Household chaos in rural families: Exploring the relationship between child physical activity, sedentary behavior, and screen-time with the home environment

A Thesis
SUBMITTED TO THE FACULTY OF THE
UNIVERSITY OF MINNESOTA
BY

Stephanie Marie Grace

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE

Daheia J. Barr-Anderson, Ph.D.

January 2021

Acknowledgements

This project could not have been completed without the help of my family, who showed loving guidance and support through the process. Thank you to my sister, Sarah, my partner, Dallas, and, of course my caring Mom, Grandma Jean, and Merry. Thank you also to my mentor, Dr. Daheia Barr-Anderson, for all the hours she has spent chatting with me, reading and re-reading my edits, and encouraging me through these challenging months. Thank you to Dr. Fulkerson and Sarah, who are always willing to offer valuable feedback in a way that teaches me about the writing process and makes me feel supported. Finally, thank you to all other members of the NU-HOME research team, who always offer an encouraging smile and an abundance of helpful tips.

This project was supported by Award Number 1R01HL123699 from the National Heart, Lung, and Blood Institute (PI: Jayne A. Fulkerson, Ph.D.). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, and Blood Institute or the National Institutes of Health. This study is registered with NIH ClinicalTrials.gov: NCT02983815. This research was supported by the University of Minnesota Obesity Prevention Center through the use of accelerometers in collection of physical activity and sedentary behavior data.

Abstract

INTRODUCTION: Regular physical activity (PA) and limited sedentary behavior (SB) and screen-time are essential for children's health. Household chaos (HHchaos), defined as disorganization characterized by noise and crowding, has been linked with negative health and behavioral outcomes in children.

MAIN PURPOSE: To examine associations between child PA, SB and screen-time with HHchaos in rural children.

METHODS: One-hundred-and-five parent/child dyads were enrolled in NU-HOME, a family-based, obesity prevention RCT. Baseline data from participants were analyzed using SAS 9.4.

RESULTS: Children were 8.96±1.05 years old, 58% female and 53% normal weight. Mean daily total PA, SB, and screen-time were 259.1±58.22 minutes, 499.9±77.46 minutes, and 2.1±1.42 hours, respectively. Unadjusted HHchaos scores (mean=5.04±3.6) were not significantly associated with child PA or SB but were positively associated with child screen-time ($p<0.01$).

CONCLUSIONS: Our findings related to screen-time align with current literature. However, the relationship between HHchaos with PA and SB need to be explored further.

Table of Contents

List of Tables

Introduction

Sixty minutes of moderate-to-vigorous physical activity is recommended daily for children and adolescents between the ages of 6 and 17 in the United States (US Department of Health and Human Services, 2018). Physical activity is shown to lessen the risk of conditions including heart disease, type II diabetes, osteoporosis, and obesity (Piercy et al., 2018). It is also linked to higher cognition and academic achievement (Marques, Santos, Hillman, & Sardinha, 2018). Children who participate in regular physical activity may experience lower levels of stress and anxiety in addition to greater self-esteem (Dale, Vanderloo, Moore, & Faulkner, 2019). Despite these extensive benefits, only 24% of US children meet the daily recommendation (Piercy et al., 2018).

Sedentary behavior is defined as any action that is completed in a sitting or lying down position that expends no more than 1.5 METS (metabolic equivalents of energy) (Bames et al., 2012). Examples of sedentary behavior include reading a book, drawing a picture, or watching television. Although there are not specific sedentary guidelines, Americans are encouraged to reduce their sedentary time, and begin by replacing it with light physical activity (US Department of Health and Human Services, 2018). This is primarily due to the adverse health outcomes associated with sedentary behavior including increased risk of cardiovascular disease (Ford & Caspersen, 2012) and overweight and obesity (Marsh, Foley, Wilks, & Maddison, 2014). According to a review of literature conducted by Arundell, Fletcher, Salmon, Veitch, and Hinkley (2016), on average, children spend 51% of their after-school time engaging in sedentary behavior. Screen-based activities are generally sedentary, and therefore screen-time is often examined as a measure of sedentary behavior in relevant literature. Although the

national screen-time recommendation for elementary-aged children is no more than two hours of “leisure” screen-use daily (Council on Communications and Media, 2016a, 2016b; Expert Panel on Integrated Guidelines for Cardiovascular Health, Risk Reduction in, Adolescents, National Heart, & Blood, 2011; Reid Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016), the average screen-based media use reported in 2015 among children aged 8-12 years is 4 hours and 36 minutes per day (Rideout, 2016).

The influences on a child that may affect their health-related behavior, such as physical activity, sedentary behavior and screen-time are complex, therefore it is common to examine them using a multi-layered approach (Barr-Anderson et al., 2017). According to the socioecological model (SEM), environmental layers, including individual (e.g., self-efficacy), interpersonal (e.g., family support, parental behaviors), and environmental (e.g., bedroom screen-use, home environment) factors, have the potential to influence a child’s development (Bronfenbrenner, 1994). This, in turn, might impact a child’s decision to be physically active or participate in inactive behaviors including using screen-based electronic devices during leisure time.

An environmental factor that has not yet been explored in the context of physical activity and sedentary behavior is household chaos. Household chaos is defined as the level of noise, disorganization, and crowding in a home (Matheny, Wachs, Ludwig, & Phillips, 1995). A home with a high amount of household chaos may lack structure and feel disorderly, oftentimes resulting in difficulty for those who reside in the home to maintain routines. Children who reside in homes with higher household chaos may experience an increased likelihood of behavioral problems (Coldwell, Pike, & Dunn, 2006), poorer sleep (Whitesell, Crosby, Anders, & Teti, 2018), and lower early literacy

skills (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). Additionally, families have been shown to eat fewer family meals together and experience greater stress around preparing meals when residing in a home with higher household chaos (Fulkerson et al., 2019).

In contrast, other findings have shown that structured family environments tend to be more developmentally beneficial for children (Ackerman & Brown, 2010). Routines around bedtime, chores, and mealtimes have resulted in positive health outcomes for children, including improved sleep quality and shorter periods of sickness (Davison, Jurkowski, & Lawson, 2013; Fiese et al., 2002). The reduction of stress and opportunity for positive interactions between parents and children that can result from establishing routines (Miller et al., 2017) could serve as a platform for children to create their own routines and maintain them through adolescence and adulthood.

According to a book chapter authored by Vernon-Feagans, Garrett-Peters, De Marco, and Bratsch-Hines (2012), those who live in rural areas and fall below the poverty line economically may experience increased household chaos due to extended distances from necessary services, such as doctor's offices, post offices, and grocery stores. Some research has shown that "nonmetropolitan areas" have higher rates of poverty consistently, which indicates that poverty might affect those residing in rural areas at a greater rate than those residing in urban areas (Summers, 2019). Taking those potential economic differences into account, it is plausible that families who reside in rural areas or who are facing economic hardship may experience a higher level of household chaos due to the increased likelihood of crowded living arrangements and of difficulties structuring life at home (Vernon-Feagans, Burchinal, & Mokrova, 2015). To

our knowledge, there are no empirical studies that have examined the potential relationship of household chaos with rural families.

Innovatively examining child health behaviors (i.e., physical activity, sedentary behavior, and screen-time) with household chaos could potentially further current knowledge about the way family routines (or lack thereof) influence a child's health. If families residing in homes with increased household chaos are participating in less than optimal health behaviors, there may be opportunity to replace disorganization with healthy behavior routines. Additionally, investing time and effort in creating healthy routines in the home may increase the children's likelihood of carrying beneficial habits into adulthood. Therefore, the primary aim of the current study is to determine whether child physical activity, sedentary behavior and screen-time are directly associated with household chaos in rural families.

Broadening the Learning Experience

As part of the learning experience of completing a master's thesis, the author also conducted exploratory analyses that were outside the scope of the primary aim. For ease of presentation, these additional analyses are referred to as the secondary aim in this document. Using the SEM as a framework, the relationship between the outcomes of interest and household chaos was evaluated while adjusting for other individual, interpersonal, and environmental factors with demonstrated associations in current literature. It is hypothesized that there is an inverse relationship between child health-behaviors and household chaos, and that this relationship differs when adjusting for other factors at varying levels of influence.

Methods

Participants and Recruitment

Baseline data were collected in 2017-2018 from the NU-HOME study, a randomized controlled trial to test a family-based, child obesity prevention intervention in rural Minnesota. A total of 114 parent-child dyads were included in the NU-HOME trial and randomly assigned to either the intervention group (n=58) or wait-list control group (n=56). Of these 114 participant pairs, 105 (92%) were used in data analysis for the current study due to the completeness of their accelerometry data (minimum of 8 hours of wear time on ≥3 days). Written consent and assent were obtained from parent and child participants, respectively. The study was approved by the University of Minnesota Institutional Review Board and the Quorum Institutional Review Board.

Participants were eligible for the NU-HOME trial if they lived within 50 miles of the New Ulm, Minnesota community and were not planning to move outside of the area within the following six months. Child participants were required to be 7-10 years of age. Most participants were recruited by a letter from a local medical center (53%). Others were recruited by friends and family members, community events, and fliers from their child's school.

Data Collection Instruments and Measures

For data collection, parent and child participants were asked to travel to a local community school district building. Parent participants completed psychosocial surveys that were programmed in REDCap software and administered electronically using an iPad. Child participants completed interviews with trained research staff where they were asked to respond to questions by pointing to their answer; staff entered children's

responses on an iPad. Children were also fitted with accelerometers by trained research assistants.

Primary Independent Variable of Interest

Household Chaos. As part of the psychosocial survey, parent participants completed an adapted version of the Confusion, Hubbub, and Order Scale (CHAOS), which surveys the level of environmental chaos present in their home (Matheny et al., 1995). One item from the original survey was adapted to read "electronics take up a lot of our time at home" instead of "the telephone takes up a lot of our time at home." Other CHAOS questionnaire items included statements such as, *'we almost always seem to be rushed', 'it's a real zoo in our home,'* and *'you can't hear yourself think in our home.'* Response options were "true" or "false", coded as 1 or 0, respectively. Items were summed to create a chaos score. The scale ranges from 0-15 with a higher score indicating a higher level of chaos (scale development sample: Cronbach's α=0.79, test-retest r=0.74; current study sample: Cronbach's α=0.83). The total sample was categorized dichotomously by median CHAOS score into low and high chaos households for descriptive analyses. Participants who had a score less than or equal to 4 were placed in the low chaos group (n=58).

Primary Outcomes of Interest

Child Physical Activity and Sedentary Behavior. Child physical activity and sedentary behavior were measured by accelerometry (ActiGraph wGT3X-BT and GT3XP-BTLE models, Fort Walton Beach, FL). The ActiGraph has been validated for use with children and has high inter-rater reliability (R_t=0.87) and strong correlations with energy expenditure (r=0.78) (Trost, McIver, & Pate, 2005). Child participants were

fitted with an accelerometer by a trained research assistant. They were instructed to wear the monitor on their right hip. Children were encouraged to wear it for most waking hours on seven consecutive days except for time spent doing water-based activities (e.g., swimming or bathing). Monitors were initialized prior to data collection and were set to begin collecting data at 6:00am on the day after they were distributed to participants. Data were collected and stored in 10-second epochs.

Data collected via accelerometry were analyzed using ActiLife software (version 6.9.1; Actigraph, LLC, Pensacola, FL). Non-wear time was defined as any period of ≥60 minutes of consecutive zeros. Participants must have had a minimum of 8 hours of wear time on ≥3 days to be included in analyses. Nine of the 114 participants (7.9%) were excluded from analysis due to not meeting the wear time requirement.

Evenson cutpoints for children were used to classify physical activity intensities: sedentary (0-100), light (101-2295), moderate (2296-4011), and vigorous (≥4012) (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008). Total physical activity included counts above 100 and moderate-to-vigorous physical activity included counts above 2296.

Child Screen-Time. Items adapted from the Planet Health study evaluated child screen-time as weekday, weekend, and daily mean hours/day (current study sample: Cronbach's α=0.95) (Gortmaker et al., 1999). Parents were asked to answer two questions on the amount of time their child typically participates in a variety of screen-based activities on weekdays and weekends. Response options were none, less than ½, ½-1, 1 ½-2, 2 ½-4, 4 ½-6, and ≥6 hours/day and were recoded to 0, 0.3, 0.75, 1.75, 3.25, 5.25, and 6.5, respectively, to create a continuous variable. Weekly screen-time

hours were calculated by multiplying the number of weekday hours by 7 and weekend hours by 2 and adding the totals together. Weekly screen-time hours were used to calculate mean daily screen-time by dividing the weekly hours by 7.

Behavior-Related Covariates

Parent Physical Activity. Parent participants' weekly physical activity behavior was assessed using an adapted Godin-Shepard Leisure Time Physical Activity Questionnaire (Godin & Shephard, 1985). Parents were asked how many hours they spend doing exercise that is strenuous, moderate, and mild in a typical week. Examples of physical activities were provided for each intensity level. Responses were none, <½, ½-2, 2 ½-4, 4 ½-6, and >6 hours/week and were recoded as 0, 0.3, 1.3, 3.3, 5.3, and 6.3, respectively, to create a continuous variable. Parent participants' physical activity behavior was evaluated as moderate-to-vigorous and total weekly physical activity (current study sample: Cronbach's α=0.92). Weekly moderate-to-vigorous activity was calculated by summing parent's moderate and vigorous physical activity responses. Total weekly activity was created by adding all mild, moderate, and vigorous physical activity amounts reported by parents.

Child Physical Activity Self-Efficacy. Child participants' physical activity self-efficacy was assessed using an adapted self-efficacy questionnaire (test retest correlations ranged from 0.61 to 0.82; current study sample Cronbach's α=0.69) (Saunders et al., 1997). Child participants were asked questions such as, '*How hard do you think it would be to be physically active instead of watching TV?' 'How hard do you think it would be to play sports on a team?' and 'How hard do you think it would be to be physically active most days of the week?'* (see appendix A). Response options were "not

at all hard", "a little hard", and "very hard" and coded as 1, 2, and 3, respectively. Items were summed and the summation score ranged from 9-25, with a higher score indicating lower self-efficacy.

Family Support of Physical Activity. Family support of physical activity was assessed on the child survey using an adapted 5-item scale from Saunders, Motl, Dowda, Dishman, and Pate (2004) (current study sample Cronbach's α=0.54). Child participants answered questions about their parents' support of their physical activity behaviors. Items prompted children to respond with how often an adult might *'encourage [them] to be physically active or play sports'* or *'watch [them] while being physically active or playing sports*.' Responses included "none", "once", "sometimes", "almost every day", and "every day" coded as 0, 1, 2, 3, and 4, respectively. Responses were summed and the summation score ranged from 0-20, with a higher score indicating higher familial support.

Parent Screen-Time. Parent screen-time was assessed similarly to child screen-time using an adapted questionnaire from the Planet Health study (Gortmaker et al., 1999). Parent screen-time data were collected via self-report. Parents were asked to answer two questions on the amount of time they typically participate in a variety of screen-based activities on weekdays and weekends. Response options were none, less than ½, ½-1, 1 ½-2, 2 ½-4, 4 ½-6, and ≥6 hours/day and were recoded to 0, 0.3, 0.75, 1.75, 3.25, 5.25, and 6.5, respectively, to create a continuous variable. Parent participant screen-time was evaluated as mean daily hours. Weekly screen-time hours were calculated by multiplying the number of weekday hours by 7 and weekend hours by 2

and adding the totals together. Weekly screen-time hours were used to calculate mean daily screen-time by dividing the weekly hours by 7.

Child Bedroom Screen Use. To survey child participants' screen use in the bedroom, they were asked if they used a variety of devices in the room where they sleep. The six questions inquired about their use of a TV, computer or laptop, tablet like an iPad or Kindle Fire, video game system like a PlayStation or an Xbox, hand-held video game player like a Nintendo DS or a PlayStation Vita, and a smart phone like an iPhone. Response options were "yes" or "no" coded as 1 or 0, respectively. Child responses were summed to create a variable totaling the number of devices they use in the room where they sleep with a potential range of 0-5.

Demographic Variables

Parent and child ages were calculated from parent-reported birthdates of each and the date of data collection. Economic assistance was assessed as yes if parents answered "yes" to either *'does your child receive free or reduced-price school lunch?'* or *'does your household receive public assistance?'*. Parents indicated the number of children living in their household, their sex, and their child's sex. Appendix A outlines additional information about response categories and scoring information and details the exact wording of questions.

Statistical Analysis

SAS 9.4 was used to complete analyses in the current study. Statistical significance was determined at $p<0.05$. Descriptive analyses (means and frequencies) were run for the sociodemographic outcomes of interest and household chaos.

Linear regression models were analyzed for all measurements of child physical activity, sedentary behavior, and screen-time. To address the primary aim, unadjusted models were run, which contained only an outcome of interest and household chaos. Next, to address the secondary aim, the following full models for each outcome of interest were run:

$$\textit{Child physical activity} = \beta_0 + \beta_{\textit{household chaos}} + \beta_{\textit{child age}} + \beta_{\textit{child sex}} + \beta_{\textit{child BMI z-score}} + \beta_{\textit{economic assistance}} + \beta_{\textit{number of children in the household}} + \beta_{\textit{parent weekly MVPA}} + \beta_{\textit{child PA self-efficacy}} + \beta_{\textit{child perceived PA support}}$$

Note: Child physical activity was examined four ways: moderate, moderate-to-vigorous, vigorous, and total.

$$\textit{Child sedentary behavior} = \beta_{\textit{household chaos}} + \beta_{\textit{child age}} + \beta_{\textit{child sex}} + \beta_{\textit{child BMI z-score}} + \beta_{\textit{economic assistance}} + \beta_{\textit{number of children in the household}} + \beta_{\textit{parent daily mean screen-time}} + \beta_{\textit{child screen use in the bedroom}}$$

$$\textit{Child screen-time} = \beta_{\textit{household chaos}} + \beta_{\textit{child age}} + \beta_{\textit{child sex}} + \beta_{\textit{child BMI z-score}} + \beta_{\textit{economic assistance}} + \beta_{\textit{number of children in the household}} + \beta_{\textit{parent daily mean screen-time}} + \beta_{\textit{child screen use in the bedroom}}$$

Note: Child screen-time was examined three ways: weekday, weekend, and daily mean.

Each full model contained potential confounders and covariates that were identified from the literature. These confounding variables included age, sex, BMI z-score, economic assistance, and number of children in the household. For child physical activity, the full model adjusted for factors including parent physical activity, child physical activity self-efficacy, and child perceived physical activity support. The same

confounders and covariates were controlled in full models for child sedentary behavior and screen-time. These covariates included parent screen-time and child screen-use in the bedroom.

Results

Table 1 presents descriptive statistics of child, parent, and household variables. Slightly more child participants are female (58.1%) than male. Most child participants fall within the normal BMI category (53.3%), followed by obese (24.8%) and overweight (21.9%), whereas most parent participants are categorized as having obesity (40%), followed by having overweight (35.2%) and having normal BMI (22.9%). Thirty-one parent participants (29.5%) reported that they receive economic assistance, which is defined as those who receive assistance or have a child who receives free or reduced-price school lunch. The mean value of household chaos is 5.04±3.60 on a scale from 1-15.

Table 2 presents means corresponding to the primary outcomes of interest (child physical activity, sedentary behavior, and screen-time). The data are presented by total sample (n=105) and dichotomously as low (n=58; 55.2%) and high (n=47; 44.8%) household chaos groups. Participant dyads were placed in the high chaos group if their household chaos score was greater than 4, which is the median score of the total sample. There are no statistically significant differences among the groups for child physical activity and sedentary behavior, however, there are significant differences in child mean daily screen-time between low (1.75±1.31 hours) and high (2.44±1.48 hours) chaos groups (p=0.01). Additionally, although not statistically significant (p=0.07), children residing in homes with low levels of household chaos reported 1.33±1.15

number of electronics in the bedroom versus those with high levels of household chaos who reported 1.75±1.19, which is trending in the expected direction.

Table 3 presents models that evaluate the relationships between child physical activity at varying intensities (moderate, moderate-to-vigorous, vigorous, and total) with household chaos. No unadjusted or full models show household chaos to be associated with child physical activity. Additionally, parent physical activity, physical activity self-efficacy, and family support of physical activity are not significantly associated with child physical activity in models for any intensity of physical activity.

In table 4, models display the relationship between child sedentary behavior with household chaos. For both unadjusted and full models, the association between child sedentary behavior and household chaos was not statistically significant.

Table 5 presents models evaluating the relationship between child screen-time with household chaos. Household chaos is statistically significant in all unadjusted models for child weekday ($p=0.01$), child weekend ($p<0.01$), and child daily mean ($p=0.01$) screen-time. However, only the full model for child weekend screen-time shows a significant p-value for household chaos ($p=0.04$; $\beta=0.90$), indicating that as household chaos increases by 1 unit, children engage in approximately 54 additional minutes of screen-time.

Broadening the Learning Experience

As previously mentioned, the scope of the study was widened to include exploratory variables as part of the author's learning experience in completing a master's thesis. To begin, models for child physical activity show the number of children residing

in the household as statistically significant in all full models. The β-coefficient (range=2.13 to 15.4) in each model is positive indicating an increase in physical activity as more children are present in the home. Most notably, the linear regression model for total physical activity indicates that for each additional child in the household there is a 15-minute increase in the child participant's total physical activity.

Similarly, child sex is significant in all models for child physical activity except for total physical activity. Regression models for moderate-to-vigorous, vigorous, and total physical activity show a negative beta coefficient for child sex (range = -10.90 to -5.53), which indicates that female participants engage in approximately 11 minutes less moderate-to-vigorous physical activity than male participants. However, the regression model for moderate physical activity shows a positive beta coefficient for child sex (β=2.01) indicating that females participate in approximately 2 minutes more moderate physical activity than male participants. Child age is significant in the model for total physical activity (β=-11.51, p=0.03), whereas child sex is not (p=0.39). This indicates that, regardless of sex, daily physical activity may decrease as a child ages; in this case, nearly 11 minutes per yearly increase in age.

Although, no statistically significant p-values were identified in table 4 for child sedentary behavior, the β-coefficient for economic assistance is relatively large and negative (β=-29.90; p=0.12). This indicates that families who responded "yes" to questions assessing economic assistance engage in approximately 29 minutes less sedentary behavior when compared to those who answered "no".

In table 5, regression models for child weekday screen-time and daily mean screen-time showed similar results. Child age, child BMI z-score, and parent daily mean

screen-time were all found to be statistically significant in both child weekday ($p=0.04$; $p=0.04$; $p=0.02$, respectively) and daily mean screen time ($p=0.04$; $p=0.04$; $p<0.01$, respectively). Additionally, resulting beta coefficients for age, BMI z-score, and/or parent screen-time were positive, indicating that as these variables increase by one unit, children are more likely to engage in more daily screen-time by 15 minutes ($\beta=0.26$), 17 minutes ($\beta=0.29$), and 19 minutes ($\beta=0.32$), respectively. Additionally, parent daily mean screen-time was significantly related to all measures of child screen-time. Most notably, the model for child weekend screen-time ($p=<0.01$; $\beta=0.40$) showed that as parent screen-time increases by 1 hour, child weekend screen-time increases by 24 minutes.

Discussion

The primary aim of the current study examined the direct relationship between child physical activity, sedentary behavior, and screen-time with household chaos in rural families. It was hypothesized that all primary outcomes would be associated with household chaos due to the difficulty individuals might face when establishing healthy routines in a disorganized environment. All measures of child screen-time were significantly associated with household chaos in unadjusted models; however, this association did not hold in adjusted analyses. Associations between child physical activity and sedentary behavior and household chaos were not statistically significant.

In the present study, for each one unit increase in household chaos, children participated in 54 additional minutes of weekend screen-time. There is only one other study that is comparable when examining this relationship, and the current study corroborated those findings that took place with preschool-aged children (Emond et al., 2018). Not only was household chaos associated with greater weekly screen use, but participants residing in more chaotic homes also reported increased use of electronic devices in their bedrooms (Emond et al., 2018). Our study found similar, but non-significant, findings related to bedroom screen use. Children residing in homes with low levels of household chaos reported using a slightly lower number of electronics in the bedroom versus those with high levels of household chaos. It is speculated that parents might utilize electronic devices to entertain their children and that engaging in screen-time might be a strategy that children use to escape chaotic environments. Parents of chaotic homes may also have increased difficulty setting limits and managing their child's screen-time (Emond et al., 2018). Addressing excessive screen use might require

different intervention strategies compared to those used for decreasing other sedentary behaviors due to the use of an electronic device. The differences between screen-time and non-screen-based sedentary behaviors could explain the significant association household chaos has with screen-time, but not sedentary behavior in the current study, as not all sedentary behavior involves screen-time. The focus of decreasing screen-time should not be underestimated as excessive use of screen-based electronic devices has been linked with negative health outcomes such as poorer sleep quality, reduced bone density, and the development of risk factors for cardiovascular disease (Lissak, 2018). Additional exploratory research about chaotic environments and their effect on screen-time might be useful when tailoring interventions aimed at reducing screen-time and sedentary behavior while increasing physical activity.

Broadening the Learning Experience

A secondary aim of the current study was to evaluate the relationship between the outcomes of interest and household chaos when including other individual, interpersonal, and environmental factors that are shown to be associated in current literature. It was hypothesized that household chaos would be significantly related to child physical activity, sedentary behavior, and screen-time after adjusting for individual, interpersonal, and environmental factors. However, this was only the case for child weekend screen-time.

Although child physical activity and sedentary behavior levels were not shown to be significantly associated with household chaos in full models, child weekend screen-time remained significantly associated with household chaos after the addition of confounders and covariates. Interestingly, child weekday and mean daily screen-time

were not shown to be associated with household chaos after accounting for additional factors. It is speculated that a chaotic home environment might be more impactful on a child's health behaviors during the weekend considering the child is likely to spend more time at home than an average weekday. As previously discussed, this finding was present in the only other comparable study (Emond et al., 2018) and was corroborated in the current study.

Some possible explanations for the finding that child physical activity and sedentary behavior are not significantly associated with household chaos include our inability to control for children's access to opportunities to be physically active (such as parks, equipment, and team sports) or account for children's screen-time activities that are active versus those that are sedentary. The amount of access one has to physical activity resources, like team sports, can be a significant factor in their level of engagement in physical activity (Hebert, Møller, Andersen, & Wedderkopp, 2015). Controlling for this access in the full models might have led to a stronger association between child physical activity and household chaos. It is interesting that child screen-time was found to be significantly related to household chaos in some models when child sedentary behavior was not because screen-time is generally a sedentary activity (Vandewater, Shim, & Caplovitz, 2004). Due to these findings, accounting for the use of screen-based electronic devices for active engagement such as learning a new dance or playing virtual sports might be important in future studies.

Literature has shown that children thrive in structured environments (Ackerman & Brown, 2010) and that their environment can impact their health (Davison et al., 2013). Therefore, it is plausible to consider that a lack of structure in the home that might result

from household chaos may have detrimental effects on one's ability to maintain healthy routines – especially regarding child physical activity and sedentary behavior. However, our results indicate that there is no evidence suggesting a relationship between child physical activity and sedentary behavior with household chaos. Nonetheless, because the current study is the first to explore this relationship, future studies should continue to investigate this association.

Child participants who were female engaged in less moderate, moderate-to-vigorous, and vigorous physical activity in comparison to their male counterparts in the current study. The differences in the physical activity levels of males and females are studied extensively, and females are consistently found to be less active than males (Sherar, Esliger, Baxter-Jones, & Tremblay, 2007; Trost et al., 2002). Encouragement to participate in extracurricular sport activities from interpersonal influences such as the family and school may be weaker for girls than boys, lessening the likelihood of their participation (Telford, Telford, Olive, Cochrane, & Davey, 2016). Additionally, some physical characteristics such as cardiorespiratory fitness and hand-eye coordination that are generally associated with physical activity may not be as actively attributed to girls (Telford et al., 2016). Future intervention strategies might address attitudes and beliefs held by families pertaining to their child's skill and the appropriateness of their engagement in physical activity, especially those attitudes and beliefs that specifically impact girls and their likelihood of participating (e.g., gender norms).

An interesting environmental factor that showed to be associated with physical activity was number of children in the home. That is, participants who reside in homes with more children were found to be more physically active. The idea that a greater

number of children in a household results in more active children has been shown before (Tandon et al., 2014), however the reasoning behind this idea has not been thoroughly studied. One might speculate that children with more siblings or other children living in the home might have more people with whom to participate in physical activity. Also, active children in the home may serve as role models to the other children who reside there, which could, in turn, influence their interest in physical activity (Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007). Regarding the support parents provide to their children who are enrolled in youth sports, it is also important to consider the financial support and time requirements that are needed for their child to participate (Dixon, Warner, & Bruening, 2008). It is plausible to assume that parents might enroll all their children in the same youth sport when only one expresses interest in participating due to the ease of taking all children to the same activities. Families with less children in the household might benefit from strategies implementing more time spent active as a family. Encouraging engagement in physical activity as a mode of "family time" could result in favorable outcomes. Additionally, parents with less children in the home might influence their child's physical activity behaviors in a favorable way by planning opportunities to participate in physical activity with other children their age (e.g., organizing "playdates").

As mentioned, child physical activity self-efficacy and family support of physical activity were not shown to be significantly associated with child physical activity levels in the current study. Self-efficacy and family support have been consistently shown in relevant literature to be influential factors on children's physical activity levels (Sallis, Prochaska, & Taylor, 2000), and it is unclear why these results were not corroborated in the current study.

Families who received economic assistance engaged in less sedentary behavior. Although this relationship was statically insignificant in the current study, 30 minutes less sedentary behavior is an impactful value in daily life, which provides evidence of clinical significance and should therefore be discussed. If families who receive economic assistance are replacing that sedentary time with physical activity, they may come close to meeting daily recommendations. However, it is important to note that the adjusted R^2 resulting from the linear regression model for child sedentary behavior is very low (R^2=0.0). This might be due to the complex nature of health behaviors and the difficulty faced when attempting to predict what affects them. Although the relationship between income status and sedentary behavior has not been investigated extensively, Shuval, Li, Gabriel, and Tchernis (2017) found that although high-income individuals met physical activity guidelines more frequently than their low-income counterparts, they also engaged in more sedentary time. Conversely, low-income participants completed more light physical activity. Perhaps low-income families participate in less organized sport or heightened bouts of physical activity in a gym or studio setting due to cost but engage in more light, leisure-time physical activity. Another possible explanation of this finding is the higher prevalence of blue-collar jobs among individuals of lower socioeconomic status. Utilizing minimal equipment when promoting physical activity will ensure affordability regardless of one's income level.

Children who were older and had a slightly higher BMI were more likely to engage in more weekday and total screen-time. This is not a surprising finding considering much of existing literature shows that children become less active as they age (Farooq et al., 2020). Additionally, because screen-time is generally a sedentary

activity, it is understandable that children who engage in more screen-time might also have a higher BMI (Hands et al., 2011). Children with a higher BMI may also be more likely to participate in more screen-time when compared with those with a lower BMI.

Children whose parents engaged in higher levels of screen-time tended to engage in more screen-time themselves. Relevant literature has concluded that when parents exceed the national recommendation of two hours, their children may also be likely to exceed the recommendation (Jago et al., 2013). This may result from the use of screen-based electronic devices as a method of securing "family time." Additionally, parental modelling has been proven as a strong force for children's behavior (Schoeppe et al., 2017) – that is, children tend to do what their parents do.

Strengths and Limitations

The current study has multiple strengths. These include the objectively measured child physical activity and sedentary behavior data; innovatively examining household chaos with child physical activity, sedentary behavior, and screen-time; and extending knowledge of child health-behaviors in a less frequently explored population (rural communities).

One limitation of the current study is that most of the variables are participant-reported, which is subjective to response bias. Additionally, parents residing in more chaotic homes might be less likely to monitor their child's screen-time. Household chaos could also be underreported by parents if they were concerned about social desirability. Finally, generalizability of the study to other rural populations nationally is unknown.

Future Directions

Studies that examine what elements of a home with high levels of chaos lead to increased screen-time among residents may prove to be beneficial in order to design and administer effective strategies to reduce screen-time in a given population. Additionally, examining household chaos in relation to the development of childhood obesity through its effects on screen-time and sleep behavior could further current knowledge of the risk factors that may be associated with a child's environment. It is also important to note that the characteristics depicting a chaotic household may not always feel stressful to those residing there. For some individuals, the fast-paced and unpredictable nature of household chaos might be invigorating. Future studies could better examine the perception of household chaos and whether residents react to disorderly situations uniformly. Perhaps individuals who view household chaos as more stressful suffer from greater preventable health consequences that may be linked to chaos compared to those who do not view household chaos as particularly stressful. Future studies might also find that adapting data collection measures to more accurately assess caregiving roles in the home to include other adults and children would improve methods of accounting for family structure and how it contributes to household chaos. Finally, the replication of the current study with a larger and more diverse study sample is necessary to improve generalizability and strengthen the reliability of the findings.

Bibliography

Ackerman, B. P., & Brown, E. D. (2010). Physical and psychosocial turmoil in the home and cognitive development [American Psychological Association doi:10.1037/12057-003]. Retrieved

Arundell, L., Fletcher, E., Salmon, J., Veitch, J., & Hinkley, T. (2016). A systematic review of the prevalence of sedentary behavior during the after-school period among children aged 5-18 years. *International Journal of Behavioral Nutrition and Physical Activity, 13*(1), 93. doi:10.1186/s12966-016-0419-1

Bames, J., Behrens, T. K., Benden, M. E., Biddle, S., Bond, D., Brassard, P., . . . Chaput, J. (2012). Letter to the Editor: Standardized use of the terms" sedentary" and" sedentary behaviours". *Applied Physiology Nutrition and Metabolism-Physiologie Appliquee Nutrition Et Metabolisme, 37*, 540-542.

Barr-Anderson, D. J., Flynn, J. I., Dowda, M., Taverno Ross, S. E., Schenkelberg, M. A., Reid, L. A., & Pate, R. R. (2017). The Modifying Effects of Race/Ethnicity and Socioeconomic Status on the Change in Physical Activity From Elementary to Middle School. *Journal of Adolescent Health, 61*(5), 562-570. doi:https://doi.org/10.1016/j.jadohealth.2017.05.007

Bronfenbrenner, U. (1994). Ecological models of human development. *Readings on the development of children, 2*(1), 37-43.

Coldwell, J., Pike, A., & Dunn, J. (2006). Household chaos – links with parenting and child behaviour. *Journal of Child Psychology and Psychiatry, 47*(11), 1116-1122. doi:10.1111/j.1469-7610.2006.01655.x

Council on Communications and Media. (2016a). Media and Young Minds. *Pediatrics, 138*(5), e20162591. doi:10.1542/peds.2016-2591

Council on Communications and Media. (2016b). Media Use in School-Aged Children and Adolescents. *Pediatrics, 138*(5), e20162592. doi:10.1542/peds.2016-2592

Dale, L. P., Vanderloo, L., Moore, S., & Faulkner, G. (2019). Physical activity and depression, anxiety, and self-esteem in children and youth: An umbrella systematic review. *Mental Health and Physical Activity, 16*, 66-79. doi:https://doi.org/10.1016/j.mhpa.2018.12.001

Davison, K. K., Jurkowski, J. M., & Lawson, H. A. (2013). Reframing family-centred obesity prevention using the Family Ecological Model. *Public Health Nutrition, 16*(10), 1861-1869. doi:10.1017/S1368980012004533

Dixon, M. A., Warner, S. M., & Bruening, J. E. (2008). More than Just Letting Them Play: Parental Influence on Women's Lifetime Sport Involvement. *Sociology of sport journal, 25*(4), 538-559. doi:10.1123/ssj.25.4.538

Emond, J. A., Tantum, L. K., Gilbert-Diamond, D., Kim, S. J., Lansigan, R. K., & Neelon, S. B. (2018). Household chaos and screen media use among preschool-aged children: a cross-sectional study. *BMC public health, 18*(1), 1210.

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences, 26*(14), 1557-1565. doi:10.1080/02640410802334196

Expert Panel on Integrated Guidelines for Cardiovascular Health, Risk Reduction in, C., Adolescents, National Heart, L., & Blood, I. (2011). Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and

adolescents: summary report. *Pediatrics, 128 Suppl 5*(Suppl 5), S213-S256. doi:10.1542/peds.2009-2107C

Farooq, A., Martin, A., Janssen, X., Wilson, M. G., Gibson, A.-M., Hughes, A., & Reilly, J. J. (2020). Longitudinal changes in moderate-to-vigorous-intensity physical activity in children and adolescents: A systematic review and meta-analysis. *Obesity reviews, 21*(1), e12953. doi:10.1111/obr.12953

Fiese, B. H., Tomcho, T. J., Douglas, M., Josephs, K., Poltrock, S., & Baker, T. (2002). A review of 50 years of research on naturally occurring family routines and rituals: Cause for celebration? *Journal of Family Psychology, 16*(4), 381-390. doi:10.1037/0893-3200.16.4.381

Ford, E. S., & Caspersen, C. J. (2012). Sedentary behaviour and cardiovascular disease: a review of prospective studies. *International Journal of Epidemiology, 41*(5), 1338-1353. doi:10.1093/ije/dys078

Fulkerson, J. A., Telke, S., Larson, N., Berge, J., Sherwood, N. E., & Neumark-Sztainer, D. (2019). A healthful home food environment: Is it possible amidst household chaos and parental stress? *Appetite, 142*, 104391. doi:https://doi.org/10.1016/j.appet.2019.104391

Godin, G., & Shephard, R. (1985). A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci, 10*(3), 141-146.

Gortmaker, S. L., Peterson, K., Wiecha, J., Sobol, A. M., Dixit, S., Fox, M. K., & Laird, N. (1999). Reducing Obesity via a School-Based Interdisciplinary Intervention Among Youth: Planet Health. *Archives of Pediatrics & Adolescent Medicine, 153*(4), 409-418. doi:10.1001/archpedi.153.4.409

Hands, B. P., Chivers, P. T., Parker, H. E., Beilin, L., Kendall, G., & Larkin, D. (2011). The associations between physical activity, screen time and weight from 6 to 14 yrs: The Raine Study. *Journal of Science and Medicine in Sport, 14*(5), 397-403. doi:https://doi.org/10.1016/j.jsams.2011.03.011

Hebert, J. J., Møller, N. C., Andersen, L. B., & Wedderkopp, N. (2015). Organized sport participation is associated with higher levels of overall health-related physical activity in children (CHAMPS study-DK). *PloS one, 10*(8), e0134621.

Hohepa, M., Scragg, R., Schofield, G., Kolt, G. S., & Schaaf, D. (2007). Social support for youth physical activity: Importance of siblings, parents, friends and school support across a segmented school day. *International Journal of Behavioral Nutrition and Physical Activity, 4*(1), 54. doi:10.1186/1479-5868-4-54

Jago, R., Sebire, S. J., Lucas, P. J., Turner, K. M., Bentley, G. F., Goodred, J. K., . . . Fox, K. R. (2013). Parental modelling, media equipment and screen-viewing among young children: cross-sectional study. *BMJ open, 3*(4), e002593.

Johnson, A. D., Martin, A., Brooks-Gunn, J., & Petrill, S. A. (2008). Order in the House! Associations among Household Chaos, the Home Literacy Environment, Maternal Reading Ability, and Children's Early Reading. *Merrill-Palmer Quarterly, 54*(4), 445-472. doi:10.1353/mpq.0.0009

Lissak, G. (2018). Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. *Environmental Research, 164*, 149-157. doi:https://doi.org/10.1016/j.envres.2018.01.015

Marques, A., Santos, D. A., Hillman, C. H., & Sardinha, L. B. (2018). How does academic achievement relate to cardiorespiratory fitness, self-reported physical

activity and objectively reported physical activity: a systematic review in children and adolescents aged 6–18 years. *British Journal of Sports Medicine, 52*(16), 1039. doi:10.1136/bjsports-2016-097361

Marsh, S., Foley, L. S., Wilks, D. C., & Maddison, R. (2014). Family-based interventions for reducing sedentary time in youth: a systematic review of randomized controlled trials. *Obes Rev, 15*(2), 117-133. doi:10.1111/obr.12105

Matheny, A. P., Wachs, T. D., Ludwig, J. L., & Phillips, K. (1995). Bringing order out of chaos: Psychometric characteristics of the confusion, hubbub, and order scale. *Journal of Applied Developmental Psychology, 16*(3), 429-444. doi:https://doi.org/10.1016/0193-3973(95)90028-4

Miller, A. L., Song, J.-H., Sturza, J., Lumeng, J. C., Rosenblum, K., Kaciroti, N., & Vazquez, D. M. (2017). Child cortisol moderates the association between family routines and emotion regulation in low-income children. *Developmental Psychobiology, 59*(1), 99-110. doi:10.1002/dev.21471

Piercy, K. L., Troiano, R. P., Ballard, R. M., Carlson, S. A., Fulton, J. E., Galuska, D. A., . . . Olson, R. D. (2018). The Physical Activity Guidelines for Americans. *Jama, 320*(19), 2020-2028. doi:10.1001/jama.2018.14854

Reid Chassiakos, Y., Radesky, J., Christakis, D., Moreno, M. A., & Cross, C. (2016). Children and Adolescents and Digital Media. *Pediatrics, 138*(5), e20162593. doi:10.1542/peds.2016-2593

Rideout, V. (2016). Measuring time spent with media: the Common Sense census of media use by US 8- to 18-year-olds. *Journal of Children and Media, 10*(1), 138-144. doi:10.1080/17482798.2016.1129808

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise, 32*(5). Retrieved from https://journals.lww.com/acsm-msse/Fulltext/2000/05000/A_review_of_correlates_of_physical_activity_of.14.aspx

Saunders, R. P., Motl, R. W., Dowda, M., Dishman, R. K., & Pate, R. R. (2004). Comparison of Social Variables for Understanding Physical Activity in Adolescent Girls. *American Journal of Health Behavior, 28*(5), 426-436. doi:10.5993/AJHB.28.5.5

Saunders, R. P., Pate, R. R., Felton, G., Dowda, M., Weinrich, M. C., Ward, D. S., . . . Baranowski, T. (1997). Development of Questionnaires to Measure Psychosocial Influences on Children's Physical Activity. *Preventive Medicine, 26*(2), 241-247. doi:https://doi.org/10.1006/pmed.1996.0134

Schoeppe, S., Vandelanotte, C., Bere, E., Lien, N., Verloigne, M., Kovács, É., . . . Van Lippevelde, W. (2017). The influence of parental modelling on children's physical activity and screen time: Does it differ by gender? *The European Journal of Public Health, 27*(1), 152-157.

Sherar, L. B., Esliger, D. W., Baxter-Jones, A. D., & Tremblay, M. S. (2007). Age and gender differences in youth physical activity: does physical maturity matter? *Medicine and science in sports and exercise, 39*(5), 830-835. doi:10.1249/mss.0b013e3180335c3c

Shuval, K., Li, Q., Gabriel, K. P., & Tchernis, R. (2017). Income, physical activity, sedentary behavior, and the 'weekend warrior' among U.S. adults. *Preventive Medicine, 103*, 91-97. doi:https://doi.org/10.1016/j.ypmed.2017.07.033

Summers, G. F. (2019). *Persistent Poverty in Rural America*: Routledge.

Tandon, P., Grow, H. M., Couch, S., Glanz, K., Sallis, J. F., Frank, L. D., & Saelens, B. E. (2014). Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Preventive Medicine, 66*, 39-44. doi:10.1016/j.ypmed.2014.05.019

Telford, R. M., Telford, R. D., Olive, L. S., Cochrane, T., & Davey, R. (2016). Why Are Girls Less Physically Active than Boys? Findings from the LOOK Longitudinal Study. *PloS one, 11*(3), e0150041-e0150041. doi:10.1371/journal.pone.0150041

Trost, S. G., McIver, K. L., & Pate, R. R. (2005). Conducting Accelerometer-Based Activity Assessments in Field-Based Research. *Medicine & Science in Sports & Exercise, 37*(11), S531-S543. doi:10.1249/01.mss.0000185657.86065.98

Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., & Sirard, J. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine and science in sports and exercise, 34*(2), 350-355. doi:10.1097/00005768-200202000-00025

US Department of Health and Human Services. (2018). *Physical Activity Guidelines for Americans* (2nd Edition ed.). Washington D.C.: U.S. Department of Health and Human Services.

Vandewater, E. A., Shim, M.-s., & Caplovitz, A. G. (2004). Linking obesity and activity level with children's television and video game use. *Journal of Adolescence, 27*(1), 71-85.

Vernon-Feagans, L., Burchinal, M., & Mokrova, I. (2015). Diverging Destinies in Rural America. In P. R. Amato, A. Booth, S. M. McHale, & J. Van Hook (Eds.), *Families in an Era of Increasing Inequality: Diverging Destinies* (pp. 35-49). Cham: Springer International Publishing.

Vernon-Feagans, L., Garrett-Peters, P., De Marco, A., & Bratsch-Hines, M. (2012). Children living in rural poverty: The role of chaos in early development. In *The Oxford handbook of poverty and child development.* (pp. 448-466). New York, NY, US: Oxford University Press.

Whitesell, C. J., Crosby, B., Anders, T. F., & Teti, D. M. (2018). Household chaos and family sleep during infants' first year. *J Fam Psychol, 32*(5), 622-631. doi:10.1037/fam0000422

Table 1

Descriptive Sociodemographics

Descriptive Variables	**Participants** (n=105)
Child Variables	
Age, mean yrs (SD)	8.96 (1.06)
BMIz, mean score (SD)	0.92 (0.94)
BMI percentile,[a] n (%)	
Normal	56 (53.33)
Overweight	23 (21.90)
Obese	26 (24.76)
Sex, n (%)	
Male	44 (41.90)
Female	61 (58.10)
Parent Variables	
BMI, mean kg/m^2 (SD)	29.98 (6.87)
BMI,[b] n (%)	
Normal	24 (22.86)
Overweight	37 (35.24)
Obese	42 (40.00)
Household Variables	
Economic assistance,[c] n (%)	
Yes	31 (29.52)
No	74 (70.48)
Number of children living in household, mean # (SD)	2.99 (1.95)
Household chaos,[d] mean (SD)	5.04 (3.60)

[a]Child BMI percentile categories include normal (5th percentile to 84th percentile), overweight (85th percentile to 94th percentile), and obese (≥95th percentile). [b]Parent BMI categories include normal (18.5-24.9), overweight (25.0-29.9), and obese (30 and above). [c]Economic assistance represents parent-reported public assistance or child receiving free or reduced-price school lunch. [d]Household chaos is assessed by the Confusion, Hubbub, and Order Scale (Matheny et al., 1995). The scale ranges from 0-14 with a higher score indicating a higher level of household chaos.

Table 2

Descriptive Statistics [a] of Child Physical Activity, Sedentary Behavior and Screen-Time for the Total Sample and by Low and High Chaos Households

Child Health Behaviors	**Total,** n=105	**Household Chaos**	
		Low,[b] n=58	*High,*[c] n=47
Physical activity,[d] min/day			
Moderate	30.69 (10.69)	30.96 (10.32)	30.37 (11.24)
Moderate-to-vigorous	44.95 (18.58)	45.76 (18.79)	43.94 (18.48)
Vigorous	14.25 (9.08)	14.81 (9.97)	13.57 (7.89)
Total	259.08 (58.22)	257.44 (53.33)	261.10 (64.28)
Sedentary behavior,[e] min/day	499.93 (77.46)	503.06 (74.85)	496.06 (81.20)
Screen-time, hrs/day			
Weekday	1.79 (1.48)	1.49 (1.33)**	2.17 (1.58)**
Weekend	2.72 (1.59)	2.41 (1.54)**	3.11 (1.59)**
Daily	2.06 (1.42)	1.75 (1.31)**	2.44 (1.48)**

[a]Statistics are presented as mean (SD). [b]Participants who reside in low chaos homes have a CHAOS score of ≤4. [c]Participants who reside in high chaos homes have a CHAOS score of >4. [d]Physical activity cut points are as follows: moderate (2296-4011 counts), moderate-to-vigorous (≥2296 counts), and vigorous (≥4012 counts). [e]Total physical activity includes any activity >100 counts. [f]Sedentary behavior includes any activity ≤100 counts.
*p<.05 **p<.01 ***p<.001

Table 3

Unadjusted and Full Linear Regression Models of Associations between Household Chaos and Child Moderate, Moderate to Vigorous, Vigorous and Total Physical Activity (PA)

	Unadjusted model		*Full model*	
Variable	**β**	**p-value**	**β**	**p-value**
Moderate PA				
Household chaos	-.10	.73	-.16	.59
Child age			-1.16	.23
Child sex			2.01	.01
Child BMI z-score			-.84	.44
Economic assistance			-1.32	.56
Number of children in household			2.19	.03
Parent weekly MVPA[a]			-.43	.22
Child PA self-efficacy[b]			.43	.20
Child PA support[c]			.53	.06
Model p-value	.73		.01*	
Adjusted R^2	-.01		.12	
Moderate-to-vigorous PA				
Household chaos	-.35	.49	-.51	.32
Child age			-2.56	.13
Child sex			-10.90	.002
Child BMI z-score			-1.71	.36
Economic assistance			-3.03	.44
Number of children in household			4.31	.01

Parent weekly MVPA[a]			-.66	.27
Child PA self-efficacy[b]			.48	.40
Child PA support[c]			.72	.14
Model p-value	.49		.004**	
Adjusted R^2	-.01		.14	
ɔus PA				
Household chaos	-.25	.32	-.35	.16
Child age			-1.39	.09
Child sex			-5.53	<.01
Child BMI z-score			-.87	.34
Economic assistance			-1.70	.37
Number of children in the household			2.13	.01
Parent weekly MVPA[a]			-.24	.42
Child PA self-efficacy[b]			.05	.85
Child PA support[c]			.20	.41
Model p-value	.32		<.01**	
Adjusted R^2	.00		0.13	

Variable	*Unadjusted model* β	*Unadjusted model* p-value	*Full model* β	*Full model* p-value
Total PA				
Household chaos	.95	.55	.49	.76
Child age			-11.51	.03
Child sex			-9.42	.39
Child BMI z-score			-1.45	.80
Economic assistance			-21.0	.09
Number of children in the household			15.4	<.01
Parent weekly MVPA[a]			-2.75	.15
Child PA self-efficacy[b]			1.91	.30
Child PA support[c]			2.75	.07
Model p-value	.55		.01*	
Adjusted R^2	-.01		.11	

Note. Unadjusted model consists of only the dependent variable and independent variable (household chaos). Full model is an adjusted model with potential confounders and any covariates that have been found in relevant literature as a potential correlate of the dependent variable.
[a]Parent weekly MVPA is defined as the number of hours parents reported that they engage in moderate-to-vigorous physical activity per week. [b]Child PA self-efficacy is the child's belief in their ability to be physically active. A higher number indicates more difficulty engaging in PA. [c]Child PA support measures how much logistical or emotional support a child believes is provided by an adult family member. A higher value indicates a greater amount of support.

Table 4

Unadjusted and Full Linear Regression of Household Chaos and Child Sedentary Behavior

	Unadjusted model		*Full model*	
Variable	**β**	**p-value**	**β**	**p-value**
Sedentary behavior				
Household chaos	.45	.83	1.11	.64
Child age			2.92	.70
Child sex			16.49	.31
Child BMI z-score			4.8	.56
Economic assistance[a]			-29.9	.12
Number of children in the household			-.30	.97
Parent daily mean screen-time			-3.28	.63
Child screen use in bedroom			1.61	.83
Model p-value	.83		.43	
Adjusted R^2	-.01		.00	

Note. Unadjusted model consists of only the dependent variable and independent variable (household chaos). Full model is an adjusted model with potential confounders and any covariates that have been found in relevant literature as a potential correlate of the dependent variable.

[a]Economic assistance represents parent-reported public assistance or child receiving free or reduced-price school lunch.

Table 5

Unadjusted and Full Linear Regression of Household Chaos and Child Screen-Time

	Unadjusted model		*Full model*	
Variable	**β**	**p-value**	**β**	**p-value**
Parent-reported child mean weekday screen-time				
Household chaos	0.11	.01	.06	.13
Child age			.28	.04
Child sex			.08	.78
Child BMI z-score			.30	.04
Economic assistance			-.25	.46
Number of children in the household			.16	.24
Parent daily mean screen-time			.28	.02
Child screen use in bedroom			.07	.59
Model p-value	.01	<.01**		
Adjusted R^2	.06		.14	
Parent-reported child mean weekend screen-time				
Household chaos	0.14	<.01	.90	.04
Child age			.23	.10
Child sex			-.23	.44
Child BMI z-score			.27	.07
Economic assistance			-.73	.04
Number of children in the household			.19	.20
Parent daily mean screen-time			.40	<.01
Child screen use in bedroom			.09	.50
Model p-value	<.01**		<.001***	
Adjusted R^2	.08		.19	

	Unadjusted model		*Full model*	
Variable	**β**	**p-value**	**β**	**p-value**
Parent-reported child daily mean screen-time				
Household chaos	.12	<.01	.07	.07
Child age			.26	.04
Child sex			-.01	.97
Child BMI z-score			.29	.04
Economic assistance			-.39	.23
Number of children in household			.17	.19
Parent daily mean screen-time			.32	<.01
Child screen use in bedroom			.08	.53
Model p-value	<.01**		<.001***	
Adjusted R^2	.07		.18	

Note. Unadjusted model consists of only the dependent variable and independent variable (household chaos). Full model is an adjusted model with potential confounders and any covariates that have been found in relevant literature as a potential correlate of the dependent variable.

Appendix A

Variable Name	Items	Response Options	Calculation of Variable	Mean (SD) Range
Primary Independent Variable of Interest				
Household chaos	1. There is very little commotion in our home. 2. We can usually find things when we need them. 3. We almost always seem to be rushed. 4. We are usually able to stay on top of things. 5. No matter how hard we try, we always seem to be running late. 6. It's a real zoo in our home. 7. At home we can talk to each other without being interrupted. 8. There is often a fuss going on at our home. 9. No matter what our family plans, it usually doesn't seem to work out. 10. You can't hear yourself think in our home. 11. I often get drawn into other people's arguments at home. 12. Our home is a good place to relax. 13. Electronics take up a lot of time at home. 14. The atmosphere in our home is calm.	0=False 1=True	Items 1, 2, 4, 7, 12, 14, and 15 are reverse coded; Summation of item responses	5.0 (3.6) 0-15

	15. First thing in the day, we have a regular routine at home.			
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Primary Outcomes of Interest				

Child screen-time	1. In [child name]'s free time (not school time), on a typical WEEKDAY (like a Monday), how many hours does he/she spend watching TV/movies/videos, playing video games, using the computer or texting? 2. In [child name]'s free time (not school time), on a typical WEEKEND DAY (like a Saturday), how many hours does he/she spend watching TV/movies/videos, playing video games, using the computer or texting?	None Less than ½ hour per day ½-1 hour per day 1 ½-2 hours per day 2 ½-4 hours per day 4 ½-6 hours per day More than 6 hours per day	Responses were recoded to 0, 0.3, 0.75, 1.75, 3.25, 5.25, and 6.5, respectively. Weekday value is multiplied by 5 and weekend value is multiplied by 2. Responses are summed and divided by 7 to create daily mean screen-time variable.	Weekday: 1.79 (1.48) 0-6.5 Weekend: 2.72 (1.59) 0.3-6.5 Daily: 2.06 (1.42) 0.09-6.5
Behavior Related Covariates				
Parent physical activity	In a USUAL week, how many hours do YOU spend doing the following activities? 1. Strenuous exercise (heart beats rapidly) Examples: biking fast, aerobics, jogging, basketball, swimming laps, soccer, rollerblading 2. Moderate exercise (not exhausting)	None Less than ½ hour a week ½-2 hours a week 2 ½-4 hours a week	Responses were recoded to 0, 0.3, 1.3, 3.3, 5.3, and 6.3, respectively. Responses of moderate and vigorous activities was summed to	Weekly MVPA: 2.97 (2.95) 0-11.6 Total PA: 5.45 (3.90) 0-16.9

	Examples: walking quickly, easy biking, volleyball, skiing, dancing, skateboarding, snowboarding 3. Mild exercise (little effort) Examples: walking slowly, bowling, golf, fishing, snowmobiling	4 ½-6 hours a week More than 6 hours a week	create weekly MVPA variable. Adding all responses created total weekly PA.	
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Child physical activity self-efficacy	1. How hard do you think it would be to be physically active instead of watching TV? 2. How hard do you think it would be to be physically active on weekends? 3. How hard do you think it would be to ask a parent or other adult to do physically active things with you? 4. How hard do you think it would be to play sports on a team? 5. How hard do you think it would be to ask friends to be physically active with you? 6. How hard do you think it would be to ask a parent or other adult to take you to a physical activity or sports practice? 7. How hard do you think it would be to be physically active most days of the week? 8. How hard do you think it would be to be physically active when inside your house?	0=Not at all hard 1=A little hard 2=Very hard	Responses are summed.	14.59 (3.31) 9-25

Family support of physical activity	1. During a normal week, how often has an adult you live with encouraged you to do physical activities or play sports? 2. During a normal week, how often has an adult you live with done a physical activity or played sports with you? 3. During a normal week, how often has an adult you live with provided transportation to a place where you can do physical activities or play sports? 4. During a normal week, how often has an adult you live with watched you participate in physical activities or sports? 5. During a normal week, how often has an adult you live with told you that you are doing well in physical activities or sports?	0=None 1=Once 2=Sometimes 3=Almost every day 4=Every day	Responses are summed.	11.57 (3.79) 0-20
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Parent screen-time	1. In YOUR free time (not work time), on a typical WEEKDAY (like a Monday), how many hours do YOU spend watching TV/movies/videos, playing video games, using the computer, or texting? 2. In YOUR free time (not work time), on a typical WEEKEND (like a Monday), how many hours do	None Less than ½ hour ½ to 1 hour 1 ½ to 2 hours	Responses were recoded to 0, 0.3, 0.75, 1.75, 3.25, 5.25, and 6.5, respectively. Weekday value is	Weekday: 1.68 (1.33) 0.3-6.5 Weekend: 2.19 (1.46)

	YOU spend watching TV/movies/videos, playing video games, using the computer, or texting?	2 ½ to 4 hours 4 ½ to 6 hours More than 6 hours	multiplied by 5 and weekend value is multiplied by 2. Responses are summed and divided by 7 to create daily mean screen-time variable.	0.3-6.5 Daily: 1.83 (1.27) 0.3-6.5
Child bedroom screen use	1. In the room where you sleep, do you use a TV? 2. In the room where you sleep, do you use a computer or laptop? 3. In the room where you sleep, do you use a tablet like an iPad or a Kindle fire? 4. In the room where you sleep, do you use a video game system like a Playstation or an Xbox? 5. In the room where you sleep, do you use a handheld video game player like a Nintendo DS or a Playstation Vita? 6. In the room where you sleep, do you use a smart phone like an iPhone?	0=No 1=Yes	Responses were summed for a total number of devices used in the room where they sleep	1.51 (1.18) 0-6
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Sociodemographic Variables				
Parent age	1. What is YOUR date of birth?	(MM-DD-YYYY)	No calculation needed.	37.91 (5.42) 27.28-54-95

Child age	1. What is [child's first name]'s date of birth?	(MM-DD-YYYY)	No calculation needed.	8.96 (1.06) 6.89-11.03
Economic assistance	1. Does your household receive public assistance (like food support/stamps, EBT, WIC, TANF, SSI OR MFIP)? 2. Does [child's first name] receive free or reduced price lunches at school? (Free or reduced price lunch means that lunch at school is provided for free or you pay less for it based on income.)	0=No 1=Yes I don't know	If parent indicated "yes" to either question, they were designated as receiving economic assistance.	No: 70% Yes: 30%
Number of children in the household	1. How many CHILDREN living in your household are newborn to 2 years old? 2. How many CHILDREN living in your household are 3-4 years old? 3. How many CHILDREN living in your household are 5-6 years old? 4. How many CHILDREN living in your household are 7-10 years old? 5. How many CHILDREN living in your household are 11-13 years old? 6. How many CHILDREN living in your household are 14-17 years old?	0=None 1=One 2=Two 3=Three 4=Four 5=Five or more	Responses were summed.	2.99 (1.95) 1-19
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Number of adults in household	1. INCLUDING YOU, how many ADULTS aged 18 years or older are living in your household?	1=One (only answer this if	Responses were summed.	2 (0.57) 1-5

		you are the only adult in the household) 2=Two 3=Three 4=Four 5=Five or more		
Variable Name	**Items**	**Response Options**	**Calculation of Variable**	**Mean (SD) Range**
Parent sex	1. What is YOUR sex?	1=Female 2=Male 3=Different identity	No calculation needed.	Female: 98% Male: 2%
Child sex	1. What is [child's first name]'s sex?	1=Female 2=Male 3=Different identity	No calculation needed.	Female: 58% Male: 42%