^2 vs. 1.2 mcg/m^2; $p = 0.04$) and parathion (median- 2.7 mcg/m^2 vs. 0.05 mcg/m^2; $p = 0.002$), with applicator levels being higher than non-applicator levels (Mann-Whitney U test). <u>Conclusions</u> The authors concluded that study findings suggest a "common source for pesticide contamination of soil and household dust"(p.1131) through occupational proximity. Although pesticide concentrations in house dust were much lower in reference families than in agricultural families, since residues from all four OP pesticides studied were present in reference families and these families lived between .25 and .5 of a mile away from an orchard—"it is likely that those who reside in an agricultural region such as Wenatchee will have measurable pesticide residues in their homes regardless of personal pesticide use."(p.1132). A hazard analysis for children's exposure to these pesticides living in study homes showed that the children are not likely to suffer from acute intoxication. The hazard analysis considered: (1) "use of toxicity data for the four OP compounds; (2) a standard EPA soil contact transfer factor of 200 mg/day for children 1-6 years; and (3) the total OP dust concentration values	

Authors	Aims	Methods	Results & Discussion	Limitations
Lowenherz, Fenske, R. Simcox, N. Garland, B. & Kalman, D. (1997). Biological monitoring of organophosphorus pesticide exposure among children of agricultural workers in central Washington State. Environmental Health Perspectives, 105: 1344-1353. [Conducted June-July,1995]	(1) measuring urinary metabolites of OP pesticides in children living with agricultural workers and comparing them with a reference population; and (2) to evaluate the relative importance of paraoccupational pathways."	This cross sectional study was conducted during June and July of 1995; families were recruited from central Washington State, including small family fruit tree orchards. Eligible agricultural families had at least one worker in the household who was a pesticide applicator, and at least one child living in the home age six or younger. The study consisted of one agricultural worker population; the comparison group also had at least one child no older than six years and lived > 200 feet from active farmland. Diverse approaches for recruitment included: (1) an invitation to 424 pesticide applicators enrolled in the Washington State University Cooperative Extension; (2) an announcement to 3,000 people receiving the Washington Growers Clearinghouse Newsletter; (3) flyers in the pesticide laboratory of the Washington State Department of Health (4) recruitment of participants from a previous study; (5) recruited of families from local organizations; and (6) referrals from previously enrolled participants. Reference participants were recruited through the same service organizations used for agricultural	from this study" (p.1133). Recommendations by the authors: (1) Additional examination is needed to estimate children's exposure levels, including children's activity, surface to skin contact, dermal transfer rates and percutaneous uptake. (2) Biological monitoring via urine may more accurately assess exposure levels children (3) Further longitudinal and intervention studies are warranted to better identify risk factors associated with bringing pesticide contaminants into the home setting. (4) Protective work practices to decrease exposure should be encouraged among agricultural workers. <u>Sample</u> Of 97 contacted applicator families, 48 (50%) were enrolled. Of 40 contacted reference families, 14 (35%) were enrolled. 71% of applicator families were Hispanic vs. 64% of reference families were Hispanic. 70 children were from applicator households (mean age 3. 5 years) while 18 children were from reference households (mean age 3.5 years). <u>Pesticides</u> OP pesticides used were AZM or guthion (75%, 36/48), chlorpyrifos or Lorsban (67%), phosmet or imidian (33%), and	(1) The study relied on voluntary participation not a probability sample of pesticide applicator families. (2) Although OP pesticides can be excreted to several products, (DMP, DMTP, DMDTP) only DMTP was used in this study for comparison purposes. Variability in the metabolism of those products could give rise to error from relying on only this metabolite. (3) Both diethyl and dimethyl OP compounds were used; however, no "reliable analytic standards" could be obtained to measure diethyl chemicals. Since only dimethyl OP pesticides were measured, "the total OP exposures may have been higher". (4) Only exposures from the occupational take-home and proximity pathways were evaluated. It is possible that exposures from other pathways, such as, diet, air, and pesticide use in other facilities (day care) may have added to these exposure levels. A marginally significant trend of increasing exposure with decreasing age was seen, with

Authors	Aims	Methods	Results & Discussion	Limitations
		families, and referrals from subjects enrolled in other studies. Applicator surveys elicited information about: the types of pesticides used during the 1995 spray season (January 1 to July 1) as well as the use of personal protective equipment and hygiene practices. Two “spot urine” samples were obtained from participating children within a one week period of time. Samples which were not obtained at home visits were collected from parents according to uniform instructions. Since pesticides used in the valley between May and June were likely to be azinphosmethyl (AZM), guthion, phosmet, and imidian, analytes of these organophosphate pesticide metabolites were measured: (1) dimethylphosphate (DMP); dimethylthiophosphate (DMPT); and dimethyldithiophosphate (DMDTP). Specific dailkylphosphate metabolite standards were used in carrying out laboratory analysis. Analysis of dialkyl urinary metabolites occurred as: (1) detectable; (2) trace; and (3) non detectable specimens.	ethyl parathion (13%). At visit # 1, applicators said they used azinpos-methyl (ranging from 80 days prior to sampling to the day of sampling); in comparison, phosmet was used (ranging from 6 days to 109 days prior to visit 1). Frequency was difficult to ascertain, since some subjects answered in terms of total number of application events, which included several days of spraying, while others answered in terms of the total number of spraying days. At visit #2, (sampling 2) 23% of all applicators (n=11) reported using an OP pesticide since the time of the first visit; of these participants, all reported using azinphos-methyl within 3-8 days prior to this visit. <u>Residential pesticide use</u> 9/25 with family pets treated them with flea powders, collars and/or shampoos. During the past 6 months, 29% (14/48) of applicators reported using pesticide products in their homes; 27% reported using them on their lawns; only one applicator said he used chlorpyrifos on his lawn. Garden pests were controlled by 3 applicators with AZM and 2/3 of the parents had DMTP concentrations greater than 0.2%. [Note: azinphos-methyl is classified by the U.S. EPA as a Toxicity I compound and due to its high toxicity; it is not registered for residential use]. Analysis of dialkyl urinary metabolites was conducted in three categories: (1)	children who are 3-4 years having significantly higher exposures than those who are 5-6 years. However, time activity patterns did not account for this difference.

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		Laboratory spike and recovery studies conducted before specimen analysis showed the following average extraction efficiencies: (1) DMTP- 80%; (2) DMDTP- 62%; and DMP-39%. Since DMP extraction efficiencies were poor, this metabolite was not included in the analysis. In addition, the stability of metabolites over time was tested at certain specified phases of the study. No loss in metabolites was found between time periods from collection to examination. Initially, chi square was conducted for homogeneity between these categories. Trace samples were then assigned the value of one-half the LOD, and non-detectable samples were assigned values of zero. Untransformed data was used to obtain means, medians, and concentration ranges, and non-parametric statistical tests. Within child variability estimates were ascertained by obtaining two samples from each child - one sample during two different sampling sessions. The means associated with the two different sampling sessions and with the metabolite concentrations in siblings within each sampling	detectable; (2) trace (detectable metabolites with concentrations below the level of detection [LOD]); and (3) non detectable specimens. The LOD for DMTP was 0.015 mcg/L. DMTP was the most common metabolite detected (40%) & selected as the biomarker of exposure. <u>Comparisons between applicator vs. reference children</u> No statistically significant difference was found between urine samples of agricultural children and reference children at the first visit. In the second visit, reference children had a two-fold greater frequency of non-detectable samples compared to applicator children (60% vs. 33%). Focus children of applicators had a four times higher median concentration of DMTP than reference children (0.021 vs. 0.005 micrograms per dilution; Mann Whitney U test, $p = 0.015$). (Similar results were obtained when these tests were adjusted for creatinine). <u>Comparisons by age</u> At the second visit, median DMTP concentrations in 3-4 year olds children of applicators were significantly greater compared to first visit samples (0.033 micrograms per dilution[mcg/dl]) 0.009	

Authors	Aims	Methods	Results & Discussion	Limitations
		session were compared by using the Wilcoxon Signed Rank test. The means between groups within a sampling session were compared using the Mann-Whitney U test and Kruskal Wallace ANOVA. To remove the dependence between intra-child variation and differences between siblings from the same household, frequencies, means, medians were analyzed that compared visit 1 samples with visit 2 samples from the same child, and only one child per household was selected as a focus child for measuring urine concentrations. Selection of focus children was based on the contribution of two urine samples with satisfactory creatinine levels; random selection occurred if more than one child met this criteria.	mcg/dl; Wilcoxon Signed Rank test; p = 0.047). Median DMTP values of 0.009 mcg/dl were seen at both the first and second visits of the 5-6 year olds applicator children. Among children of applicators, a marginally significant difference was seen at visit two between median DMTP values of the 3-4 year old children vs. those of the 5-6 year old children (0.033mcg/dl vs. 0.009 mcg/dl; Mann-Whitney U test, p = 0.060). In a paired analysis of sibling pairs, from families of applicators, the younger sibling in each pair had significantly higher analytes (Wilcoxon signed Rank test, p = 0. 040 Proximity Exposure levels also varied according to proximity to pesticide spraying. Focus children of applicators living less than 200 feet from spraying showed a marginally significant increase in median concentrations in the second visit (0.015mcg/ml vs. 0.023 mcg/ml; Mann-Whitney U test, p = 0.062). Children living less than 200 feet had significantly higher frequencies of detectable concentrations (bar chart: ~ 59% vs. ~25%; Fisher Exact test, p = 0.036). Differences in exposure levels were also found in sibling pairs. Sibling pairs of applicators who lived within 50 feet of	

Authors	Aims	Methods	Results & Discussion	Limitations
			where spraying of pesticides reportedly occurred had a higher level of detectable metabolites (9/10) compared to those living greater than 50 feet from pesticide spraying (2/6). Worker hygiene Differences were found in exposure related to a worker home hygiene practice. Of sibling pairs with detectable metabolites, 70% lived with an applicator who reported wearing work shoes inside the home vs. 33% of sibling pairs with non-detectable metabolites. While 62% of sibling pairs had non-detectable DMTP levels at the first visit, 48% (n=10) of pairs had detectable levels at visit #2 (chi square, $p = 0.018$). Conclusions Children living with pesticide applicators "have higher urinary biomarker levels of OP pesticides than reference children", which is consistent with higher dust and soil levels in agricultural homes [Simcox, 1995]. Exposure levels increased over time from the beginning to the end of the spraying season for coddling moth. Since, the biological half- life of azinphos-methyl is 30-36 hours, repeated environmental exposures as the season moved on could	

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			create a build-up of this pesticide that would result in higher urinary metabolite levels in children. Thus higher exposure levels from the start to finish of the study are plausible. [NOTE: In Simcox (1995) and Lowerherz (1997) OP pesticide concentration levels were higher in children who resided closer to orchards, and higher in children of applicators, even though Simcox measured dust/soil (indirect exposure) and Lowenherz measured an OP pesticide metabolite (biomarker for direct exposure). Thus both studies support the proximity pathway to exposure as related to household dust, soil and urinary exposure.] <u>Agricultural vs. reference families</u> 19/24 agricultural had the OP pesticide "AZM" detected pesticide residues in the play rooms of their homes (median of .71 ppm). Other OPs were found in the play areas of these homes, including phosmet (n= 7, median .38 ppm) and chlorpyrifos (n=7, median .14ppm) and malathion (n=3, median .15 ppm). In comparison, no OP residues were detected in the play areas of the control family homes.	

Authors	Aims	Methods	Results & Discussion	Limitations
McCauley, L., **Michaels, S., Rothlein, J., Muniz, J., Lasarec, M. & Ebbert, C. (2003).** Pesticide exposure and self-reported home hygiene: Practices in agricultural families. AAOHN Journal, (51)3: 113-119. Recruitment occurred in September to October, 1998.	(1) To characterize the pesticide exposures of orchard owners and operators and their families and determine the relationship between self report hygiene practices and the levels of OPs in the play areas of their homes. Specific questions: "(1) Does an association exist between type of agricultural work and levels of pesticide residues found in the home? (2) Are self-reported, after-work hygiene practices associated with levels of pesticide residues in the home? (3) Are home and geographic characteristics associated with the levels of pesticide residues in the home?	Families from 24 family farms from rural Oregon participated in this study convenience sample. Qualifications were that families owned an orchard or had one member who was currently working or managing an orchard. Four control families participated who lived in the area, but were at least one mile from a farm, and had no family members employed in the industry. Both groups had at least one child between the ages of infancy and 7 years. Four questionnaires were administered to elicit information in the following domains (1) demographics (2) usage of residential and non-commercial pesticides in home and garden, such as, weed control, rodent control, flea treatment, and mosquito control; (3) parental work-practices, including, work descriptions, use of protective clothing, and household hygiene practices; (4) information about the household, such as, cleaning practices, that include the frequency of vacuuming, dusting, sweeping, the presence of pets, and house characteristics and (5) play locations and precautions taken during pesticide spraying events to keep children away from	The median level of total OP residues found in dust samples from play areas was significantly associated with the number of individuals in the home reporting high contact job descriptions ($W = 194$; $p = .007$). Median residue levels for total OPs were 4.44 ppm higher in homes with two individuals reporting direct pesticide contact work compared to homes in which only one adult reported these job activities. <u>Work hygiene practices</u> No significant association was found between reports by male workers that shoes or boots are removed before entering the home and total level of OPs ($W=86$, $p= .36$) or the level of AZM (W 83, $p = .46$). No association was found between the mean levels of residues in the home of those who washed immediately after arriving home and those who waited more than 30 minutes. However, significantly higher mean levels of total OPs and AZM in the households of workers who reported waiting more than two hours before changing out of their work clothes compared to homes with workers who reported changing out of their work clothes within two hours after returning from work ($t(21) = -3.3, p<.01$).	Recruitment for this study relied on a voluntary, convenience, not a probability study Although the questionnaires used have been validated, the surveys relied on self-report, and thus, may not be accurate due to an inability to recall information accurately.

Authors	Aims	Methods	Results & Discussion	Limitations
		equipment and exposure from spraying. Dust samples were taken from inside the front entry and in the children's play area of the homes by vacuuming carpet, and or by wiping bare floors with gauze dressing pads and cotton swabs treated with isopropanol per OSHA sampling protocol. Pesticide residues were extracted via solvents and gas chromatography. Mean and median pesticide levels were ascertained from home samples. T-tests, nonparametric statistics and ANOVA were used to compare levels of pesticide residues according to work activity, within areas of the home and between homes. Multiple regression was used to assess associations between work, and home cleaning practices, and characteristics of the home with pesticide levels. An exposure variable was created "to quantify an aggregate effect of after work hygiene practices thought to increase the presence of pesticides in the home. The male workers responses included: (1) ever entering the home with work	No association was found between the summary variable and all after-work hygiene behaviors and the mean levels of AZM or total OP pesticide residues found in the home ($r = .17$, $p = .43$ for AZM; $r = .05$, $p = .80$ for total OP" (p. 117). <u>Proximity</u> No significant relationship between total OP residue and the distance of the home to the nearest active orchard. <u>Conclusions</u> Although it is assumed that home hygiene practices will decrease exposure, prior to this research, no published study demonstrated the existence of a relationship between hygiene practices of agricultural workers at home after working and pesticide levels in the household.	

Authors	Aims	Methods	Results & Discussion	Limitations
Thompson, B. Coronado, G. Grossman, J. Klaus, P., Solomon, I. Curl, C., Shiraz, J. Kisser, J. & Finke, R. (2003). Pesticide Take-Home Pathway among children of Agricultural Workers: Study Design, Methods, and Baseline Findings. Journal of Occupational and Environmental Medicine, 45(1): 42-52.	These are reports on exposure pathways from 571 farm workers and their children living in an agricultural area of Washington state. Findings will serve as baseline information for a community participatory intervention to reduce pesticide exposure among workers and their children. After a two year intervention, a post exposure assessment will be used to evaluate the effectiveness of the intervention.	clothes on; (2) ever entering the home with boots or shoes on; (3) the time between arriving home and washing up; (4) the time between arriving home and changing."(p.115). The study used a cross sectional design and blocked randomization for recruitment. Eligibility criteria included at least one self reported farm worker who had at least one child between the ages of 2 and 6 residing in the home. Farmers who had children between 2 and 6 years were recruited to participate in the urine and dust study. A 73 item questionnaire was administered that inquired about demographics, job tasks, and pesticide exposure; protective practices at work, employer practices, and family protective practices. A small urine specimen was obtained by pooling three voided samples from each worker and their child taken over a period of three days to two weeks. The urine was measured for concentration of six metabolites which are by products of organophosphate pesticides.	Evidence exists from this study to supports the premise that workers can inadvertently carry agricultural chemical from their work into their homes, thereby increasing the risk of pesticide exposure to other family members inside the home." <u>Sample</u> A response rate of 93% among eligible participants for the cross sectional interviews was obtained (571/613). Of those interviewed, 80.3% were Hispanic and 10.05 % were White. Pesticide handlers mix, load and apply pesticides, while non-handlers may be involved in cultivating, weeding, thinning, pruning, and harvesting crops. The majority of pesticide handlers were White vs. Hispanic (71.7% vs. 25.8%). <u>Occupational exposures: pesticide handlers vs. non-handlers</u> Participants reported pesticides touching clothes daily (63.4%); pesticides touching skin daily (28.6%); and breathing in pesticide dust daily (19.7%); 2.5 % said they were dusted or sprayed daily with pesticides compared to 14.8% who said they were dusted or sprayed once in a while. Of these respondents, a significantly higher number reported working as	The agricultural valley where recruitment took place has a high proportion of undocumented workers; it is possible that these workers refused to speak with recruiters due to fear that the researchers were affiliated with the Immigration and Naturalization Services. The refusal rate was based on only known eligible farm-workers, since there was no way to document whether or not this happened. Second, the accuracy of responses may be decreased due to the fact that this study relied on self-report. Workers may not have understood that multiple agents could have been applied to crops, such as, pesticides, insecticides and fungicides; as such, they may have classified these agents together as pesticides. Third, because there was no non-agricultural worker control group, it is not possible to ascertain if the associations may be attributable to other factors such as, "general environmental" or "family lifestyle practices" (p.51).

Authors	Aims	Methods	Results & Discussion	Limitations
		Dust samples were uniformly collected and measured for pesticide concentrations from two areas: the area in homes where the children played most frequently, and the foot wells and front and rear of the vehicle used to transport workers to and from their jobs. Linear regression was conducted using log transformed data for associations between dust samples in vehicles and in households, and between urinary metabolite concentrations of workers with their children. Worksites were analyzed by worker self-report worker for protective work facilities as required by OSHA and EPA that include: drinking water; bathrooms; soap; water; towels; eye washes; and showering facilities, which are required for pesticide handlers. Chi-Square was used to evaluate bivariate comparisons by job tasks and protective practices for those with and without children in the home according to job task. .	pesticide handlers compared to non-handlers (26.5% vs. 13.5%, $P < 0.001$). Pesticide handlers were significantly more likely than non-handlers to implement protective work practices, such as: (1) wash their hands immediately after work ($p<.001$); washing their clothes after one wearing ($P= .003$); and changing work clothes before holding children. <u>Household hygiene</u> No significant differences were seen in protective household practices between those with and without children residing in the home. <u>Pesticides</u> Six OP pesticides were found in 156 house dust samples ($n = 156$) and vehicles ($n = 90$). Geometric means and geometric standard deviations of house dust values in mcg/g are as follows: AZM, 0.53, SD 4.3; malathion, 0.05, SD 3.0; chlorpyrifos, 0.05, SD 4.6; m-Parathion 0.03, SD 4.8; phosmet 0.02, SD 0.02; and diazinon 0.01, SD 0.01. Vehicle dust OP pesticide geometric mean and geometric standard deviations include: AZM 0.75, SD 5.3; chlorpyrifos 0.03, SD 4.8; malathion 0.02, SD 5.3; m-Parathion 0.01: phosmet 0.01, SD 20; and diazinon 0.00, SD 7.6.	

Authors	**Aims**	**Methods**	**Results & Discussion**	**Limitations**
			AZM was the most common OP pesticide found in both house dust samples (85%) and in vehicle samples (87%), and had the largest values of the six compounds found. Geometric means and geometric standard deviations for dimethyl and diethyl concentrations in children were 0.09, SD 2.9 and 0.06, SD 1.5 and for adults were 0.9 SD 7.2 and 0.04, SD 2.0 respectively. Pesticide metabolites in the urine of children were significantly associated with those of their parent workers (r= 0.42, R^2 = 0.18; P<0.0001). Azinphosmethyl was found in 85% of household dust samples (n=156) and in 87% (n=190) of vehicle dust samples. A significant association was found for azinphosmethyl between house dust and vehicle dust (r = 0.64; R2 = 0.41). 100% of pesticide handlers self-reported they were exposed to pesticides on the job, despite worker protective standards. (Fourteen percent of licensed pesticide applicators reported high exposure events who participated in the Iowa <u>Conclusion</u> Evidence from this study supported the occupational track-in pathway for pesticide exposure with the family vehicle as a vector, since a significant association was found between AZM in the vehicles	

Authors	Aims	Methods	Results & Discussion	Limitations
			and house dust (r=0.64; R2=0.41). The associations between child and parent urine metabolites does not provide evidence for this exposure pathway since other common pathways for families could have been the result of this finding, such as diet.	

APPENDIX B

DRIFT PATHWAY TO PESTICIDE EXPOSURE

Drift Pathway to Pesticide Exposure

Authors	Aims	Methods	Results & Discussion	Limitations
Bryden, P, McKnight, R. & Westneat, S. (2005). Using U.S. poison control center records to identify bystander pesticide exposures: A one-year surveillance of four southeastern States. American Society of Agricultural and Biological Engineers, 112(2): 159-166.	To conduct a descriptive study to better characterize pesticide exposure events to bystanders; pesticide drift has been measured as far as 900 meters from spraying, and the extent of unintentional exposure to bystanders is not known. To ascertain the degree of information that poison control centers can supply related to environmental exposures to pesticides, since a mandatory national surveillance system that monitors non-occupational pesticide exposures does not exist.	Identification of cases from 129 counties of four states (Kentucky, Tennessee, Alabama, and Louisiana) was conducted in two phases. First, the poison center computer database of the American Association of Poison Control Centers (AAPCC) was searched for 2001 calendar year reports of poison control calls that involved 54 agricultural-related chemical categories (fertilizers, fungicides, insecticides, fumigants, herbicides and rodenticides). Second, narrative notes from professionals answering calls were examined for bystander exposure, defined as: "a potential environmental pesticide exposure occurring to a person who was not using or having control over the use of that pesticide" (p. 4). Definition and Inclusion of Cases Bystander exposure was defined as "a potential environmental pesticide exposure occurring to a person who was not personally using, or having control over the use of that pesticide" (p.4).	Descriptive Information Out of 980 pesticide exposure reports, 46 bystander exposures occurred in 32 incidents. Of those exposed, the median age was 45, with a range of 2 to 81 years. Nineteen reports identified gender, which consisted of 16 females and 13 males. Eight cases were reported by a health care professional, and almost two-thirds of those exposed were either referred to or examined in a medical facility. No deaths were reported. Symptoms In 73.9 % of 32 cases, symptoms were recorded. Route of exposure for the majority of cases implied both inhalation and dermal (62.5%) followed solely by inhalation (28.1%), and solely by dermal (9.4%). Fifteen symptoms were reported from 73.9% of the cases: (1) dermal irritation- 17.4%; (2) nausea-15.2%; (3) headache-15.2%; (4) neurological-10.9; (5) dizziness- 8.7%; (6) diarrhea-8.7%; (7) irritated throat-8.7%; (8) shortness of breath-6.5%; (9) coughing-6.5%; (10) vomiting-6.5%; (11) eye irritation-4.3%; (12) lip stinging or feeling thick-4.3%; (13) bad taste in mouth-4.3%; (14) nasal stuffiness-2.1%; and (15) salivation-2.1%. The severity of dermal complaints	Lack of Knowledge of Pesticides by Subjects Of the 46 people exposed, 19.6% (n=14) did not know the name of the substance involved even though they placed it in a general classification category, such as, a fertilizer or insecticide. Since it was not possible to verify the names or doses of the chemicals implicated in exposures, symptoms were used as a proxy. Under-reporting Under-reporting of bystander exposures most likely occurred since many people may not seek medical treatment, and may not contact the poison control centers. Potential barriers include: an inability to speak English, lack of phones, and lack of knowledge about poison control services and how to access poison control centers. Even if treatment is sought, mandatory reporting

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		Case reports of pesticide exposure included sources related to pesticide drift, direct spray, transport releases, or manufacturing plant discharges.	ranged from "sunburn-like redness to whole-body rashes to blistering skin; headaches ranged from mild to migraine, and neurological impairments ranged from malaise, disorientation, and confusion to slurred speech, constricted pupils and visual impairments"(p.7). Symptoms from acute pesticide poisonings in the literature from least to most serious include: dizziness, nausea, increased mucus production, respiratory failure, coma, and death. The health effects reported are consistent with adverse effects from insecticides due to acute poisoning. <u>Types of Pesticides Involved</u> Insecticides were the most common type of pesticide identified, with 17/25 insecticides consisting of organophosphates (malathion, (n=14), methyl parathion (n = 1), acephate (n = 1), and dicrotopos (n = 1)). Other chemicals included: herbicides, fertilizers, and defoliants. Other insecticides included: pyrethrums (three cases); carbamates (2 cases); and botanicals consisting of nicotine (3 cases). In addition, anhydrous ammonia was named in three cases. <u>Odor</u> Four cases discussed pesticide odor; "odor is not a reliable indicator for the amount of pesticide active ingredient;	by health professionals is not required. <u>Limitations with the Use of AAPC Records</u> Not enough detail was included in the poison control report to allow recommendations for preventing future incidents.

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			herbicide active ingredients are usually odorless, the odor being from manufacturing impurities or additives in commercial formulations."(p.6). <u>Conclusion</u> This was a pilot study to evaluate the effectiveness of using poison control center data for surveillance of bystander pesticide exposures. Prior to this study, the extent of bystander exposure to pesticides was not known. The study showed that in these four southern states nearly five percent of acute pesticide ingestions included bystander exposure, and that narrative notes from poison control were able to capture these reports.	
Richards, S., McClure, G., Lavy,	To assess the potential for	<u>Study Eligibility Requirements</u>	<u>Demographics</u>	<u>Lack of Control for Confounding Variables</u>

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T., Mattice, J., Keller, R., and Gandy, J. (2001). Propanil (3, 4-Dichloropropionanilide) particulate concentrations within and near the residences of families living adjacent to aerially sprayed rice fields. Archives of Environmental Contamination and Toxicology, 41: 112-116.	exposure to propranil through aerial spraying for families who live adjacent to treated rice fields.	Proximity of the home to an active rice field was the primary criteria for selection of participants, with treatment group members living preferably within 125 meters of an active rice field. Members of the control group must have lived at least 1 mile from a treated rice field. Requirements common to both groups included: (1) A family consisting of at least one adult male, one adult female, and one child; (2) no exposure to propanil within 10 months; and (3) consent for environmental monitoring. Measurement was conducted identically for both groups. Active and passive air monitors were placed strategically both indoors and outdoors at all residences. Meteorological factors were measured during application that included temperature, relative humidity, wind speed, and wind direction. <u>Active Collection of Vapors</u> Active collection of propanil vapors was accomplished through cartridges in 15 ml glass pipettes (20-50 mesh AmberliteXAD-4 nonionic polymeric adsorbent) placed at 90 degree angles, one	A total of 11 families met eligibility requirements and were recruited in the experimental group while 3 families were in the control group. Air monitoring samples were conducted on 8 / 11 of the experimental families for this study. The study took place during two consecutive spring seasons (years not specified in the journal article). Active sampling was not discussed in this report, since the active samples were detected in only one station at the first three household sites and this station was "located at the edge of the rice field, directly under the aerial application" (p.114). <u>Differences in Conditions Between Household Sites</u> Propanil application varied between different sites. Differences existed with respect to: wind speed and direction, relative humidity, wet bulb temperature, dry bulb temperature, date and time of application, duration of application, application rate, the combination of herbicides or additives, and the doses of propanil. All eight household sites differed with respect to wind conditions and or differences in distances from the field edge to the location of the sampling placements (stations).	The study did not control confounding variables, such as, the height of the application, drafts in the walls of the structure, the status of windows (open vs. closed during the application, and the number of times family members entered or left the home during the collection period. Possibly a clearer relationship between wind speed and deposition would; have been established if these factors had been controlled. <u>Validity and Reliability of Instruments</u> The authors stated that wind speed was measured by a handheld wind anemometer; however, there was no information provided about the reliability or validity of this instrument. The method for measuring wind direction was not delineated, so the validity and reliability of this information was not able to be assessed by the reader. Temperature and relative humidity were

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		meter off the ground; the cartridges were attached to one of three air pumps: SKC Model PCXR7; SKC model 3031-V104-G570X; or a gast pump with a General Electric motor model 5KCP35KG-3665. An airflow rotameter (Dweyer instruments, Michigan City, MI) was used to measure the amount of air flow for each cartridge. Passive Collection of Particulate Passive collection of Propanil particulate was accomplished by clear polyethelene material wrapped around 20 X 20 ceramic tiles. Sampling Locations Samplers were placed strategically between the rice fields and the households at the following four sampling stations: (1) inside the homes (2-3 tiles and media); adjacent to the homes (3 tiles closest to the side of the house facing the fields, and located within 9 meters of the household); intermediate distance from the homes (2 tiles between the house and the field, within 30 meters of the sampling station adjacent to the houses); and (3) on the field edge of the homes (2 tiles located	Wind Direction "Wind direction was correlated with concentrations of propanil in and around the homes"--both indoors and outdoors (p.114). Three wind patterns were present among the eight household sites: "toward the home (sites 3, 4, 6 and 8); away from the home (sites 1, and 7); and multidirectional (sites 2, and 5)" (p.114). The highest concentrations of propanil were found among the group which had the wind blowing toward the home; site #3 had the highest levels at the edge of the field (12,390 mcg) while site # 4 had the highest level within the home (6.7 mcg). Families who experienced the wind blowing away from their homes (sites 1 and 7) conversely had the lowest detectable residues. Only one station at household site #1 yielded detectable levels and this station was located in a rice field. Household site # 7 had detectable levels of propanil which were 25 times less than levels found from a monitor at a similar distance on site #8, where the wind was blowing toward the household (18.2 mcg vs. 432.8 mcg). Levels inside of the home were also related to wind direction. Of those households who experienced the wind blowing toward them from the fields,	stated to be measured by wet bulb, and dry bulb, however, the validity and reliability of these methods was not presented in the article. Lack of Biological Monitoring The study does not include biological monitoring or dermal sampling; therefore, the reader does not know if these indirect sources of residues are likely to become sources of direct exposures. Without biological exposure indices or dermal sampling, an exposure risk assessment for the children in this study related to health effects of propanil is not possible.

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		on the edge of the rice field closest to the houses). <u>Methods for Sampling Analysis</u> Sampling tiles were placed at their stations 15 minutes before aerial spraying began and they remained in those positions for 1.5 hours after the spraying was finished. Then the 20 X 20 polyethelene material was cut from the tiles, placed in glass vials and sealed, and kept at 25 degrees C. Extraction with 10 ml. of ethyl acetate was conducted < 4 hours after collection. After extraction, "1000 micro liters of the extract solution was drawn from each vial and transferred to a gas chromatography (GC) vial." As an internal standard, 99.9% pure atrazine (100 micro liters of 100 microgram/ml) was added to each GC vial of extract solution (p.114). Analysis was performed at the University of Arkansas, Fayetteville by a GC mass spectrometer system. GC analysis by a Varian Saturn 2000 gas chromatograph mass spectrometer system was used for quantification of polyethelene extracts collected from both active and passive	75% (3/4) had detectable propanil concentrations in their homes (site #4, 6.65; site # 8, 3.5; site # 6, 3.1). <u>Distance of the Household from the Field</u> Distance was also a factor. Of the four sites which experienced the wind blowing toward their households, the closer the home was to the field, the higher the indoor concentrations of propanil that were measured (site #4, 46 meters-6.65 mcg; site #8, 101 meters-3.5 mcg; site #6, 108 meters-3.1 mcg; and site #3 - 113 meters-non-detectable. <u>Wind Speed</u> Wind Speed was an influencing factor. The largest amount of propanil was found in and outdoors at household site #3. Site #3 had a strong wind (370 m/s) in addition to a wind direction blowing from the field toward the household. Because the amount of the concentration was substantially higher than the three other households with wind directions blowing toward them, (12,390.7, vs. 760.3, 565.3, and 524 mcg /sample) it is suggested that wind speed as well as wind direction had an impact on the amount of drift measured. Household # 6 was sampled under relatively still wind conditions; the total amount of propanil concentrations	

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		samples. Sampling plates spiked with a known amount of propanil were included in with the field sampling plates for quality control; recovery from the spiked plates was 107% $\pm$ 12%. The LOD for propanil was 2.0 mcg per extract. Active sampling results were determined as mcg of propanil per ml of extract (mcg/ml) and then converted to mcg/m^3; passive sampling was converted to total mcg of propanil per 400 cm^2 of the polyethelene collecting surface that gathered during the 90 minute sampling period. Meteorological conditions The following meteorological conditions were measured: (1) temperature (wet bulb and dry bulb); (2) relative humidity; (3) wind speed; and (4) wind direction. Wind speed was determined by a handheld wind anemometer (Style 1000 B, Bacharach Instruments, Pittsburgh, PA).	measured was 565.3 mcg. (a moderately high level compared to the other 7 sites). The researchers asserted that other influences could be responsible for these findings besides wind speed, such as, "higher application heights may have allowed the propanil to freely drift toward the home" (p.115). Although, the total amount of propanil residue was the highest at site #3, no detectable residue was found inside of this household.The authors suggest that this finding could be due to lower travel in and out of the home, differences in home integrity, such as drafts in walls, or having the windows open during aerial spraying. No patterns were found to be correlated between propanil concentration and the following variables: application rate, formulation rate, time of application, duration of application, relative humidity, or temperature. Control Group Control household sites and stations were measured with the same methods as the experimental households. No detectable concentrations of propanil were found in the control group. Discussion	

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			Arkansas is the leading producer of rice in the U.S. and 70% of all rice in the nation is treated with propranil. Many families live next to active fields, and could potentially be exposed to pesticide through drift. Acute toxicity of propanil has been seen in mice at 200mg/kg; these symptoms include: central nervous system depression, cyanosis and loss of righting reflexes; methamoglobinia; and immunotoxic effects, such as, alterations in T-cells, and reduced natural killer cell responses. This research is the first part of a larger study evaluating health effects of this pesticide. <u>Complexity & Lack of Statistical Analysis</u> Multiple factors can influence drift (defined as the travel of very small droplets which remain air-born after emission through spray to non-target locations). These factors include: height of the application, formulation, droplet size, pilot judgment, turbulence, temperature, humidity, wind speed, wind direction, and topography. Given these differences, along with a lack of ability to create standard orientations, and the presence of multiple potential confounders (household structure, the presence of windows being open vs. shut and the frequency of family members entering and leaving the home during application) -- traditional	

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			analytical statistical measures were not carried out in this study. <u>Conclusion</u> The results of this study show that drift from aerial spraying can occur both indoors and outdoors after pesticide application. The concentrations of propanil were influenced most strongly by the direction of the wind blowing from the treated field toward the households, and the location of the households from the fields. The authors assert that supporting evidence was present that the speed of the wind had an influence in the household with the greatest; however, I think these findings were mixed. If this was a solid finding, then the household with calm wind conditions should have had lower levels of propanil; instead, moderately high levels were found in and around this household compared to the other home sites. While the authors hypothesized a confounding factor may be responsible for this finding, (higher application heights allowing the pesticide to drift more easily toward the home), more research which controls for this confounding factor is needed in order to sort out the role of wind speed as a contributing factor to drift. <u>Strengths of the Study</u> A major strength of this research is that it is one of the first (if not the first) study in	

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			the U.S.. to measure deposition in and around households where aerial spraying was conducted. A second strength of the study is that the authors included a hypothesis for the lack of propanil found through active collection of vapors. Propanil in water is a volatile solution, and when it evaporates, it creates a vapor from which only the propanil remains, and, therefore, can theoretically be measured. The researchers stated that the lack of detectable propanil [via active air measurement] through the AmberliteXAD -4 nonionic polymeric is consistent with the low vapor pressure for propanil.	
Weppner, S., Elgethun, K., Lu,	To assess off target pesticide drift from	<u>Sample Recruitment</u>	<u>Study Sample</u>	<u>Ideal Conditions</u>

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C., Hebert, V., Yost, M. and Fenske, R. (2006). The Washington aerial spray drift study: Children's exposure to methamidophos in an agricultural community following fixed-wing aircraft applications. Journal of Exposure Science and Environmental Epidemiology, 16, 387-396.	aerial spraying as a pathway for children's exposure	A community meeting was held in a small farming town in Central Washington State for recruitment. Eligibility included being a resident of this community, and having at least one child in the household between age 2 and 12. Methods The first application of the growing season of liquid methamidophos (Monitor4) was applied to potato fields in this location during the month of July. Spraying occurred by a 400 gallon tank, 1340 Thrush aircraft flying 10 feet above the crop canopy at 110 miles per hour. Five fields were sprayed using 60 medium jet whirl nozzles located 2-3 feet below the wing and oriented at 180 degrees from the flight; the spray boom was located in front of the wing, and took up 75% of the wingspan. Between the hours of 0500 and 0930, four fields were sprayed to the north, southwest, west and east of the community, after which time, the application ceased due to winds greater than five miles per hour. Spraying resumed between 1400 and 1500 hours for application of the south fields. Factors that can impact off-target drift include the speed	Eight families with six children between the ages of 2-12 years living in a small farming town in Central Washington State who had households within 15 to 200 meters of a treated field participated. Outdoor Deposition Primary pesticide contact occurred outdoors. Plates just within the boundaries of the sprayed fields had the greatest concentrations. An inverse relationship was found between the median values of residue on the four deposition plate sets located inside the boundaries of the fields and the median distance of the deposition plates from the nearest sprayed field (R^2=0.94; $p = 0.03$). Community Outdoor Air Community air concentrations rose from median pre-application levels of 0.05 to 0.11micrograms per cubic meter (mcg/m^3) on the morning of application to 0.48 mcg/m^3 on the afternoon of the application day, and then decreased to 0.10 mcg/m^3 on the day after application; significantly higher application and post application values were found compared to pre-application values (Wilcoxon's Signed Rank Test, $p < 0.05$). Air samplers located outdoors at residences showed a four-fold greater median concentration the day after application compared to the day before application.	The researchers pointed out several limitations. Since the pilot was aware of this study, it is possible that bias may have been introduced. The first pilot turned back and landed without applying the pesticide after seeing the monitoring equipment. Measurements were taken from the spraying that took place by a second pilot that took flight the next day. The fact that residue levels collected inside the perimeters of the field were three times greater than residue levels next to the field within residential boundaries shows that this spraying was administered very precisely. This execution took place while the wind was blowing *away* from the community. Participants had prior knowledge of the spraying; and most of the households had their windows shut with their air conditioner running during the application. However, the authors say

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		of the wind direction, topography, and the distance from the source. Wind-speed and direction were obtained from the Washington State University Public Agricultural System sited two miles from the location of the study; since the topography was flat, the readings were reliable. The community had a centrally located park and soccer field and was located between potato, corn and wheat fields. Deposition plates consisting of silica gel chromatography (20X20 cm) were placed on the inner boundaries of two potato fields, length-wise within the community park, and in the yards of participants. The plates were collected after both the morning and afternoon applications. Morning deposition plates were in the field for 6.75 hours, while afternoon deposition plates were in the field for 5 hours. Two medium flow "Staplex" samplers, and two high flow air "Thermo Anderson" samplers were placed within the community space, with a third high flow reference sampler located 1.5 kilometers upwind. Samplers extracted residues through polyurethane foam (PUF) cartridges. Residential air	<u>Residential Outdoor Air</u> Higher residential outdoor levels compared to community levels were seen, with the highest residential concentration at 0.98 mcg/m^3 vs. the highest community concentration at 0.68 mcg/ m^3; the researchers hypothesized that this is due to the fact that some residences bordered treated fields. The highest indoor residential air concentration was seven times lower than the highest outdoor residential sample, with the majority of indoor air samples being less than or near the level of detection. Indoor air concentrations did not exceed 0.03 pg/m3 (median level not available in report). In comparison, the highest median outdoor community and median outdoor residential air concentrations were 0.48 pg/m3 and 0.49 respectively, which were found between noon and 8PM on the spray day. No detectable residue was found on counter surfaces or on apples inside the households. <u>Playground Equipment and Toys</u> Compared to pre-application levels, significantly higher Monitor[4] concentrations were seen on playground equipment at six hours and eleven hours after spraying began ($p = 0.04$	this was because of "extreme weather" and do not imply it was because of prior knowledge of aerial spraying. To what extent the weather vs. prior knowledge of aerial spraying drove the decisions to close windows and run air conditioners is unknown. For these reasons, the results of this study were obtained under ideal conditions and my not be representative of exposures that occur from aerial spraying under less than ideal circumstances. <u>Lack of Risk Assessment</u> A risk assessment is not included for the children who were exposed to this chemical, so the reader does not know the level of risk that exposure to drift from aerial spraying may present. The authors state that this will be the topic of a future paper; they are developing models for volatilization of residues which will be used in conjunction with GPS-

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		sampling was collected by a medium flow "SKC Hi-Lite" sampler placed at one meter high (within the breathing zone of a child) in the yards, and inside the homes of participants. Samples were collected on the day before spraying, the day of spraying, and the day after spraying. <u>Wipe Samples</u> Dermal wipes were obtained from children's hands, playground equipment; a plastic template (10X10) was used to obtain samples from the kitchen tables and counters and pre-cleaned apples at each household. Uniform technique was incorporated across participating families. Wipe samples from children involved wiping both hands, and including the entire palm of each hand. Playground samples were taken from the monkey cross and side bars, a tire swing, a baby swing, and swing chains. A pre-cleaned ball was placed in the soccer field and in the yards of participating families. Samples were collected "from the same surface once prior to, and twice following the start of	Wilcoxon's Signed Rank Test) with median concentrations seen at 0.04, 0.57 and 1.04 nanograms per cubic centimeters (ng/cm^3) respectively. While no measurable residues were found on toys at pre-application, 4 out of 6 toys had measurable residues ranging from 0.11-0.37 ng/cm^3. <u>Children's Hand Wipes</u> Children's hand-wipes contained significantly higher median residues on the day of application (0.08 mcg/sample) compared to baseline (<0.02mcg/sample; and pre-application residues (<0.02 mcg/sample) (Wilcoxon's Signed Rank Tests, $p = 0.03$). Median levels extracted during the spray day were also significantly higher than median levels extracted on the day after application (0.08 vs. 0.05 mcg/sample; Wilcoxon's Signed Rank Test, p = 0. 05). Using Spearman's rank correlation test, hand-loading levels extracted on the day of spraying and the day after spraying were significantly correlated ($r = 0.84$, $p = 0.02$). Post spray day levels were significantly higher than baseline and pre spray levels (Wilcoxon's sign-rank tests, $p=0.017$). <u>Urine Samples</u>	based children's activity to arrive at refined estimates of children's exposure pathways. <u>Short-term Measurement</u> A limitation of this study is that it ceases sampling at 11 hours when the residue is the highest, and does not sample further out in time so the reader can see a drop in those concentrations. Mothers may want to know the best practices for how long they should have their children play indoors after aerial application.

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		the spray event (approximately 6 and 11 hours after aerial application began)" (p.389). Kitchen wipe samples were extracted on the day before application, and at 15 and 36 hours after the start of the application. Children's hand-wipes were obtained on the day before the onset of spraying, two times after spraying began, and three to four times on the day after spraying. Urine Samples Spot urine samples were taken at baseline (two months prior to the spraying event), and the evening before spraying began. On the morning of the application, 24-hour urine specimens were collected, followed by the collection of three spot urine samples on the day after spraying. Uniform procedures were employed for all collections, and handling; analysis was conducted according to a standard protocol using solvent extraction and gas chromatography. Urine samples were analyzed for the metabolite of methamidophos "O, S-DMPT" at the University of Washington's	A total of 85/100 urine samples were obtained from eight children at baseline, pre-application, application, and post-application. On the day of spraying, median concentration levels obtained after 11AM were significantly higher than those obtained before 11AM (170 mcg/l. vs. 61 mcg/l., Wilcoxon Signed Rank Test, $p = 0.06$). Results from Spearman's Rank Correlation showed that urinary metabolite levels from specimens obtained after 11AM on the day of spraying were correlated with the following factors: (1) the amount of time the children spent outdoors ($r = 0.68$, $p = 0.09$); (2) hand-wipe levels obtained on the day of spraying ($r = 0.67$, $p = 0.10$); and (3) metabolite levels collected on the day after spraying ($r = 0.66$, $p=0.11$). Discussion This was the first study to include outdoor and indoor measurements along with children's dermal and biological measurements for exposure from off-target drift due to aerial spraying. The results provide evidence that drift from aerial spraying occurred since Monitor[4] residues were found on deposition plates located within the boundaries of fields in the community park, the playground equipment, the	

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		Environmental Health Laboratory. For quality control, 15 samples were fortified with specified amounts of the metabolite; no degradation of the metabolite was seen in analysis. In addition, blank laboratory and field samples that were analyzed with the urine specimens showed no measurable amounts of OS-DMPT. The average recovery of the metabolite from 12 spiked samples was 92 ± 42%. "The LOD was 9 mcg/l and the LOQ was 18 mcg/L." (p.391).	yards, and on the outdoor toys of residences. In addition, elevated residues on the hands of children and elevated metabolite levels of O, S-DMPT in the urine of children following spraying confirmed that direct exposure to this pesticide did occur. Since no residues were found inside households, and hand-wipe levels were associated with the amount of time the children spent outside—it is likely that this exposure occurred outdoors. Although the residues were confined to outdoors and not inside households, this study shows that drift from aerial spraying can be a pathway to pesticide exposure for children.	
Petrie, K. Thomas, M. and Broadbent,	"To investigate the effect of aerial	The study was conducted in New Zealand's Ministry of Agriculture	<u>Study Sample</u>	<u>Respondent Bias</u>

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E. (2003). Symptom complaints following aerial spraying with biological insecticide Foray 48B. The New Zealand Medical Journal, 116(1170): 1-7.	Bacillus thuringienis (Foray 48B) spraying on Self - reported symptom complaints, health perceptions, and visits to healthcare providers."	and Forestry (MAF) West Auckland spray zone. Subjects were recruited in the most intensively targeted initial area (n=13,500 residents) of a pre-planned aerial spraying campaign with Bacillus thuringiensis (Foray 48B) for the purpose of eradicating the painted apple moth. Eligibility involved being age 18 or over. Door to door recruitment occurred at the end of October 2001, 10 weeks prior to spraying, at which time, baseline questionnaires were administered. The spraying season began in January 2002 and was completed in March 2002, after three spraying occasions. Follow up questionnaires were administered to participants at the conclusion of the spray campaign. <u>Questionnaires</u> The baseline survey included content as follows: demographic information, previous diagnosis with asthma, hay fever, or allergies and a list of 25 symptoms for identification of health symptoms in the past four weeks. The symptom list was taken from a survey called "The Subjective Health Complaint Scale," which had high reliability	A total of 292/315 residents participated (93%), including 131 males and 161 females. Ages ranged from 18-79 years, with a mean of 42.1 years (SD 15.2). Ethnicity was representative of the total population in the area. Of those participating, 181/292 people responded to the follow-up survey (62%). Non-responders did not differ from responders pertaining to the number of baseline symptoms, previous diagnosis of asthma, hay fever, or rates of other allergies. <u>Symptom Elevations</u> Significant elevations in three clustered categories were found in symptoms before and after the spraying campaign: (1) neuropsychiatric responses; (2) local effects on the upper airways; and (3) gastrointestinal responses. <u>Neuropsychiatric</u> Neuropsychiatric responses included: sleep problems (26.6 vs.36.2; p= 0.03); (2) difficulty concentrating (5.2 vs. 12.5; p=0.001). <u>Upper Airways</u> Effects on upper airways consisted of: (1) irritated throat (16.2 vs. 31.9 (p=0.0001); and (2) itchy nose (16.2 vs. 23.2 (p=0.04). <u>Gastrointestinal (GI)</u>	Those who responded to the second questionnaire were more likely to be older than younger; therefore, responders may be more likely to have symptom exacerbation than non-responders, causing an over estimate of adverse health effects compared to the target population. <u>Control of confounders</u> Several possible confounding factors were not controlled in this study, such as, age, education, occupation, history of relevant medical conditions, and prescriptions of certain relevant medications. Due to this lack of statistical control,, causal inference of these symptoms from the spraying campaign cannot be made. Causation between the association between spraying and significantly increased symptoms in participants with hay fever cannot be inferred, since several confounding factors which could be responsible

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		from use in a previous study. Subjects were asked to rate their overall health using a 7-point scale, and to indicate the number of times they visited a general practitioner or alternative health care provider during the past three months. The follow-up survey included repetition of the symptom checklist and a self-rated health care item that asked the following additional questions: (1) an estimation of the number of visits to a general or alternative health care provider during the past three months; whether or not a discussion of concerns related to spraying occurred with their health care professional; and whether or not a change in medication regime including new medications, occurred in response to the spraying. Lastly, subjects were asked to rate how much their health was affected by the spray programme, and how much their children's health was affected by the spray programme. <u>Statistical Analysis</u> Statistical Analysis was conducted via SPSS for Windows statistical software, and included the	GI responses included: stomach discomfort (16.6 vs. 25.5; $p=0.03$); gas discomfort (8.6 vs. 16.8; $p=0.02$); and diarrhea (8.6 vs. 16.8; $p=0.03$). <u>All Symptoms</u> Overall, a significant increase was seen in the total number of all symptoms at follow-up compared to baseline(mean=3.9, SD=3.56 vs. mean 4.78, SD=4.48), $t\ (156)=-2.99$, $p=0.003$). (Degrees of Freedom not included by authors) <u>Effects on participants with Hay Fever, Asthma, and Allergies</u> Results of ANOVA showed a significant increase in symptoms from baseline to the conclusion of the spray campaign for participants with a diagnosed history of hay fever compared to the reference groups of participants without hay fever ($F\ (1147)=5.30$, $p = 0.02$). No significant elevations were seen after spraying in participants with health histories of asthma or other allergies compared to the reference group. (Degrees of Freedom not included by authors). <u>Health Care Provider Visits</u> While participant self-rated health declined significantly from the baseline surveys to the follow-up surveys, (mean=5.08, SD=1.21) $t\ (175)=3.69$, $p=0.0001$) — the number of visits to	for these findings, were not controlled. These factors include local weather conditions that are known to exacerbate such health conditions, including outdoor humidity, ozone levels, and particulate matter. A control group with inclusion of people with hay fever in the same weather region who were not exposed to the pesticide would be needed to infer causation. Confounders that were not controlled pertaining to GI symptoms include a history of diagnosed GI problems, and current medications which participants may be taking that could cause GI upset. Confounders that were not controlled related to insomnia include a history of anxiety disorders, and taking current psychotropic medication prescriptions. Verification of B. thuringiensis infection by a sub-sample of random cultures on those who

Authors	Aims	Methods	Results & Discussion	Limitations
		following associations: (1) Paired sample t-tests, conducted to measure differences between baseline and follow-up surveys in the frequency of symptoms and the self-rated health reports. Analysis of Variance (ANOVA) was conducted separately for each group of participants with a history of asthma, hay fever, or allergies compared to those without these diagnosis, controlling for their symptom scores at baseline, to ascertain differences in reported symptoms between the groups after the spraying campaign. Non-parametric tests (due to skewed distributions) were used to analyze changes in the frequency of visits to health care providers at follow-up compared to baseline information.	physicians (Wilcoxon $Z=-0.94$, $p=0.35$) or to alternative care practitioners (Wilcxon $Z=-0.39$, $p=0.69$) was not significantly increased (Degrees of Freedom not included by authors). . A total of 9.2% of respondents said they discussed the effects of the spraying with their physician, and 6.5% of participants reported that they changed their medication because of the spraying. <u>Perception of Spraying on Self and Children's Health</u> Most adult participants reported that their own health was not adversely affected by the spraying (bar chart: 58% vs. 42%), but were equally divided about whether or not the spraying had an adverse impact on their children's health (bar chart: 50% vs. 50%). Thus, they were more likely to view negative affects of the spraying on their children's health than their own health. <u>Plausibility of Symptoms</u> The study found increased adverse health symptoms from self- reported questionnaires administered before and after a 12 week spraying campaign. The most notable increase of symptoms included a "doubling of throat irritation," along with neuropsychiatric, upper airway, and gastrointestinal complaints.	reported GI symptoms would provide evidence that the GI symptoms were directly related to aerial spraying.

Authors	Aims	Methods	Results & Discussion	Limitations
			Plausibility: Upper airway and GI symptoms The authors state that an increase in upper airway symptoms and GI symptoms from the spraying are plausible. Foray 48B contains spore associated crystals derived from an endotoxin, named *thuringiensis kurstaki*, several volatile chemicals, and "residual components of the medium in which the organism was cultivated. Therefore, this pesticide could cause local irritation of the upper airways (presumably from the volatile chemicals, although the authors did not explicate this source). GI effects could be due to germinating spores that produce replicating bacilli, since exposure to B. thuringiensis has led to documented human infection with the organism and an associated immune response in the past. In addition, they state *that B. thuringiensis* "is almost indistinguishable from *B. cereus*, a relatively common cause of food poisoning, and produces an enterotoxin which is identical to that produced by B. cereus, although at a much lower level" (p.5). Plausibility: Neuropsychiatric Symptoms The authors assert insomnia could be due to the early morning noise of the planes overhead, or due to anxiety about the spraying.	

Authors	Aims	Methods	Results & Discussion	Limitations
			<u>Discussion</u> The study found that although no increase in health care visits were seen during the spraying campaign, a statistically significant increase in reported symptoms was perceived by members of this sample population at baseline compared to after the campaign. The authors stated that the unique contribution of this research is that past studies have been largely based on monitoring for increases in health care visits, with no elevations in visits related to spraying found. Although causation cannot be inferred that these symptoms were due to the spray campaigns, the results suggest that such campaigns may result in subtler aggravating health symptom complaints which are not treated by health care providers.	
Karpati, A., Perrin, M. Matte, T.,	A population level study was	In the summer of 2000, pyrethroids were applied in New	<u>Asthma Related Hospital ED Visits</u>	<u>Ideal Conditions</u>

Authors	Aims	Methods	Results & Discussion	Limitations
Leighton, J. Schwartz, J. & Barr, G. (2004). Second potential off-target pathway to pesticide exposure may occur from truck-based application of insecticides for mosquito control within communities.	conducted to determine if elevated levels of asthma-related admissions to public hospitals occurred in association with on-the-ground community spraying by trucks.	York City to decrease mosquitoes as a control for West Nile Virus. Human exposure to this insecticide is associated with respiratory irritation, asthma aggravation, and lung inflammatory conditions. Using a time series approach with zip codes, the dates of spraying and emergency department (ED) admissions to public hospitals were analyzed from four out of five New York City boroughs during a 14 month period between October 1999 and November 2000. The number of asthma-related visits was compared according to zip code locations during the three days before and three days after spraying with pyrethroids. Since each neighborhood served as their own control, confounding by intrinsic differences between various communities were held constant. In addition, information was collected for 14 months about asthma visits in relation to certain patterns, such as: day of the week; season of the year; and daily conditions that included, particulate, ozone, temperature, and precipitation. Asthma related admissions were defined according to the International	The researchers found no significant increases in asthma-related admissions to public hospital EDs associated with neighborhood spraying. Out of all asthma related visits (n = 1,011) in the four zip code areas that occurred three days before and three days after spraying, 50. 4% (n = 510) occurred three days before application and 49.6% (n = 501) occurred three days after application (p = 0.78). Under the null hypothesis of no relationship in the number of visits before vs. after spraying—the proportion of visits after spraying would have been 0.5. In addition, multivariate models using lag times showed no significant association between relative risk (RR) increases in asthma-related ED visits and truck-fogging up to six days after spraying (five days post spraying: RR = 0.94; 95% confidence interval [CI], 0.82-1.08). <u>Vulnerable Populations</u> These findings were consistent when analysis was conducted with only children under age 15 (RR = 0.78; 95% CI, 0.61-1.01), and with adults who had chronic obstructive pulmonary disease (RR = 0.91; 95% CI, 0.80-1.04). <u>Asthma Related Hospital ED Visits & Weather Conditions</u> In comparison, significant associations were found in multivariate models	The study was conducted under ideal conditions. First, residents were warned of the spraying by public service announcements and instructed to stay indoors with their windows shut; spraying occurred between 2200 hours and 0500 hours while most people were sleeping. Since not all municipalities warn citizens in advance of pesticide fogging, these results may not be generalizable to other populations. <u>Lack of Measurement for Self-Managed Asthma Symptoms</u> Second, the study only measured ED admissions, and did not account for milder asthma exacerbations which could have been self-treated, or treated in clinics. <u>Lack of Inclusion of Private Hospital ED Visits</u> Third, private hospitals were not surveyed; however, the researchers add that this should not bias the temporal effect, since it is not likely

Authors	Aims	Methods	Results & Discussion	Limitations
		Classification of Diseases, 9th Revision (ICD-9). Air quality data was obtained from local monitoring stations of the New York State Department of Environmental Conservation, Bureau of Air Quality Surveillance, while meteorological data was collected from the National Weather Service.	between increases in asthma visits and elevated ozone levels, as well as elevated particulate matter (PM_{10}) levels. A 7% increase in ED asthma related visits was associated with each increase in PM_{10} of 20 mcg/m^3 (RR =1.07; 95% CI, 1.05-1.09). A 4% increase in ED asthma-related visits was associated with each 0.02-ppm increase in ozone.	that people would change hospitals during the study period. Further, they add that those affiliated with public hospitals may be more sensitive to the effects of spraying since they may be more likely use EDs vs. private doctors and may be more likely to have less-controlled asthma compared to those not affiliated with public hospitals. <u>Lack of Environmental & Biological Monitoring</u> Since no environmental or biological monitoring was conducted, this article does not lend evidence to support a pathway to pesticide exposure from truck spraying. However, the finding of significant associations in multivariate models between increases in asthma visits and elevated ozone levels, as well as elevated particulate matter (PM_{10}) levels, raises questions that warrant further research.

APPENDIX C

RESIDENTAIL PATHWAY TO PESTICIDE EXPOSURE

RESIDENTAIL PATHWAY TO PESTICIDE EXPOSURE

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
Fenske, R., Blalck, K. Elkner, K. Chorng-Li, L., Methner, M. & Soto, R. (1990). Potential exposure and health risks of infants following indoor residential pesticide applications. *American Journal of Public Health, 80*(6): 689-693.	To measure air and surface residues of chlorpyrifos after residential application; to conduct an exposure risk assessment for a 9-10 month old infant after entering the area, following labeling instructions for safe entry time.	<u>Application</u> A solution of Dursban containing 41.5% chlorpyrifos was applied by a licensed pesticide applicator in three rooms of an empty apartment with a total surface area of 45.27 m3, which contained carpet with 1.2 cm thick nylon pile. The broadcast method was used, which involves hand spraying onto to target surfaces such as rugs, floors, furniture; whereas, foggers consist of activating a pressurized canister in an unoccupied room to cover all surfaces of the room with pesticide aerosol. Windows and doors were open in two rooms and no ventilation was present in the third room. Heating and air-conditioning were off. Spraying was conducted in all three rooms uniformly at 40 centimeters (cm) above the carpet with a "hand held fan broadcast bottle attached to a CO2 pressurized tank" (p.689). Applications covered the complete area of the floor and lasted five to seven minutes in each room. <u>Collection</u> Chlorpyrifos vapors were collected via two air samplers placed in the center of each room at 100 cm and 25 cm above the treated surfaces approximately 1.5 meters apart at these hourly intervals: baseline; 0-0.5; .5-1; 1-1.5; 1.5-3; 3-5;	<u>Comparison of broadcast to other methods</u> Chlorpyrifos residues from broadcast application yielded residues that were 5-10 times higher, with peak air concentrations roughly one to two orders of magnitude higher than those reported from crack and crevise, baseboard, aerosol, or termiticide applications. <u>Vapor levels</u> Chlopyrifos vapors measured in the adult breathing zone increased over time up to a peak at seven hours before falling. Levels in the non-ventilated room were substantially greater than the ventilated rooms. The infant breathing zone contained significantly higher chlorpyrifos levels than the adult breathing zone. Concentrations in non-ventilated rooms never exceeded 20 micrograms per meter3 in the adult breathing zone, however, in the infant breathing zone concentrations reached 94 micrograms per meter3 at 5-7 hours in the non-ventilated room, and 60 micrograms per meter^3 in the ventilated room at three to five hours post-application. Time weighted averages for 24 hour post application in the infant breathing zone were 41.2 and 66.8 micrograms per meter^3 for ventilated and non-ventilated rooms vs. 12.3 and 45.7 micrograms per meter^3 for the adult breathing zone.	<u>Risk Assessment</u> Several limitations were present that pertained to uncertainties in this risk assessment. <u>Uncertainties in Dermal Absorption and Non-Dietary Absorption</u> Uncertainties were present in this risk assessment that may have resulted in an underestimate of exposure. First, the authors believe that their estimate of 3% dermal absorption may underestimate the actual amount of chlorpyrifos absorbed since this estimate was based on adult occupational studies, and infant rats have demonstrated increased percutaneous absorption compared to adult rats. Also, the study did not account for a potential increased absorption in infants with rashes and chaffed skin. . Second, the results of this risk assessment did not account for the non-dietary route of exposure from hand to

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		and 5-7. Additionally, a two hour sample was taken at 24 hours. Chlorpyrifos residues were collected via five aluminum foil squares (10 X10cm) for each room on carpet surfaces, and by wipe samples using surgical gauze pads sprayed lightly with distilled water. Five squares were collected at baseline and five minutes after application. Three wipes were collected in each room at the following minutes after application: 20, 40, 80,100, 170, 260, 380, and 24 hours. Samples were analyzed via gas chromatography and a wipe sample protocol by OSHA. A risk assessment was conducted for a 9-10 month infant playing on the carpet after 1 hour of broadcast application of .5% chlorpyrifos. Dermal dose was based on "the product of surface area contacted, available residues and percent absorbed, divided by body weight". Respiratory dose was based on "the product of time-weighted air concentrations, respiratory volume and percent absorbed, divided by body weight" (p.691). <u>Application</u> A broadcast pesticide solution with .5% chlorpyrofos in one gallon of water was applied in two apartments in New Jersey in 1996 that simulated label instructions. The apartments were laid out and furnished indistinguishably in living spaces of 860 square feet. The living room and two bedrooms were carpeted, and lineoleum lined all other floor surfaces. An evaporator/cooler system was used for	<u>Risk Assessment for Infants</u> The U.S. EPA has set the reference dose (RfD) for chlorpyrifos at 0.003 mg/kg/day. set a No Observable Effect The NOEL used to set the RfD was based on measureable plasma changes in acetylcholinesterase. Estimates from this study exceeded the RfD by 10-50 times. The total absorbed dose estimates were 0.075 mg/kg in ventilated space plus 0.158 mg/kg in non-ventilated space on day one; day two estimates were approximately two to three times less than day one estimates. Dermal esposure represented approximately 68% of the total dose absorbed. Labeling instructions to return to the area after the pesticide has dried (1-2 hours) were not protective for infants and small children. <u>Discussion</u> This study was conducted in June 1987 in the state of New Jersey. This treatment approach was selected due to the possibility of high exposure levels through inhalation and dermal ingestion. The authors said that despite the uncertainties in their risk assessment, which included the estimation of exposure via the dermal route and the simulation of intermittent rather than continuous exposure--the dose value that was derived may result in toxicological responses to infants and as such is a public health concern. They explained	mouth. <u>Uncertainty in toxicological interpretation</u> Additional uncertainty was present in interpreting the toxicological implications; since the NOEL is based on continuous daily exposure and the conditions in this study represented an intermittent exposure, the toxicological significance of these findings are difficult to interpret. <u>Uncertainty in structural air infiltration rates</u> Lastly, although the authors described the type of dwelling (a small multi-dwelling structure) ventilation conditions, they did not report the air infiltration rate in the dwelling, or account for uncertainties under different air exchange rates. Since air infiltration can impact the degree of indoor air pollution, uncertainty exists as to what degree these findings can be generalized to other mulit-family structures with varied air infiltration rates (U.S. EPA Indoor Air Quality [IAQ]

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		heating, ventilation and air-conditioning. A scheme of partial ventilation was used since it was considered to be representative of conditions by homeowners applying the	that it is unlikely that these doses would result in acetylcholinesterase depression, sub-clinical effects could not be ruled out. Prevention Strategies The authors state that at the time of this study federal regulation for indoor applicators only required adherence to label instructions. These instructions were typically recommendations to occupants to vacate their homes during, and for 1-2 hours after application ; the findings of this study showed that these instructions were not protective for infants. Prevention strategies included recommendations for use of acutely toxic compounds, similar to chlorpyrifos that include: a careful ventilation of rooms before re-entry, irrespective of the season, and more complete labeling instructions that recommend specific re-entry for periods longer than one to two hours after application, with special warnings for infants and children.	website, 2007).

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Alarcon, W., Calvert G., Blondell, J.,Mehler, L., Siervert, J., Propeck, M., et al. (2005). Acute illnesses associated with pesticide exposure at schools. Journal of the American Medical Association, 294(4), 455-465.	(1) To estimate the magnitude of acute pesticide induced illnesses related to exposures among children and adults at schools and daycare centers in America. (2) To determine risk factors related to acute illnesses associated with pesticide exposure among these populations.	hours was used to estimate dermal exposure. Surveillance Databases Information was collected on cases of acute illnesses induced by exposure to pesticides to adults and children at daycare and school settings from three national surveillance databases and participating states: (1) the National Institute for Occupational Safety and Health's Sentinel Event Notification System of Occupational Risks pesticides program ([SENSOR] California, Louisiana, New York, Oregon, and Michigan); the California Department of Pesticide Regulation ([CDPR] California); and the Toxic Exposure Surveillance System, ([TESS], all U.S. states and the District of Columbia, except Hawaii). SENSOR and CDPR receive information from sources such as, government agencies, poison control centers, and health care, while TESS is a national database maintained by the American Association of Poison Control Centers (AAPC) consisting of calls made to state poison control centers. Definitions SENSOR & CDPR largely consist of work-related pesticide poisoning, while TESS largely consists of non-work related poisoning cases. Specific case definitions existed for SENSOR and CDPR (not delineated in the article) which involved adverse health effects following exposure to a pesticide that were consistent with known toxicological mechanisms associated with the implicated pesticide. In comparison, TESS cases were dependent	Pesticide Exposure on School Grounds Including Workers and Non-Workers A total of 406 pesticide induced illnesses were reported to SENSOR / CDPR as occurring on school grounds. Of these, 281 cases (69%) were reportedly sustained due to pesticide exposure on school grounds, while 125 cases (31%) were reportedly sustained by pesticide drift from nearby farms. On the school grounds, the pesticides most frequently implicated were insecticides (n=156, 56%) and disinfectants (n=99, 35%). Of these, the most common active ingredients were: diazinon (n=64, 23%), sodium hypochlorite (n=47, 17%) chlorpyrifos (n=40, 14%), quaternary ammonium compound (n=38, 14%) and malathion (n=14, 5%). Ninety-one percent of the cases from pesticide drift (n=114) were from insecticides and seven percent were from fumigants (n=9), with the most common ingredients as follows: chlorpyrifos (n=28, 22%); methamidophos combines with chlorothalonil and propargite (n=25, 20%), mancozeb combined with glyphosate (n=20, 16%), cyfluthrin combined with dicofol (n=16, 13%), and malathion (n=13, 10%). "A higher proportion of children [59/90] compared with adults [63/191] were exposed via drift from neighboring farmland (40% vs. 25%, p=0.001)." (p.461). Surveillance Contributions and Demographics A total of 2,593 persons meeting inclusion criteria had acute pesticide-induced illnesses at schools between 1998-2002 (p. 459); the majority of cases were identified by TESS (n=2187, 84%) followed by SENSOR (n=147, 6%) and CDPR (n=259, 10%). TESS was the largest contributor of children's cases, which	Surveillance databases These results likely underestimated the incidence of pesticide exposure illnesses since individuals who do not seek medical care may not report their episodes. Even when medical treatment is sought out, it has been estimated that less than one-third of cases are reported to poison control centers. Also, since pesticide induced illnesses can be transient and mimic other illnesses, these symptoms may not be accurately attributed to pesticides. Conversely, some temporary illnesses may be falsely attributed to pesticides. Lastly, limitations existed with regard to each Surveillance system which could have influenced these findings. Since SENSOR and CDPR pertain primarily to work-related exposures, children's exposures, may have been missed; in addition, only eight states participated in these two surveillance systems. Although, TESS was effective in capturing children's exposures, it did not capture

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		upon the judgment of each poison control professional managing individual cases. <u>Illness Classifications</u> SENSOR and CDPR cases were narrowed to illness among employees and students resulting from pesticides applied on school grounds from indoor and outdoor applications, and from applications to neighboring farmlands. Severity of heath effects were classified by SENSOR and CDPR for 2001-2002 and two researchers from this study categorized severity for 1998-2000 to all SENSOR, CDPR and TESS cases. These classifications were defined as: (1) high severity (hospitalization to prevent death from effects such as, seizures and pulmonary edema); (2) moderate severity (systemic manifestations requiring treatment, with no residual loss of functioning); and (3) mild severity (skin, eye, or upper respiratory irritation that resolves without treatment). <u>Descriptive Analyses</u> Several analyses by number and percent were conducted according to severity, which included: physical symptoms (respiratory, gastrointestinal, nervous system, eye, skin, cardiovascular, and miscellaneous); type of pesticide exposure (insecticides, disinfectants; repellents; herbicides, and other functional classes); pesticide toxicity categories (U.S. EPA, classes I-IV); occupation (student, teacher, custodian/gardener, food preparation, maintenance worker, parent or other occupation); and whether the exposure occurred from pesticide on the ground or drift from farmland.	consisted of 84 % of its cases (n=1831), while the majority of cases from SENSOR (n=96, 65%) and CDPR (n=158, 61%) were adults. Of those with known ages (n= 2,181), age of children varied from six months to 17.2 years, with a mean of 9.5 years, while the age of adults varied from ages 18-76 years, with a mean of 36.1 years. Moderate symptoms were more commonly reported by those exposed to: fumigants (40%, n=4); herbicides (25%, n=41); disinfectants (12%, n=101); and insecticides (9%, n=83). <u>Insecticides Associated with Illnesses</u> Insecticides were the most common pesticide associated with illnesses (n=895) with pyrethins (n=119) and chlorpyrofos (n=116) implicated in 13% of cases followed by malathion (n=84,) diazinon (n=78) at nine percent, and pyrethroids (n=47) at five percent. Disinfectants were the second highest pesticide classification associated with illnesses (n=830), with sodium hypochlorite and phenol compounds implicated in 21% of exposures (n=175) followed by pine oil at 13% (n=104), and quaternary ammonium compounds at 10% (n=81). Repellents were the third highest classification of pesticides associated with illnesses (n=335), which included naphthalene (n=136, 41%) and DEET (n=127, 38%). Herbicides were the fourth highest classification of pesticides associated with illnesses (n=279), which consisted of exposures in the following order: glyphosate (n=100, 36%) 2,4 -dichlorophenoxyacetic acid (n=53, 19%; and pendimethalin (n=40, 14%). <u>Toxicity</u>	occupational exposures, or the activity being performed when the incident occurred, and thus precluded targeted prevention strategies to prevent exposures. Lastly, while CDPR and SENSOR had specifically defined case definitions, TESS cases relied upon the judgment of professionals who managed cases; therefore, misclassification could have occurred from TESS depending upon the experience of individual poison control specialists.

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		<u>Incidence Rates for Children</u> Subjects who were less than 18 years of age were classified as children. Numerators for children consisted of the sum of the number of pediatric cases reported each year, while denominators consisted of the sum of the number of children in each corresponding state and year, which were obtained from U.S. census data; home-schooled and pre-schooled children were not included in the denominator. <u>Incidence Rates for School Employees</u> Illness incidence rates per million persons were determined only for school workers reported through SENSOR and CDPR. Adults were considered as 18 years or older. Based on data from the Current Population Survey, denominators consisted of the sum of the "number of full-time equivalents employed in schools in states and years that contributed to the numerator." (p.458); non-work related cases, which included parents, as well as all TESS cases were excluded <u>Odds Ratios, 95% CIs, Poisson Regression</u> Odds ratios (ORs), 95% confidence intervals (CIs) and p values were calculated to ascertain the determinants of illness severity, that included:, sex, acute toxicity, pesticide category, surveillance system, and site of pesticide applications. Poisson regression was used to test trends in incidence rates over the years of exposure. A p value of $\leq .05$ was set for statistical significance. SAS and Epi-Info software was used for all statistical analyses.	Toxicity information was available for 1686 / 2,593 cases. Adults were more likely to be exposed to pesticides from toxicity category I than children (42% vs. 14%, $p < 0.001$); furthermore, exposure to pesticides classified in toxicity category I (18%) had a greater association with moderate to severe illness compared to exposure to pesticides in toxicity category III (12%; OR, 1.5; 95% CI 1.1-2.2). <u>Incidence Rates</u> The general incidence rate of pesticide induced illness among children was 7.4 cases per million during the years 1998-2002. A statistically significant trend of increasing incidence rates in cases per million through time was present for pre-school, ages 0-5 years ($p < 0.001$), and school children, ages 6-17 years ($p < 0.001$) between the years of 1998-2002: Pre-school (1998-11.3; 1999-13.4; 2000-19.0; 2001-16.6; 2002-22.5); school-age (1998-5.0; 1999-7.0; 2000-6.6; 2001-7.7; 2002-6.4). In comparison, the general incident rate for adult workers was 27.3 per million full-time equivalents, while the yearly incident rates decreased between 1998 and 2002 ($p < 0.001$;1998-44.4; 1999-31.6;2000-26.7-2001-11.6; 2002-25.8) <u>Odds Ratios</u> The odds of severe and moderate illness were higher for adults than children (18% vs. 8%; OR 2.6, 95% CI 1.1-2.2), and higher for females than males from adults and children combined (12% vs. 8%; OR 1.5, 95 CI1.2-2.0). The odds of severe and moderate illness being higher in adults is consistent with a higher exposure to category I pesticides by adults. <u>Pesticide Exposure on School Grounds and Agricultural Drift from Nearby Farms to</u>	

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
			<u>Workers</u> From SENSOR and CDPR databases, a total of 144 / 244 work-related cases were sustained while not applying pesticides; 96 (67%) were exposed to pesticides on school grounds, and 48 (33%) were exposed to pesticides from nearby farmland drift. The remaining 93 workers who were exposed to pesticides during direct application had the following job titles: (1) custodian or gardners [n=41]; food preparation [n=26]; teachers [7]; maintenance [n=7]; and unspecified school employees [n=12]. <u>Discussion</u> The researchers asserted that prior to this study there has not been an effort to provide a nationwide summary of this health problem. The study results show that acute illnesses from pesticide exposure does occur to children in the school environment, albeit in low incidence rates. Of some concern is that the incidence rates increased over time. The finding of higher odds for severe and moderate illness in adults who were exposed to category I toxicity pesticides compared to category III toxicity pesticides (OR 1.5, 95% CI, 1.1-2.2) is consistent with the delineation of toxicity categories by the U.S. EPA; these categories are ascertained by the findings of six acute toxicity studies. Studies include: acute oral, acute dermal and acute inhalation, which evaluate systemic toxicity, as well as research on the outcome of primary eye irritation to measure irritation or corrosion, and primary skin irritation to measure dermal sensitization and allergic contact dermatitis. A toxicity category is designated for each study based on results, except for dermal	

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			sensitization. The categories are designated as I, II and III, with category I having the highest toxicity and category III having the lowest toxicity. Pesticide labels are determined by the particular toxicity categorization of a specific pesticide (U.S. EPA, Regulating Pesticides: http://www.epa.gov/oppfead1/labeling/lrm/chap-07.htm]. That children were found to be less likely exposed to category I pesticides than adults was hypothesized to be due to increased exposure during certain situations, such as cleaning up pesticide spills after removing children from the area. In addition, adult workers are involved in mixing and applying pesticides and, therefore, have more prolonged direct contact with these chemical compounds. The trend of decreasing cases from 1998-2002 was hypothesized to be due to an increase in awareness and the adoption of safer work practices. Although, the trend showed that acute cases of pesticide induced illnesses among adults have been decreasing, the potential for low-dose chronic exposure to children is a concern due to track-in from adult workers who are mixing and applying the pesticides. Since 40% (n=59) of the SENSOR / CDPR cases that involved children were sustained through pesticide drift, the authors hypothesized that urban sprawl may be related to the trend of increasing incident rates of pesticide induced illnesses in children over the five years analyzed. <u>Policy</u>	

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			While the Food Quality Protection Act of 1996 mandated the consideration of adverse health effects from pesticides in setting food tolerances for pesticides, no specific provisions exist in federal law related to protecting children from pesticide usage at schools. Policy varies between states with respect to this issue. The U.S. EPA has endorsed integrated pest management in the schools (IPM), along with the National Parent Teacher Association (PTA), the National Education Association (NEA), and other organizations. IPM involves each school having a pesticide policy in writing which is distributed to stakeholders annually, and providing written notice prior to spraying; the application should be conducted by trained, qualified personnel while students and staff are off of the property and entry should be restricted for a specified duration. The findings that many types of workers were exposed while applying or handling pesticides, (custodians, gardeners, teachers, food preparation workers, and maintenance workers) suggests that the IPM principle of having only qualified personnel who are specifically trained in pesticide application may not typically be followed in school and daycare settings. IPM is not designed to reduce pesticide exposure due to drift. Recommendations to prevent pesticide drift from farmland, includes not performing applications when school is in session, adherence to regulations and guidance, and establishing non-spray buffer ones around schools. The authors say that seven states in the U.S. require buffer zones around schools that vary in distance.	

APPENDIX D

Pesticide Exposure to Children: Dietary Pathway

Pesticide Exposure to Children: Dietary Pathway

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
Fenske, R., Kedan, G., Chensheng, L., Fisker-Anderson, J., & Curl, C. (2002). Assessment of organophosphosphor-ous pesticide exposures in the diets of preschool children in Washington State. *Journal of Exposure Analysis and Environmental Epidemiology, 12*:21-28.	To characterize pesticide exposures from 15 OP pesticides to preschool children through their diets. This study was part of a larger effort to assess the relative contribution of dietary and non-dietary pathways of pesticide exposure with urinary biomarkers.	Two samplings occurred between the months of June to August of 1998, and again in October of 1998; in addition, one household was sampled during the first week of December. Recruitment consisted of families that resided in both rural and urban/suburban areas. Families with children between the ages of 2 and 5 years living in two rural agricultural counties in Central Washington State (n = 6), were recruited through county WIC offices, and families in the City of Seattle and surrounding suburbs of King and Snohomish counties (n = 7) were recruited from a private pediatric clinic in the Seattle metropolitan area. These children were enrolled previously in other larger pesticide studies, and were targeted for recruitment based on their relatively higher combined urinary diaklyphosphate (DAP) levels in those past studies. <u>Collection</u> Households were provided with plastic cups, zip lock bags, and foil; duplicate diets were prepared and covered with this material. Parents made duplicate portions of all food and beverages consumed by their children during a 24- hour time period, and then covered and refrigerated these samples until they were collected by research staff.	<u>Demographics</u> A total of 13 children participated; the average age was 3.9 years old, while the average weight of each child was 16.8 kg. Ten children were female and three were male. All children from rural areas had at least one parent working in agriculture, whereas, no suburban children had parents in agricultural occupations. <u>Pesticide residuals</u> From 88 dietary samples, 6 /15 targeted OP pesticides were detected, consisting of AZM, chlorpyrifos, malathion, methidathion, methyl parathion, and phosmet. Detectable levels of at least one OP pesticide were found in 18% of samples (n=16), while 2% (n=2) contained two OP pesticides. Samples containing two OP pesticides were both found from the fruit and vegetable category. Not all samples contained all four food groups. Of the rural children, 50% did not eat any fresh fruits and vegetables during the summer compared to 14% (1 out of 7) of the suburban children. Fresh produce contained the most pesticide determinations of any category of food. Seventy-eight percent of the food samples with detectable OP pesticides were fresh fruits and vegetables; AZM was the most common pesticide detected, with 24% (4/17) fresh fruit and vegetable samples containing this pesticide.	<u>Generalization</u> The results cannot be generalized to even the target population since they were derived from a small convenience sample, and children with higher DAP levels in previous studies were targeted because they were more likely to have detectable OP concentrations. <u>Risk Assessment</u> This study assumed that complete absorption occurred across the gastrointestinal tract of each child, and did not perform biological measurement to quantify how much pesticide was actually absorbed. Since direct biological measurements were not taken, exposure levels in this study are based on indirect inference. The short duration (24 hours in two different seasons) of sampling was not conducive to depicting diet variability in the children over time.

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		Items were frozen at -20^0 C and transported to the University of Washington Laboratory, where each sample was divided into four categories (unprocessed fruits and vegetables; fruit juices and beverages; dairy products, and processed foods), weighed, and shipped on dry ice to the Washington State University Food and Environmental Quality Laboratory for analysis. Solid food samples were homogenized at slightly thawed temperatures and re-frozen, and liquid samples were blended by manual shaking. <u>Processing</u> Samples were processed according to an adapted method by the Association of Analytical Chemists (970.52, Organochlorine and Organophosphorous Pesticide Residues), which involved the following steps: an extraction using acetonitrile; a wash with 30% aqueous sodium chloride and hexane; the addition of de-ionized water before partitioning into methyl chloride; concentration of the samples, resulting in a product of 2 milliliters in 1:1 hexane, and analysis by gas chromatography. In addition, a sample of tap water was collected and analyzed for pesticides from each household. <u>Quality Assurance</u> Quality assurance included fortifying samples with a known amount of OP pesticides directly into a representative matrix for each type of food.	One serving of fresh produce contained methyl parathion and phosmet. AZM was also found in 19% of beverages (4/ 21) and in 44% (4/9) of apple juice samples. Two beverages consisting of orange drinks contained methidathion. No OP detections were found in any of the 24 dairy samples. No OP pesticides were found in tap water from any of the homes, and AZM could not be measured in milk due to analytical difficulties (p.24). <u>Risk Assessment</u> The upper bound of the cumulative risk from dietary OP pesticides was estimated in a risk assessment for the child with the highest dietary exposure. This child lived in the suburbs and consumed a serving of 114 grams of cherry tomatoes in the fall, which contained 30 ng/g of AZM and 350 ng/g of chloropyrifos. Using a method recommended by the NAS (1993), a TEF was derived through creating a ratio of the LOEL for AZM and chlorpyrifos, with chlorpyrifos as the reference chemical. Since the LOEL was 1 mg/kg/day for each chemical, the TEF was equal to 1. "The mass of AZM consumed was converted to chlorpyrifos equivalents through multiplying by this TEF and then adding the mass of chlorpyrifos consumed (43.3 mcg)," which was divided by the child's body weight. The total dietary dose of OP pesticides was 2.5 mcg/kg/day. Since sampling occurred during short time periods, these results reflect acute exposure instead of chronic exposure. The acute population adjusted daily reference dose (aPAD) for chlorpyrifos is 1.7mcg/kg/day. Therefore, the exposure exceeded the safety benchmark dose for this	This study only analyzed OP pesticide exposure from the dietary pathway and did not take into account cumulative exposure from multiple pathways; measurements of exposure from non-dietary as well as dietary pathways need to be conducted in order to completely characterize exposure (as per recommendations by the 1996 FQPA). <u>Misclassification</u> Pesticide concentrations may have been diluted, resulting in an underestimate of exposure, since foods with detectable residues were combined with foods containing OP pesticides that were less than the limit of detection. Underestimation of exposure levels through the dietary pathway may have occurred since this study did not measure pesticide contamination that could have occurred via dermal transfer while children were eating their food.

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		For example, milk was used as a matrix for dairy foods; method performance was verified by including one fortification sample in each batch during the extraction set. After preparation of chromatographic standards at five concentrations, peak areas of three solutions with known concentrations of OP pesticides were measured at the beginning and end of each sample set. Calibration standards with concentrations inside the calibration curve were run at intervals during each batch. The lowest limits of quantification along with mean recoveries in percents were delineated across food groups for each of the 15 analytes. "The lowest standard concentration regularly used represented the level of quantitation" (p.24). The data were not corrected for recovery efficiency. <u>Risk Assessment</u> A toxicity equivalent factor (TEF) was used to assess cumulative risk from OP pesticide exposure, which consisted of "the toxic potency of an individual chemical relative to the potency of a reference chemical that has a well-defined toxicity." The two chemicals being compared caused "the same critical effects," acted "on the same molecular target," and acted "by the same biochemical mechanism" (p.23). Benchmarks in the form of NOELS and lowest-observed adverse effects (LOELS) were used for the comparison that comprises TEFs; the formula used is:	pesticide. Concentrations from all other samples were considerably less than the aPAD, with the second highest exposure at 0.24/mcg/kg/day. <u>Discussion</u> Duplicate diet monitoring allows quantification of pesticide residues that have been directly consumed and accounts for the effects of food processing, storage, and preparation. The method has the advantage of being able to depict diets of subpopulations that may differ from the major population norm and has been recommended by the World Health Organization to measure contaminants ingested by these groups. With that said, two disadvantages of this method of analysis is that it does not take into account contamination that could occur from hand contact between surfaces and food during eating, and it assumes complete absorption across the gastrointestinal tract without accounting for differences in absorption. The approach of targeting participants from the children who had higher DAP urine levels in a previous study was used by the researchers to improve the chances of finding OP pesticide residues from the children's homes and their diets, and as such, the authors asserted that this strategy was a more efficient use of study resources. While one cannot generalize the results of this study since it was a small convenience sample, targeting children with higher pesticide intake levels may make them less typical compared to their peers.	This underestimation could be significant, since one study estimated that 20-80% of the total dietary intake of pesticides by children were from the interaction of handling food and touching contaminated surfaces (Akland and colleagues, 2000, Factors influencing total dietary exposures of young children, Journal of exposure analysis and environmental epidemiology, 10: 710-722). Sixth, spiked recoveries may have been falsely elevated in this study; the food within the spiked matrixes were not organic, and therefore, contained pesticide analytes that were not accounted for in addition to the known amount of spiked analytes which were added to the matrices. The authors stated that "these background levels prevented consistent fortification recovery results at low concentrations, and therefore the reported levels of quantitation are likely higher than they would have otherwise been" (p.26). They concluded that organic foods would have been better to use for creating blank matrices.

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		$Dose_{TEQ} = \sum_i (dose_i \text{ X } TEF_i)$ Through this approach, the doses of several chemicals were normalized and summed to arrive at the total equivalency dose of each OP pesticide, expressed as mcg/kg/day.	It was explained that while the USDA and the USFDA both monitor pesticide residues in food, this study was the first to report results of pesticide intake specifically from foods ingested by children of this age group. Seventy-eight percent of the food containing residues consisted of fresh produce or fruit juice. The authors explained that the 95^{th} percentile and the maximum values for malathion in solid food, and the 99^{th} percentile and maximum value for chlorpyrifos in solid food were higher in this study than in a duplicate dietary study conducted in subjects older than 10 years old by the National Human Exposure Assessment Survey in Maryland; therefore, the researchers asserted that these results are consistent with the premise that due to age related differences in dietary patterns, young children have greater exposures to pesticide residues in their diets compared to older children (malathion: 6.9 vs. 5.9 mcg/kg) (chlorpyrifos: 60.4 vs. 7.7 mcg/kg). The authors asserted that the source of the contamination for the serving of tomatoes with the highest levels of pesticide residue (AZM & Chlorpyrifos) was due to agricultural use of the pesticide on the food, since the parents denied using pesticides in or around the home, and AZM is not registered for residential usage. Although the legal tolerance was not exceeded, since the daily dose of the amount of pesticide residue consumed was greater than the acute population-adjusted daily reference dose, the tolerance was not protective for this child.	Therefore, the accuracy of their recovery levels is in question. If recovery levels were actually lower than the study findings, this could result in an underestimation of the children's dietary pesticide intake. In addition, the data were not corrected for recovery efficiency. The authors do not comment as to whether this misclassification could have caused a substantial difference in exposure levels.

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			The researchers used an acute reference dose instead of a reference dose as their unit of exposure since the sampling occurred with 24 hour time frames. The acute population adjusted reference dose (aPAD) is “the level of 1-day exposure to a pesticide residue that is believed to have no significant deleterious effects in humans, including children” (Marris & Ballantyne; 2004, in <u>Pesticide Toxicology and International Regulation</u>, p.519) The aPAD is calculated by the following process. A no observed adverse effect level (NOAEL) is selected from a single dose study to reflect acute health effects or a repeat dose study that could be induced in a single exposure. This value (which is known as the acute reference dose (aRfD) is then divided by an FQPA safety factor if the compound shows evidence of sensitivity to children. The final dose is referred to as an acute *population adjusted* reference dose, since it has been adjusted to be protective of sensitive populations. The U.S. EPA uses both acute and chronic population adjusted reference doses to assess the risk of pesticide exposure in food. The chronic population adjusted reference dose (cPAD) is arrived at through the same steps as the aPAD except the NOAEL is selected from a *repeat dose* study that reflects an adverse health endpoint from prolonged or continuous exposure. These are the definitions of the RfD and the acute RfD from the U.S. EPA IRIS website glossary of terms:	

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			Reference Dose (RfD): An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's non-cancer health assessments. [Durations include acute, short-term, sub-chronic, and chronic and are defined individually in this glossary]. **Acute Reference Dose (RfD):** An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure for an acute duration (24 hours or less) to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's non-cancer health assessments. In summary, the most important findings of this study are as follows: (1)Younger children in this study had higher levels of dietary pesticide exposure than did older children in past research, which is consistent with age specific differences in dietary consumption patterns.	

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			(2) While 22/23 children were considerably below the acute reference dose, one child who ate a serving of tomatoes was substantially above the acute reference dose; residential contamination of this food was ruled out, since the parents did not use this pesticide in or around the home (3) Methodological issues do not allow for generalization of these findings to the target population or the U.S. population of children as a whole; nonetheless, these findings support the precautionary principle as it applies to consuming organic foods, since the results of this study have shown that the possibility exists for children to exceed the acute reference dose from ingesting pesticide residues in conventional diets. (4) Since a high variability in dietary exposure to pesticides among children was found in this research, direct biological monitoring is needed to determine aggregate exposure to pesticides from multiple pathways; this is also in accordance with recommendations from the 1996 FQPA.	

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Curl, C., Fenske, R., Elgethun, K. (2003). Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. Environmental Health Perspectives, 111(3): 377-382.	"To compare pesticide OP metabolite levels in the urine of preschool children ages 2-5 whose diets included mostly organic or mostly conventional juices, fresh fruits, and fresh vegetables."	<u>Recruitment</u> Families were recruited at the entrances of two grocery stores in Seattle, Washington that served clientele of the same socioeconomic status: one was a food coop that sold mostly organic products, and the other was a large retail store that sold mostly conventional products. Eligibility requirements included: having a toilet trained child between the ages of 2-5 years, and parental reports of serving their children a diet consisting of primarily organic foods or primarily conventional foods. Families were enrolled in either an organic or a conventional study group based on self- disclosed dietary patterns. <u>Baseline Survey</u> Two household visits occurred. During the first visit, a survey was administered that elicited the following information: (1) parental age, annual income, occupation, length of time living in the residence, and home ownership (2) home practices and use of other pesticides in and around the home, names of pesticide products used, product registration number, and length of time from last application; (3) child age, weight, frequency of thumb sucking and hand to mouth behavior, amount of time spent outside, and hand washing habits. <u>Food Diaries</u> Parents kept food diaries for two days before and on the day of their child's 24-	<u>Participant Categorization</u> At the outset of the study, a total of 43 were enrolled, 25 children in the organics group and 18 children in the conventional group. Food diary records indicated that 8 self-reported organic children and 1 self-reported conventional child were misclassified during this three day time period. Four children in the organics group only consumed 41-65% organic produce and juice; these families were excluded from the analysis. Four other children in the organic group consumed < 25% of their fruits, vegetables and juices from organic sourses; these children were placed in the conventional group. One child in the conventional group consumed organic food in 75% of his fruits, vegetables and juices; this child was placed in the organic group. Final reclassification included 18 diets in the organic category, 21 in the conventional category and four exclusions. <u>Demographics</u> Demographics among organic and conventional groups respectively are as follows: mean ages, 46 and 47 months; 56 and 57% male. No substantial differences were found between groups according to the children's mean body weight (37 pounds or 17 kg), annual income, home ownership, children's time spent in the home, and child behavior, such as, thumb sucking, hand to mouth habits and hand washing.	<u>Generalizability</u> The results of this study cannot be generalized to even the Seattle area, since it was a small voluntary study with a population selected from only one socioeconomic strata. (Although income levels were not reported, it was stated that the food coop and the conventional supermarket were selected since customers shared the same socioeconomic strata.) <u>Misclassification</u> Misclassification may have occurred with self-reported residential pesticide usage since it was dependent upon subject recall. Not all samples were complete 24 hour voids; while an average volume for each void was calculated and used for adjustment, misclassification of exposure may have occurred since the precise metabolite concentration was not known. While the authors statde that they determined the average volume for each void and used this in adjustment, it is not explained if they used this same method to adjust for the concentration levels within

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		hour urine collection. Only one child was monitored per family. Diaries contained a record of the type and amount of all foods their child ate (breakfast, lunch, supper, and snacks) and whether or not it was organic, as determined by the label. Foods consumed while the child was not at home were included (such as daycare). Portions were determined through the use of The United States Department of Agriculture (U.S. D.A.) "5 a day" method. A serving was considered as follows: one whole piece of fruit; one-half of a cup of vegetables; three-quarters of a cup of juice; and one cup of leafy vegetables. The study did not count dried, canned or processed food. Based on these diaries, a child who consumed 75% or more of their food as organic was categorized in the organic group, while a child who consumed 75% or more of their food as conventional was categorized in the conventional group. This cut-off was selected since it was rare to find a family that ate organics exclusively, and a lesser cut point may not have clearly separated the two groups. <u>Urine Collection</u> 24-hour urine collection began with the first morning void on the third day. The child could not be in daycare during this collection time. Supplies were given to parents for the collection which included: nine 250 ml bottles,a large plastic Tupperware container which held all nine bottles, and commode inserts. Parents captured each void in a separate bottle that was labeled with the time of the event. A	<u>Residential Pesticide Use</u> Parents in the conventional group reported greater frequency of using pesticides in or around the home than those in the organic group (86% vs. 56%, $p < 0.05$); however, this difference did not reach statistical significance (binomial probability test, $p = 0.2$). Most of the pesticides used were not OPs; this was determined by parental self-report with subsequent label verification. The most frequent pesticides used for residential purposes included: (1) pyrethrins; Round-Up (glyphosate); Raid (cyfluthrin); Advantage (imidachloprid); and Frontline (fipronil). The ensuing analysis only included those pesticides which were OPs. <u>Urine collection</u> Parental collection of voids were as follows: full 24-hour specimens were collected by 33% (n=13); one void was missed by 38% (n=15), and three voids were missed by 13% (n=5). Children urinated an average of 6.7 times in 24 hours, and parents collected an average of 5.7 of these specimens. The average total volume collected for each child after adjustment for missed voids was 570 ml with a range of 180-1600 ml. <u>Urine Analysis</u> Significantly lower levels of total dimethyl metabolites in mcg per liter were found in the urine of children from the organic group than the conventional group (medians, 0.03 vs. 0.17, Mann Whitney U-test, $p = 0.0003$).	those voids. <u>Risk Assessment Assumptions</u> An assumption of the model used was that the metabolite is an expression of 100% of the absorbed pesticide dose. However, in a human pesticide study, an intravenous dosing of pesticide showed that only 70% of the dose was excreted in the urine. Therefore, the total dose absorbed by the children could be underestimated Generic DAP metabolite monitoring does not allow for a complete determination of pesticide dose. There was no way to discern with certainty which pesticides were responsible for the metabolites, since 40 different OP pesticides can be broken down into these by products. Thus considerable uncertainty existed in the calculation of the cRfDs. The assumption that only one of four pesticides was responsible for these metabolites is unlikely, since multiple pesticides are used on a myriad of fruits and vegetables that children could consume.

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		urine collection form documented any voids that were missed from the collection. The voids were stored in the Tupperware container and placed in the family refrigerator until a staff member picked them up the next morning. The samples were transported to the University of Washington lab within a 30 minute timeframe and processed immediately after arrival. <u>Urine Processing</u> All voids per child were combined into one 24-hour specimen; the total volume was measured, and an average volume for each individual void was calculated. The 24-hour specimen was adjusted for missing voids under the assumption that they were equivalent to the average volume of individual samples. Three 15ml tubes were filled with aliquoted samples and stored at -20C until analysis. <u>Urine Analysis</u> Specimens were analyzed for five DAP metabolites: dimethylphosphate (DMP); dimethylthiophosphate (DMTP); dimethyldithiophosphate (DMDTP); diethylphosphate (DEP); and diethylthiophosphate (DETP). Analytic difficulties prevented a sixth DAP metabolite, diethyldithiophosphate (DEDTP) from inclusion in this evaluation. The Limit of detection (LOD) for DMP was 1.2 mcg/L while other compounds had an LOD of 1.3 mcg/L. Although creatinine concentrations were determined, adjustment	DMTP was ascertained in 87% of all voided samples and was substantially higher than concentrations of the other four metabolites. (Wilcoxon matched pairs, signed rank test, $p < 0.0001$); as such it was the most common metabolite found. DEPT was found in 85% of the urine specimens, making it the second most common metabolite. No other metabolites were found at similar frequencies. A significantly higher level of total dimethyl DAPs were ascertained compared to total diethyl DAPs (medians, 0.06 vs. 0.02 micromoles/L; Wilcoxon matched pairs signed-rank test, $p < 0.0001$). Therefore, chronic reference doses were estimated only for pesticides that could break down to DMTP. The four pesticides in the OP classification used to determine chronic reference doses for the children were: oxydemeton-methyl (pesticide with the highest chronic toxicity, Rfd 0.13 mcg per kg per day); malathion (pesticide with the lowest toxicity, RfD 24 mcg per kg per day); AZM, and phosmet (highest annual use on fresh fruits and vegetables). Chronic reference doses for each of these four pesticides which produce DMTP were calculated using the assumption that all exposure came from a single given pesticide. Under the premise that all exposure was from oxydemeton-methyl, 88% of the children who ate organics and 100% of the children who ate conventional foods would have exceeded the US EPA chronic reference doses (cRfD). If AZM were the only source of exposure, one child (6%) who ate organics would have gone beyond the cRfD, and 11 children (52%) who	

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		was not needed to normalize for hydration, since the samples represented full or near 24-hour voids. <u>Quality control / quality assurance</u> Blank samples were taken into the field during collection and analyzed with the actual samples. In each batch of specimens, one blank sample and two spiked samples were analyzed. “Laboratory duplicates were analyzed for 10% of the samples and quality control criteria required that there be no more than 15% variation between laboratory duplicates.” [NOTE to PAT: Do duplicates refer to the two spiked samples that were identical? Otherwise, I do not know what the authors mean by the term, “duplicates.”] Laboratory personnel were blinded to the “three blank” and “four duplicate” samples which were submitted randomly. [Pat this is a contradiction to what was stated above (one blank and two spiked instead of three blank and four duplicates.] “Calibration curves consisting of a minimum of five fortification levels were run with each batch with squared correlation coefficients of > 0.9999” (p.378). [Pat I presume these curves mean that the machine was nearly perfectly calibrated at each level of fortification (a total of five fortification levels) from the spiked samples that were introduced; therefore, measurement was accurate.] Recovery efficiency adjustment was not performed. Random duplicate samples varied on average less than 25%. <u>Data Analysis</u>	ate conventional food would have exceeded the cRfD. If 100% of the exposure was from malathion or phosmet, no child in either group would have exceeded the cRfD. In consideration of all four pesticides, children who ate conventional diets had significantly higher doses than those who ate organic diets (Mann-Whitney U-test, $p = 0.0002$). RfDs and means for children in the organic group vs. the conventional group are as follows: (1) Oxydemeton-methyl: RfD, 0.13; organic, 0.3, vs. conventional, 2.2 (2) AZM: RfD, 1.5; organic 0.4 vs. conventional, 2.8 (3) Phosmet: RfD, 11; organic, 0.4 vs. conventional, 2.8; (4) Malathion: RfD, 24; organic, 0.4 vs. conventional, 2.3 [Pat, there is an entire chart of 48 dosages. I selected the means as an average tendency.] <u>Discussion</u> The authors explained that they selected OP pesticide since they are commonly used on produce, they have been widely reported on foods tested by the USDA and US FDA; and many are acutely toxic. As such, the risk for these four pesticides varied greatly depending upon the toxicity of the compound. Although, it is not likely that exposure from diet was derived solely from one pesticide, given the uncertainties in establishing this risk	

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		Samples below the LOD were assigned a value of .50 of the LOD. A formula was developed to calculate total dimethyl molar quantities: [Dimethyl DAP] = [DMPmcg/L]/125g/mole + [DMTP "]/141 " + [DMDTP "]/157 " X 1 Since the distributions were not normal, non parametric tests such as the Wilcoxon matched pairs signed-ranks test for paired samples, the Mann-Whitney U-test for independent samples, and the binomial probability test for proportions were employed to test for significant differences between the groups. Analysis was performed on STATA statistical software. "Total molar metabolite quantities were multiplied by the adjusted volume of the 24-hr urine sample and the molecular weight of the parent pesticide, and were divided by the child's bodyweight according to the formula": Dose = [Dimethyl DAP (in micromoles per liter)] X Volume (in L per day) X MW of the pesticide (in grams per mole) X L/ bodyweight (where body weight is in Kg) Dose units are in mcg per kg per day. There are over 40 OP pesticides in use in the U.S. Since Dimethyl DAPs are	assessment based on dosage, the approach in this study was reasonable; the ingestion of these pesticides were feasible and determining the least and the worst case exposure scenarios is a valid approach to assessing risk. The findings of this study demonstrated that with the moderately toxic, yet frequently used pesticide, AZM, the dose of several children who ate organics were shifted under the RfD, while those who ate conventional foods had doses over the RfD. Since the health consequences for children who frequently exceed the RfD are not known, this risk is uncertain. Therefore, these results show that eating organic foods is a fairly simple strategy that can shift risk from a domain of uncertainty into a domain of certainty that is protective of children's health. The authors discussed the results of the National Health and Nutrition Survey III (NHANES) conducted by the CDC in 1999. Urine samples (n= 700) were analyzed for 6 DAPs among participants between the ages of 6 and 59 years. The DMTP and DMDTP urine metabolites of children in this study who ate conventional foods were greater than the top 50^{th} percentile or higher levels of the NHANES findings, while those who ate organic foods were lower than the NHANES results. These findings are consistent with the National Research Council report that children consuming conventional foods may have a higher proportionate level of exposure to pesticides than adults. Secondly, while children in this study who consumed conventional foods exceeded the NHANES DAP compound levels, those who consumed	

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
		produced as metabolites from all 40 of these OP pesticides, it is not possible to ascertain which pesticides are derived from Dimethyl DAPs. In addition a wide variety of toxicity levels exists among these OP pesticides. For a meaningful discussion, dose estimation was limited to four pesticides: those that produced the metabolites with were most commonly found in this study; those that are currently used on fruits and vegetables and have the highest annual pound usage; and those that meet the first and second criteria and contain either the highest, or the lowest toxicity levels in the OP pesticide group.	organic foods were actually under the DAP pesticide metabolite levels of the general public from NHANES. NHANES was a national multi-stage probability study from which findings can be generalized to the U.S. population. In comparison, the results from this study cannot be generalized even to the greater Seattle metropolitan area. In order to generalize the findings of this study, a similar methodology as that incorporated by NHANES would need to be employed. Lastly, the scientists stated that they controlled for residential usage of OP pesticides by excluding those who reportedly used them and no differences were noted in the findings. Therefore, residential usage of OP pesticides did not confound these findings.	

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
Chensheng, L, Toepel, K., Irish, R., Fenske, R., Barr, D., and Bravo, R. (2006). Organic diets significantly lower children's dietary exposure to organophosphorus pesticides. *Environmental Health Perspectives, 114(2)*: 260-263.	A longitudinal study was conducted in the summer of 2003 to assess "the contribution of daily dietary pesticide intake to overall pesticide exposure" (p. 260). This article only reports the exposure results of OP pesticides.	<u>Recruitment</u> Children between the ages of 3-11 years who ate conventional foods (n=23) were recruited through a flyer sent home from public and Montessori schools in the suburbs of Seattle Washington. After phone contact, an in-home interview occurred with parents to elicit information about other potential pathways of pesticide exposure. Eligibility included children who consumed exclusively conventional food and spent most of their time in one place of residence. The study was divided into three phases over 15 days: Phase I: children consumed conventional foods during days 1-5; Phase II: organic foods were supplied and substituted during days 4-8; and Phase III: conventional foods were eaten during days 9-15. Organic foods were substituted for all foods reported by the United States Department of Agriculture (USDA) to contain OP pesticides; these foods consisted of fresh fruits and vegetables, cereal, pasta, popcorn and chips, while meat and dairy foods were excluded since they are not regularly reported to contain OP pesticides. Parents kept a food diary delineating daily food consumption of their child during the study period. Organic foods were replaced for each child's *usual* diet. Organic juices and fresh fruits were purchased, and analyzed by the USDA pesticide laboratory in Washington State both before and during the study, and no pesticide residue was identified in these foods.	A total of 724 urine samples were collected from 23 children during this study. Of the five OP pesticides detected (malathion, chlorpyrifos, diazinon, methyl perimiphos, and coumaphos), malathion and chlorpyrifos varied significantly between the conventional and organic phases of the study. At the time of enrollment, all urine samples contained malathion (analyte, MDA) and chlorpyrifos (analyte, TCPY), with levels of detection at 0.3 mcg/L and 0.2 mcg/L respectively. Median urinary MDA and median urinary TCPY dropped directly after introducing organic foods into the children's diets, and rose again immediately after conventional foods were re-introduced (MDA Phase I: 1.5 mcg/L; Phase II: 0 mcg/L; Phase III: 1.6 mcg/L) (TCPY Phase I: 6.0 mcg/ L; Phase II: 0.9 mcg /L; and Phase III: 4.3mcg/L). Using one-way ANOVA, the DVWA for both metabolites were significantly lower in the organic food consumption phase compared to DVWAs in the conventional foods phase ($p < 0.01$); (MDA means and standard deviation in mcg/L.: Phase I: 2.9 ± 5.0; Phase II: 0.3 ± 0.9; Phase III: 4.4 ± 12.4; $p < 0.01$) (TCPY means and standard deviation in mcg/L: Phase I: 7.2 ± 5.8; Phase II: 1.7 ± 2.7; Phase III: 5.8 ± 5.4; $p < 0.001$). Food diaries showed that children did not change their normal dietary consumption patterns during the study. While effects were seen between the conventional and organic phases for malathion and chlorpyrifos, no effects were seen on urinary exposure levels for diazinon, methyl	A major limitation of this study is that it consisted of voluntary participation from a small, non-randomized sample and, therefore, the results can not be generalized to other children. No pesticide residues were detected by the USDA pesticide laboratory in Washington both before and during the study. The findings of this study may differ if replicated with different vendors and locations, since the U.S. EPA Organic Standard allows up to 5% of synthetic pesticide residues in foods (USDA, National Organic Program: http//www.usda.gov/nop/NOP/standards/residuetestPre.html). In addition, rare incidents involving errors in labeling, processing, and handling could result in foods that contain synthetic pesticides above the 5% level (Baker et al., 2002).

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
		For phase II, parents requested organic items to replace the conventional foods that the children would have normally consumed as part of their usual diet. Organic foods purchased for the study were purchased by research staff from the same grocery store. In addition, all items were analyzed for pesticides before and during the study at a participating laboratory; no pesticides were detected in any of these organic foods. Urine samples were collected from the children at bedtime and upon awakening the next morning for 15 days. Samples were stored, transported, and analyzed at the National Center for Environmental Health at the Centers for Disease Control and Prevention in Atlanta, Georgia. Metabolites were measured for specific OP pesticides, herbicides, and pyrethroid insecticides. The limit of detection for chlorpyrifos (TCPY) was 0.2mcg/liters. Three different categories of concentrations were created for reporting: (1) detectable (> level of detection [LOD]); (2) detectable but not quantifiable (<LOD); and (3) not detectable (ND). Only samples < LOD and > LOD were analyzed. A daily volume-weighted average (DVWA) of OP pesticides was created in mcg/liter by averaging the morning sample with the bedtime sample from the night before, and normalizing for the combined volume of these two samples. No adjustment of samples with the use of creatinine or specific gravity was conducted.	perimiphos, and coumaphos. The researchers deduced that the organic diet provided a "dramatic" and "immediately protective effect" in preventing exposure to chlorpyrifos and malathion in the diets of children who regularly consumed foods containing OP pesticides, such as, conventional fresh fruits and vegetables, juices, and wheat products. They further asserted it is "intuitive to assume that children whose diets consist of organic food items would have a lower probability of neurological health risks, a common toxicological mechanism of the OP pesticide class." (p.262). <u>Discussion</u> The researchers attributed the differences in urinary exposure levels for malathion and chlorpyrifos to the fact that these pesticides are more commonly consumed. It was a concern that children would reject organic foods and eat less during the organic phase. Food diaries showed that the children consumed an average of two extra items of fresh produce and wheat/rice/ and soybean based foods during the organic phase. Therefore, the drop in urinary MDA and TCPA during Phase II did not occur due to a decrease in food consumption. Since no OP pesticides were reportedly used in the households during this study, it was assumed that the changes in analytes were the result of changes in diet. The authors discussed the recent finding that	The authors noted that a large variation was found in the OP metabolites in this study and attribute these findings to: "the variation of OP pesticide residues in foods; the probability of consuming those food items; and the relatively short biological half-lives of the OP pesticides in children" (p.262). However, this variation did not preclude the finding of a statistically significant trend between phases. Twenty-four hour urine collections would have provided urine samples with less variability since they would have shown the pattern of excretion over time. However, this approach may have been cost prohibitive and more work intensive over a 15 day period for participants. The authors stated that two urinary samples were collected in a given 24-hour period to increase the likelihood of detecting metabolites.

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
			“OP metabolites can occur as degradates in food commodities or in environments” (p.262). However, since the metabolites changed predictably in between both all three phases, one cannot use this information to implicate a lower direct dietary exposure to pesticides. An editorial was written by Alex Avery, a scientist working for an institute that receives funds by the pesticide industry; he said that doses at which neurodevelopmental effects occurred in animals exposed to OP pesticides in utero “were at least three orders of magnitude higher than those consumed as food residues by the children in this study. Therefore, he asserted that the words “dramatic” and “immediate protective effect” were misleading. Lu and colleagues wrote an editorial in response to this opinion. They said that the “assessment of health risks associated with neurotoxic chemicals such as OP pesticides is a complex analysis that includes substantial uncertainty. A child may be exposed to dozens of OP pesticides simultaneously through diet as well as through use around the home or in schools.” They explained that the 1996 Food Quality Protection Act (FQPA) mandated the EPA to assess both multiple exposure pathways for single pesticides and cumulative exposure for compounds that have the same mechanisms of toxicity. Their conclusion was that Avery’s critique “ignored the thrust of the 1996 FQPA, and the scientific advances of the past 10 years [on elucidating pesticide exposure pathways]”.	

ARTICLE	AIMS	METHODS	FINDINGS & DISCUSSION	LIMITATIONS
			My opinion on this controversy is that these dosages could have been discussed in the article and related to the RfD, the 1996 FQPA, and the precautionary principle. Lu et al. (2006) are correct in describing their findings as dramatic and immediately protective, since the data provided evidence for this assertion. In light of the potential for cumulative exposure from multiple pathways, consuming organic food may afford more protection to children from a dose-response perspective and is consistent with the precautionary principle.	

APPENDIX E

FLYER FOR HALLOCK PARTICIPANTS

Flyer for Participants in the Study

"Reducing Children's Exposure to Pesticides in the Red River Valley"

The University of Minnesota's Regional Sustainable Development Partnership, under the leadership of its director, Kathy Draeger, PhD, is working with its community partners in the Red River Valley to study the concerns of mothers and grandmothers related to their contact with pesticides. Professor Pat McGovern and Ms. Maggie Stedman-Smith, a graduate student, from the University of Minnesota will be working in the Red River Valley in the summer of 2007 to conduct the study and would like you to participate.

You were nominated as a possible study participant because you are a mother or grandmother of at least one young child, living in the greater Red River Valley and have worked with the WIC-Quin and Kristin Eggerling.

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.

5. Be given a digital camera to take home and take pictures that express your concerns, if any, related to pesticide exposures and how best to prevent them
6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

The first meeting will be held on **June 4, 2007, 9 am to noon at the Caribou Inn located at 203 E Broadway in Hallock.** The second meeting will occur about one month later and the exact date will be arranged in conversation with project participants. Light refreshments or treats will be provided.

You will receive payment of $150.00 in appreciation for your participation. The money will be distributed in separate payments of $75.00 each at the two meetings. Please call or talk with **Kristin Eggerling at 218-874-7845 to let her know if you would like to participate or not**. Once we hear that you are planning to participate we will mail you a reminder postcard.

We hope that you will help us with this important study. Your concerns and opinions are very important to us, and are a critical first step in helping us learn what issues exist in this community in relation to pesticide exposures and public health. Thank you for your time and help with this project.

Additional Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; draeg001@umn.edu.

APPENDIX F

FLYER FOR WHITE EARTH RESERVATION PARTICIPANTS

Flyer for Participants in the Study

"Reducing Children's Exposure to Pesticides in the Red River Valley"

The University of Minnesota's Regional Sustainable Development Partnership, under the leadership of its director, Kathy Draeger, PhD, is working with its community partners in the Red River Valley to study the concerns of mothers and grandmothers related to their contact with pesticides. Professor Pat McGovern and Ms. Maggie Stedman-Smith, a graduate student, from the University of Minnesota will be working in the Red River Valley in the summer of 2007 to conduct the study and would like you to participate.

You were nominated as a possible study participant because you are a mother or grandmother of at least one young child, living in the greater Red River Valley and have worked with the White Earth Tribal and Community College and Stephanie Williams.

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.

5. Be given a digital camera to take home and take pictures that express your concerns, if any, related to pesticide exposures and how best to prevent them
6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

The first meeting will be held on **May 29, 1:00 pm to 4:00 pm at main campus of the White Earth Tribal and Community College in the SMART Room located at 202 Main Street in Mahnomen.** The second meeting will occur about one month later and the exact date will be arranged in conversation with project participants. Light refreshments or treats will be provided.

You will receive payment of $140.00 in appreciation for your participation. The money will be distributed in separate payments of $70.00 each at the two meetings. Please call or talk with **Stephanie Williams at (218) 936-5620 (x313) to let her know if you would like to participate or not**. Once we hear that you are planning to participate we will mail you a reminder postcard.

We hope that you will help us with this important study. Your concerns and opinions are very important to us, and are a critical first step in helping us learn what issues exist in this community in relation to pesticide exposures and public health. Thank you for your time and help with this project.

Additional Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; Draeg001@umn.edu.

APPENDIX G

FLYER FOR PARTICIPANTS AT FARGO-MOORHEAD

Flyer for Participants in the Study

"Reducing Children's Exposure to Pesticides in the Red River Valley"

The University of Minnesota's Regional Sustainable Development Partnership, under the leadership of its director, Kathy Draeger, PhD, is working with its community partners in the Red River Valley to study the concerns of mothers and grandmothers related to their contact with pesticides. Professor Pat McGovern and Ms. Maggie Stedman-Smith, a graduate student, from the University of Minnesota, will be working in the Red River Valley in the summer of 2007 to conduct the study and would like you to participate.

You were nominated as a possible study participant because you are a mother or grandmother of at least one young child, living in the greater Red River Valley and have worked with the Immigrant Development Center and Fowzia Adde and Abby Gold

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.

5. Be given a digital camera to take home and take pictures that express your concerns, if any, related to pesticide exposures and how best to prevent them
6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

The first meeting will be held on **May 30, 2007 from 9 am to noon at Minnesota State University Moorhead in the conference room in Nemzuk.** The second meeting will occur about one month later and the exact date will be arranged in conversation with project participants. Light refreshments or treats will be provided.

You will receive payment of $100.00 in appreciation for your participation. The money will be distributed at the second of the two meetings. Please call or talk with **Fowzia Adde at (701) 729-3352 or Abby Gold (701) 388-3309 to let her know if you would like to participate or not**. Once we hear that you are planning to participate we will mail you a reminder postcard.

We hope that you will help us with this important study. Your concerns and opinions are very important to us, and are a critical first step in helping us learn what issues exist in this community in relation to pesticide exposures and public health. Thank you for your time and help with this project.

Additional Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; Draeg001@umn.edu.

APPENDIX H

UNIVERSITY OF MINNESOTA

INSTITUTE OF REVIEW BOARD

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Research Subjects' Protection Programs
Institutional Review Board: Human Subjects Committee (IRB)
Institutional Animal Care and Use Committee (IACUC)
Institutional Biosafety Committee (IBC)

Mayo Mail Code 820
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420 Delaware Street S.E.
Minneapolis, MN 55455

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iacuc@umn.edu
ibc@umn.edu
www.research.umn.edu/subjects

05/25/2007

Patricia M McGovern
Environmental Health Sciences
MMC 807
Minneapolis Campus

RE: "Children's Exposure to Pesticides in the Red River Valley: Blue Cross Blue Shield Foundation **Planning Grant: Part 1, Using Photovoice Methodology** as a Needs Assessment Tool"
IRB Code Number: 0704S07021

Dear Dr. McGovern

The Institutional Review Board (IRB) received your response to its stipulations. Since this information **satisfies the federal criteria for approval at 45CFR46.111 and the** requirements set by the IRB, final approval **for the project is noted in our files. Upon** receipt of this letter, you may begin your research.

IRB approval of this study includes the consent forms and recruitment materials dated May 23, 2007.

The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 32 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB.

For your records and for grant certification purposes, the approval date for the referenced project is May 17, 2007 and the Assurance of Compliance number is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003). Research projects are subject to continuing review and renewal; approval will expire one year from that date. You will receive a report form two months before the expiration date. If you would like us to send certification of approval to a funding agency, please tell us the name and address of your contact person at the agency.

As Principal Investigator of this project, you are required by federal regulations to inform the IRB of any proposed changes in your research that will affect human subjects. Changes should not be initiated until written IRB approval is received. Unanticipated problems or serious unexpected adverse events should be reported to the IRB as they occur. The IRB wishes you success with this research. If you have questions, please call the IRB office at 612-626-5654.

Sincerely,

Cynthia McGill

Cynthia McGill, CIP
Research Compliance Supervisor
CM/egk
CC: Kristin Eggerling, Adde Fowzia, Abby Gold, Maggie Stedman -Smith, Stephanie Willioms

APPENDIX I

ASSENT FORM FOR PARTICIPANTS AT HALLOCK

CONSENT FORM

Reducing Children's Exposure to pesticides in the Red River Valley

You are invited to be in a research study of Reducing Children's Exposure to pesticides in the Red River Valley. You were nominated as a possible participant because you are the mother of at least one young child, living in the Red River Valley, who has worked with WIC Quin and Kristin Eggerling.

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community, and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.
5. Be given a digital camera to take home and take pictures that express your concerns, if any, related to pesticide exposures and how best to prevent them
6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Pat McGovern, PhD., Professor, and Maggie Stedman-Smith, RN, doctoral student from the School of Public Health, University of Minnesota, and Kathy Draeger, PhD, Statewide Director, Regional Sustainable Development Partnerships, University of Minnesota.

The purpose of this study is to learn what health concerns mothers from the greater Red River Valley may have about their families' contact to pesticides (used in the house or garden, on a nearby farm, or on foods purchased at the grocery store).

Benefits and Risks of Being in the Study

There are no direct benefits to participation. The study has minimal risks. For one example, you may be uncomfortable sharing photographs or talking with other mothers and the research team.

Compensation:

You will receive payment of $150.00 in appreciation for your participation. The money will be distributed in separate payments of $75.00 each at the two meetings.

Confidentiality:

The records of this study will be kept private. In any sort of written report we might publish, we will not include any information that will make it possible to identify you, unless the photographs and quotes used for the public exhibit are of you and your family and we have your verbal permission to publish those on our exhibit poster board. Any research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or with the WIC Quin and Kristin Eggerling.

If you decide to participate, you are free to not answer any question and may withdraw at any time with out affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; Draeg001@umn.edu . If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

You will be given a copy of this information to keep for your records.

IRB Code # 0704S07021

APPENDIX J

ASSENT FORM FOR PARTICIPANTS AT

WHITE EARTH RESERVATION

CONSENT FORM

Reducing Children's Exposure to pesticides in the Red River Valley

You are invited to be in a research study of Reducing Children's Exposure to pesticides in the Red River Valley. You were selected as a possible participant because you are the mother of at least one young child, living in the Red River Valley, and have worked with the White Earth Tribal and Community College and Stephanie Williams.

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community, and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.
5. Be given a digital camera to take home and take pictures that express your concerns, if any, related to pesticide exposures and how best to prevent them
6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Pat McGovern, PhD., Professor, and Maggie Stedman-Smith, RN, doctoral student from the School of Public Health, University of Minnesota, and Kathy Draeger, PhD, Statewide Director, Regional Sustainable Development Partnerships, University of Minnesota.

The purpose of this study is to learn what health concerns mothers from the greater Red River Valley may have about their families' contact to pesticides (used in the house or garden, on a nearby farm, or on foods purchased at the grocery store).

Benefits and Risks of Being in the Study

There are no direct benefits to participation. The study has minimal risks. For one example, you may be uncomfortable sharing photographs or talking with other mothers and the research team.

Compensation:

You will receive payment of $140.00 in appreciation for your participation. The money will be distributed in separate payments of $70.00 each at the two meetings.

Confidentiality:

The records of this study will be kept private. In any sort of written report we might publish, we will not include any information that will make it possible to identify you, unless the photographs and quotes used for the public exhibit are of you and your family and we have your verbal permission to publish those on our exhibit poster board. Any research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or with the White Earth Tribal and Community College and Stephanie Williams.

If you decide to participate, you are free to not answer any question and may withdraw at any time with out affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University of Minnesota. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; Draeg001@umn.edu . If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

You will be given a copy of this information to keep for your records.

IRB Code # 0704S07021

APPENDIX K

ASSENT FORM FOR PARTICIPANTS AT FARGO-MOORHEAD

CONSENT FORM

Reducing Children's Exposure to pesticides in the Red River Valley

You are invited to be in a research study of Reducing Children's Exposure to pesticides in the Red River Valley. You were selected as a possible participant because you are the mother of at least one young child, living in the Red River Valley, and have worked with the White Earth Tribal and Community College and Stephanie Williams.

The study will involve having you attend two, 3-hour meetings with other mothers and grandmothers from your community, and a research team where you would:

1. Learn about the health effects of pesticides and how families may be exposed to pesticides in their usual daily lives
2. Discuss how what you learn may apply to your family's life
3. Discuss the use of locally grown and organic foods as one option to decrease pesticides in the foods we eat
4. Receive guidance on digital camera operation and selection of quality photographs.
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6. Select a few photos that are most important to you and show these to the group and tell us why they are important to you
7. Work with the research team to create a poster board of photos and quotes from this work that could be shared with the public and government representatives interested in public health and prevention of pesticide exposures.

Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Pat McGovern, PhD., Professor, and Maggie Stedman-Smith, RN, doctoral student from the School of Public Health, University of Minnesota, and Kathy Draeger, PhD, Statewide Director, Regional Sustainable Development Partnerships, University of Minnesota.

The purpose of this study is to learn what health concerns mothers from the greater Red River Valley may have about their families' contact to pesticides (used in the house or garden, on a nearby farm, or on foods purchased at the grocery store).

Benefits and Risks of Being in the Study

There are no direct benefits to participation. The study has minimal risks. For one example, you may be uncomfortable sharing photographs or talking with other mothers and the research team.

Compensation:

You will receive payment of $140.00 in appreciation for your participation. The money will be distributed in separate payments of $70.00 each at the two meetings.

Confidentiality:

The records of this study will be kept private. In any sort of written report we might publish, we will not include any information that will make it possible to identify you, unless the photographs and quotes used for the public exhibit are of you and your family and we have your verbal permission to publish those on our exhibit poster board. Any research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or with the White Earth Tribal and Community College and Stephanie Williams.

If you decide to participate, you are free to not answer any question and may withdraw at any time with out affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Pat McGovern, Ph.D., R.N., and Kathy Draeger, Ph.D. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University of Minnesota. Pat McGovern can be contacted at 612-625-7429; pmcg@umn.edu and Kathy Draeger can be contacted at 612-625-3148; Draeg001@umn.edu . If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

You will be given a copy of this information to keep for your records.

IRB Code # 0704S07021

APPENDIX L

UNIVERSITY OF MINNESOTA PHOTO RELEASE CONSENT

UNIVERSITY OF MINNESOTA

Permission to Use Photographs

I grant to the Regents of the University of Minnesota a non-exclusive license to use, reproduce, distribute, and publicly exhibit (see attached copies of photographs) photographs in print and electronic form for any purpose, especially, to be included in the visual exhibits associated with the research projects entitled: (1) "Using Photovoice to Document Perceived Routes of Pesticide Exposures and Health Concerns among Mothers from Minnesota's Red River Valley," and (2) "Reducing Children's Exposures to Pesticides in the Red River Valley". I represent that I am the photographer and own the copyright to the photographs.

I understand that use of the images will be without compensation, but that attribution will be provided.

By: ______________________________

Name:

Address:

Date: ______________________

FORM: OGC-SC256

Form Date: 11.14.05

APPENDIX M

BLUE CROSS AND BLUE SHIELD OF MINNESOTA

PHOTO RELEASE

General authorization & release

Project Description: Photovoice Workshop

Date: Summer 2007

Use: research

For a period of: 5 years

By signing this release, I give the Blue Cross and Blue Shield of Minnesota Foundation, its agents, representatives and assigns the absolute right and permission to use:

- ☒ Photographs
- ☐ Other likeness
- ☐ Recordings
- ☒ Testimonials or quotations
- ☐ Performances
- ☐ Other ______

I also relinquish any rights I may have to the final inspection of the work or finished product.

I understand that the Blue Cross Foundation will be granted full permission to use and publish, in whole or in part, the information from sources checked above.

I hereby release the Blue Cross Foundation and all persons acting with its permission or authority from any liability which I, my heirs, successors or assigns may claim. I acknowledge any physical risks associated with my performance and I accept full responsibility for any injury due to my negligence.

For minors: I, the undersigned hereby state that I am the parent or legal guardian of the child and do hereby consent and give my permission to this agreement. I have read the above authorization, release and agreement and am fully aware of all that it states or implies.

Name (or Parent or Guardian Name) ______

Signature ______ Date ______

Address ______

City ______ State ______ Zip code ______

Phone ______

Blue Cross Foundation Representative ______ Title ______

Witness ______ Date ______

APPENDIX N

SURVEY FOR EVALUATION BY PARTICIPANTS

Photovoice Project Evaluation

We are very interested in your experience with this research project. Below are some questions about your experience. There are no right or wrong answers. Please *circle* the response that is closest to your opinion.

(1) My participation in this Photovoice project has helped me become **more aware of possible health problems associated with pesticide exposure**. Do you.......(Circle one response).

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

(2) My participation in this project has helped me become more aware of how myself and my family can get **exposed to pesticides.** Do you.......(Circle one response).

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

(3) As a result of my participation in this Photovoice project, I have become **more aware of the health benefits of eating locally and organically grown, fresh fruits and vegetables**. Do you....(Circle one response).

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

(4) Participating in this project has been **valuable** to me.
Do you....(Circle one response).

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

(5) What was **most valuable** to you about participating in the Photovoice project?

____

____

____

(7) Will your participation in Photovoice **change your home practices to prevent pesticide exposure**?

Yes	No	Unsure
1	2	-9

If yes, **how will you change your home practices** to prevent pesticide exposure?

____

____

____

PLEASE TURN THE PAGE OVER FOR MORE QUESTIONS.

(8) If there was an **opportunity to work with the University of Minnesota Regional Sustainable Development Partnership and your local project representative** (e.g., Kristin Eggerling) **again on a project** related to sustainable agriculture or gardening, **would you be interested in being contacted** about possible participation? (Circle one response).

Yes No
1 2

Next we would like to know a little about you and your children:

(1) What is your **age**? ____years

(2) Do you **have children**?
___Yes ____No (If no, skip to question 5).
1 2

(3) If yes, **how many children** do you have?____________

(4) If yes, what are the **ages of your children**?

____

(5) Do you **work outside of your home**? (Circle one response)
Yes No
1 2

(6) If you yes, **what is your occupation or job title**? (If you are a student, please say that as well as any job or occupation)____

(7) How **long have you lived** in the United States?________years

(8) Are you an **immigrant**? (Circle one response)

Yes No

(9) If yes, please name the **county from which you immigrated**:______________________

(10) Please tell us if there is anything else you would like us to know about your experience with the Photovoice project:

____

____

____

Thank you very much for your participation and for answering these questions!

APPENDIX O

SURVEY FOR EVALUATION BY CO-RESEARCHERS

Photovoice in the Red River Valley—Reducing Pesticide Exposure to Children:

Project Evaluation for Research Partners

As a research partner in this Photovoice needs assessment we would like to hear your perceptions related to how participating in this effort has benefited you and the community you serve. Please circle the one response that is closest to your opinion.

1. The team of co-researchers worked effectively in planning this project.

   Strongly Disagree   Disagree   Agree   Strongly Agree

   Please tell me why you selected this response.

2. The team of co-researchers worked effectively in implementing this project.

   Strongly Disagree   Disagree   Agree   Strongly Agree

   Please tell me why you selected this response.

3. The team of co-researchers worked effectively in disseminating knowledge generated from this project.

   Strongly Disagree   Disagree   Agree   Strongly Agree

   Please tell me why you selected this response.

4. I have made a contribution to families in the Red River Valley of Minnesota and North Dakota through my participation in Photovoice.

   Strongly Disagree   Disagree   Agree   Strongly Agree

   Please tell me why you selected this response.

5. As a result of my participation in Photovoice, I have learned new knowledge and skills that will enhance my future work.

   Strongly Disagree   Disagree   Agree   Strongly Agree

   Please tell me why you selected this response.

5A. [If disagree or strongly disagree, skip to question 6]

5B. **[If Agree or strongly agree] How will you use the new knowledge and or skills gained through this Photo voice effort in your work?**

6. My personal and or professional goals for participating in this Photovoice effort were met through my participation in this needs assessment.

Strongly Disagree Disagree Agree Strongly Agree

Please tell me why you selected this response?

6A. [If no, skip to question 7]

6B. **[If yes] please tell me how your personal and or professional goals were realized.**

7. I would recommend Photovoice to others as a tool for community needs assessment in the future.

Strongly Disagree Disagree Agree Strongly Agree

Please tell me why you selected this response.

Thank you for your time and consideration in answering these questions!

APPENDIX P

OPEN ENDED RESPONSES TO EVALUATION BY CO-RESEARCHERS

Evaluation from Co-Researchers: Qualitative Responses Ordered by Open-Ended Questions

1. The team of co-researchers worked effectively in *planning* this project. Please tell me why you selected this response.

"I think that there were challenges in communication b/c of the distance, but we did the best we could in the time frame that we had. I think overall we did a great job. There were so many of us from different places- we couldn't have daily interaction with each other. We did the best we could. We used available technology and we were in touch with each other. The collaboration was inspiring, but challenging. It was a good collaboration. We were able to overcome some communication issues- we used technology." [agreed]

"…You all worked together well and did a good job in planning."[strongly agreed]

"Overall I thought it went well given a one year timeline and that people did not know each other very well when the project began. My perspective is that the PI of this project did not fully understand how best to work with an academic co-investigator. Since this was just a one year project our process worked well enough. With a longer time frame I would have liked to have seen closer planning between the PI and the academic co-investigator on issues such as time-lines, deliverables, and expectations for graduate student contributions. There was also need for more comprehensive planning on budgeting since the initial grant did not fully cover the cost of implementing the project." [agree]

"While I was not there for the initial planning, when I did come on board they were able to talk to me about what plans had been made and where they were going- they seemed to have a logical flow to it. They seemed to think of a number of things that could occur and had plans for this, should they occur." [agree

"The communication was great, even though we were spread apart, everything just clicked perfectly." [strongly agreed]

"The academic side brought new innovative methodology that resonated well as a tool with the various cultural groups in the Red River Valley." [strongly agreed]
"This was a team of diverse talents who worked respectfully together in selecting groups to recruit, working through issues of informed consent, recruiting, planning and budgeting related to workshops I and II. I think we needed to more completely address planning with regard to long-term dissemination of the findings, and publications. See question about dissemination." [agreed]

We had meetings 1 on 1 together. We had conference calls that we talked about, who is our target audience, we did a lot of planning before we started working on this project." [strongly agreed]

"Even though I came into the project late, I felt there was evidence of prior effective planning. The partners were engaged, and the second workshops that I attended were well organized, & productive. You asked 'What's next'? As future partners, this was the purpose for Kathy and I to attend the debriefings. That question was answered. Because at that point we did not know an implementation grant would be awarded to us by BCBS." [Agreed]

2. The team of co-researchers worked effectively in *implementing* this project. Please tell me why you selected this response.

"Once we set out to do the interviews in the groups, this aspect of the project went very smoothly. There were hardly any glitches."[strongly agreed]

"I thought that you all worked together well and did a good job in implementation."
"Overall I thought the team worked well together in implementation. There was a need for more discussion and planning by the co-researchers about implementing the informed consent protocol in a consistent manner. There was also a need for closer follow-up of the community partners when implementing the informed consent as some partners found it difficult to review the forms with participants in advance of the first Photovoice session given project timelines."[strongly agreed]

"I base that on conversation with the participants (mothers) went and hearing how they had been informed, knowing how I had been informed and watching them through the steps. The implementation seemed to be very smooth. I was at the Hallock presentation and so as they – the women who participated and did the pictures— went through and discussed their photos, I had an opportunity to speak with them"[agreed]

"The parameters of the project were clearly stated we knew exactly what you were looking for and what to do and the participants of the project learned a lot."
"I think that between community members, field staff, and the graduate student, there was a high degree of mutual respect. The Photovoice project was the best combination of grassroots generated knowledge and university academic based knowledge and I think we brought this together in a good way."[strongly agreed]

"A few of the key collaborations that were effective were: the methodology came from you and pat and all of the co-researchers involved with recruiting were familiar with the community so we could have an iterative process together in all of the planning; my contribution was more in cohesion rather than particular application."[strongly agreed]

“All voices worked well together; there was mutual respect among everyone and every one brought their talents to the table and put them to good use.”[strongly agreed]

“The implementation of Photovoice workshops I and II seemed to be carried out seamlessly. A strong sense of enthusiasm and group cohesiveness was evident in the debriefing sessions after the second Photovoice workshops; in Hallock and Fargo-Moorhead, these meetings also felt very much like a celebration, since they occurred in restaurants over meals. In White Earth, socializing took place when the group took a walk to look at a local garden in town.” [strongly agreed]

“We had a coordinator who focused on working on mothers about pesticides and we recruited mothers who spoke English because we didn’t have any budget for interpreting. But at the same time we could have done better if we had budget for interpreter. We reached our goal we educated women from every culture who is here… The new American culture…. Somalian, sudenese [Suma] Bosnians and etopian [Habiba]—so we had every culture” [strongly agreed]

“Again, coming late into the project, it was apparent that the PV participants had become aware of pesticide exposure issues, learned how to use digital cameras, applied awareness training to their individual environments, and functioned as spoke persons for their community at the second workshop.” [agreed]

3. The team of co-researchers worked effectively in *disseminating* knowledge generated from this project. Please tell me why you selected this response.

“I was just so amazed with how generous you and Pat were with allowing Linda and I to share the data. So many people are proprietary about data.. First you taught me about PV then you embraced the intent of PV by keeping it situated in the community…bringing the data back to the community so we can take these photos back to the community and shear the exhibit with the people who were involved. Without your collaborators you wouldn’t have been able to keep it situated in the RRV as easily. I am just tickled that both you and Pat had that attitude.” [strongly agreed]

“I think you did get information out, but I don’t recall what it was. It’s been enough time that I don’t recall everything.” [agreed]

“Given a 12 month timeline, there was an effective translation of study findings to the study participants, the research partners, the funding agency and a few community groups. However, we have not yet had an opportunity to publish in the peer reviewed literature and there was not a plan developed to address co-authorship of scholarly products from the research. Most research projects have a written protocol for developing scholarly products in terms of how they get reviewed by the research team and how authorship will be determined. There will be a need for this as we go forward when the doctoral student and her advisor prepare presentations and publications for dissemination." [agreed]

"I do not have enough information to answer this question; I know what they said they were going to do, but I was probably only privy to only a small bit of information that is not all of the venues for disseminating this information. I know they were going to put this on the web, but I never got a link to actually go on the web and see what was there."

"Most of the women who were able to come to see the photos saw them and they really enjoyed looking at the photos. I think it would have been better if we could have looked at all of the groups. The participants made that comment-- they would have liked to have seen them. They really liked seeing the individual results from their group (White Earth) but they would have liked to have seen the results from the other groups as well. I got to see them but the mothers did not. (This pertains to the workshop II)." [strongly agreed]

"The process of dissemination is still ongoing; we are continuing to take the Photo- voice exhibit to different audiences around the region and the state. I've encountered more barriers to dissemination at the university level compared to at the community level. Maybe our team hasn't updated each other about dissemination. There's a question of team cohesion and information sharing that we can improve….because we are no longer a team." [agreed]

"I think the co-researchers really planned it well; the recruiters brought the women into the meetings effectively. I wish we could have followed through with the White Earth group more. That group has more drop-offs. I think it's normal anytime there's a group of people that meet once and several weeks later gets together again-they're going to miss that second meeting. I was kind of sad we had more in the White Earth drop off than the other groups. I don't know that there's really a way to fix that unless you start with 8 when you want 6. I do think we truncated the PV effort and if we had had a little more time, the groups would have been more cohesive (the mothers) in each of the three groups. In some of the applications of this method people may meet 5 or 6 times over the process and there's more of a jelling of the community feeling. We did really well given the time constraints and resource constraints. And the women just stepped up with those photo's—I look at them and think WOW they did a great job!" [strongly agreed]

"The group successfully undertook three planned venues, including: (1) showing a poster at the U of MN-Morris community meeting; (2) creating a successful grant proposal with BCBS for the purpose of reducing pesticide exposure to children in the Red River Valley; and (3) creating an art exhibit with photos and quotes to facilitate community dialogue to assist mothers raising children in the Red River Valley. While I was made aware through group communication of the fulfillment of these goals—during the process of interviewing, I have learned of other venues that have been carried out to disseminate the Photovoice findings, which I would not otherwise have known about. I too have presented Photovoice findings in presentations to graduate classes at the U of MN, and the other partners have not been aware of my activities. Incorporating the step of *long-term* dissemination into the group planning phase may have facilitated better communication so that the partners could be aware about ongoing dissemination through the emergence of new venues. In addition, procedures related to upcoming group publications could also have been included in the phase of planning, since this activity will still need to be negotiated with the partners. [agreed]

"In our area here because we had PV, we will have photo display. Abby is putting this together. So a lot of people will hear about this project. In the next step we will work with health mentors who will work with the community [in terms of] education. We need to look for other ways to make it easier to reach people for education, for people who have a language barrier. When we did PV we specifically included people who spoke English. If we had had budget for interpreters then we would have had more people who don't speak English. I answered agree because I feel that we left some people behind, people who don't speak English; we only included people who could speak English and understand English. We need to have a way to reach people who don't speak English or educate them in our next phase". [agreed]

"I was in attendance at the March Rural Health Assoc Summit where the PV exhibit was put up on the wall in Crookston, on March 31, 2008. I also participated and attended the public engagement day on April 22nd at the U of MN Twin cities where the PV results and the implementation grant plans were shared. I also negotiated with Linda Kingery to present the PV poster at a public health regional meeting (Wendy Kvale) where Linda discussed the PV project with them. I selected "agree" instead of "strongly agree" because I do not know what the intended dissemination plan was." [agreed]

4. I have made a contribution to families in the Red River Valley of Minnesota and North Dakota through my participation in Photovoice. Please tell me why you selected this response.

"I don't know yet until we have the exhibit to gauge the reaction of people; so I have to wait to know." [agreed]

"I think that some people are more aware of the pesticide issue and how to protect themselves as a result of Photovoice." [agreed]

"The group we worked with was quite small but we were effective with them. Given a second grant with the initial funding agency, we have the potential to influence the RRV community more broadly." [agreed]

While I have not been as directly involved with it; initially I was involved with it and then I passed it along to another coordinator who worked with me on the grant. So now while I am not directly involved I feel because of that initial contact and continued support of the project and the coordinator who has continued to work with the group, I am indirectly impacting the community by providing a coordinator to work with the rest of the group." [regarding phase II intervention grant with BCBS] [agreed]

"It was the participants (mothers) not my involvement alone—I had a piece in it but it wasn't just me." [agreed]
"The Photovoice has spurred more investment into these families and preventing pesticide exposure." [agreed]

"I observe that the outcomes are evident, children of the RRV show indications of higher exposure to pesticides than others in the nation. And awareness is a key element in addressing the issue. That's a place we need to start. I think it's also a pretty contentious issue. One other part, raising the awareness not just of the mothers but at the community level and among public health professionals is a key contribution." [agree]

"The mothers were very enthused, inspired and empowered from their participation in these workshops. They thanked us and said that they have become more aware of the issue of pesticide exposure and as a result, will take precautions to protect their children. In addition, the findings led to a successful grant proposal and funding for a long-term intervention to reduce pesticide exposure to families in the Red River Valley. [Strongly agreed]

"For the new American community-- it was very educational; bc pesticides themselves- they didn't know what pesticides were, what their health effects were, or why they were used. Now it is something they look for. B4 they never knew. It is something that is very educational bc of the new culture, the new chemicals and what they used to use. Pesticides were a product that was not used in our culture it was something they did not know about. They had some suspicions in their mind that Americans have a lot of chemicals in their foods but they did not know what. In the future we need more education about this" [strongly agreed]

"Because of my participation in the PV project, I have new contacts for outreach and education opportunities to families in the RRV to promote pesticide exposure prevention education. My participation on the PV project was minimal compared to my participation on the implementation grant. Therefore, my participation in PV was less than my participation will be through the implementation grant. This is why I selected agree rather than strongly agree." [agree]

5. As a result of my participation in Photovoice, I have learned new knowledge and skills that will enhance my future work. Please tell me why you selected this response.

“Because when I went to my interview at the U of MN Extension in April and I presented my project, the committee was amazed, they were wowed and they didn’t hold back. Usually people are stoic and you don’t know what they are thinking. They wanted to talk about or discuss all the different ways that PV could be used and agreed the possibilities were endless. And I got that job (in St. Paul, for an extension specialist position- they called it an associate director—they combined the position with an extension position at NDSU). I am hoping to able to use this again and again.”[strongly agreed]

“I didn’t learn any new knowledge or skills.” [disagreed]

“The use of Photovoice created visual images that are very powerful for teaching and outreach. The literature I reviewed with the project with the graduate student is helpful for my new work with the National Children’s Study.”[agreed]

“I say that because while I have some knowledge about farm workers and farm families, I was not familiar with the areas they are working on as it relates to pesticides and pesticide exposures. I don’t think I have looked at it from the perspective they did related to mothers and children and I did not know how the moms felt and what they did to reduce their risks. I was aware of pesticide exposure mostly as it relates directly to the workers. I hadn’t totally thought about it from the family perspectives.”[strongly agreed]

“It really opened up my eyes. I thought I was in a little organic house, but taking the pictures and seeing how we were really exposed…. The daily exposure that I wasn’t really aware of …. like I was driving down the road and the sprayer along side me and being aware and knowing how I needed to take a picture of that-- it was like –hey! And just to take steps like for instance my husband works part-time for a farmer in the neighborhood. They are good people-- they had no intention of harming anyone. They were just doing a job, so they did not even think about this. But this opened up their eyes so they are letting people know before they spray. It was just through casual conversation. There wasn’t any big town meeting where people got defensive-- it was just a conversation, where they said, ‘hey they didn’t think about it before’. Actually this was two [different] farmers.” [strongly agreed]

“Because I learned a new methodology that empowered individuals.” [agreed]

“PV is an example of using your whole mind to understand the problem and to respond to the problem. By whole mind, I mean in addition to the analytical investigation of pesticide exposure we also consider the big picture; so literally we used pictures to show the metaphorical “big picture”. When I look at the pictures I hear the words of the mothers and I feel their concerns, I empathize with them. And I think that is the beauty of PV. It’s more than understanding, it’s feeling it—it’s really living their concerns.” [strongly agreed]

“I have learned how to facilitate the planning, implementation, and dissemination of findings for the methodology of Photovoice, as one qualitative approach to community-based participatory research. This is a valuable methodology for me to have in my tool-box as a public health researcher.” [strongly agreed]

“This also gives me passion in working with foods, health foods and organic foods. I now have an area that I am so passionate about. It’s now focused on how we work with families to make sure their food is healthy. It gives me a focus area on how I want to educate the community” [strongly agreed]

“I have seen first-hand the empowerment that PV creates among participants and felt the energy that advocacy around a topic of community interest can initiate.” [strongly agreed]

5B. How will you use the new knowledge and or skills gained through this Photo voice effort in your work?

“I will probably use it for needs assessment purposes. And also the body of literature for using the PV method is growing so I can refer to published research articles. So I can look at my own research but also look at the research of others.”[strongly agreed]

“I will think more creatively about the use of digital photography as a voice for study participants and as a teaching tool. I will also use some of our thinking about evaluation approaches for community partners for my work in the National Children’s Study. The literature that I reviewed with the graduate student on exposure to pesticides is helpful to me as I implement the National Children’s Study in Ramsey County. The literature is relevant to a study hypothesis addressing pesticide exposure and children’s health and development. It is also useful for me as we are setting up a lab to process environmental samples for the study.” [agreed]

“I think I am able to use it; for one thing it just broadens my perspective so that when I am looking at this topic or other topics I can think about it more broadly. Additionally in the area of Agricultural Health & Safety, this will be something that will stay in the back of my mind as something we can help educate people in the area of pesticide exposure as it relates to agricultural safety and health.”[strongly agreed]

“I will continue to talk about it because in this area it works on an informal level. This is a simple technique that has worked so far. There is a misunderstanding between farmers and natives here because we don’t know each other. It’s just talking to each other when it comes up, when we’re just chatting about the weather. Because, if we had a conference then people would come with their armor up. We’re neighbors talking rather than adversaries’”.[strongly agreed]

“I think I can be a better spokesperson for the families. I have another tool in my toolkit that I can take to other projects.”[agreed]

“First, I am looking for another opportunity to use PV. I am anxious for the right kind of project to come along where PV will be the right methodology. More than that I see how capable citizens are in informing our science and our research priorities. The other thing that I see from my collaborators is I see Public Health as the bridge. The bridge that links the way we use our natural resources and our community development, and our agriculture. Pub H is the mirror that shows how all of these factors show up in our human society. It has reinforced my intention and my comfort with collaborating with new groups of people. I was open to this before -- I learned a lot about the PubH discipline and the women who live in these small communities in rural MN, the Somali immigrants and the Ojibwe people.”[strongly agreed]

“I will use this tool when appropriate for both assessment, evaluation, and community building in situations that are methodologically consistent with Photovoice and that require the direct input of citizens.”[strongly agreed]

“I am right now a health mentor. I go out in the community once a week for a couple of hours, and talk about just simple things—like food safety, how you use chemicals in the home. You know when you go outside there is spray stuff you use for mosquitoes, I tell them about which one is better, or what to read from the labels—what is the ingredients. Also, how to read and follow the labels when using sunscreen. Everything that is new to us. .. food if you can keep it out. In Africa you buy daily food. That’s what you can afford. Here you can afford to have one months worth of food in the house. So here people may cook three days worth of food and then leave it out. But that’s not healthy. That’s why I tell them that you have to cook one days worth of food and put it back in the refrigerator and seal it. Because if you leave your food out for three days it is unhealthy for the kids. That’s actually what I do on weekends-- educating people about the refrigerator, how to warm up food and how long you can leave it out. Something that an average American will think ‘Oh, everybody knows this’, but is very appreciated by new American’s. This will be a tool that I will use with my visits with families. I will talk about pesticides to tell them about the truck that goes around on the evenings for mosquitoes --to bring the kids inside, toys inside, and close the windows, because it has pesticides. I have some notes that I follow from the training”[strongly agreed]

“I plan to use photography and advocacy teaching tools for community members.” [strongly agreed]

6. My personal and or professional goals for participating in this Photovoice effort were met through my participation in this needs assessment. Please tell me why you selected this response?

“I always like to take on new challenges and this was something that helped me think creatively about how I can— about my concern for this issue and communicating this issue to the community—this was just another way to do that.”[strongly agreed]

“I agree and I don’t have anything else to say.” [agreed]

“It provided a dissertation project for one of our PhD students; this was my primary goal.”[agreed]

“To begin with I wanted to find out more about this project in general. I was not aware of the challenges in the area of the northwest region of MN. I wanted to learn what the needs were and how we might be able to assist with those needs in this area.”

“I really enjoyed working with the U of MN and all of the partnership and we just work well together. I live in a community where there’s two totally different view points. There are good people on both sides-- just different ideas. On the native side, we take care of mother earth and we don’t do all these drastic agricultural methods-- we work more with mother nature. There’s a different thought in mind. Nobody wants to hurt the earth it’s just the way we were taught. The farmers really care about the land because it’s their bread and butter, they just have a different view about how to do that. It’s like raising children, how we raise our children might be totally unacceptable to a different community and the way they reason with their children we might not understand but it doesn’t mean either is right or wrong—it’s just the difference between the people. For me, in talking to them [I saw] how they really know what’s going on in the land and [that] they really care about the land. And to me it’s like ‘Oh no, no, no!; but to them it’s not that way. I wouldn’t personally use those techniques but that’s what they know and when we share why we do those techniques then there’s an understanding.” [I said, it sounds like the results of PV have brought the community together and promoted understanding—she said yes to this statement]. [strongly agreed]

“Yes, it’s baby steps--only a couple of people, but that’s how it starts].” [strongly agreed]

“Part of my goal was to build stronger community/university partnerships; we were successful in bringing more university resources to the Red River Valley.”[strongly agreed]

“First, one goal was to try a new methodology. We certainly accomplished that. My personal and professional goal was to broaden our range through the partnership program. By that I mean, collaborate with new parts of the U and broaden our range into new research topics. Another goal was to partner with organizations like BCBS. Their funding of this project and all resources they bring to the table have really enhanced both this project and the Reg. Partnerships ability to broaden its range. Personally, an outcome of this project that I have been exposed to and appreciate is qualitative analysis, which is a right brained skill." [strongly agreed]

"My participation in this research project has enabled me to learn how to use this methodology and to write a dissertation. Both of these outcomes were important professional and personal goals." [strongly agreed]

"Because I was a nurse before in my country and it gives me kind of another—it gives me life again something that I used to be passionate about to work with again. BC when I came to this county, my license of bring a nurse in Africa they said it doesn't work here and I have to go back to school again to earn my degree. This kind of gives me a way of working with my community again and also practice my nursing skills while I am working on getting my degree back, like I am planning this year—I am saving it and keeping it in my goals. I did my nursing assistants training and I am going to nursing classes but it is going to take me a little bit of time while raising kids." [Fowzia had 4 years of college education after high school in Africa to be a nurse, then she went on and took a 6 month training course to earn a certificate to become a nurse midwife; she says she had delivered 400 babies as a certified nurse midwife]. [strongly agreed]

"Environmental Health is a professional interest area of mine and this project gave me an opportunity to expand my expertise and contribution to public health." [strongly agreed]

6B**. Please tell me how your personal and or professional goals were realized.**

"First by meeting new people- our team. And Linda and I got closer, I liked that. And then it took me down a whole other road with the BCBS grant—it was exciting to be able to keep going with it. Its funny how ideas get put into reality. I remember in a conference call during our planning- my husband is an artist and I thought this becoming an exhibit would be a nice thing to do and I don't think any of you were thinking we would put the photos up on the wall…and then all of you embraced that Idea. And it was really amazing to me how open you were- and I was really new to the team."
"Answered As Above"
"As answered above"

"Pictures speak a thousand words. You can talk about these things but when you see them it really opens up your eyes and awareness is opened up. We use a lot more pictures now-- you can talk about what you do but people don't understand unless they see it. [For example,] at Health conferences if you have those photos up there people understand what you're talking about. The words don't mean much but the pictures do."

"Same response as question # 6."
As Answered in question # 6
"As stated above" #6

“Same as above.”
“Answered as above.”

7. **I would recommend Photovoice to others as a tool for community needs assessment in the future. Please tell me why you selected this response.**

“It really depends on a lot of factors. You don’t pick a method and then answer the question; the method emerges as the best way to answer the question to deal with or understand a problem. So you have to say which method do I have in my toolbox that would be the best way to answer a question that you have from your needs assessment. The nature of PV is very similar to a method called performance ethnography. It’s similar in its intent—the method is very, very different when you go about it. Performance ethnography is where you go into a community you gather your data using ethnographic methods, photos, participant observation, [all of your tools] and then you develop a play and you perform that back to the community. It’s like a self-reflection and from the performance you can stimulate change in the community. PV is meant to bring about social change according to what the community wants and [does] not push an agenda. What you’re showing to the community is what they showed to you. If we did this the way Carolyn Wang did it, we would have gone back to the community several times to have discussions and we did not do that. It really depends on what you’re trying to accomplish with your needs assessment. If you want a community-based grass roots approach- here’s the problem now do something about it- PV is a method for that.”[agreed]

“I thought it was effective and served its purpose, and the people who participated appreciated participating.” [agreed]

“I think that depending upon what the purpose of the assessment is and who the study subjects are, it can be a wonderful way to engage people in discussing and documenting their needs. It is particularly relevant to individuals who are not comfortable with survey research methodology or who lack trust of the research community” [agreed]

“Well, because it involves the community of which you are working with and you are able to hear their voice, you are able to see their concerns as well. So I think it has a stronger impact than focus groups alone.” [Strongly Agreed]

“Strongly agree for the reason I just said. All of the other efforts about pesticide has been on the militant side, we don’t want this, stop it. They say we can’t because it’s what they know. But when you talk about it, then you understand it, so people can just say this is what were going to do, so that people can protect themselves. It’s just as simple as that. It really opened up my mind. The next time we have a health conference I would like to have this (Photovoice results) here. It’s when all of the departments come together with the community to see what they are doing. The tribal department puts on the health conference. It’s an all day event, 5-6 hours sometimes [held] at the casino, or sports center. We’re all getting community buildings now.”[strongly agreed]

“It’s a very respectful, empowering methodology that people responded positively to, even months after they had finished the Photovoice project. The community, the researchers and the individuals responded positively; they were still enthusiastic and proud of those photos. Linda and Abby are still inspired and proud of the photos that resulted, months after the workshops.” [strongly agreed]

“I see the buy-in--- the participants of this program are such an active part of this research. They just really show up as full participants. That’s my first reason. It really engages the community in the research effort. Then I think this method also puts the community participants in a very empowered position. They own their observations. It levels the playing field between the researchers and the participants. So I see that as a way of being very inclusive. I anticipate that those photos as this plays out with the community forums and exhibits—the exhibits will provide a starting place for conversation. It’s not a --- it’s many persons view of the world. I see it not only as an assessment of what’s needed but as an assessment of the community’s strengths in addressing those issues.” [strongly agreed]

“In research situations that are congruent with the methods of Photovoice, I would recommend this approach.” [strongly agreed]

“If they use the Photovoice exactly like we used it—it is simple and very educational and will be useful for the community” [strongly agreed]

“Depending upon on the nature and or content of the community participatory research, PV may be a good method. There would be times when PV might not be the best method to use. For this project PV was a very good method to use.” [agree]

Thank you for your time and consideration in answering these questions!