

**Whole Grain Kids: Acceptability of Whole Grain Pizza Crust
Among Children in a Restaurant Setting**

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Abstract

Current dietary intake data indicate that U.S. children consume far fewer than the recommended number of servings of whole grains per day. Objectives of this project were twofold: 1) Assess acceptability of whole-grain pizza crust among children in a restaurant setting. 2) Examine motivations of parents and children when choosing children's restaurant meals and parents' opinions about whole-grain children's meals. A 55% whole grain pizza crust was developed to replace refined grain children's pizza crust at a Midwest U.S. chain. Consumption was observed in the Minneapolis/St. Paul, MN metropolitan area, before (n=194) and after (n=200) the new crust was introduced. Acceptability of the crust was assessed via observation. Additionally, a side-by-side taste test was conducted with children in the 3rd–5th grades. Children (n=120) at an elementary school tasted the original, refined grain crust alongside the 55% whole grain crust and rated their liking of each product. A parent survey was conducted with an online sample and in person at the Minnesota State Fair. Children consumed as much of the whole grain crust (42.1%) as the original, refined grain crust (44.6%) ($p=0.55$), based on an average adult serving size of 350–400g. Liking ratings for both types of pizza were high and did not differ by type ($p=0.47$), which supported the observation results. Survey data indicated that taste was the most important factor influencing selection of children's meals. These are important outcomes that could serve as the foundation for future work with large, national restaurant chains.

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List of Abbreviations

AACCI: American Association of Cereal Chemists International

BMI: Body mass index

CDC: Centers for Disease Control and Prevention

CSFII: Continuing Survey of Food Intakes by Individuals

CVD: Cardiovascular disease

DGAC: Dietary Guidelines Advisory Committee

FAFH: Food away from home

FDA: Food and Drug Administration

FFQ: Food frequency questionnaire

HWW: Hard white wheat

IOM: Institute of Medicine

IOR: Interobserver reliability

NHANES: National Health and Nutrition Examination Survey

NSBP: National School Breakfast Program

NSLP: National School Lunch Program

RG: Refined grain

RWW: Red whole wheat

SCT: Social Cognitive Theory

USDA: U.S. Department of Agriculture

USDHHS: U.S. Department of Health and Human Services

WG: Whole grain

WW: Whole wheat

WWW: Whole white wheat

Chapter 1: Literature Review

Introduction

Pizza is a favorite food of both children and adults. It is purchased fresh and frozen, served in homes, restaurants, and school cafeterias, and can be delivered hot within 30 minutes to most areas of the United States. The market research firm Packaged Facts recently reported that 93% of U.S. adults had eaten at a pizza restaurant in the previous 12 months.¹ Statistics for children are also striking. The NPD Group reported in 2009 that pizza was the fifth most commonly eaten food in school cafeterias, after milk, sandwiches, fruits, and vegetables.² Data from the 2003–2004 National Health and Nutrition Examination Survey (NHANES) showed that pizza was the second greatest source of solid fats and added sugars for children 2–18 years of age.³ Similarly, 2003–2008 NHANES data showed that pizza was the top source of sodium for the same age group.⁴ Clearly pizza is a significant source of problem nutrients for school-aged children, and could benefit from reformulation.

The 2010 Dietary Guidelines for Americans called for a reduction in the number of servings of refined grains eaten, and recommended consuming at least 50% of total grains as whole grains.⁵ Most Americans fall far below this amount,⁵ though familiarity with whole grains and their health benefits is increasing, according to Internet search trends and the *2013 International Food Information Council's Food & Health Survey*.^{6,7} Manufacturers have rushed to develop products that assist consumers in increasing their whole grain (WG) intake. According to the Whole Grains Council, almost 20 times more WG products were introduced in 2010 than in 2000.⁸ Whole grains are now being added to cereals, granola bars, frozen meals, cookies, crackers, and many other foods, in an effort to supply this growing demand.

The flavor and texture of whole grains are problematic for many people.⁹ The rough texture and bitter aftertaste that often accompany a higher whole grain content¹⁰ may contribute to lower acceptability of foods reformulated to contain whole grains among adults who did not eat WG foods as children. Many manufacturers are addressing this issue by using white whole wheat (WWW) flour, which is made from a milder variety of wheat. WWW flour has a similar texture, appearance, and flavor as refined grain (RG) flour made from red wheat, with approximately the same vitamin, protein, and fiber content of red whole wheat (RWW) flour. Sara Lee® Soft & Smooth®

Whole Grain White bread, a product containing WWW flour, contains three grams of dietary fiber per serving, which is actually one gram more than their 100% Whole Wheat bread made with RWW flour.¹¹

Knowledge deficit and lack of experience are also issues that may limit WG intake. Recent focus group discussions in Northern Ireland with adults responsible for food purchasing explored barriers to WG consumption, and determined that after perceived sensory qualities, the most common barrier to WG intake was lack of knowledge regarding benefits, preparation, availability, and appropriate serving sizes.¹² When parents avoid whole grain foods due to inexperience or negative preconceptions, they may pass on this behavior to their children, creating another generation of consumers who prefer RG products to WG products. Simple exposure to WG foods has been shown to increase intake in both children and adults,^{13,14} which supports the theory that environmental modification can lead to positive behavior change.

Replacing RG flour made from red wheat with WWW flour has been successful in improving WG intake in school children,¹⁵⁻¹⁷ but to date, no one has determined if similar results can be achieved in a restaurant setting. It makes sense that children would eat the same amount of a pizza made with WWW flour as a pizza made with red wheat RG flour, especially if they cannot detect the presence of whole grain. A number of studies have compared refined red wheat products with closely matched WWW counterparts and garnered positive feedback from consumers in side-by-side taste tests.^{9,16,17} Applying this principle to pizza served in restaurants could significantly increase a child's intake of whole grains during a restaurant visit, as well as intake of dietary fiber and a number of other healthful components present in WG flour. Given that children consume 33% of their meals away from home, and away-from-home foods tend to contain fewer whole grains (only 0.09 ounces per 1,000 calories),¹⁸ this type of change could make a real difference in children's WG consumption.

My project expands on previous research completed in schools and shows that children will eat pizza crust made with WWW flour when it is served in a restaurant. In order to examine the complex process of meal choice as it pertains to WG foods, we also surveyed parents regarding the most important factors when selecting meals for children in restaurants. The survey examined parent attitudes and parent perceptions of

child attitudes toward WG foods and parental opinions regarding their children's likelihood of accepting WG versions of favorite foods. Finally, we served two versions of pizza to elementary school children to determine if there was a difference in their liking of pizza crust made with refined red wheat or WWW flour.

This thesis begins with a review of the literature related to whole grains and their consumption, focusing on scientific evidence, recommendations, consumer attitudes and behavior, data collection methodologies, and previous research with children.

Whole Grains and their Benefits

Whole Grain Definition

When we eat grain foods, we are consuming the seeds of plants such as wheat, barley, sorghum, corn, oats, or rice. These seeds are referred to as *kernels* during the milling process, which transforms them into flour or other products. A kernel of grain is made up of three parts: bran, germ, and endosperm, as illustrated in Figure 1.1. The bran is the outer covering of the seed, the germ is its embryo, and the endosperm is its starchy food supply. The bran and germ are removed to produce refined grain (RG) flour, resulting in a loss of protein, vitamins, minerals, and fiber. Processors are required by law to add back some vitamins and minerals to RG flour,¹⁹ but the amounts of these nutrients do not match the amounts found in flour made from whole grains.²⁰ If the bran and germ are added back in the same proportion found in the original seed, or if the bran and germ are never removed during the milling process, a product is considered "whole grain."²¹ In 1999, the American Association of Cereal Chemists International (AACCI) developed an official definition for whole grains, as *"the intact, ground, cracked, or flaked caryopsis, whose principal anatomical*

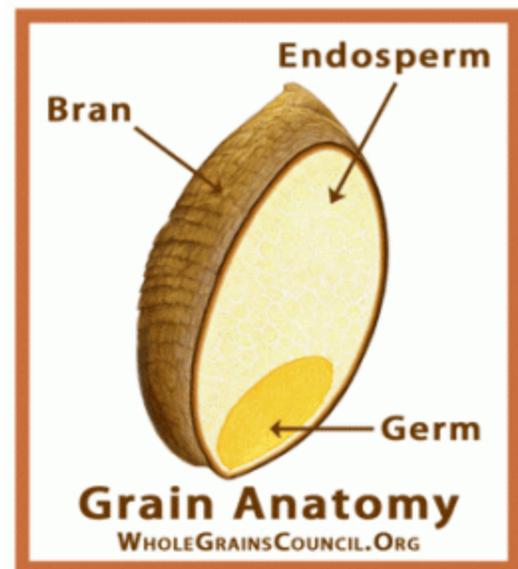


Figure 1.1. Anatomy of a whole grain.¹⁶¹

components—the starchy endosperm, germ, and bran—are present in the same relative proportions as they exist in the intact caryopsis.²²

The AACCI definition is a scientifically precise one, but does not translate well to the average consumer. To address this issue, the Whole Grains Council, a nonprofit consumer advocacy group, created a new definition that is more easily understood. *“Whole grains or foods made from them contain all the essential parts and naturally-occurring nutrients of the entire grain seed. If the grain has been processed (e.g., cracked, crushed, rolled, extruded, and/or cooked), the food product should deliver approximately the same rich balance of nutrients that is found in the original grain seed.”*²¹ The two definitions are used in policy making, regulatory decisions, and the milling industry.

Whole Grain Labeling

Defining whole grains becomes more complicated when labeling products. Because whole grains are usually one of several ingredients in packaged foods, it makes sense to adopt a set of guidelines based on a minimum amount of whole grain that must be present in order to label a food as

“whole grain.” The United States Department of Agriculture (USDA) defines a serving of whole grains as an “ounce-equivalent,” or 16 grams.²³ Whole grain products began to enter the marketplace in increasing numbers after the Food and Drug Administration (FDA) issued a notification regarding the use of a specific health claim on whole grain products in 1999.²⁴ The claim stated, *“Diets rich in whole grain foods and other plant foods and low in total fat, saturated fat, and cholesterol, may help reduce the risk of heart disease and certain cancers.”* This claim was modified in 2003 to remove the reference to total fat, based on a request by Kraft Foods and supporting scientific evidence.²⁵ In order to use the whole grain health claim, foods must contain 51 percent or more whole grain ingredients by weight and be low in fat (6.5g per serving or less).



Figure 1.2. Whole Grains Council stamps.¹⁶²

To further clarify the issue of whole grain content for consumers, the Whole Grains Council created Whole Grain Stamps (Figure 1.2). These stamps appear on packages and denote different amounts of whole grain content, based on the recommended three servings of whole grains per day.⁵ For a product to have the 100% Whole Grain Stamp, it must contain at least 16g (a whole serving) of whole grains and cannot contain any refined grains. The Basic Stamp is used on products that contain at least 8g (a half serving) of whole grains and also contain other grains.

Red vs. White Wheat

Wheat is categorized according to its hardness, the color of its kernel, and the time of year it is planted and harvested. Red wheat has the reddish-brown color, grainy texture, and phenolic compounds that give whole wheat bread its flavor and appearance.²⁶ Its high protein content and water absorption make it ideal for use in yeast breads and other products that rely on a strong gluten network for shape and texture.²⁷ Most RG flour is made from hard red wheat.²⁷

A new type of wheat grown in the United States, hard white wheat (HWW), is having a dramatic effect on the whole grains industry because of its ability to replace RG flour in many applications. HWW is also high in protein and effective in yeast products, but it has the pale hue and mild flavor of RG flour due to its lack of a gene for bran color. According to the USDA, 10–15% of the wheat currently grown in the U.S. is HWW.²⁷ HWW can be grown using practices similar to those for hard red wheat, with the potential exception of steps to address preharvest sprouting and inferior disease resistance.²⁸ Products made with whole grain HWW flour are referred to as “white whole wheat.” Studies in Texas and Minnesota have shown that when schoolchildren are served grain products made with white whole wheat (WWW), they consume them in amounts equal to RG products made from red wheat.^{15,16,29} Manufacturers have embraced HWW as a means to improving WG content of products without sacrificing flavor or texture. The Whole Grains Council lists ten major manufacturers that sell products made with WWW, including King Arthur, Eagle Mills®, Rich’s®, and Horizon Milling® (Cargill).²⁶

Whole Grains and Health

Whole grain foods are nutritionally superior to RG foods because they contain greater amounts of dietary fiber, antioxidants, some vitamins and minerals, and other compounds known to lessen risk of chronic diseases.³⁰ While numerous studies have shown that a diet rich in whole grains can reduce a person's risk of heart disease,^{31–33} diabetes,^{31,34,35} obesity,^{31,36,37} and certain types of cancer,^{38–41} the exact mechanisms through which this occurs have not yet been elucidated.^{42,43} Current theories include improvement of fecal bulk and general gut health, cholesterol reduction through plant sterols and stanols, increased antioxidant activity, the presence of antinutrients such as protease inhibitors and phenolic compounds, and independent effects of certain vitamins and minerals on glucose and cell metabolism.³⁰

Specific Health Benefits for Children

Though a large volume of research has focused on health benefits of whole grains for adults, few studies have examined relationships between whole grain intake and markers of health in children and adolescents. Positive associations in research with adults and current trends toward obesity and type 2 diabetes in children indicate that further research in this area is both warranted and necessary. The following section will address the current state of health-related whole grain research with children and adolescents.

Obesity

Several studies have examined the association between whole grain intake and body weight measures in adolescents. Steffen et al. conducted a prospective cohort study with 285 adolescents in Minnesota.⁴⁴ They collected dietary intake and anthropometric data twice during a two-year period, and found that adolescents with greater WG intake (≥ 1.5 servings per day) tended to have lower BMIs than adolescents who consumed fewer whole grains (< 1.5 servings per day). Cheng et al. attempted to reproduce these results among a similar cohort of German adolescents, but were unsuccessful.⁴⁵ Instead, the researchers found that children with higher intakes of whole grains actually had higher BMIs and percent body fat. This could have been a result of the heavier children consuming more calories overall, or attempting to lose weight by consuming greater amounts of “healthy” foods. Zanovec et al. also assessed whole grain

intake and body weight in children and adolescents, via NHANES data (1999–2004).⁴⁶ They found no association between WG intake and body weight measures in young children, but they did find that adolescents with higher intakes of whole grains (≥ 3 servings per day) tended to have lower BMIs. Bradlee et al. found an inverse association between WG intake (based on NHANES data from 1998–2002) and central obesity (measured via waist circumference) in adolescents.⁴⁷ Subjects with a waist circumference in the 85th percentile or greater consumed fewer whole grains (0.92 vs. 0.60 servings per day). Choumenkovitch et al. studied 792 3rd–6th graders in rural areas of California, Mississippi, Kentucky, and South Carolina, and found that higher levels of WG intake (≥ 1.5 servings per day) were associated with a lower BMI z-score.⁴⁸ The children in this study were more obese on average than the children in other studies, which may have been a factor in the results. Finally, Hur and Reicks used NHANES data (1999–2004) to assess WG intake, chronic disease risk factors, and weight status in 4928 adolescents.⁴⁹ They found an inverse association between higher WG intake and weight status, but this association disappeared when the models were adjusted for food group intake. Although these results are somewhat inconsistent, when combined with the evidence from studies with adults,^{31,36,37} they support the current recommendation to increase WG intake in children and adolescents.

Chronic Disease

Two of the studies mentioned above also assessed chronic disease risk factors in the adolescents they studied. Steffen et al. found a positive dose-response relationship between WG intake and insulin sensitivity, and this association was mirrored in fasting blood glucose levels.⁴⁴ Notably, these interactions were stronger in adolescents with a higher BMI. The researchers also assessed CVD risk factors such as blood pressure and cholesterol levels, but found no significant associations. After adjusting for food group intake, Hur and Reicks reported an inverse relationship between WG intake and fasting insulin levels in girls, as well as improved homocysteine levels in boys and folate levels in both boys and girls.⁴⁹ These studies offer preliminary support for the reduction in chronic disease risk in children via whole grains, but further research is needed to strengthen the body of evidence.

Constipation

Chronic constipation is a children's health issue that has recently received increased attention from media and academic sources.^{50,51} A recent study at the Children's Hospital of Pittsburgh determined that constipation was the most common diagnosis for children presenting with abdominal pain.⁵⁰ Though incidence rates vary widely based on diagnostic criteria, constipation is mostly a problem for younger children, with rates of constipation in children 0–9 years old more than double the rates in children from 10–18 years old.⁵² The ability of dietary fiber to relieve constipation in adults is widely known, but until recently, few studies have focused on children. Lee et al. studied kindergarten children in Hong Kong and determined that almost 30% were chronically constipated, as defined by Rome II pediatric criteria,⁵³ and these children had lower intakes of dietary fiber than non-constipated children (3.4g per day vs. 3.8g per day).⁵⁴ A similar study in Ireland found that 76% of hospitalized children 5–8 years old did not consume adequate dietary fiber, and that constipation rates were doubled in this group.⁵⁵ A recent review addressed this issue, and discussed the inconsistencies in recommendations for dietary fiber intake in children, and the need for further research.⁵⁶ Because whole grains often contain more dietary fiber than refined grains, increasing children's intake of whole grains could help to alleviate constipation. Researchers in Brazil used wheat bran to treat 28 children aged 0–15 years (three children were less than 1 year old) with chronic constipation, and reported that the treatment was effective in 75% of the cases.⁵⁷ Further, whole grains contain numerous compounds that could have a synergistic effect on gastrointestinal health.³⁰ Additional research is needed to confirm these preliminary results and determine the amounts of fiber and/or whole grains that are beneficial in treating constipation in children.

Whole Grain Intake

Whole Grain Intake Recommendations

The U.S. Department of Health and Human Services (USDHHS) and the USDA have worked together to publish dietary intake recommendations for Americans every five years since 1980. Each time the *Dietary Guidelines for Americans* are revised, a Dietary Guidelines Advisory Committee (DGAC), composed of "nationally recognized

experts in the field of human nutrition and chronic disease prevention,” reviews the previous guidelines and determines which sections should be updated, based on new scientific evidence.⁵⁸ A recommendation to eat whole grains was first mentioned in the 2000 Dietary Guidelines for Americans,⁵⁹ but this recommendation was not quantified until 2005. The 2005 Dietary Guidelines for Americans state, “*Consuming at least 3 or more ounce-equivalents of whole grains per day can reduce the risk of several chronic diseases and may help with weight maintenance. Thus, daily intake of at least 3 ounce-equivalents of whole grains per day is recommended by substituting whole grains for refined grains... At all calorie levels, all age groups should consume at least half the grains as whole grains to achieve the fiber recommendation.*”⁶⁰

The 2010 Dietary Guidelines for Americans added to this by recommending a reduction in the intake of refined grains. They stated that, “Americans should aim to replace many refined-grain foods with whole-grain foods that are in their nutrient-dense forms to keep total calorie intake within limits.”⁵ The new guidelines also included specific information about the amount of whole grain that should be present in partial WG foods, directing consumers to look for “*foods with at least 51 percent of the total weight as whole-grain ingredients*” or “*foods with at least 8 grams of whole grains per ounce-equivalent.*”⁶ These new guidelines are a step forward in improving WG intake and reducing the intake of refined grains in the U.S. population, in alignment with current scientific evidence regarding nutrition and chronic disease prevention.

In 2012, the nutrition standards for the National School Lunch and School Breakfast Programs (NSLP and NSBP)⁶¹ were updated to correspond with the 2010 Dietary Guidelines for Americans.⁵ The updates were based largely on an Institute of Medicine (IOM) report published in 2009.⁶² The report recommended dividing fruits and vegetables into two separate, required food groups and creating a requirement for whole grain-rich foods, which are to contain at least 51 percent whole grains with the remaining grain content being enriched.⁶¹ This requirement is a significant step toward improving whole grain intake in U.S. schoolchildren. During school years 2012–2013 and 2013–2014 (the first two years of implementation) whole grain-rich foods must make up half of all grain foods offered to students. By school year 2014–2015, schools must offer only whole grain-rich foods.

Actual U.S. Whole Grain Intake

Unfortunately, actual intake of whole grains in the United States is far below the recommended levels. Less than 10 percent of Americans consumed the recommended three ounce-equivalents per day, and the average American ate less than one ounce-equivalent of whole grains per day according to data collected before 2000.^{63,64} The NPD Group, a market research firm, reported that of all the grains purchased by Americans from 1998–2008, only 11% were whole grains.⁶⁵ This estimate supports a 2008 study that used NHANES data (2001–2002) to determine that whole grains accounted for approximately 10% of all grains consumed in the U.S among those 2 years and older.⁶⁶

One source indicates that intake of whole grains is increasing, albeit slowly. The NPD Group report showed that WG consumption increased 20% overall from 2005–2008, with a 38% increase in adults from 18–34 years old.⁶⁵ Twenty percent seems like a dramatic increase, but an increase of approximately 400% is necessary for most Americans to reach recommended levels of WG intake. Additionally, these data were based on retail and restaurant sales and not measurements of individual dietary intake. Increased sales to consumers who were already purchasing WG foods could have masked unchanged or even decreased consumption in other families.

Publications from 2000–2007

Understanding WG intake in the U.S. is more complicated than the NPD Group's sales data indicates. Because the availability of government data lags by several years, gaining insight into current trends is challenging. Many recent studies of WG intake used data that were collected more than 10 years ago, and common sense dictates that things may have changed since then.

Studies by Harnack et al.,⁶³ Cleveland et al.,⁶⁴ and Kantor et al.⁶⁷ used nationally representative data from the 1994–1996 and 1998 USDA Continuing Survey of Food Intakes by Individuals (CSFII) to show that WG consumption was low in children and adolescents (0.8–1.0 servings per day),⁶³ low in adults (1.0 servings per day) and a good indicator of overall diet quality,⁶⁴ and affected by knowledge, attitude, and socioeconomic status.⁶⁷ More recent papers by Burgess-Champoux et al.⁶⁸ and O'Neil et al.⁶⁹ looked specifically at nutrient intake trends in adolescents using data from 1999–2004. The Burgess-Champoux study surveyed Minnesota adolescents in 1999 and 2004

and reported that significant changes in WG intake did not occur as the participants reached their late teens. The O'Neil et al. study used NHANES data to show results similar to the Cleveland et al. study in 2000: while WG intake was very low overall, adolescents who consumed more whole grains had better nutrient intake. The O'Neil et al. study participants consumed 0.45, 0.59 and 0.63 servings per day, at ages 2–5, 6–12 and 13–18, respectively. In all of the age groups, intakes of energy, fiber, vitamin B6, folate, magnesium, phosphorus and iron were significantly higher among children who consumed three or more servings of whole grains per day when compared to those consuming fewer than three servings per day, while intakes of protein, total fat, saturated fat and cholesterol were lower.

In 2007 the USDA Economic Research Service conducted a detailed analysis of the CSFII data from 1994–1996 and 1998, along with its companion Diet and Health Knowledge Survey, in a publication entitled *The U.S. Grain Consumption Landscape: Who Eats Grain, in What Form, Where, and How Much?*²⁰ The authors examined WG intake in conjunction with socioeconomic status, demographic information, health-related knowledge, and meals consumed at or away from home. Their findings supported the work of other researchers in several key areas.^{63,64,67} They determined that children's intake of whole grains was particularly low, and that the presence of a child in a household actually was associated with lower adults' WG intake as well.²⁰ They also found restaurant meals to be lacking in WG content, with 1000 calories of the average restaurant meal containing less than one-third of an ounce of whole grains.

Publications from 2008–Present

Slightly more recent data come from a German project conducted from 1997–2008. Alexy, Zorn, and Kersting reported in 2010 that whole grain intake in German children and adolescents from 2-18 years old was far below recommendations, and actually declined with age when adjusted for caloric intake and total grain intake.⁷⁰ Children in the German study consumed an average of 20–33g of whole grains per day, based on three-day dietary records, which is better than most U.S. estimates but still very low. Similarly, a study of Irish children and teenagers published in 2012 reported that children aged 5–12 consumed 18.5g per day, while adolescents aged 13–17 consumed 23.2g per day.⁷¹ It is possible that German and Irish children and adolescents consume more whole grains than U.S. children because of culture-specific dietary

habits. The authors of both studies pointed out that breakfast consumption of breads and ready-to-eat cereals is particularly high in their countries,^{70,71} and these are known to account for large percentages of WG intake.^{66,68}

Economists at the USDA's Economic Research Service used an indirect method to show an increase in the demand for whole grains.⁷² Mancino and Kuchler used bread-purchasing data to show that the demand for whole-grain bread increased significantly after the release of the 2005 Dietary Guidelines for Americans when compared with the release of the 2000 guidelines. The researchers set up an economic demand model that accounted for regional variation, and used Nielsen Homescan purchasing data to detect monthly changes in demand for whole grain bread. Even after accounting for a concurrent decrease in the price of WG foods, Mancino and Kuchler found that retail demand for WG bread increased, especially among high-income consumers.

The most recent U.S. data from NHANES (2009–2010) showed almost no change from previously reported consumption averages.⁷³ The 3124 children and adolescents consumed an average of only 0.57 servings of whole grains per day, which is almost identical to the findings from the 1999–2004 NHANES data analyzed by O'Neil et al.⁶⁹ This is surprising, given the trends reported by the NPD Group and Mancino and Kuchler.^{65,72} The conflict between sales data and individual consumption data could indicate that increased WG consumption by high-income adults accounts for much of the change in sales data, and that WG intake levels in children have remained static. Indeed, multiple studies have shown that WG intake is inversely related to socioeconomic status.^{63,67,74}

Influences on Whole Grain Intake

Social Cognitive Theory

Researchers must understand the determinants of children's eating behavior in order to develop effective interventions. To this end, interventions to improve dietary intake are often developed in the context of Social Cognitive Theory (SCT).⁷⁵ SCT explains human behavior in terms of personal, behavioral, and environmental influences that interact in a reciprocal manner. SCT also identifies a set of core determinants

affecting the potential for behavior change, including *knowledge* of health risks and benefits of health practices, perceived *self-efficacy* for controlling one's behavior, *outcome expectations* about expected costs and benefits, the health *goals* people set for themselves and their strategies for realizing them, and the perceived *facilitators* and social and structural *impediments* to the changes they seek.

Several studies have examined the relationship between variables based on SCT and children's fruit and vegetable intake,⁷⁶⁻⁷⁹ but very few have examined SCT in conjunction with whole grains.^{14,80} Two reviews of the fruit and vegetable intake literature have found that the most significantly associated variables were availability/accessibility and taste preferences.^{81,82} Among the studies that successfully linked these variables to fruit and vegetable intake, predictiveness was generally low, with models assessing availability/accessibility and taste preferences accounting for only 10–15% of variability in intake.^{76,78} It is generally accepted that the whole of behavioral theory has only been able to account for 30% of variance in eating behaviors.⁸³ The cross-sectional studies by Rosen et al. and Larson et al. addressing WG intake among children and adolescents in the context of SCT yielded consistent results: availability/accessibility and taste preference were most significantly associated with intake, and the greatest amount of variability explained was 34%.^{14,80}

Current research provides moderate evidence that psychosocial and environmental factors influence children's intake of whole grains, and several interventions have attempted to improve WG intake by manipulating these factors.^{13,15,84} Recent interventions have addressed personal constructs (self-efficacy and outcome expectancies), behavioral influences (knowledge and food choice), and environmental factors (whole grain availability).^{16,85,86} The studies examined later in this literature review approach the issue of WG consumption among children from different and often multiple angles, and together offer a comprehensive view of effective and feasible intervention techniques for improving WG intake in children.

Children's Taste Preferences

Many factors contribute to forming children's taste preferences. In general, children tend to avoid bitter-tasting foods and prefer sweeter and saltier foods than adults.^{87,88} Genetic differences in sensitivity to the bitter flavor compound 6-n-

propylthiouracil can affect the degree to which children consume some vegetables, such as broccoli and cucumbers.⁸⁹ Similar research has been completed with whole grains in adults.⁹ Taste preferences are also shaped by experience and environment. Parenting styles can affect children's taste preferences by building associations between foods and emotions. Children are more likely to establish a preference for a food that has been offered as a reward and dislike foods they have been forced to eat.⁹⁰ Children also learn from the behavior of family members at the dinner table. When parents and siblings appear to like a food, a child is more inclined to want to try it.⁹⁰ As children get older, their knowledge of and interest in nutrition increases, and may begin to affect their food choices. A recent study of 4th and 5th grade students found that foods with nutrition claims on their packaging elicited a more positive response than foods without the claims.⁹¹ Finally, exposure is a determinant of food preferences in children. A study with 8–11-year-old children in Finland found that better-educated parents exposed their children to a greater variety of foods, and those children were less likely to avoid new foods.⁹²

Introducing New Foods to Children

Reluctance to accept new foods is a hallmark of childhood. Equal numbers of parents classified their infants and toddlers as “picky eaters” in all demographic groups, when divided by race, income, age, and gender.⁹³ This aversion to new foods is termed “food neophobia” by researchers, and usually first appears in children between the ages of two and six.⁹⁴ Food neophobia may have evolved as an adaptation preventing young children from ingesting foreign substances, at a time when they begin receiving less supervision from their parents.⁹⁴

Researchers have determined several methods for reducing food neophobia and introducing new foods to children. Flavor-flavor learning elicits a Pavlovian-type response in children by causing them to associate new flavors with flavors they already know and like.⁹⁵ When familiar foods are paired with new foods, children tend to eat more of the new foods and also report greater liking, as seen in two studies that paired familiar dips with novel vegetables or chips.^{96,97} This method also works when a liked flavor is simply used to enhance a newly introduced food. Several studies have shown that children find new vegetables more acceptable when they are flavored with sugar.^{95,98} Repeated exposure can also be used to combat food aversions, thereby

increasing both consumption and liking of newly introduced foods.⁹⁹ Several studies have shown that 8–15 exposures to a new food are necessary before a child accepts the food readily.^{87,100,101} Simple exposure has been found to be more successful in mitigating food aversion than rewards,⁸⁷ flavor-flavor learning,⁹⁸ and parental education,⁹⁹ though a recent study found that exposure and rewards yielded superior results when used in combination.¹⁰²

Interestingly, these techniques appear to be effective with children across a wide age range. Though most flavor-flavor learning studies are conducted with preschool age children,^{97,98} they are also effective in older children.⁹⁶ Repeated exposure has been effective with both preschool and elementary school children.^{98,99,101,103} This improves the likelihood that these methods could be used to introduce WG foods to children in an institutional setting such as a restaurant or cafeteria, where their ages and experience level with WG foods are varied. Pizza is an ideal food to use for flavor-flavor learning, because children are familiar with the flavors of the sauce, cheese, and usual pizza toppings. Repeated exposure could also be facilitated through a school cafeteria setting, where menus tend to be cyclical and repetitive.

Taste Preferences and Whole Grain Foods

Few sensory studies have examined children's taste preferences for WWW versus RWW and RG foods. Lukow et al. reported in 2004 that more children aged 6–11 preferred WWW bread than bread made with RWW.¹⁰⁴ Delk and Vickers found that school-aged children preferred rolls with lower WG content to rolls made with 50% and 100% RWW flour, though they did not test rolls made with WWW flour.¹⁰⁵ Products made from 50% WWW flour have been found to be acceptable to schoolchildren in several studies.^{15,16,29}

Sensory tests with adults are somewhat inconsistent with results from tests with children. Bakke et al. found that testers preferred lab-made RG bread to lab-made WG bread, but that they liked commercial RG and WG breads equally.⁹ In the same study, consumers preferred bread made with RWW to bread made with WWW. Similarly, Challacombe et al. found that testers preferred both bread and crackers made with RWW to products made with WWW.¹⁰⁶ Though these results have implications for product development, it is important to note that grain flavors are often masked by other

ingredients, and RG and WG versions of the same product are rarely consumed side-by-side.

Availability of Whole Grain Foods

Examining the availability of whole grains for children is complicated because of the number of different food environments a child is exposed to on a typical day. Research in this area must assess the home food environment, as well as school cafeteria environments, restaurant environments, and any other locations where children routinely eat their meals. In 2009, the Whole Grains Council (WGC) set out to measure progress in WG availability since the release of the 2005 Dietary Guidelines for Americans, which were the first version of the guidelines to recommend that half our grains should be whole.⁶⁰ They used nationally representative food log data from 5,000 U.S. citizens, as well as surveys of magazines, supermarkets, and restaurants to measure changes in consumption, attitudes, and availability.⁶⁵ Their supermarket survey results are particularly interesting, and when combined with recent assessments from academic journals, offer a comprehensive look at WG availability in an important food environment.

Supermarket Availability

The WGC counted WG and RG products at a supermarket in New Hampshire and determined that 34.7% of grain foods were made with whole grains, based on the presence of a Whole Grain Stamp or a whole grains health claim, or having whole grains listed as the first ingredient on the product's label.⁶⁵ They also recorded prices for all the products, and determined that while a price gap still existed in many categories (bread, tortillas), WG products were actually priced similarly (cereals, pasta) or were less expensive (granola bars, chips) than RG products in several other categories.

Many low-income Americans live more than a mile away from the nearest supermarket, and for these individuals, corner stores are an important food source.¹⁰⁷ Though availability of WG foods at corner stores is generally poor,¹⁰⁸ recent changes to food packages in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) have forced corner store owners to make positive changes.^{109,110} Andreyeva et al. found that the implementation of these new rules, which were based on IOM recommendations,¹¹¹ prompted a significant increase in the availability of WG foods

at WIC-authorized corner stores (n=252) in five Connecticut towns.¹¹⁰ Havens et al. found similar results in a smaller sample (n=45) of Connecticut corner stores.¹⁰⁹ Improved availability of WG foods in these neighborhoods could lead to improved household availability of WG foods for resident children.

Industry Changes

Improved product selection would not be possible without a shift toward WG products by major manufacturers. Since 2005, General Mills has worked to improve the whole grain content of their cereals. Currently, all of their “Big G” cereals (including *Cheerios*, *Chex*, *Fiber One*, *Raisin Bran*, and *Total*) contain 10g or more of whole grains per serving.¹¹² Because research has shown that 30% of whole grains are consumed in the form of cereal,^{63,64} this change from General Mills alone could have improved WG consumption among children. Sara Lee has also increased their WG profile, with the percentage of WG products nearly doubling to 45% in 2010 from 24% in 2005.⁸ In fact, the Mintel Global New Products Database reported that nearly 6% of all food products and 18% of natural food products launched in 2010 included the WG health claim.¹¹³ As previously discussed, positive effects of improved supermarket availability have yet to be seen in NHANES dietary intake data.⁷³ This could be because consumers have not had enough time to permanently change their intake patterns, or it could be due to a discrepancy in WG food purchasing between different income groups, with higher-income individuals’ increased intake compensating for static intake in other groups.

Previous Whole Grain Research with Children

Multi-Component Interventions

Interventions to improve intake of whole grains among children are a fairly recent endeavor. The earliest reference is a study performed in 2005 at the University of Minnesota, in cooperation with two Minneapolis elementary schools.¹³ Burgess-Champoux et al. designed a multiple-component intervention based on principles of SCT. The intervention consisted of classroom instruction, cafeteria menu changes, and family involvement, effectively addressing environmental, personal, and behavioral factors. To measure the effectiveness of the intervention, the researchers observed children dining in the school cafeterias, surveyed participating children and parents with

questionnaires they designed and tested prior to the study,¹¹⁴ and assessed parental WG intake with items modified from the Block Food Frequency Questionnaire,¹¹⁵ availability of WG foods in the home, and WG intake enabling behaviors, role-modeling, and health benefit knowledge information. The researchers found a significant increase in both availability and consumption of WG foods in school cafeterias, as well as a decrease in the consumption of RG foods among parents who participated in the study. No differences in the availability of WG foods in the home environment were found, however.

This study had several strengths. It was the first to use a multi-component intervention focused on whole grains, and it was based on previous focus group data¹¹⁶ and tested questionnaires.¹¹⁴ The researchers included lunches brought from home when evaluating intake, which many school-based studies are not able to do. The weaknesses of the study were the small sample size and the low participation rate for many of the extra-curricular family activities. Future interventions should investigate ways to improve family participation while maintaining a robust school cafeteria component.

Gillis et al. examined the nutrition intervention component of the HEALTHY study, which was developed to combat risk factors for type 2 diabetes in middle school students, focusing on overweight and obesity. The study was conducted in 42 schools across the U.S.⁸⁴ This multi-faceted intervention addressed personal, behavioral, and environmental factors through a wide variety of projects, cafeteria changes, and educational activities involving students, teachers, cafeteria staff, and administrators. The stated project goals were as follows: “(1) lower the average fat content of foods, (2) increase the availability and variety of fruits and vegetables, (3) limit the portion sizes and energy content of dessert and snack foods, (4) eliminate whole and 2% milk and all added sugar beverages, with the exception of low fat or nonfat flavored milk, and limit 100% fruit juice to breakfast in small portions and (5) increase the availability of higher fiber grain-based foods and legumes.”⁸⁴ The nutrition intervention was designed to affect the total school food environment, which the researchers defined to include federal meal programs (NSBP, NSLP, the After-School Snack Program and the Supper Program), a la carte venues, such as snack bars and school stores, vending machines, fundraisers, and classroom parties and celebrations. Research dietitians used new foods, taste tests,

nutritional messaging, new plating techniques and dishware, educational sessions, cafeteria activities, materials sent home with students, and meetings with foodservice personnel and administrators to achieve the project's goals. The project was successful in increasing the number of high-fiber, grain-based foods served to students, but fell short of quantified goals. School foodservice personnel cited cost and availability as barriers to success in this area.

This study was one of the first to use a comprehensive approach in improving the school food environment. However, the intervention lacked a parental outreach component, which may have improved outcomes. Further, the study did not assess its success via dietary recall or FFQ, so the impact on actual student food intake is unknown. The HEALTHY study serves as an example of the type of intervention that is possible with complete buy-in from school administrator and personnel, but these studies must be evaluated by nutrition professionals to determine which aspects are most effective and the degree of change they are able to foster.

A third study focused on a pilot test of a multi-component program called Lunch is in the Bag, which was aimed at parents of preschool-aged children.^{85,117} The program used parent handouts, classroom activities, teacher training, and parent-child activity stations (at pickup time) to increase the number of fruits, vegetables, and WG foods that were packed in children's lunches. The researchers based their educational materials and outcome measures on SCT, and designed them to address knowledge, self-efficacy, attitudes, and social norms related to packing healthy lunches. To measure the success of the intervention, researchers counted the number of items present in children's lunches at both intervention and control childcare centers. They also surveyed parents to determine the influence of psychosocial variables in predicting behavioral outcomes. The researchers found that the number of servings of whole grains packed in lunches increased significantly in the intervention group, and was correlated with an increase in knowledge on the part of the parents, as assessed by a follow-up survey. Further, the researchers conducted detailed statistical analysis and concluded that the increase in whole grains was due to more parents packing whole grains and not the same set of parents packing additional whole grains.¹¹⁸ This suggests that the educational component of the program had a direct influence on parental lunch-packing behavior.

The researchers who conducted this study performed a secondary data analysis to correlate behavioral outcomes (increased whole grains in lunches) with specific behavior changes. They modeled four variables corresponding to different types of behavior change (portion size, frequency, daily exposure, and the percentage of parents packing WG foods) in order to identify the most effective intervention points. This is a strength of the study, as it provides depth of information that is useful in designing future research. The authors also assessed the program components for cultural competency and evaluated their processes. They found very high levels of engagement among parents who participated (100% read at least one handout that was sent home) and compliance among teachers, which suggests that the materials were well-designed for their target audience. The small size of the sample in this study means that further research is needed to verify the positive effects of the program.

School Foodservice Interventions

Several studies completed at the University of Minnesota focused solely on improving the school cafeteria environment to facilitate increased intake of WG foods. Chan et al. created a pizza product made with 50% WWW flour and measured acceptability at a Minneapolis elementary school.¹⁶ This was the first study to compare WWW with RG flour made from red wheat in a school foodservice product. The researchers measured consumption via aggregate plate waste and also collected liking data from 4th and 5th grade students. They found no significant differences in liking or consumption between the two products based on providing the modified product on five days over a two-month period. The researchers concluded that WWW flour can be used to perform a simple intervention that increases WG intake in school children. The sample size based on only providing the WG product five times was small, so the project should be repeated with more observation days. It might also be interesting to see if an educational or parental component adds to the effect of the ingredient substitution. Educating children and parents about the health benefits of new products could work to increase consumption. It could also decrease consumption due to preconceptions of “healthy” foods as less flavorful.

Toma et al. also focused on a school cafeteria environment, but this group more closely examined sensory and nutritional properties of WG foods.²⁹ The researchers developed chocolate chip cookies and burritos made with WG flour, and determined that

elementary school children ate similar amounts of these foods as control versions of the same foods made with RG flour. This suggests that the children did not notice a difference in flavor or texture of the new products, or that they liked the new products as well as the RG counterparts. The researchers went further and conducted a nutritional analysis of the products to determine their dietary fiber content, along with a qualitative analysis of the texture, color, water activity, and weight of the products. They found that the WG products were softer, moister, and heavier than the RG products, and that the burritos and cookies contained 10.2 g and 2.6 g of dietary fiber, respectively. Though these qualities did not appear to influence consumption, the information is useful for further product development efforts.

This study was grounded in food science and attempted to explain the qualities that make foods acceptable to children. It also quantified the improvements in dietary fiber intake that accompany the substitution of WG for RG foods. Though this information is valuable, it is unfortunate that the researchers were not able to gather liking data from the children or have the children compare the WG and RG products side-by-side. It would be helpful to correlate the qualitative product information with information about the children's preferences in taste tests. Further research in this area should gather liking data from students along with the consumption data.

Roth-Yousey et al. conducted a study focused on a school cafeteria environment, but instead of changing the food composition or menu, the researchers developed a continuing education program for school foodservice personnel.⁸⁶ Employees attended educational sessions that focused on identifying WG foods, incorporating whole grains into recipes, storing and cooking whole grains, and basic nutritional information regarding whole grains. The researchers administered pre- and post-tests to all attendees to determine changes in their knowledge of and likelihood of using whole grains, with post-tests collected immediately following the sessions and after 3–6 months. The researchers found that knowledge improved in both post-tests, and that the school foodservice personnel were more likely to serve whole grains in school cafeterias after the educational sessions. This increased the number of WG foods available to children within the relevant school districts. One limitation of this study was that only a small percentage (34%) of attendees completed the 3–6 month post-test, so results reflected a self-selection bias and may not have been representative of the entire

sample. This study was unique in focusing solely on the education of school foodservice personnel and its impact on the availability of WG items in school cafeterias. Future research should incorporate educational programs for foodservice personnel along with other intervention components, in order to comprehensively address the issue of WG food availability.

Rosen et al. used a gradual approach to increase the WG content of bread rolls and buns for schoolchildren.¹⁷ They developed WWW and RWW-containing dinner rolls and hamburger buns at 16 levels for RWW and 7 levels for WWW inclusion, and progressed through the levels over the course of a school year at two elementary schools in the Minneapolis, MN area. Consumption remained the same for rolls and buns for both wheat types until 55-70% of refined flour was replaced with WG flour. With the greatest level of WG flour inclusion, consumption decreased by approximately 20%. The researchers used these data to determine the threshold at which students decrease consumption of WG foods, thereby reducing their additional intake of dietary fiber. This information can be used in product development for school cafeteria foods, and the method of gradually increasing WG flour content could prove valuable to school-based nutrition interventions. This study also prompted questions about repeated exposure, and its effect on acceptability among children. It would be interesting to compare product acceptance among children who were previously exposed to samples at several levels of WG inclusion versus children who consumed the products just once. It is possible that the effects of repeated exposure improved intake in this study. As with other cafeteria based studies, larger sample sizes and repeated trials are necessary to verify results.

A study by Chu et al. also compared consumption of foods made with WG flour against traditional school cafeteria foods.¹⁵ To address the issue of WG foods having a higher cost, the researchers used USDA commodity foods in the study. These foods are available to schools at a set cost per student, and therefore do not reflect the higher cost of WG flour. The researchers examined children's consumption and liking of WG pancakes and tortillas, and argued that a simple intervention such as food substitution could be more cost-effective and have greater results than a multi-component approach. Children consumed similar amounts of the WG and RG products, though they did rate some WG products slightly lower in terms of flavor, color, and texture. Notably, the children rated WG products made with WWW flour higher than those made with red

wheat flour, and the same as those made with RG flour. This indicates that an opportunity exists to use WWW flour in applications where RG flour is typically used, thereby increasing children's WG intake.

This study addressed a gap in the Toma et al. study, where WG foods were evaluated scientifically but not rated by children.²⁹ It also addressed the issue of cost by using USDA Commodity foods. The researchers noted that school foodservice personnel were not provided with instructions for handling the WG products, however which may have affected acceptability ratings by students. Brief educational sessions or informational materials for foodservice personnel could help to improve the acceptability of the new products.

The Chef Initiative is a program established by a nonprofit organization in Boston Public Schools. At Chef Initiative schools, school foodservice personnel work with chefs to learn how to prepare palatable, nutritionally balanced meals. Cohen et al. used the Chef Initiative program to compare the content, food selection by students, and plate waste at intervention schools vs. control schools.¹¹⁹ Goals of the program included increasing the number of WG options, decreasing the amount of saturated and trans fat in meals, reducing sodium content, and improving fruit and vegetable options. Data were collected via observation of purchases and aggregate plate waste at all participating schools. Students at Chef Initiative schools selected more WG items than students at control schools. In addition, students who selected WG side dishes consumed 45% more than students at the control schools. This suggests that the improved dietary quality and palatability of lunches has the potential to improve WG intake.

The ability to generalize these findings is limited because the program was in place beforehand and schools were pre-selected based on kitchen size and equipment, so intervention and control schools could not be randomized according to demographic characteristics. However, the demographic makeup of intervention and control schools did not differ significantly. Further, the pilot test nature of the study and limited amount of data collected suggest that the results are preliminary and must be confirmed with greater sample sizes and methodological rigor. Improved palatability should be confirmed by surveying students regarding their liking of the new entrées and side dishes. Finally, a cost analysis of the Chef Initiative meals was not completed. For the

program to be a feasible intervention for improving WG intake, the meals cannot exceed the cost of normal school meals, or a funding source must be identified.

Educational Intervention

Ha et al. conducted a study with college students in an introductory nutrition course.¹²⁰ The students completed a three-day food log at the beginning and end of the course, and data were recorded and analyzed. SCT constructs were used in development of the course materials, with an emphasis on interactive activities that improved self-efficacy and basic nutrition knowledge. The college students tripled their intake of whole grains by the end of the course period, while keeping their overall grain intake consistent. This means that they replaced refined grains with whole grains, which is in keeping with the recommendation from the 2010 Dietary Guidelines for Americans.⁵ Though this study was conducted with college students and not children, transferability to middle or high school children should be considered. A basic nutrition course at the high school or middle school level could improve children's knowledge regarding whole grain foods and improve intake via the personal/behavioral constructs of SCT. The strength of this study is in its novelty and use of an existing framework to measure the effectiveness of nutrition education. Also, food logs are superior to recall data because they are completed as food is consumed and not afterward. Limitations of the study are its use of a convenience sample and lack of a control group. Further research should focus on younger students and include control samples of similar demographic makeup.

Nutritional Value of Restaurant Meals

According to a 2013 National Restaurant Association report based on sales data, Americans now spend 47% of their food dollars on restaurant meals, which has almost doubled from 25% in 1955.¹²¹ Lin and Morrison reported that the average child consumed 33% of his or her calories away from home (2005-2008), and these meals contained far fewer whole grains than at-home meals (0.43 vs. 0.09 ounces per 1,000 calories).¹⁸ Researchers from the USDA's Economic Research Service reported that "FAFH (food away from home) lowers children's diet quality by reducing intake of food groups for which consumption is encouraged, while increasing intake of those that should be consumed in moderation."¹²² Powell and Nguyen used NHANES data from

2003–2008 to analyze the effects of fast-food and full-service restaurant meals on daily total energy intake among children.¹²³ They found that fast-food and full-service restaurant meals, respectively, were associated with an increase in daily total energy intake of 126 and 160 calories for children aged 2–11 and 310 and 267 calories for adolescents aged 12–19.

The negative effects of restaurant meals on children’s dietary intake are not without cause. A recent analysis of children’s meal options at popular chain restaurants by the Center for Science in the Public Interest (CSPI) found that fewer than 5% of menu options conform to U.S. Dietary Guidelines, with 66% containing too much sodium and 55% containing too much saturated fat.¹²⁴ This is an improvement from a similar study done in 2008, which found that only 1% of children’s restaurant meals met U.S. Dietary Guidelines.¹²⁵ These studies only addressed chain restaurants with nutrition information available online or in stores; 50% of restaurants were independently owned. A 2013 study published in the *Journal of the American Medical Association (JAMA)* used bomb calorimetry to analyze 157 meals purchased at independent and small-chain (fewer than 20 locations) restaurants in the Boston area, and reported that these meals actually contained more calories than comparable meals from chain restaurants.¹²⁶ Eating at restaurants will continue to be detrimental to children’s nutritional intake until healthy options exist in greater proportions.

Industry Trends

There are several indicators that the restaurant industry might be headed toward healthier practices and offerings for children. The National Restaurant Association lists the top 20 menu trends in its annual *What’s Hot* list, and the list for 2013 included the following: “healthful kids’ meals,” “children’s nutrition,” “whole grain items in kids’ meals,” “fruit/vegetable children’s side items,” “health/nutrition,” and “half-portions/smaller portions for a smaller price.”¹²⁷ Recently, the CDC analyzed children’s menus at 75 full-service restaurant chains and found that although choice was somewhat limited, healthful children’s meals were not more expensive than meals that did not meet dietary guidelines.¹²⁸ Removing the cost barrier is a key step in encouraging families to order healthier kids’ meals. Finally, a number of national, state, and local programs have appeared in the past two years that encourage restaurants to create and label healthy menu items, for both children and adults. The National Restaurant Association’s *Kids*

LiveWell program sets standards for nutritional content in both entrées and sides for children, and advertises the participating restaurants on their *Healthy Dining Finder* website.¹²⁹ The Healthy Dining Colorado program also uses healthydiningfinder.com to post information about restaurants' meals built around lean protein, vegetables, fruits, whole grains, and low-fat dairy.¹³⁰ Washington D.C.'s Responsible Epicurean Agricultural Leadership (REAL) certification is similar to a Leadership in Energy and Environmental Design (LEED) certification in that it uses third-party verification to assign points to restaurants in a number of healthy dining categories.¹³¹ Hopefully, this increased focus on healthy eating in restaurants will lead to improved menu options for children.

Menu Labeling

The implementation of menu labeling laws for chain restaurants may also lead to healthier menu options for children. In March of 2010, the U.S. Congress passed the nation's first menu labeling law, as part of H.R. 3590, the Patient Protection and Affordable Health Care Act.¹³² Several states and other municipalities had previously passed laws affecting smaller areas of the country,^{133,134} but the Affordable Care Act was the first to address menu labeling nationwide. The FDA proposed guidelines for the new law in 2011,¹³⁵ but the final version has not yet been released and implemented. The rules will apply to all restaurant chains with 20 or more locations, and require that calorie information be posted on menus or menu boards, with additional nutrition information available upon request.¹³⁶

Preliminary studies completed in cities and states with current, active menu labeling laws have shown mixed results. Tandon et al. found that calorie information on a Seattle, WA fast-food menu led parents to make healthier meal choices for their children aged 3–6.¹³⁷ Parents who viewed a McDonald's menu with calorie information chose children's meals with 100 fewer calories than parents whose menus did not include calorie information. However, another study comparing a regulated county (Seattle/King County) with an unregulated one (San Diego County) found no difference in the calorie content of fast food meals ordered by parents of children aged 6–11.¹³⁸ Both of these studies had fewer than 100 participants in the intervention group, so it is possible that a larger sample could yield more conclusive results.

The effects of menu labeling on child and adolescent food choices are also inconsistent. A study with Hawaiian adolescents found that 31 of 106 participants changed their order when viewing a fast food menu labeled with calorie and fat content.¹³⁹ Of the changed meals, 46% were lower in calories than the original meal. Elbel et al. studied 349 low-income children and adolescents at fast food restaurants in New York City before and after the implementation of menu labeling laws, and found no statistically significant differences in calories purchased.¹⁴⁰ A majority of participants (57%) reported seeing the nutrition information, however, and 9% claimed to consider the information when choosing a meal.

The effects of menu labeling laws may depend on how the information is presented. A study of 236 children aged 6–11 found that those who saw fast food menus with a “healthy heart” symbol chose meals with fewer calories and grams of fat than those who just saw the fat and calorie information.¹⁴¹ In a subsequent study, Holmes et al. presented families at a full-service restaurant with four different menus for two months each to gauge how different labeling styles affected meal selection.¹⁴² One menu was labeled with fat and calorie information, another had a “healthy” symbol denoting the choices with the greatest nutritional density, and a third menu included a nutritional value in dollars, based on a completeness score for each item. The fourth menu was a control. Although they did not find any significant differences in the amounts of fat and calories the purchased meals contained, they did see a shift toward à la carte items and away from combo meals. They also saw differences between menu styles, with the “Nutrition Bargain Price” design (the third menu) having the most significant impact.

Regardless of the impact of menu labeling on parent and child meal choices, restaurants themselves may make changes to their children’s meals. A study in King County, Washington found that restaurants were offering moderately healthier entrées 18 months after the implementation of the state’s menu labeling law.¹⁴³ The researchers compared post-implementation data with the nutritional value of the same menu items before the law went into effect, and found that energy, saturated fat, and sodium were reduced significantly, especially at sit-down restaurant chains. A continuation of this trend could increase the number of children’s meals that fall within U.S. Dietary Guidelines.

Meal Selection

Very little has been written about children's meal selection process at restaurants. Margo Wootan, the Director of Nutrition Policy for the Center for Science in the Public Interest, argued that restaurants should improve the default options in children's meals, in order to increase the likelihood that parents and children will make the healthiest choice.¹⁴⁴ Indeed, point-of sale data gathered from 485 Disney-operated restaurant locations in 2008 indicated that when offered a healthier default option (such as apples instead of fries or low-fat milk instead of soda), children and parents stuck with it the majority of the time.¹⁴⁵ Further research with national restaurant chains is needed to confirm these preliminary results.

The Elbel et al. study mentioned earlier surveyed adolescent participants and found that taste was the most important factor in meal selection, with price and nutritional value having much less influence.¹⁴⁰ The adolescents in the study also claimed to choose food for themselves at restaurants, with only 4% acknowledging a caretaker's role in their meal selection (61% of adolescents were not accompanied by a caretaker at the time of the survey). This differed from their meal selection process at home, where 41% said that a caretaker influenced their food choices. These results support qualitative research findings by Bassett et al. which described the co-construction of food choice by adolescents and their parents.¹⁴⁶ While food choice was controlled to an extent by the main grocery shopper in the household, parents responded to child requests and preferences, and sometimes allowed children to choose their own breakfasts and lunches or prepare an alternate meal if they did not want to eat what the rest of the family was eating. A similar study by Holsten et al. identified hunger levels, nutritional knowledge, and the child's own food preparation skills as important factors for home food choice.¹⁴⁷

On a related note, Mata et al. found that parents were good predictors of their children's meal choices.¹⁴⁸ When viewing a two-item school cafeteria menu, parents were able to correctly identify their child's selection 73% of the time. With a four-item menu, they chose correctly 46% of the time. This suggests that assessing child food preference and likely meal selection via parent report is a viable research method.

Data Collection Methods

Direct Meal Observation

Many methods have been used to assess dietary intake of children at mealtimes. While 24-hour recalls rely on children (or parents) to remember foods they have consumed previously, and food frequency questionnaires (FFQ) require an unbiased assessment of a person's dietary pattern, direct meal observation allows researchers to collect real-time information and avoid recall bias. Because of this, direct meal observation is considered the "gold standard" of dietary intake data collection methods, along with weighing plate waste.^{149,150} While weighing plate waste avoids the need for observers to make visual estimates, it also fails to account for shared or discarded food items. Further, direct meal observation has been found to be accurate when compared with weighed plate waste.^{151–154}

Direct meal observation is not without challenges. It can be both time-consuming and expensive, requires training for consistency, and limits the number of children who can be observed simultaneously.¹⁴⁹ An observation protocol should be developed to ensure that observers follow the same process and record the same information, and interobserver reliability (IOR) should be assessed to verify consistency across observations.¹⁵⁰ Simons-Morton and Baranowski define IOR as the comparison of "two simultaneous observations on identification of foods or amounts of each food eaten by a subject."¹⁴⁹ Acceptable level of agreement for IOR has been established at > 85%.^{150,155}

School Meal Observations

Researchers often observe children's meals at school in order to assess dietary intake. While some observers record only the number and type of items consumed, others quantify the portion of each food eaten by the child.¹⁴⁹ Observers in school cafeterias can note standard serving sizes of lunch items and subtract a visual estimate of the amount left on a child's plate in order to determine intake.^{13,149,150} Even when children bring lunches from home, trained observers can successfully record the food items packed and amounts that are consumed.¹⁵⁴ School meal observers also make notes about items that are traded, shared, or discarded, often inspecting tables after children leave for evidence of unrecorded activity.¹⁵⁴ More than one study has indicated that when done unobtrusively, school cafeteria meal observations do not affect the

accuracy of children's dietary recalls, meaning that the awareness of an observer's presence does not affect children's recollection of the meal.^{156,157}

Restaurant Meal Observations

Studies using restaurant-based meal observations to measure dietary intake are limited. Given that 33% of children's meals take place away from home,¹⁸ it makes sense to develop direct meal observation methods that are feasible and accurate in restaurant settings. Certain qualities of school meals, such as the trading and discarding of food items, may be less of a concern in restaurants, while the sharing of foods between family members and the ability to observe meals unobtrusively may be more of a concern. Future researchers can use the aforementioned examples as a starting point for observation protocols built around the unique characteristics of restaurant meals.

Acceptability Ratings by Children

To determine how well a product is liked by consumers, researchers use an acceptance test.¹⁵⁸ This type of test pairs a product with a similar, well-liked or competitive product and uses a hedonic scale to measure degrees of like and dislike. Researchers use the resulting scores to infer preference; the product with the higher score is preferred by the testers. For the best results, acceptance tests should use scales that have equal numbers of positive and negative choices and steps of equal size.¹⁵⁸ Common scales for acceptance tests have nine, seven, or five points, with the middle point being neutral.

Many acceptance tests with children use scales based on work by Peryam and Kroll, two researchers who own a marketing and sensory research firm. In a study published in 1990, the firm established standards for sensory research with children.¹⁵⁹ They found that children 8–10 years old were able to differentiate sensory properties between foods effectively using the standard hedonic scale, a facial hedonic scale, and a new scale commonly referred to as the P&K scale. The P&K scale performed the best in these tests. The researchers also reported that children in this age range were able to complete questionnaires independently, and that both 7- and 9-point scales yielded discriminatory results. Popper and Kroll suggested that sensory research should be completed in the morning when children are most alert, and that the timing of tests should match the foods being tested (e.g., breakfast foods should not be tested at

dinnertime). They argued that face scales can be misleading and can introduce unintended bias, especially in younger children.¹⁶⁰ They also stated that although children can differentiate products equally as well as adults, children tend to give foods higher ratings overall. This may be because adults tend to “reserve” the highest ratings on a scale for a hypothetical perfect future food, while children do not feel the need to do this. The sum of this work indicates that children are effective in rating their liking of different foods, and that they can be an important source of information in product development.

Summary and Specific Aims

Rationale and Significance

Several points are apparent when considering this body of literature as a whole. Whole grain intake among U.S. children is far below recommended levels, despite increased efforts to improve palatability and availability. Significant research suggests a beneficial relationship between WG intake and disease risk, with recent research in children showing promising results for obesity and constipation. Barriers limiting WG intake still exist, but have lessened as WG foods have become more popular in the marketplace and knowledge regarding health benefits has become more common. The 2010 Dietary Guidelines for Americans reflect the changing food landscape by recommending a decrease in consumption of RG foods to facilitate replacement with WG foods.

All of the measured interventions for improving WG intake in children were successful to a certain degree, so it appears that improving WG intake in children is a realistic and feasible goal. There is variety in the techniques used by researchers, however. Some studies focused solely on environmental modifications, while others attempted to influence personal and behavioral factors as well. Many of the studies implemented a small change in the ingredient makeup of common school foods, and found that children consumed similar amounts pre- and post-intervention. Educating school foodservice personnel was effective in increasing the number of whole grain items available to children at meal times. Implementing these changes nationwide, as is

suggested in the new standards for the NSLP and SBP, could have a dramatic impact on whole grain intake of children in the U.S.

There are opportunities to increase the WG content of meals outside the school cafeteria as well. Only two studies focused on foods from children's homes, and none of them mentioned foods from restaurants. Multi-component interventions could continue to refine educational programs for children and parents and determine effective ways of increasing parent participation in extra-curricular activities related to nutrition. A new area of research could focus on changing the restaurant food environment to include more WG foods. A simple substitution of WG flour for RG flour in children's restaurant meals could increase children's WG intake significantly, based on the previous research done in school cafeterias.

The interaction of personal, behavioral, and environmental influences on food intake is incredibly complex. The literature discussed in this review has begun the process of unraveling these interactions and creating interventions designed to work within home and institutional frameworks. Future research can build from these discoveries and create positive change within restaurants that serve U.S. children and their families.

Research Objectives and Hypotheses

This project focused on introducing WG foods to children in a restaurant setting, where they have more options than in a school cafeteria, and their parents influence food selection. The purpose of the first study was to assess the acceptability of WG pizza crust. Acceptability was measured via observed consumption at a sit-down pizza restaurant and a taste test at a local elementary school. The purpose of the second study was to examine attitudes among parents regarding WG foods in general and the likelihood of their children accepting WG foods as part of a restaurant meal. We also asked parents about the factors that contribute to children's meal selection in restaurants. Specific study objectives, hypotheses, and research questions are as follows:

Study I: Motivations of Parents and Children when Choosing Children's Restaurant Meals

(July 2012 to January 2013)

Objectives:

- Examine the motivations of children and parents when choosing children's restaurant meals.
- Assess the likelihood of parents ordering WG items in restaurants and their perception of whether their child would also order these items.
- Explore the attitudes of children and parents toward WG foods in general.

Research questions:

- What is the most important motivating factor in parents' meal selection for their children and what do parents perceive as their child's most important motivating factor?
- Will parents' ranking of other motivating factors, such as value for money and weight control, differ according to their own perceptions and their perception of what would motivate their child?
- Are parents likely to order children's meals containing whole grains?
- Do parents have a knowledge deficit regarding WG foods, and will this be reflected in their attitudes?
- Will parents have a more positive attitude toward WG foods than they perceive their children will have?

Study II: Acceptability of Whole-Grain Pizza Crust in a Restaurant Setting

(July 2012 to April 2013)

Objectives:

- Compare the consumption of pizza crust made with 55% WWW flour to pizza crust made with 100% RG flour made from red wheat.

- Evaluate the liking of pizza crust made with 55% WWW flour and pizza crust made with 100% RG flour.

Hypotheses:

- Pizza crust made with 55% WWW flour will be consumed at the same level as pizza crust made with 100% RG flour when served to children at a sit-down pizza restaurant.
- Elementary school children will rate liking of pizza crust made with 55% WWW flour the same as pizza crust made with 100% RG flour when they taste the two crusts side-by-side.

This thesis contains two manuscripts, which are presented in Chapters II and III. The Appendix contains a survey used during the course of the project.

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Table

Table 1.2. Matrix of previous whole grain studies with children.

Study	Participants	Intervention Components	WG Goals/Objectives	Measures	Outcomes
Burgess-Champoux et al., 2008 ¹³	<ul style="list-style-type: none"> Parent/child pairs from 4th and 5th grades at two Minneapolis suburban elementary schools. 67 in intervention group and 83 in control group. 	Cafeteria changes Classroom activities Family involvement	Increase WG intake by 4 th and 5 th grade children.	<ul style="list-style-type: none"> Dietary intake via observation. Psychosocial variables for children via questionnaire. Psychosocial variables for parents via questionnaire. 	<ul style="list-style-type: none"> WG intake increased by one serving and RG intake decreased by one serving in the intervention compared to control group. Child knowledge increased. Parent RG intake decreased.
Gillis et al., 2009 ⁸⁴	<ul style="list-style-type: none"> 6th grade students from 42 middle schools across the U.S. 21 intervention schools and 21 control schools. 	Cafeteria changes Classroom activities Family involvement School personnel	Increase the availability of higher fiber, grain-based foods and legumes.	<ul style="list-style-type: none"> Product nutrition and sales data collected by researchers. Nutrient analysis via NDSR. 	<ul style="list-style-type: none"> Increased grams of fiber served in intervention schools. Did not change servings of WG foods per student. Did not change NSLP; only SBP.
Sweitzer et al., 2010 ¹¹⁷	<ul style="list-style-type: none"> Parent/child pairs from 6 childcare centers in Texas. 3 intervention centers and 3 control centers. 	Classroom activities Family involvement School personnel	Increase servings of WG sent in from home in lunches.	Number of servings of WG foods, via observation.	Servings of WG increased in both groups, but to a much greater degree in the intervention group ($p < 0.001$).
Chan et al., 2008 ¹⁶	638 students in 1 st -6 th grades at one suburban	Cafeteria changes	Increase consumption of WG by substituting WG	<ul style="list-style-type: none"> Consumption of pizza, via plate waste. Liking of pizza, via ratings 	<ul style="list-style-type: none"> No difference in consumption. No difference in liking.

Study	Participants	Intervention Components	WG Goals/Objectives	Measures	Outcomes
	Minneapolis elementary school.		flour for RG flour in pizza crust.	by children.	<ul style="list-style-type: none"> 5th and 6th graders consumed nearly a whole serving of WG.
Toma et al., 2009 ²⁹	466 students in K-6 th grade at an elementary school in California.	Cafeteria changes	Evaluate quality of WG burritos and cookies.	<ul style="list-style-type: none"> Consumption, via plate waste. Sensory qualities, via specific tests for each quality examined. 	<ul style="list-style-type: none"> Consumption did not differ for cookies or burritos. WG products were softer, moister, and heavier than RG products.
Roth-Yousey et al., 2009 ⁸⁶	211 women from school districts in Minnesota.	School personnel	Develop and test an education program for foodservice personnel, in order to increase WG foods offered to school children.	<ul style="list-style-type: none"> WG knowledge, attitudes, and intentions, via survey. WG foods served to children, via survey. 	<ul style="list-style-type: none"> Knowledge and intention improved, but some attitudes were worse. More WG foods were available for children.
Rosen et al., 2008 ¹⁷	600 students in K-6 th grades in the Minneapolis metropolitan area.	Cafeteria changes	Test a gradual approach to increasing WG content of school cafeteria foods, with both red and white whole wheat flours.	Consumption of products, via plate waste.	<ul style="list-style-type: none"> Intake of rolls did not differ from the baseline level up to 59% RWW and 45% WWW. Children's intake of WG increased to almost a full serving.
Chu et al., 2011 ¹⁵	Elementary, middle, and high school students from Texas and Minnesota.	Cafeteria changes	Compare acceptance of WG pancakes and tortillas made with red and white whole wheat to RG versions at school	<ul style="list-style-type: none"> Consumption of products, via plate waste. Liking of products, via ratings by children. 	<ul style="list-style-type: none"> Consumption of all types of WG pancakes was similar to RG pancakes. Consumption of WWW tortillas was lower than RG tortillas. Liking of RWW pancakes

Study	Participants	Intervention Components	WG Goals/Objectives	Measures	Outcomes
			lunch.		<p>was lower than RG pancakes, but liking of WWW pancakes was similar.</p> <ul style="list-style-type: none"> Liking of WWW tortillas was lower than RG tortillas.
Cohen et al., 2012 ¹¹⁹	<ul style="list-style-type: none"> Middle school students at 19 schools in the Boston area. 1,609 students at intervention schools and 1,440 students at control schools. 	Cafeteria changes	Increase WG and fiber served to students, while improving palatability of meals.	<ul style="list-style-type: none"> Healthfulness of foods, via nutrition information. Amounts of food discarded, via plate waste. Percentage of students selecting items, via observation. 	<ul style="list-style-type: none"> Intervention schools served healthier meals, and consumption of these meals was the same as meals at control schools. More WG were selected by students at intervention schools.
Ha et al., 2011 ¹²⁰	80 college students, 18–24 years old, at a Midwestern university.	Classroom activities	Determine whether college students increased WG consumption after completing an interactive introductory nutrition course.	<ul style="list-style-type: none"> Dietary WG intake, via 3-day food logs. Dietary sources of WG, via 3-day food logs. 	<ul style="list-style-type: none"> WG intake increased from 10% of grains to 38% of grains. Number of sources of WG also increased, from 7 to 11.

**Chapter 2: Parental Attitudes and Perceptions of
Restaurant Meal Selection Priorities: Implications for
Whole Grain Children's Meals**

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Summary

Objectives

This study explored 1) attitudes among parents regarding whole grain pizza crust and whole grain foods in general, and the likelihood of parents ordering a whole grain entrée for their child. The study also assessed 2) parental perceptions of their child's meal selection priorities and likelihood that their child would order a whole grain entrée. Lastly, this study examined 3) the association between parental attitudes and the likelihood that they would order whole grain restaurant entrées for their child.

Methods

Parents of children 8–12 years old (n=253) were recruited at the Minnesota State Fair (n=76) and via Amazon Mechanical Turk (n=177) to respond to a survey regarding meal selection in restaurants and whole grain foods. Items were designed to address all three components of the reciprocal determinism construct of Social Cognitive Theory and to inform a concurrent intervention at a sit-down pizza restaurant chain.

Results

Parents saw themselves as more likely to order whole grain versions of popular children's meals than their children. Parental attitudes toward whole grain foods were generally positive, though they rated their children's attitudes less positively. Parent likelihood and perception of their children's likelihood of ordering whole grain children's entrees were correlated. A positive association existed between parental attitudes toward whole grain foods and parental likelihood of ordering whole grain children's entrées for their children ($p < 0.05$).

Conclusions and Implications

Restaurant interventions may be successful if they consider the priorities of both parents and children when promoting whole grain children's entrees. Future research should use a number of different techniques to improve children's food environment and influence their food selection behaviors.

Introduction

Significant research indicates that regular consumption of whole grains can reduce a person's risk of heart disease,¹⁻³ diabetes,^{1,4,5} obesity,^{1,6,7} and certain types of cancer.⁸⁻¹¹ The 2010 Dietary Guidelines for Americans recommend that U.S. citizens consume at least 50% of total grains as whole grains, and call for a concomitant reduction in intake of refined grains.¹² However, analysis of 1999–2004 National Health and Nutrition Examination Survey (NHANES) data showed that fewer than five percent of children and adolescents consumed the recommended three ounce-equivalents per day, and the average American child consumed less than one serving of whole grains per day.^{13,14} Though these data are 10 years old, the most recent data from NHANES (2009–2010) showed almost no change in whole grain consumption on the part of children and adolescents.¹⁵ The updated average whole grain consumption among 3124 participants was 0.57 servings per day.¹⁵

The Center for Science in the Public Interest (CSPI) recently found that fewer than 5% of children's menu options at popular chain restaurants conformed to U.S. Dietary Guidelines.¹⁶ The USDA Economic Research Service reported that the average child consumes 33% of his or her calories away from home, and these meals contain far fewer whole grains than at-home meals (0.43 vs. 0.09 ounces per 1,000 calories) based on national data collected from 2005-2008.¹⁷ These findings support a Whole Grains Council report on whole grain foods availability in chain restaurants.¹⁸ Though 11 of 30 top U.S. chains served at least one whole grain food, these foods were either marketed toward adults or only available as substitutions. In contrast, the 2013 *What's Hot* list from the National Restaurant Association included the following trends: "healthful kids' meals," "children's nutrition," "whole grain items in kids' meals," and "fruit/vegetable children's side items."¹⁹ This focus on healthy eating may eventually lead to improved children's menu options and increased availability of whole grain foods.

Researchers need to understand the determinants of children's eating behavior in order to develop effective interventions. To this end, interventions to improve dietary intake are often developed in the context of Social Cognitive Theory (SCT).²⁰ SCT explains human behavior in terms of personal, behavioral, and environmental influences that interact in a reciprocal manner. Current research provides moderate evidence that

psychosocial and environmental factors influence children's intake of whole grains, and several interventions have attempted to improve whole grain intake by manipulating these factors.²¹⁻²³ Recent interventions have addressed personal constructs (self-efficacy and outcome expectancies), behavioral influences (knowledge and food choice), and environmental factors (whole grain availability).²⁴⁻²⁶

Most meal selection studies in restaurants are intended to determine differences in ordering behaviors pre- and post-implementation of menu labeling laws.^{27,28} Very few have addressed the importance of multiple factors in meal-purchasing decisions, especially with children's meals.^{28,29} Parental influence on children's restaurant meal choice is not well understood, though research has established that children's food preferences are in part shaped by their parents.^{30,31} Elbel et al. surveyed adolescents at fast food restaurants and found that taste was the most important factor in meal selection, with price and nutritional value having much less influence.³² The adolescents in the study also claimed to choose food for themselves, with only 4% acknowledging a caretaker's role in their meal selection (61% of adolescents were not accompanied by a caretaker at the time of the survey). To our knowledge, similar studies do not exist with younger children.

Though substituting whole grains for refined grains in school meals has been effective in increasing whole grain intake in children, it has generally been accomplished without children's knowledge of the substitution.^{23,26,33} Determining parent and child attitudes toward whole grain foods is necessary to predict the success of whole grain-based entrées on children's menus, and current knowledge in this area is limited. The purpose of this study was to determine the most important factors contributing to children's meal selection in restaurants, from a parental perspective, in order to inform a concurrent intervention at a Midwestern restaurant chain.³⁴ Our survey examined 1) attitudes among parents regarding whole grain pizza crust and whole grain foods in general, and the likelihood of parents ordering a whole grain entrée for their child. The survey also assessed 2) parental perceptions of their child's meal selection priorities and likelihood that their child would order a whole grain entrée. Lastly, this study examined 3) the association between parental attitudes and the likelihood that parents would order whole grain restaurant entrées for their child.

Methods

Subjects

Parents (n=40) of children 8–12 years old were recruited in the development phase to pretest the survey via social media. Another group of parents was recruited to complete the final version of the survey either in person at the Minnesota State Fair or via a crowdsourcing Internet marketplace called Amazon Mechanical Turk (MTurk).³⁵

Parents participating in the pretesting process were recruited over the course of one week via social media sites (Facebook and Twitter) with the following post: "If you are a parent with a child between the ages of 8 and 12, you are eligible to complete the linked survey for a chance to win a \$200 Amazon gift card." Participants were directed to SurveyMonkey to complete the survey, and were asked via an email message sent 10 days later to complete the survey a second time using a link to SurveyMonkey. SurveyMonkey is a web-based tool that allows users to create, manage, and distribute surveys through e-mail, websites, or social media.³⁶ Twenty-eight of 40 respondents completed the survey twice within a 10-day to 2-week period.

Parents (n=76) who completed the final version of the survey in person were recruited by investigators at a table in the 4H building at the Minnesota State Fair. Parents completed the survey on paper while their children participated in activities. The survey was advertised on two large signs as a "University of Minnesota Research Study" and respondents who completed it were entered in a drawing to win an iPad.

The online version of the survey was administered through Amazon MTurk and SurveyMonkey (n=177). Paolacci et al. described MTurk as "an online labor market where employees (called *workers*) are recruited by employers (called *requesters*) for the execution of tasks (called *HITs*, acronym for Human Intelligence Tasks) in exchange for a wage (called a *reward*)." The survey was visible to MTurk workers who lived in the United States, had a HIT approval rate higher than 95% (fewer than 5% of their submissions were rejected for any reason), and had completed 1,000 or more approved HITs. The HIT was titled "Answer a survey about whole grain kids' meals in restaurants" and described as "This survey is intended for parents of children 8–12 years old." When workers accepted the HIT, they were directed to SurveyMonkey to give their consent and take the survey. They were then required to enter a completion code in Amazon

MTurk to prove they had responded to the entire questionnaire. The first survey question asked workers to select the number of children they had between 8 and 12 years of age. Workers who entered “0” were redirected to a “thank you” page and eliminated from the survey results. This study was approved by the University of Minnesota Human Subjects committee with informed consent procedures.

Measures

Survey Development

This survey was designed to inform an intervention project in a Midwestern sit-down pizza restaurant chain.³⁴ All survey items were developed by the investigators to assess frequency of dining in pizza restaurants, restaurant meal selection priorities, likelihood of ordering whole grain restaurant entrées, and attitudes regarding whole grain foods. For most categories, items were developed to assess parental perceptions of their own attitudes and behaviors and those of their child. Meal selection priorities were based on a survey by Tandon et al. that examined the importance of several factors in food and beverage choice for families in fast-food restaurants.²⁷ Items were also developed to address all three components of the reciprocal determinism construct of SCT: parental influence on child meal selection is a component of the child’s social environment, an individual’s taste preferences and ranking of meal selection factors addresses the personal component, and a parent or child’s likelihood of ordering specific meals represents a behavioral intention.

Background information on typical restaurant use

Parents were asked how often they ate at a sit-down pizza restaurant, who selected their child’s meal (parent, child, or parent and child together), and how often they ate part of their child’s meal when dining out.

Meal selection priorities

Meal selection priorities for children’s meals, such as “taste” and “value for money” were assessed via a 5-point scale ranging from 1 = *Not important at all* to 5 = *Extremely important*. Parents were instructed to respond for themselves in one set of priorities, and then respond based on how they thought their child would answer in the next set of the same priorities.

Likelihood of ordering whole grain foods in restaurants

Parents were also asked to rate their likelihood of ordering four different whole grain entrées for their child (pizza, hamburger, chicken tenders, pasta) via a 5-point scale ranging from 1 = *Very unlikely* to 5 = *Very likely*. They then rated their perception of the likelihood of their child choosing the same entrées. Items based on parental perceptions of their own likelihood and their child's likelihood were scaled separately by summing across responses to each item and dividing by the total number of items.

Attitudes toward whole grain foods

To assess parental attitudes and perceptions of child attitudes toward whole grain pizza crust and whole grain foods in general, parents were asked to rate their agreement with a final set statements ("I like whole grain foods," "My child likes whole grain foods") via a 5-point scale ranging from 1 = *Strongly disagree* to 5 = *Strongly agree*. An attitude scale was created by summing across responses to each item and dividing by the total number of items. One item was reverse-coded to maintain the same directionality as the remaining items.

Demographic information

Parents also completed demographic items regarding their age, gender, race/ethnicity, education, marital status, and employment status.

Pretest Procedures

The survey was pretested to measure internal consistency and test-retest reliability. Participants were directed to SurveyMonkey to complete the survey, and were e-mailed 10 days later with a link to complete the survey a second time.

Data Processing and Statistical Analysis

Survey responses on paper were entered into SurveyMonkey by the lead author (AT), using a 10% audit process to reduce errors. All data were analyzed using SAS version 9.3 (Cary, NC), with comparisons made at $\alpha = 0.05$. Pretest responses were compared via Spearman correlation.³⁷ Cronbach α correlation coefficients were used to determine internal consistency.³⁸

For the responses to the final survey items, descriptive statistics (frequencies/means) were used to assess responses to individual items and scales.

Spearman correlation analysis was used to determine which scales were significantly correlated with one another. PROC GLM was used to determine whether the parent's likelihood of ordering whole grain entrées for their child (dependent variable) was associated with their attitudes toward whole grain foods (independent variable), controlling for age, race, gender, marital status, and employment status.

Results

Pretest

The pretesting group of parents was fairly homogenous: 96% were Caucasian, 89% were married, 82% were female, 61% were employed full-time, and 89% had earned a Bachelor's degree or more. Cronbach α coefficients used to assess internal consistency of scales ranged from 0.66 to 0.84 after two items were removed, which were considered acceptable.³⁸ All Spearman correlation values for individual items and scales were within the acceptable range (0.40–0.73) for items that neither compared two groups nor measured change over time, indicating acceptable test-retest reliability.³⁷

Final Survey Responses

Seventy percent of respondents accessed the survey through Amazon MTurk and 30% took the survey in the 4H building at the Minnesota State Fair. Demographic information for these groups and the overall sample is shown in Table 2.1. Those completing the survey online averaged three minutes to respond, while those completing the survey in person took an average of eight minutes to respond. Sixty-seven percent of respondents were female and 83% were Caucasian. Thirty-seven percent indicated their age range as "18–34 years" and 60% as "35–54 years." Survey respondents were well educated. Thirty-six percent had earned a Bachelor's degree and 15% had earned a Master's, professional, or Doctorate degree. Sixty-one percent were employed full-time, and 75% were married. The respondents from Amazon MTurk were younger and more racially/ethnically diverse, and more were male (40% versus 16%) than in the State Fair sample. Amazon MTurk respondents were also more likely to be single and not employed for wages and were less educated than respondents in the State Fair sample.

Most parents selected "monthly" or "several times a year" as the frequency with which they dined at a sit-down pizza restaurant. Seventy-eight percent indicated they

and their child usually selected the child's meal together, and 85% indicated they "never" or "sometimes" ate a portion of their child's meal.

Results for meal selection priorities are shown in Table 2.2. Parents overwhelmingly chose "taste" as the most important meal selection priority for both themselves and their children. "Value for money" and "nutrition/healthfulness" were also important for parents, while most parents indicated that "what other kids order" was not at all important. Aside from "taste," parents saw their children's priorities as different from their own. Most indicated that "value for money," "nutrition/healthfulness," and "weight control" did not factor into their children's meal selection decisions. They also indicated that restaurant sales or promotions would not influence their children.

Parents rated their likelihood and their children's likelihood of ordering whole grain versions of common children's menu items (Table 2.3). For all four foods listed, parent perceptions of their child's likelihood of ordering them were clustered near the center of the scale, or "neutral." Interestingly, parents saw themselves as more likely to order these meals for their children, especially pizza with whole grain crust.

The attitudinal part of the survey asked parents to rate their agreement with 11 statements related to whole grain foods or whole grain pizza crust, specifically (Table 2.4). Parents overwhelmingly agreed that whole grain pizza crust is healthier than regular pizza crust. Most also indicated that they liked whole grain foods, though fewer indicated that their children liked whole grain foods. In fact, when asked how their children felt about the flavor and chewiness of whole grain pizza crust, most parents responded neutrally. Almost 90% of parents agreed or strongly agreed with the statement, "I would like the menu to tell me if the pizza crust contains whole grains." Most parents also agreed or strongly agreed that they like their children to try new foods, though fewer indicated that their children like to try new foods.

Correlations between scales for parent responses and parents' perceptions of their children's responses for likelihood of ordering whole grain entrées were significant ($r=0.54$, $p<0.0001$). The multivariate linear regression analysis showed that the likelihood of ordering whole grain entrées was associated with whole grain attitudes ($r=0.46$, $p<0.0001$). Parent gender was also significantly associated, with women having a higher likelihood of ordering whole grain meals for their child compared to men.

Discussion

Parents saw their children's meal selection priorities as different from their own. Aside from the "taste" variable, ratings of importance for all priorities differed between parents' own responses and how they responded for their children. Parents' responses for their children were consistent with the limited previous research in this area.^{29,32} Taste appears to be the most important factor for most children and adolescents, while nutritional value holds little influence. The importance of cost may differ with a child's age and whether they are accompanied by a parent. Adolescents in previous studies have attributed higher importance to the cost of food items when they are alone and financially responsible for their choices.^{28,32}

Mata et al. found that parents were good predictors of their children's meal choices.³⁹ When viewing a two-item school cafeteria menu, parents were able to correctly identify their child's selection 73% of the time. With a four-item menu, they chose correctly 46% of the time. These results suggest that assessing child food preference and likely meal selection via parent report is a viable research method, though the current study was not evaluated against children's responses. Further research could apply this method to meal selection in restaurants, where the greater number of options may affect prediction accuracy.

Parents' attitudes and perception of their children's attitudes toward whole grain foods may be predictive of meal selection behaviors. This is consistent with research showing that children's eating behaviors are strongly influenced by their parents.^{30,31} Increased efforts by parents to select whole grain meals in restaurants and serve whole grain meals at home could improve children's acceptance of and preference for whole grain foods, via a change in their physical and social environment. Future studies could explore this relationship via assessment of meal choice behaviors and attitudes toward whole grain foods in parent-child pairs.

Parents indicated that they visited sit-down pizza restaurants "monthly" or "several times a year," and this may have been influenced by their geographic location and whether they lived in an urban or rural area. In order to expand the influence of restaurant interventions involving whole grains and improve children's food environment to a greater degree, other entrées should be reformulated in a similar fashion to the

pizza crust in the companion project to this survey.³⁴ Hamburger buns, chicken tenders, and pasta are served at a wide variety of full-service, fast food, and fast-casual restaurants, and improving the nutritional value of these foods could have a more significant impact than a single redeveloped food at a single type of restaurant. These foods may be highly acceptable to parents and children, as indicated by the responses to the survey conducted in the current study.

This study has a major strength in that it directly addressed an aspect of parent-child interaction that has rarely been examined. While previous studies have focused on restaurant meal selection behaviors to a certain degree, most were focused on changes due to menu labeling^{28,32} and did not assess parent and child priorities from a parental perspective. Additionally, this is the first study to examine parental attitudes toward whole grain restaurant entrées. Considering the children's menu trends mentioned earlier, this preliminary study provides a foundation for important future work.

The use of Amazon MTurk for data collection could be considered a limitation of this study, though recent work by Paolacci et al. argued several strengths of the service.⁴⁰ The researchers found that MTurk workers skewed female and toward a high level of education, but were overall at least as representative of the U.S. population as a typical university research sample. The researchers also compared a group of MTurk workers with an in-person subject pool, and found that MTurk data quality was high and the two groups' responses were not significantly different. The sample in the current study was not diverse and this may have affected our results. However, because most of the demographic characteristics were different among the State Fair and MTurk respondents, combining the sample may have increased the likelihood that the overall sample was more representative of a broader group of U.S. parents. While there's no way to know where the MTurk workers were when they completed the survey, parents at the Minnesota State Fair may have been distracted by their children or noise within the building. Finally, it would have been useful to compare parents' perceptions of their children's attitudes and behavior with actual data from their children. Future research should address this limitation.

Implications for Research and Practice

Future research should explore a variety of methods for introducing whole grain children's entrées in restaurants. Many factors influence food selection and eating behaviors in children, therefore addressing this issue from multiple angles is necessary. Parental modeling of whole grain meal selection would affect a child's social environment, and having whole grains available in a greater variety of products would affect the physical environment. Understanding children's top priorities (taste, menu photos, and what they usually order, in this study) could help researchers design effective interventions that appeal to the personal component of the SCT reciprocal determinism construct. Offering samples of attractive, familiar whole grain foods may influence children to choose and consume greater amounts of these foods. Finally, interviewing children regarding their behavioral intentions during the meal selection process could elucidate relationships between food knowledge, familiarity and routine, and food choice.

In an accompanying intervention study, whole grain pizza crust was well accepted and liked by children. A 55% white whole wheat pizza crust was developed to replace the 100% refined grain children's pizza crust at Green Mill restaurants. Consumption data collected before and after the introduction of the new crust showed that children consumed approximately equal amounts of both crusts (42.1% whole grain vs. 44.6% refined grain, $p=0.55$). A taste test was conducted with elementary school children, and liking ratings were similar for pizzas made with the two crusts ($p=0.47$). These results support the ranking of children's meal selection priorities reported by parents in this study. Children were unaware that the pizzas contained whole grains, but the taste and appearance of the crust was acceptable enough that consumption was not affected. The redeveloped crust may have been close enough to Green Mill's original crust that children who had eaten the refined crust previously (as their "usual order") could not tell the difference between the two.

This research has identified an area of eating behavior where parent and child priorities are likely to differ. Because children are active and important participants in the meal selection process, restaurants may be successful in introducing whole grain children's entrées if they describe and advertise them in a way that appeals to both

parents and children. Though a focus on nutrition and value may attract parents, offering samples or prominently featuring menu photos may be a better method of influencing children. A combined approach may be necessary to overcome parents' perceived barriers to increasing their children's whole grain intake.

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Tables

Table 2.1 Demographic information for respondents, by source.	Overall	State Fair	Amazon MTurk	P-value ¹
	n (%)			
Age				<0.001
18-34 years old	93 (36.8)	4 (5.3)	89 (50.3)	
35-54 years old	152 (60.1)	69 (90.8)	83 (46.9)	
55-64 years old	4 (1.6)	1 (1.3)	3 (1.7)	
65 years or older	1 (0.4)	1 (1.3)	0 (0.0)	
Gender				0.001
Female	170 (67.2)	64 (84.2)	106 (59.9)	
Male	83 (32.8)	12 (15.8)	71 (40.1)	
Race				0.005
White	209 (82.6)	74 (97.4)	135 (76.3)	
Hispanic or Latino	11 (4.4)	1 (1.3)	10 (5.7)	
Black or African American	19 (7.5)	1 (1.3)	18 (10.2)	
Native American or American Indian	2 (0.8)	0 (0.0)	2 (1.1)	
Asian / Pacific Islander	10 (4.0)	0 (0.0)	10 (5.7)	
Other	2 (0.8)	0 (0.0)	2 (1.1)	
Education				0.001
Some high school, no diploma	4 (1.6)	0 (0.0)	4 (2.3)	
High school graduate, diploma or the equivalent	21 (8.3)	3 (4.0)	18 (10.2)	
Some college credit, no degree or trade/technical/vocational training	64 (25.3)	8 (10.5)	56 (31.6)	
Associate degree (2-year)	32 (12.7)	14 (18.4)	18 (10.2)	
Bachelor's degree	92 (36.4)	36 (47.4)	56 (31.6)	
Master's, Professional or Doctorate degree	39 (15.4)	15 (19.7)	24 (13.6)	

Table 2.1 Demographic information for respondents, by source, continued.	Overall	State Fair	Amazon MTurk	P-value ¹
	n (%)			
Marital status				0.003
Single, never married	39 (15.4)	3 (4.0)	36 (20.3)	
Married or domestic partnership	188 (74.3)	66 (86.8)	122 (68.9)	
Widowed, divorced, separated	25 (9.9)	7 (9.2)	18 (10.2)	
Employment status				0.311
Employed for wages	154 (60.9)	51 (67.1)	103 (58.2)	
Self-employed	43 (17.0)	8 (10.5)	35 (19.8)	
Out of work and looking for work	12 (4.7)	3 (4.0)	9 (5.1)	
A homemaker	32 (12.7)	14 (18.4)	18 (10.2)	
A student	8 (3.2)	0 (0.0)	8 (4.5)	
Military	2 (0.8)	0 (0.0)	2 (1.1)	
Retired	1 (0.4)	0 (0.0)	1 (0.6)	
Total	253 (100.0)	76 (30.0)	177 (70.0)	

¹P-value for differences between State Fair and MTurk participants according to chi square tests (P<0.05).

Table 2.2 Parent perceptions of parent and child meal selection priorities.	Not at all/slightly important	Moderately important	Very/extremely important
	n (%)		
Taste¹			
Parent	10 (3.0)	26 (10.4)	215 (85.6)
Child	11 (4.4)	18 (7.1)	223 (88.5)
Value for money			
Parent	9 (6.8)	46 (18.3)	189 (75.0)
Child	194 (78.6)	25 (10.1)	28 (11.4)
Nutrition/healthfulness			
Parent	31 (12.4)	66 (26.3)	154 (61.4)
Child	186 (75.0)	37 (14.9)	25 (10.1)
Speed of service			
Parent	50 (19.9)	105 (41.2)	96 (38.3)
Child	113 (45.2)	56 (22.4)	81 (32.4)
Special occasion/treat			
Parent	63 (25.4)	87 (35.1)	98 (39.0)
Child	68 (28.1)	63 (25.6)	115 (46.7)
Weight control			
Parent	109 (44.5)	66 (26.9)	70 (28.6)
Child	213 (86.9)	19 (7.8)	13 (5.4)
Usual order			
Parent	107 (43.0)	84 (33.7)	58 (23.3)
Child	51 (20.6)	66 (26.6)	131 (52.8)
Promotion (advertised deal)			
Parent	116 (46.4)	76 (30.4)	58 (23.2)
Child	159 (64.6)	52 (21.1)	35 (14.3)

¹Priorities are listed in order of parent importance.

Table 2.2, continued. Parent perceptions of parent and child meal selection priorities.	Not at all/slightly important	Moderately important	Very/extremely important
	n (%)		
Menu photos			
Parent	144 (57.2)	65 (25.8)	43 (17.1)
Child	56 (22.4)	57 (22.7)	138 (55.0)
What other kids order			
Parent	209 (83.3)	25 (10.0)	17 (6.8)
Child	91 (28.0)	61 (24.3)	97 (38.6)

¹Priorities are listed in order of parent importance.

Table 2.3 Parent likelihood and perceptions of child likelihood of ordering whole grain children's meals.	Very unlikely/unlikel y	Neutral	Likely/very likely
	n (%)		
Pizza crust			
Parent	25 (10.0)	34 (13.5)	193 (76.6)
Child	87 (35.0)	64 (25.7)	98 (39.4)
Hamburger bun			
Parent	37 (14.3)	41 (16.3)	174 (69.0)
Child	98 (39.5)	65 (26.2)	85 (34.3)
Chicken tenders (breeding)			
Parent	36 (14.4)	51 (20.5)	162 (65.1)
Child	99 (40.3)	63 (25.6)	84 (34.1)
Pasta			
Parent	36 (14.3)	49 (19.4)	167 (66.2)
Child	112 (45.0)	69 (27.7)	68 (27.3)

Table 2.4 Parent and child attitudes toward whole grain foods.	Strongly disagree/ disagree	Neutral	Agree/ strongly agree
	n (%)		
I like my child to try new foods. ¹	4 (1.6)	10 (4.0)	239 (94.5)
I would like the menu to tell me if the pizza crust contains whole grains.	8 (2.4)	20 (8.0)	223 (88.8)
Whole grain pizza crust is healthier than regular crust.	10 (4.0)	24 (9.5)	219 (86.6)
I like whole grain foods.	18 (7.2)	24 (9.6)	208 (83.2)
If my child doesn't like whole grain pizza crust, it will be a waste of money to order it at a restaurant.	32 (12.9)	46 (18.6)	169 (68.4)
My child likes to try new foods.	61 (24.2)	55 (21.7)	137 (54.2)
I am getting more for my money if my child's meal contains whole grains.	40 (16.1)	78 (31.5)	130 (52.4)
My child likes whole grain foods.	41 (16.2)	85 (33.6)	127 (50.2)
Ordering a new food at a restaurant is a good way to see if my child will eat it before purchasing it for home use.	69 (27.6)	64 (25.6)	117 (46.8)
My child likes the flavor of whole grain pizza crust.	39 (16.5)	109 (46.0)	89 (37.6)
My child likes the chewiness of whole grain pizza crust.	54 (22.8)	105 (44.3)	78 (33.0)

¹Statements are listed in order of parent agreement.

Chapter 3: Acceptability of Whole Grain Pizza Crust by Children in a Restaurant Setting

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Summary

Objectives

Acceptability of whole grain pizza crust was assessed via observation among children in a restaurant setting. Additionally, a side-by-side taste test was conducted with children in the 3rd–5th grades.

Methods

A 55% whole grain pizza crust made with white wheat was developed to replace refined grain children's pizza crust at Green Mill restaurants (a Midwest US chain). Consumption by children was observed by researchers (n=6) in five restaurant locations in the Minneapolis/St. Paul, MN metropolitan area over six months, with high inter-rater reliability (IOR >0.86). Data were collected before (n=194) and after (n=200) the new crust was introduced. Pre- and post-intervention consumption data were compared via t-tests. Children (n=120, grades 3–5) at one elementary school in the same metropolitan area tasted the original, refined grain crust alongside the whole grain crust and rated their liking of each product on a five-point scale. Data were compared via a paired t-test.

Results

Children consumed as much of the whole grain crust (42.1%) as the original, refined grain crust (44.6%) (p=0.55), based on an average adult serving size of 350–400g. Liking ratings for both types of pizza were high and did not differ by type (p=0.47), which supported the observation results.

Conclusions and Implications

Children liked the whole grain crust as well as the refined and ate the whole grain pizza in amounts similar to the refined grain pizza in a restaurant setting. These are important outcomes that could serve as the foundation for future work with large, national restaurant chains.

Introduction

Whole grain foods are nutritionally superior to refined grain foods because they contain greater amounts of dietary fiber, antioxidants, some vitamins and minerals, and other compounds known to lessen the risk of chronic diseases.¹ Numerous studies show that a diet rich in whole grains can reduce risk of heart disease,²⁻⁴ diabetes,^{2,5,6} obesity,^{2,7,8} and certain types of cancer.⁹⁻¹² The 2010 Dietary Guidelines for Americans call for a reduction in the number of servings of refined grains, and recommend that U.S. citizens consume at least 50% of total grains as whole grains.¹³ However, analysis of 1999–2004 National Health and Nutrition Examination Survey (NHANES) data showed that fewer than five percent of children and adolescents consumed the recommended three ounce-equivalents per day, and the average American child consumed less than one serving of whole grains per day.^{14,15} The most recent data from NHANES (2009–2010) showed almost no change from previously reported consumption averages.¹⁶ The 3124 children and adolescents surveyed consumed an average of only 0.57 servings of whole grains per day.¹⁶

Studies by Larson et al.¹⁷ and Burgess-Champoux et al.¹⁸ cited familiarity and taste preference as important factors in determining children's acceptance of new foods.^{17,18} In general, children tend to avoid bitter-tasting foods and prefer sweeter and saltier foods than adults.^{19,20} Genetic differences in sensitivity to the bitter flavor compound 6-n-propylthiouracil can affect the degree to which children consume some vegetables,²¹ and one study showed similar results with whole grains in adults.²² Researchers have used flavor-flavor learning to elicit a Pavlovian-type response in children by causing them to associate new flavors with flavors they already know and like.²³ When familiar foods are paired with new foods, children tend to eat more of the new foods and also report greater liking, as seen in two studies that paired familiar dips with novel vegetables or chips.^{24,25} This method also works when a liked flavor is simply used to enhance a newly introduced food. Several studies have shown that children find new vegetables more acceptable when they are flavored with sugar.^{23,26}

A recent analysis of children's meal options at popular chain restaurants by the Center for Science in the Public Interest (CSPI) found that less than 5% of menu options conform to U.S. Dietary Guidelines, with 66% containing too much sodium and 55%

containing too much saturated fat.²⁷ Lin and Morrison reported that the average child consumed 33% of his or her calories away from home, and these meals contained far fewer whole grains than at-home meals (0.43 vs. 0.09 ounces per 1,000 calories) based on national data collected from 2005-2008.²⁸ In contrast, the 2013 *What's Hot* list from the National Restaurant Association included the following: "healthful kids' meals," "children's nutrition," "whole grain items in kids' meals," fruit/vegetable children's side items," "health/nutrition," and "half-portions/smaller portions for a smaller price."²⁹ It appears that nationwide food trends have yet to affect the average daily intake of whole grains among children. Hopefully, the increased focus on healthy eating at restaurants will lead to improved children's menu options.

Red wheat has the reddish-brown color, grainy texture, and phenolic compounds that give whole wheat bread its flavor and appearance.³⁰ Its high protein content and water absorption make it ideal for use in yeast breads and other products that rely on a strong gluten network for shape and texture.³¹ Most refined grain flour is made with hard red wheat.³¹ A newer type of wheat grown in the U.S. has changed the whole grains industry because of its ability to replace refined grain flour in many applications. White wheat is also high in protein and effective in yeast products, but it has the pale hue and mild flavor of refined grain due to its lack of a gene for bran color.³⁰ Studies have shown that when schoolchildren are served grain products made with white whole wheat (WWW), they consume them in amounts equal to refined grain products.³²⁻³⁴ Manufacturers have embraced WWW as a means to improve the whole grain content of products without sacrificing flavor or texture. The Whole Grains Council lists ten major manufacturers that sell products made with WWW, including King Arthur, Eagle Mills, Rich's, and Horizon Milling (Cargill).³⁰ Although replacing refined grain flour with WWW flour has been successful in improving WG intake in school children,³²⁻³⁴ to date, no studies have determined if similar results can be achieved in a restaurant setting.

Data from the 2003–2004 National Health and Nutrition Examination Survey (NHANES) showed that pizza was the second greatest source of solid fats and added sugars for children 2–18 years of age.³⁵ Similarly, 2003–2008 NHANES data showed that pizza was the top source of sodium for the same age group.³⁶ Clearly pizza is a significant source of problem nutrients for school-aged children, and could benefit from reformulation. It makes sense that children would eat the same amount of a pizza made

with WWW flour as a pizza made with RG flour, especially if they cannot detect the presence of whole grain. Additionally, pizza is an ideal food for use in flavor-flavor learning experiments, because children are familiar with the flavors of the sauce, cheese, and usual pizza toppings.

This project expands on previous research completed in schools by introducing whole grain pizza crust to children in a restaurant setting. Acceptability was measured via observed consumption at a sit-down pizza restaurant and a taste test at a local elementary school. The purpose of this study was to determine if white whole wheat flour can be substituted for refined grain flour in a restaurant pizza crust without affecting consumption by children.

Methods

Pizza Formulation

A 55% whole grain pizza crust was developed by the Executive Chefs at Green Mill and ConAgra Foods, Inc. The pizza crust was made with a hard white winter whole wheat flour (Ultragrain, ConAgra Mills, Omaha, NE), and was designed to closely resemble Green Mill's children's pizza crust, which is made with 100% refined flour from hard red winter wheat. During the study, the 55% whole grain crust was prepared in the same manner as the other pizza crusts: dough was mixed from 25 or 50 lb. bags of flour and formed into appropriately sized dough balls, which were then frozen until needed. The children's pizza is the same serving size as an individual adult pizza, at approximately 10 inches in diameter and 350–400g. The 55% whole grain pizza crust contained at least 2 servings of whole grains and 10g of dietary fiber per serving, while the original crust contained no whole grains and 6g of dietary fiber per serving, based on a nutritional analysis of similar products.³² The most commonly ordered toppings were cheese, pepperoni, macaroni and cheese, and sausage. The same pizza crust (55% whole grain or refined grain) was used for the taste-test with cheese as the only topping.

Taste Test

Subjects included third, fourth, and fifth graders from Little Canada Elementary School in Little Canada, MN. Although the children observed at Green Mill restaurants ranged in estimated age from 3 to 13, this age group (8–11) was chosen to participate

because older children are more effective at differentiating between product samples.³⁷ The school had an enrollment of 405 students in kindergarten through sixth grades, of which 45% were white, 25% were Asian, and the remaining 30% were African American, Hispanic, and American Indian. At the time of the study, 60% of the students received free or reduced-price school meals. This study was approved as exempt from committee review by the University of Minnesota Institutional Review Board. An opt-out letter was sent home to parents the week before the taste test, and two parents indicated their children did not have permission to participate because of food allergies.

The taste test took place on April 3, 2013. Children (n=131) were asked to rate their liking of two samples of cheese pizza. The taste test was set up on three large tables in the hallway outside the school cafeteria. Teachers brought the children to the taste test tables on their way to the cafeteria for lunch that day, and children completed the test in groups of eight. A researcher assisted each group by distributing pizza samples and giving directions for completing the taste test forms. Children were allowed to interact as usual with their classmates and teachers while completing the taste test.

Children rated their liking of each sample on a 5-point hedonic scale with descriptors ranging from 1=*Dislike A Lot* to 5=*Like A Lot*.³⁸ Samples and rating forms were randomized so that some children tasted the 55% whole grain crust first while others tasted the original crust first. Green Mill pizza boxes were hidden from view so that knowledge of the pizza source did not affect children's ratings. When the students finished the taste test, they were allowed to continue on to the cafeteria and researchers collected their forms. Eleven forms were eliminated due to incomplete or illegible data, leaving 120 complete responses.

Meal Observations

Subjects included children estimated to be between the ages of 3 and 13 who visited one of five Green Mill restaurant locations between August of 2012 and March of 2013 in the Minneapolis/St. Paul metropolitan area. Children consumed either the refined grain pizza crust (n=194) or the 55% whole grain pizza crust (n=200), and were accompanied by parents and/or other adults. Subjects were unaware they were being observed and no identifying data were collected, though observers did record the child's gender and approximate age.

Pizza crust consumption data were collected by trained observers (n=6) both before and after the introduction of the 55% whole grain pizza crust. Observers recorded the date, time, restaurant location, pizza crust type, table number, number of children at table, number of adults at table, number of children's pizzas ordered, type(s) of children's pizza(s) ordered, other foods eaten by the child, whether the pizza was shared, how many slices were boxed, the percentage of meal time the child was observed, and the overall percentage of pizza crust not eaten by the child. The entirety of the observations of children consuming the 55% whole grain pizza crust were conducted at one restaurant, while observations of children consuming the original pizza crust were conducted at one of five locations.

Observers dressed as Green Mill waitstaff and roamed the bar and dining room areas in order to observe pizza consumption by children. Some observers performed basic dining room tasks such as vacuuming, carrying food, clearing and wiping down tables and retrieving to-go boxes, in order to give themselves a better vantage point for their observations and appear less conspicuous. When possible, they collected plates from tables after diners had left the restaurant in order to verify the estimated percentage of pizza crust not eaten (or percent waste). In some situations, observers also queried waitstaff or other restaurant staff members for more information about children's orders or to confirm the consumption data they had gathered. Project staff members were instructed not to converse with diners and to redirect requests to actual restaurant waitstaff when necessary.

Data collection was preceded by a two-month period in which observers were trained and an observation form was developed. Several versions of the observation form were tested, both in simulated data-collection settings and actual restaurant settings, and revised for use in data collection. The front of the final observation form is shown in Figure 3.1. The pizza-shaped diagram on the form allowed observers to shade in the portion of pizza left on children's plates in order to estimate percent waste. The box to the left of the diagram lists percentages (per slice) associated with each ring of the "bullseye," or intervals of 10%. Observers were instructed to round up to the nearest 10% of a slice if their shading fell between two rings on the diagram. The dotted lines on the diagram represent halves and thirds of slices, and were used by observers when pizzas were cut unevenly by kitchen staff or cut into smaller portions at the table.

Observers did not include cheese and toppings removed from pizzas when estimating percent waste because the pizza crust was the item of interest in this study.

Intra- and interobserver reliability (IOR) were assessed during the project development period and the data collection period, in conjunction with observer training. IOR was assessed in a simulated environment, with observers allowed three views each of several half-eaten pizzas with a variety of toppings. Assessments were completed during the project development period and at the beginning of the data collection period with all four observers participating. When two observers were replaced in the middle of the study, IOR was assessed a third time with the two new observers and one veteran observer. Agreement was defined as the estimated percent waste per pizza falling within a certain range across all observers. The number of pizzas with percent waste agreement was then divided by the total number of pizzas observed at each session. Intraobserver reliability was calculated similarly, with each person observing the same pizza twice within each session. In addition, observed estimates were compared with weighed plate waste in order to determine the accuracy of observations. Because IOR is defined differently throughout the literature, with some studies defining agreement to include as much as 25% variability per serving³⁹ and others allowing no disagreement,⁴⁰ IOR was calculated with multiple ranges of agreement. Results of these calculations are found in Table 3.1. IOR improved dramatically at Session 3, and this may be reflective of a more realistic simulation of observation conditions based on experience. More specifically, we had a better idea of what pizzas half-eaten by children actually looked like, and determined that previous practice sessions included pizzas much more difficult to observe than average pizzas seen in restaurants.

Statistical Analysis

All data were analyzed using SAS version 9.3 (Cary, NC), with comparisons made at $\alpha = 0.05$. For the taste test, liking ratings were compared across the two types of pizza crust using paired t-tests and within grade, age, and gender groups using analysis of variance (ANOVA) or t-tests. For meal observations, the groups of children observed consuming the 55% whole grain crust (WG) and original crust (RG) were compared using t-tests for continuous variables (e.g., mean percent time observed) and chi-square tests for categorical variables (e.g., gender of child). PROC GLM was used to assess differences in percent waste (dependent variable) by type of pizza crust

(independent variable). Because significant differences were observed in the number of children observed consuming WG and RG pizza crust by gender, pizza toppings, and “shared” (yes or no), these variables were also included in the model.

Results

Taste Test

Children were approximately evenly divided by grade (28%, 34% and 38% in 3rd, 4th and 5th grades, respectively) and gender (49% were girls). The overall mean liking rating for the RG pizza (4.58 ± 0.78) was statistically similar to the overall mean liking rating for the WG pizza (4.51 ± 0.92), $p=0.47$). These results indicate that children liked the two types of pizza equally during the taste test. When children were categorized by age, grade, and gender, no significant differences were observed in liking ratings for the two types of pizza.

Meal Observations

Consumption of all the WG pizzas and a large number of the RG pizzas ($n=83$) was observed at the Green Mill restaurant in Blaine, MN. Consumption of the remaining RG pizzas ($n=111$) was observed at the Green Mill restaurants in Lakeville, Eagan, Shoreview, and Woodbury, MN. Observations were divided similarly among project staff members. One observer was responsible for 69 RG and 122 WG observations, and consumption of the remaining 125 RG and 78 WG pizzas was recorded by five additional observers.

Two hundred twenty-six boys and 165 girls were observed eating pizza, and the mean estimated age of all children was 7 years old. Parties had an average of 2.3 children and 2.5 adults, and ordered an average of 1.6 children’s pizzas. Most of these pizzas had only cheese as a topping ($n=209$), though a significant number were also topped with pepperoni ($n=95$). Some restaurants allowed children to select their pizza toppings from a comprehensive list rather than the four options listed on the children’s menu (cheese, pepperoni, sausage, and macaroni and cheese), and these restaurant locations had greater variability in the toppings selected. Observers were able to watch tables during an average of 65% of their meal time, and this was dependent upon the location of the table within the restaurant and number of other tables she was watching.

Twenty-eight percent of children shared some of their pizza with another person at the table, ranging from one bite to several slices. Shared amounts were counted as waste by observers. Sixty-two percent of children consumed at least one other food (not including beverages) in addition to their pizza, and 20% of children had two or more additional foods. Children most commonly consumed French fries, bread, and appetizers in addition to their pizza.

Continuous variables describing the meal experience (e.g., numbers of children and adults at the table) are presented in Table 3.3. None of these differed significantly between groups of children consuming the WG or RG pizza crust. However, several categorical variables, including child gender, pizza toppings, and whether the pizza was shared, were significantly different between the two groups (Table 3.4). More boys consumed the WG pizza crust than girls, more RG pizzas were topped with pepperoni and fewer were topped with sausage and macaroni and cheese, and fewer children shared the WG pizza than the RG pizza. After adjusting for gender, whether the pizza was shared, and differences in pizza toppings, the mean percent waste did not differ significantly for children consuming the RG (55.4%) versus the WG pizza crust (57.9%) (Table 3.3). Children ate slightly less than half of both types of pizza crust. The adjusted model also showed that the type of topping affected the amount of waste, but only for sausage pizzas ($p=0.02$).

Discussion

This study supports previous work with grain-based foods and WWW flour, though previous research has been limited to school cafeterias.³²⁻³⁴ Both taste test and observation data from the current study showed that children will consume refined red wheat and 55% white whole wheat pizza crust in equal amounts. Chan et al. found similar results with a similar pizza product in an elementary school.³² Toma et al. tested 51% and 100% WG products made with white whole wheat and barley flours among school-children.³⁴ Chu et al. used WG tortillas and pancakes from the USDA Commodity Food Program in schools in two states.³³ Tortillas were made with 66% and 100% white whole wheat flour, and pancakes contained 51% and 100% red whole wheat, and 100% white whole wheat. In the previous studies, only the white whole wheat tortillas were consumed in lesser amounts than their RG counterparts.³³ All of these foods are

frequently found in restaurants as well, and present opportunities for future research. Additionally, future studies could compare children's consumption and liking of restaurant foods made with white whole wheat vs. red whole wheat flour, or other combinations and percentages of refined grain and whole grain flours.

The portion size of the children's pizzas in this study was very large (350–400g) because Green Mill uses the same size dough ball for their children's pizzas and individual adult pizzas. Though children consumed less than half of the pizza on average (44.5%), the large serving size could have influenced them to consume more of the pizza than they normally would have, as seen in previous studies.^{32,41,42} Children in this study would have consumed a full serving of whole grains and approximately 5 grams of dietary fiber by consuming half a children's pizza with the reformulated crust. Future research could focus on a smaller serving size to verify that consumption of whole grains remains significant even if the pizza's serving size changes.

Designing interventions for restaurants involves unique challenges, due to competing priorities for restaurateurs and a greater focus on food cost and profit margin. While school foodservice personnel also must source cost-effective products and ingredients, restaurateurs operate under a different type of pressure to meet established quality criteria, address changing customer demands, and provide a dining "experience." Researchers who work within restaurants must be sensitive to these issues and priorities, and design studies that operate within existing supply-chain relationships, minimizing disruption to distributors, business managers, chefs, and waitstaff. Newly introduced WG products and ingredients must be easily sourced and available at equal or lesser cost than RG products and ingredients. Increased demand for WG foods may positively affect the cost, variety, and quality of WG products and ingredients available to restaurateurs in the future, but these issues remain significant in the present.

The strengths of this study are in its novelty. To our knowledge, it is the first intervention to target restaurants as a potential site for increasing whole grain intake among children. Further, the observations were conducted in a manner that preserved the integrity of the restaurant environment, ensuring authenticity in the eating behaviors that were observed. Finally, the tool developed in conjunction with our observation protocol was effective in allowing observers to quickly and easily record consumption

data. Previous research has shown that portion sizes of wedge-shaped foods are particularly difficult to estimate, and that research subjects tend to underestimate portion sizes of pizza slices by 20%.⁴³ While the observers in this study knew the overall portion size of the pizzas, slices were often cut and consumed unevenly. Within simulated settings, observers were able to estimate percent waste of an entire pizza within 10% of actual waste and within 10% of each other's estimates.

This study also had limitations, many of which were due to the restrictions of conducting research in a restaurant environment. Meal observation was used to record pizza consumption rather than weighed plate waste. However, observational data collection for pizza consumption were accurate and precise according to IOR within a simulated setting. Observers were unable to quantify the amounts of other foods eaten by children because they could not observe them 100% of the time. This may also mean that observers occasionally missed or misreported pizza that was shared, dropped, or discarded. In a survey administered in conjunction with this project, with a convenience sample of parents in another community setting and online, most parents reported eating some portion of their child's restaurant meals "never" or "sometimes," when given the options "never," "sometimes," "half the time," "often," and "always."⁴⁴ This is similar to our findings that 36% of RG and 20% of WG pizzas were shared. The taste test data are from a different group of children than the consumption data because researchers were not allowed to interfere with guests' dining experiences at any point during the meal. However, the taste test was conducted with a diverse group of children, which may improve its transferability to other populations. Lastly, this study was conducted in the Midwestern U.S. within a chain of several sit-down pizza restaurants, which may limit its generalizability to other locations and other types of restaurants. Further research is needed to confirm results in other locations and with other foods.

Conclusions and Implications

The results of this study suggest that children will consume equal amounts of a pizza crust containing 55% WWW flour and a crust made from 100% refined grain, when both crusts are served in a restaurant setting. This substitution helped children to consume an entire serving of whole grains and approximately five grams of dietary fiber, on average. Children also rated their liking of pizza made with both crusts approximately

equally. Introducing whole grains through a familiar and well-liked product was apparently successful in overcoming children's barriers to consumption.

This project did not compare products made from red whole wheat flour and white whole wheat flour. Other studies have used various products made from red whole wheat and other flours successfully,^{33,34,45} so future restaurant research should incorporate a variety of whole grain ingredients in a variety of applications. Further, restaurateurs should be trained in how to store and use whole grain ingredients. With a shorter shelf life and slight differences in resulting dough texture, whole grain flours present challenges for chefs that can be easily overcome with education and practice.

With the forthcoming implementation of nationwide menu labeling laws for restaurant chains with 20 or more locations,⁴⁶ consumers will soon be seeing much more information about restaurant meals. In keeping with this trend toward transparency, businesses that use whole grain foods in children's meals could advertise this information on children's menus. This could have positive and negative effects. A nationwide survey of parents (n=253) of children 8–12 years old conducted in conjunction with this project found that while most were aware of the benefits of whole grain foods and indicated they would like their children to eat more of them, they were unsure whether their children would eat whole grain versions of common children's menu items.⁴⁴ This reluctance could harm sales of whole grain foods that are advertised as such.

The outcomes of this study could serve as the foundation for future work with large, national restaurant chains. Pizza is an ideal example of a food that benefits substantially from reformulation, but surely others exist. Hamburger buns, tortillas, pastas, rice, and even breading on chicken tenders/nuggets could be redesigned to include whole grains. These products are currently available for use in schools, and could easily be adapted for use in restaurants. Future studies could focus on large organizations or small, independent businesses; each type of restaurant will present unique challenges and opportunities for intervention.

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Figures and Tables

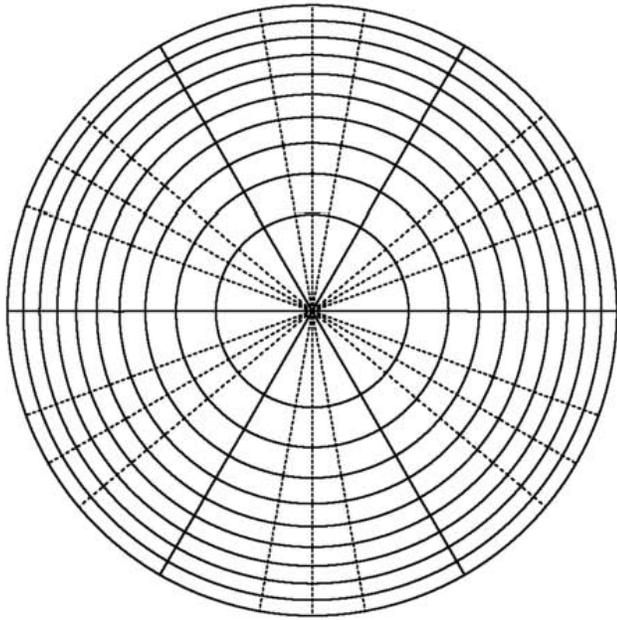
Figure 3.3. Observation form.

TYPE OF CRUST: _____

Whole Grain Kids Restaurant Meal Observation

Restaurant location:	Observer:
Date:	Time:

Shade in the space that represents the pizza NOT eaten by the child:



$16.67 * .1 = 1.67$	$16.67 * .6 = 10.00$
$16.67 * .2 = 3.33$	$16.67 * .7 = 11.67$
$16.67 * .3 = 5.00$	$16.67 * .8 = 13.34$
$16.67 * .4 = 6.67$	$16.67 * .9 = 15.00$
$16.67 * .5 = 8.34$	$16.67 * 1 = 16.67$

Slice 1: _____ Slice 4: _____

Slice 2: _____ Slice 5: _____

Slice 3: _____ Slice 6: _____

Number of slices boxed: _____

Percentage not eaten: _____
(total)

% of time observed: _____

Child:

Boy Girl Estimated age: 3 4 5 6 7 8 9 10 11 12 13

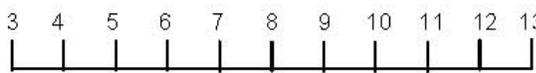


Table:

Table number:	Number of children at table:
Number of kids' pizzas ordered:	Number of adults at table:
Type(s) of pizza ordered:	

Table 3.1. Observation accuracy and precision assessments during three training sessions.

	Session 1	Session 2	Session 3
Number of observers	4	4	3
Number of pizzas observed	6	12	9
Interobserver reliability (IOR) ¹			
≤ 15% disagreement ²	1.00	1.00	1.00
≤ 10% disagreement	0.83	0.83	0.89
≤ 5% disagreement	0.17	0.33	0.89
Intraobserver reliability ¹			
≤ 5% disagreement	1.00	1.00	1.00
Observations vs. plate waste ³			
≤ 15% disagreement	1.00	1.00	N/A
≤ 10% disagreement	0.83	0.92	N/A
≤ 5% disagreement	0.67	0.58	N/A

¹Values determined by dividing the number of pizzas with the stated level of agreement by the total number of pizzas observed. Agreement was determined for each pizza by subtracting all estimates of waste from the largest estimate.

²Three levels of agreement are reported to show the evolution of the data collection tool over time.

³Values determined by dividing the number of pizzas with the stated level of agreement by the total number of pizzas observed. Agreement was determined for each pizza by subtracting the mean observed waste from the actual weighed plate waste.

Table 3.2. Taste test liking ratings by age, grade, and gender.

Children	Frequency	Percent	RG ¹ Mean Score ± SD	WG ¹ Mean Score ± SD	P-value ²
Age					
8	12	10.0	4.67 ± 0.49	4.67 ± 0.49	1.00
9	36	30.0	4.64 ± 0.54	4.61 ± 0.96	0.86
10	47	39.2	4.60 ± 0.77	4.51 ± 0.88	0.64
11	25	20.8	4.44 ± 1.16	4.28 ± 1.06	0.56
Grade					
3	33	27.5	4.70 ± 0.53	4.55 ± 1.00	0.41
4	41	34.2	4.68 ± 0.61	4.73 ± 0.59	0.73
5	46	38.3	4.41 ± 1.02	4.28 ± 1.05	0.53
Gender					
Girl	59	49.2	4.66 ± 0.51	4.54 ± 0.75	0.32
Boy	61	50.8	4.51 ± 0.98	4.48 ± 1.06	0.85
All children					
Overall	120	100.0	4.58 ± 0.78	4.51 ± 0.92	0.47

¹RG = refined grain; WG = 55% whole grain

²P-values are based on t-tests (p<0.05 significance level)

Table 3.3. Observation data by pizza crust type (continuous variables).

Data	RG¹ Mean ± SE	WG¹ Mean ± SE	P-value²
Percent waste ³ (%)	56.36 ± 1.58	54.69 ± 1.63	0.47
Percent of time observed (%)	63.00 ± 1.47	66.83 ± 1.37	0.06
Estimated age of child (years)	6.92 ± 0.19	7.00 ± 0.16	0.75
Number of kids at table	2.24 ± 0.06	2.31 ± 0.08	0.47
Number of adults at table	2.49 ± 0.11	2.56 ± 0.12	0.69
Number of kids' pizzas at table	1.52 ± 0.05	1.65 ± 0.09	0.26
Number of other foods eaten by child	0.72 ± 0.06	0.79 ± 0.05	0.41
Adjusted percent waste (%)	55.42 ± 2.04	57.90 ± 2.06	0.40 ⁴

¹RG = refined grain; WG = 55% whole grain

²P-values are based on t-tests (p<0.05 significance level)

³Percentage of pizza crust not eaten

⁴According to PROC GLM (p<0.05 significance level), adjusted for child gender, pizza type, and whether the pizza was shared.

Table 3.4. Observation data by pizza crust type (categorical variables).

Data	RG ¹ Frequency/Percent	WG ¹ Frequency/Percent	P-value ²
Child gender			0.04
Boy	100/44.3	126/55.8	
Girl	91/55.2	74/44.9	
Pizza toppings			0.03
Cheese	107/55.2	102/51.0	
Pepperoni	56/28.9	39/19.5	
Mac & cheese	11/5.7	30/15.0	
Sausage	7/3.6	13/6.5	
Other	13/6.7	16/8.0	
Was pizza shared?			<0.001
No	125/64.4	160/80.0	
Yes	69/35.6	40/20.0	

¹RG = refined grain; WG = 55% whole grain

²P-values are based on chi-square tests (p<0.05 significance level)

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Appendix: State Fair Whole Grains Survey

For the following questions, please choose the response that is best for you and your child.

1. How often do you eat at a sit-down pizza restaurant with your child? (Please circle one.)

Weekly Twice a month Monthly Several times a year Yearly Never

2. Who usually selects the meal for your child when you eat at a sit-down pizza restaurant? (Mark only one.)

____ child alone
 ____ parent alone
 ____ child and parent

3. If you were eating at a sit-down pizza restaurant with your child and he/she ordered a pizza from the children's menu, how often would you eat part of it? (Please circle one.)

Never Sometimes Half the time Often Always

4. Please rate the importance of the following when YOU choose food for your child at a sit-down pizza restaurant:

	Not at all important 1	Slightly important 2	Moderately important 3	Very important 4	Extremely important 5	No opinion
Taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Speed of service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nutrition/healthfulness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value for money	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weight control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Promotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Menu photos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What other kids order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usual order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Special occasion/treat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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5. Please rate the importance of the following when **YOUR CHILD** chooses food for him or herself at a sit-down pizza restaurant:

	Not at all important	Slightly important	Moderately important	Very important	Extremely important	No opinion
	1	2	3	4	5	
Taste	<input type="checkbox"/>					
Speed of service	<input type="checkbox"/>					
Nutrition/healthfulness	<input type="checkbox"/>					
Value for money	<input type="checkbox"/>					
Weight control	<input type="checkbox"/>					
Promotion	<input type="checkbox"/>					
Menu photos	<input type="checkbox"/>					
What other kids order	<input type="checkbox"/>					
Usual order	<input type="checkbox"/>					
Special occasion/treat	<input type="checkbox"/>					

6. Please rate **YOUR** likelihood of choosing meals containing the following whole grain items for your child if they were to appear on a children's menu:

	Very unlikely	Unlikely	Neutral	Likely	Very likely	No opinion
	1	2	3	4	5	
Pizza crust	<input type="checkbox"/>					
Hamburger bun	<input type="checkbox"/>					
Breading on chicken tenders	<input type="checkbox"/>					
Pasta	<input type="checkbox"/>					

7. Please rate **YOUR CHILD'S** likelihood of choosing meals containing the following whole grain items for him or herself if they were to appear on a children's menu:

	Very unlikely	Unlikely	Neutral	Likely	Very likely	No opinion
	1	2	3	4	5	
Pizza crust	<input type="checkbox"/>					
Hamburger bun	<input type="checkbox"/>					
Breading on chicken tenders	<input type="checkbox"/>					
Pasta	<input type="checkbox"/>					

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8. Please rate your agreement with the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion
	1	2	3	4	5	
Whole grain pizza crust is healthier than regular crust.	<input type="checkbox"/>					
My child likes whole grain foods.	<input type="checkbox"/>					
I like whole grain foods.	<input type="checkbox"/>					
My child likes the flavor of whole grain pizza crust.	<input type="checkbox"/>					
My child likes the chewiness of whole grain pizza crust.	<input type="checkbox"/>					
I would like the menu to tell me if the pizza crust contains whole grains.	<input type="checkbox"/>					
I am getting more for my money if my child's meal contains whole grains.	<input type="checkbox"/>					
I like my child to try new foods.	<input type="checkbox"/>					
My child likes to try new foods.	<input type="checkbox"/>					
Ordering a new food at a restaurant is a good way to see if my child will eat it before purchasing it for home use.	<input type="checkbox"/>					
If my child doesn't like whole grain pizza crust, it will be a waste of money to order it at a restaurant.	<input type="checkbox"/>					

9. What is your age? (Mark only one.)

- 18-34 years old
- 35-54 years old
- 55-64 years old
- 65 years or older
- Prefer not to answer

10. Are you...? (Mark only one.)

- Female
- Male

11. Please specify your ethnicity or race (Mark all that apply.)

- White
- Hispanic or Latino
- Black or African American
- Native American or American Indian
- Asian / Pacific Islander
- Other
- Prefer not to answer

12. What is the highest degree or level of school you have completed? *If currently enrolled, highest degree received.* (Mark only one.)

- No schooling to 8th grade
- Some high school, no diploma
- High school graduate, diploma or the equivalent (for example: GED)
- Some college credit, no degree or trade/technical/vocational training
- Associate degree (2-year)
- Bachelor's degree
- Master's, Professional or Doctorate degree
- Prefer not to answer

13. What is your marital status? (Mark only one.)

- Single, never married
- Married or domestic partnership
- Widowed, divorced, separated
- Prefer not to answer

14. Are you currently...? (Mark only one.)

- Employed for wages
- Self-employed
- Out of work and looking for work
- Out of work but not currently looking for work
- A homemaker
- A student
- Military
- Retired
- Unable to work
- Prefer not to answer

Thank you for completing the survey!

If you are the winner of our drawing for a new iPad3, we will contact you via e-mail.

Please enter your e-mail address: _____

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