



2020

Parental Impact on Child Physical Activity and Sedentary Time in Appalachian North Carolina

Allison V. Farrell

Appalachian State University, farrellav@appstate.edu

Richard W. Christiana

Appalachian State University, christianarw@appstate.edu

Rebecca A. Battista

Appalachian State University, battistara@appstate.edu

J. Joy James

Appalachian State University, jamesjj@appstate.edu

Follow this and additional works at: <https://uknowledge.uky.edu/jah>



Part of the [Appalachian Studies Commons](#), and the [Public Health Education and Promotion Commons](#)

Recommended Citation

Recommended citation: Farrell AV, Christiana RW, Battista RA, James JJ. Parental Impact on Child Physical Activity and Sedentary Time in Appalachian North Carolina. *J Appalach Health* 2020;2(3):26–40. DOI: <https://doi.org/10.13023/jah.0203.05>

Copyright © 2020 Allison V. Farrell, Richard W. Christiana, Rebecca A. Battista, and J. Joy James

This Research Articles is brought to you for free and open access by the College of Public Health at the University of Kentucky.

Parental Impact on Child Physical Activity and Sedentary Time in Appalachian North Carolina

Abstract

Introduction: Physical activity has positive health benefits across the lifespan including reduced rates of chronic disease. Despite having ample availability of outdoor space for physical activity in the Appalachian Mountain region, there are low rates of physical activity along with high rates of sedentary time and increased prevalence of overweight individuals across all age groups. Therefore, there is a need to understand the factors that influence family's physical activity and sedentary time.

Purpose: To assess whether parental attitudes and behaviors influence children's physical activity and sedentary time.

Methods: The current study was a secondary analysis of the baseline data from a pilot study of a pediatrician prescription program for outdoor physical activity. Parents ($N = 70$) with children aged 5–13 years living in a county served by a single-pediatrician office completed surveys in the pediatrician's office during a well-child visit. The survey included questions related to parental attitudes toward children's physical activity and the physical activity and sedentary time performed by the parent and their child.

Results: Parent sedentary time was the only factor that had an impact on child sedentary time, with 18% of the variance in children's sedentary time being explained by parent sedentary time. No factors predicted children's physical activity.

Implications: To decrease child sedentary time, interventions should focus on reducing parental and joint parent–child sedentary time.

Keywords

Appalachia, North Carolina, sedentary time, children, adolescents, physical activity

Creative Commons License



This work is licensed under a [Creative Commons Attribution 4.0 License](https://creativecommons.org/licenses/by/4.0/).

Cover Page Footnote

No competing financial or editorial interests were reported by the authors of this paper.

INTRODUCTION

Physical activity is an important component of health as it reduces the risk of various chronic diseases both physical and mental.¹ Despite the health benefits only 24% of children aged 6 to 17 years in the U.S. meet the recommended 60 minutes of daily moderate to vigorous physical activity.² As a result, determining ways to increase physical activity and understanding the influences on children and adolescent physical activity behavior has seen much attention.

The family unit has been a recent area of interest as it may impact children's physical activity, particularly the parent's role on their child's physical activity.^{3,4} For example, Trost et al. discovered parental physical activity, enjoyment in participation in physical activity, and physical activity performance were positively associated with parental support for child physical activity. However, Bauer et al. suggested that parents modeling physical activity does not necessarily mean their child will also be physically active.^{3,4} Nonetheless, it has been suggested that parental support, particularly tangible (e.g., transportation, equipment) and intangible (e.g., verbal support, encouragement) social support is positively associated with child physical activity.³⁻⁵

Along with physical activity, sedentary time may also impact health outcomes. Similar to the time spent being active, the time spent being sedentary (e.g., sitting at work or school, watching television, or playing video games) may also affect children's health. Sedentary time poses great health risks as children develop to adulthood, including low metabolism and poor musculoskeletal health and is associated with all-cause mortality and cardiovascular disease, independent of physical activity.^{6,7} Sedentary time is defined as "the time spent for any duration (e.g., minutes per day) or in any context (e.g., at school or work) in sedentary behaviors."⁸ Increased time spent in sedentary activities is predominant in both adults and children with the concern that a decrease in physical activity may result in engaging in more sedentary time.⁶ If the focus is on the family unit, perhaps parental sedentary time may actually influence the child.

Bauer et al.⁴ suggested that children tend to mirror their parents in sedentary time, although children may not mirror their parents in physical activity. Though parental role-modeling of physical activity may have little effect on children, parental beliefs about physical activity have been shown to influence children's physical activity and sedentary time regardless of children's perception of these beliefs.^{3-5,9} Additionally, it has been suggested parents may also want to consider placing limits on sedentary activities, which may decrease child sedentary time.¹⁰

Thus, the parents physical activity and sedentary time and their current beliefs or boundaries regarding these activities may influence their child's time spent in either physical activity or sedentary activity.

However, there is limited research investigating the relationship between parent physical activity on child physical activity; parent sedentary time on child sedentary time; and parent limiting sedentary time on child's physical activity and sedentary time. This lack of research is especially pronounced for rural Appalachian populations that have been found to have youth with high rates of poor health behaviors.^{11,12} Therefore, this study explored whether children's physical activity and sedentary time were influenced by parental physical activity, sedentary time, parental beliefs about the importance of children's physical activity, and parental limits on children's screen time in rural Appalachia?

METHODS

Study Design and Population

This cross-sectional study is a secondary data analysis of baseline data from a pilot study of a pediatrician prescription program for outdoor physical activity for children. Full study procedures are described elsewhere.¹³ Parents with children aged 5 to 13 years were recruited from the single pediatrician's office in a county in the Appalachian Mountains in western North Carolina during a well-child visit. Parents completed a baseline survey asking for informed consent prior to seeing the pediatrician. All study procedures were approved by the Institutional Review Board at Appalachian State University. A total of 70 parents were recruited.

Measures

The survey collected data on the age of the child, parent race/ethnicity, total household income, and highest level of education in the home. Survey questions assessed child and parent physical activity, sedentary time, whether parents regularly limit their child's screen time (watching TV, playing video games, using the computer), and parental beliefs about children's physical activity (Table 1).

Parent and child moderate-to-vigorous physical activity (MVPA) was assessed using two questions from the Godin Leisure-Time Exercise Questionnaire (LTEQ) that asked about weekly time spent in moderate and vigorous physical activities.¹⁴ Two variables were created for child and parent MVPA by multiplying the time spent in vigorous physical activity by two and then summing with the time spent in moderate physical activity. Child's sedentary time was assessed

using two questions that asked the amount of time during an average weekday and weekend day the child spends in sedentary behaviors. Parent sedentary time was assessed using a similar question adapted for adults. Parent and child's sedentary time per week was estimated by the sum of weekday sedentary time multiplied by five and weekend day sedentary time multiplied by two. Parental limits placed on children's screen time was assessed by three questions. To allow for regression analysis, each of these questions was converted to a dichotomous variable where "0" was "never to sometimes" and "1" was "very often to always."

Table 1. Survey Instrument Items

Child Items
About how many hours a day on (school days/weekends or non-school days) does your child spend in sedentary activity (sitting while listening to music, watching TV, playing video games, using a computer or tablet/iPad, doing homework, reading, etc.)?*
How often do you put limits on how much time your child may watch TV? **
How often do you put limits on how much time your child may play video games? **
How often do you put limits on how much time your child may use the computer? **
Kids who do regular physical activity have more self-confidence. ***
Kids who do regular physical activity are healthy. ***
Kids who do regular physical activity will be healthier adults. ***
It is the parents' responsibility to help their child find physical activity. ***
All kids should be physically active every day. ***
Parents play an important role in whether their kids are physically active when they grow up. ***
Parent Items
About how many hours a day do you spend in sedentary activity (sitting while listening to music, reading, watching TV, playing video games, using a computer or tablet/iPad, doing paperwork, driving, etc.)?*
* none, less than 1 hour a day, 1 hour a day, 2 hours a day, 3 hours a day, 4 hours a day, 5 or more hours a day
** never, rarely, sometimes, very often, always
*** strongly disagree, disagree, neither disagree nor agree, agree, strongly agree

Items assessing sedentary time and parental limits placed on children's screen time were adapted and tested for comprehension with a separate small group of parents. Parental beliefs related to the importance of children's physical activity was measured using the Parental Beliefs about Physical Activity scale developed by Lee et al.¹⁵ To allow for regression analysis, each of these instrument items was converted to a dichotomous variable where "0" was "strongly disagree to neither disagree nor agree" and "1" was "agree to strongly agree."

Data Analysis

Multiple linear regression ($p < 0.05$) was conducted to assess whether parent physical activity, sedentary time, beliefs about child's physical activity, and limiting child's screen time predicted child's physical activity and sedentary time. All statistical analyses were conducted using IBM SPSS Statistics, version 24. A hierarchical multiple regression was then conducted on models that were statistically significant to assess whether significance was maintained with the inclusion of parent race/ethnicity, the highest level of education in the home, total household income, and child's age as control variables.

RESULTS

Despite being in a small town in the Appalachian region of western North Carolina, the participants were mostly white and highly educated, with more than half of parents having a college degree or higher, (Table 2). Most households consisted of married parents, with a higher socioeconomic status and a household income of \$55,000 per year. This is not a typical representation of the county as a whole based on census data, with residents outside of the town having lower levels of education and household income.¹⁶ However, the race and ethnicity of the participants is representative of the area, which is predominantly white.

The bivariate associations reveal strong relationships between child's sedentary time and parent sedentary time, between the three variables assessing parents limiting child's time watching TV, playing video games, and using the computer as well as several of the parental belief variables (i.e., $r >$ Cohen's standard for a large effect size, $r > 0.371$).¹⁷ The associations between child's sedentary time and one of the parental belief variables as well as parents limiting child's time watching TV were smaller ($r = -0.253$ and -0.250 , respectively) and represent a medium effect size (i.e., the standard for a medium effect size $r = 0.243$). The associations between parent physical activity and parent sedentary time ($r = -0.268$) and between two of the parental belief variables ($r = 0.284$) represent a medium effect size.

A multiple linear regression to predict child's physical activity based on parent physical activity, sedentary time, beliefs about child's physical activity, and limiting child's screen time was found not significant ($F(11,56) = 1.04, p = 0.43$).

Table 2. Demographic Characteristics for Parents and Children

Variable	n (%)
Child	
Gender	
Female	31(44.3)
Male	39(55.7)
Race/ethnicity	
White	65(92.9)
Hispanic or Latino	3(4.3)
Other*	2(2.9)
Parent	
Race/ethnicity	
White	66(94.3)
Hispanic or Latino	1(1.4)
Other*	3(4.3)
Highest level of education of all adults in household	
High school grad or GED	7(10.0)
Some college	10(14.3)
College grad	33(47.1)
Graduate/professional school	20(28.6)
Total household annual income	
Under \$15,000	5(7.1)
\$15,000–\$34,999	9(12.9)
\$35,000–\$54,999	13(18.6)
Over \$55,000	40(57.1)

A second multiple linear regression to predict child's sedentary time based on parent physical activity, sedentary time, beliefs about child's physical activity, and limiting child's screen time was significant ($F(11,55) = 3.71, p < 0.00$), with an R^2 of 0.43. More specifically, parent sedentary time, one parental belief variable (i.e., parents responsibility to help their child find physical activity), limiting child's time watching TV, and limiting child's playing video games made statistically significant, unique contributions to the estimation of child's sedentary time ($p < 0.05$) with parent sedentary time positively associated with child's sedentary time and the one parental belief variable, limiting child's time watching TV, and limiting child's time playing video games negatively associated with child's sedentary time. The relative contribution of the independent variables was evaluated through the interpretation of squared semi-partial

coefficients.^{18,19} Results indicated parent sedentary time made the largest unique contribution and revealed a predictive efficacy of over 1.5 times larger of the one parental belief ($0.116/0.070 = 1.7$), and two times larger than that for limiting child's time watching TV ($0.116/0.049=2.4$) and playing video games ($0.116/0.050=2.3$).

Effect sizes were calculated for the four predictors using Cohen's f^2 , where values of 0.02 represent a small effect, values of 0.15 equal a medium effect, and values of 0.35 denote a large effect.¹⁷ Results illustrate parent sedentary time had a medium-to-large effect size ($f^2 = 0.20$), the one significant parental belief had a small-to-medium effect size ($f^2 = 0.12$), and both limiting child's time watching TV and playing video games had small effect sizes ($f^2 = 0.09$) in predicting child's sedentary time.

A hierarchical multiple regression stratified by child's age to predict child's sedentary time based on parent sedentary time was calculated due to differences in parental influence among children and adolescents. Child's age was stratified into two age groups, those aged 5–9 years and those aged 10–13 years, based on the literature indicating that sedentary time tends to increase at early adolescence.²⁰ Parent race/ethnicity, highest level of education, and total household income were controlled for in the regression analysis using a two-stage model recommended by Keith.²¹ Parent sedentary time, the belief that it is the parents responsibility to help their child find physical activity, and parent's role in limiting child's TV and video game use were entered in the second stage. Distributional statistics are presented in Table 3 for the predictors and criterion. Results from the hierarchical multiple regression indicate a statistically significant increase in the variance explained in child's sedentary time among the group aged 10–13 years, $\Delta R^2 = .35, F(4,23) = 4.06, p < 0.01$, but not the 5–9 year old group, $F(4,25) = 0.88, p = 0.49$ (Table 4). In fact, only parent sedentary time was positively associated and made a significant unique contribution to the prediction of child's sedentary time among the group aged 10–13 years ($p < 0.01$) with a large effect size ($f^2 = 0.44$).

IMPLICATIONS

This study investigated the impact of parent physical activity, sedentary time, parental beliefs about children's physical activity, and parents limiting child's sedentary activities on child physical activity and sedentary time. Parent sedentary time was the only significant predictor of child sedentary time, but only among early adolescents (aged 10–13 years). No significant predictors of child sedentary time were found among children (aged 5–9 years). Parent

physical activity, sedentary time, beliefs, and limits on child's sedentary activities did not predict child physical activity.

Table 3. Distributional Statistics for Child's Sedentary Time and Predictors for Hierarchical Multiple Regression

Variable	Group Aged 5-9 Years M(SD)	Group Aged 10-13 Years M(SD)
Child's Sedentary Time	15.33(4.60)	21.45(8.14)
Parent Race/Ethnicity	1.39(1.41)	1.10(0.54)
Highest Level of Education in Home	5.58(1.32)	6.13(0.85)
Total Household Income	3.64(1.69)	4.19(1.42)
Parent's Sedentary Time	17.18(9.60)	18.06(10.50)
Parental Belief		
It is the parents' responsibility to help their child find physical activity	0.94(0.24)	0.90(0.30)
Frequency of Limiting Screen Time		
Watching TV	0.58(0.50)	0.45(0.51)
Playing Video Games	0.61(0.50)	0.58(0.50)

Note: M = mean, SD = standard deviation, N_{5-9yrs} = 33; N_{10-13yrs} = 31.

Parental physical activity and its influence on child physical activity is varied, with conflicting findings. The results that parental physical activity is not related to child physical activity, is consistent with a majority of current literature. Parental modeling of physical activity, simply parents being physically active, has been found to not be related to their child's physical activity.^{3,4,9,22-24} However, several studies have shown a positive relationship.²⁵⁻²⁷ For example, Zarychta et al. concluded parents that modeled a healthy diet and physical activity were more likely to have adolescents who were more physically active and had overall healthier lifestyles.²⁵ Similarly, Fuemmeler et al. found that children with two physically active parents had significantly higher MVPA than children with two inactive parents,²⁶ while other researchers determined that physical activity performed as a family may relate to increased child physical activity.^{5,28} Thus, the relationship between parent and child physical activity may be more complex than simple parent modeling of behavior.

Table 4. Hierarchical Multiple Regression Analysis Summary for Variables Predicting Child's Sedentary Time

Variable	<i>B</i>	<i>SE B</i>	β	<i>pr</i> ²	<i>f</i> ²
Group aged 5–9 Years					
Step 1					
Parent Race/Ethnicity	0.417	0.561	0.128	0.019	0.073
Highest Level of Education in Home	-0.463	0.757	-0.133	0.013	0.050
Total Household Income	-0.731	0.590	-0.269	0.050	0.194
Step 2					
Parent Sedentary Time	0.078	0.086	0.164	0.032	0.126
Parental Belief	-3.08	3.51	-0.162	0.030	0.116
Limiting TV	-6.87	5.09	-0.749	0.068	0.264
Limiting Video Games	6.01	5.04	0.648	0.054	0.209
Constant	18.44	5.12			
Group Aged 10–13 Years					
Step 1					
Parent Race/Ethnicity	5.13	2.74	0.339	0.115	0.225
Highest Level of Education in Home	-0.113	1.97	-0.012	0.0001	0.0002
Total Household Income	-1.80	1.18	-0.315	0.080	0.156
Step 2					
Parent Sedentary Time	0.405	0.134	0.522**	0.285	0.558
Parental Belief	-5.50	5.20	-0.203	0.046	0.090
Limiting TV	-6.55	3.78	-0.407	0.116	0.226
Limiting Video Games	3.71	3.87	0.228	0.038	0.075
Constant	29.64	10.60			

Note: $R^2_{5-9yrs} = 0.258$ ($N = 33$, $p = 0.49$); $R^2_{10-13yrs} = 0.511$ ($N = 31$, $p < 0.01$), pr^2 = squared semi-partial coefficient, f^2 = Cohen's (1988) effect size statistic for multiple regression analyses.

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

In terms of sedentary time, the current study found that parents' sedentary time was a significant predictor of children's sedentary time among early adolescents, but not among children. In fact, the effect size of parents' sedentary time among early adolescents was large ($f^2 = .54$). These results are similar to Jago et al. when looking at both physical activity and sedentary time.²² However, Jago et al. determined, television viewing was the only factor associated between parents and children.²² Additionally, Dunton et al. found that parents and children are more likely to engage in sedentary time together (92.9 minutes/day) than physical activity (2.4 minutes/day).²⁸

When examining parental physical activity, beliefs about their child's physical activity on adolescents' physical activity and sedentary time, Bauer et al. concluded there is a complicated relationship between parent and child sedentary time, with parental encouragement and perception not having an impact on child sedentary time.⁴ In other words, parents may have a greater impact on adolescent sedentary time compared to child sedentary time because of decreasing physical activity levels as children age.⁴ Nonetheless, the evidence regarding the influence of parental beliefs about children's physical activity on behavior is conflicting. For instance, Kimieck et al. identified children's perceptions of their parents' beliefs were not related to their own physical activity and suggested parental support, specifically belief in their child's physical activity competency, was related to increased physical activity among children.⁹ Yet, others revealed parental encouragement was the main factor impacting child physical activity.^{4,29} Thus, there may be a complicated relationship between parental beliefs and child physical activity and parents must take an active role in their child's physical activity through supporting and motivating physical activity behavior.

Most studies have examined only physical activity,^{3,9,22,27,30} with some looking at both physical activity and sedentary time.^{4,5,22} Few studies have investigated the influence of parental physical activity, sedentary time, beliefs about physical activity, and limiting children's screen time on children's physical activity and sedentary time. There is support for the interrelatedness of all of these factors, however the current study is the first to examine all of these factors together.

These results provide evidence for the development of effective interventions to improve the health of youth. Interventions may be designed for the entire family to participate versus only children or only parents. Setting limits on total sedentary time, encouraging physical activity participation, developing these limits with the child's age in mind and, educating parents about their own sedentary time and its influence on their children's sedentary time may be worth implementing. Nonetheless, it is important that more children meet physical activity recommendations and less exceed the suggested amount of daily screen time to prevent future health problems. Decreasing parent sedentary time may be valuable in improving the health outcomes of their children. Healthy People 2020, which sets 10-year national objectives for public health in the United States, aims to increase child physical activity and decrease the proportion of children who exceed recommended limits for screen time.³¹ The results from this study can be used by health professionals to help accomplish the objectives of Healthy People 2020.

Overall, this study fills an important gap in the literature regarding the relationship between parental behavior, beliefs, and limits placed on their child's screen time and child physical activity and sedentary time. Currently, there is a lack of research exploring parent and child sedentary time, with only some focusing on physical inactivity (i.e., not getting an adequate amount of MVPA), as a proxy for sedentary time.^{5,32,33} It is important that physical activity and sedentary time are observed as separate variables as they are not mere opposites but rather separate factors associated with different health outcomes.^{6,34} As such, future research and interventions should approach sedentary time and physical activity separately because they are distinct behaviors.

Specific to Appalachia, there is limited research on parent impact on child physical activity and sedentary time. The Appalachian region is unique in the challenges it faces including being rural and geographically isolated while having low average income and poor health outcomes. Other challenges include limited access to recreation, sports programs, and transportation.³⁵ In North Carolina, the Appalachian region has higher levels of physical inactivity and almost half of adults fail to meet physical activity recommendations.^{32,33} The results of this study help fill a gap in knowledge on the specific impact of parents on children's physical activity and sedentary time in Appalachia. This information can be used by health professionals to create programming targeted at improving children's healthy behaviors that incorporates parents. Future interventions should focus on creating more opportunities for sports, adding recreational programming opportunities for whole families in communities, and providing transportation.

To the best of our knowledge, this study is one of the few that has measured and examined predictors of children's physical activity and sedentary time separately rather than using physical inactivity as a proxy for sedentary time. However, this study had several limitations. Given the small sample size, conclusions drawn from this data are limited. In addition, subjects came from a single pediatrician's office, which both limited the sample size and the diversity of subjects. However, the area where this study was conducted only had one pediatric office which serves a three-county area. Another limitation was that parent physical activity and sedentary time were self-reported, while parents reported their child's physical activity and sedentary time. Parents have been found to often overestimate their child's physical activity and this could have impacted the results.³⁶

SUMMARY BOX

What is already known about this topic? Although ample research has shown that parents influence children's health behaviors, there is limited research investigating the relationships between parent physical activity, sedentary time, and limiting children's sedentary time on children's physical activity and sedentary time in rural Appalachian populations.

What is added by this report? This study fills a gap in knowledge on the impact of parents on children's physical activity and sedentary time in rural Appalachia. While the results indicated that parent physical activity did not have an impact on child physical activity, parental sedentary time may be one of the many factors that contribute to child sedentary time. Parent sedentary time may have more of an impact on child behavior than physical activity because parents are more often engaged in joint sedentary time than joint physical activity.

What are the implications for future research? Future interventions should incorporate decreasing parent sedentary time as a means to lower child sedentary time and include joint parent and child physical activity to increase child physical activity by creating opportunities for sports and recreational programming for whole families.

REFERENCES

1. Centers for Disease Control and Prevention. The burden of chronic diseases and their risk factors: National and state perspectives. Atlanta, GA: U.S. Department of Health and Human Services, 2004.
2. The Child & Adolescent Health Measurement Initiative. Data Resource Center for Child & Adolescent Health 2019 [Available from: <https://www.childhealthdata.org/>].
3. Trost SG, Sallis JF, Pate RR, Freedson PS, Taylor WC, Dowda M. Evaluating a model of parental influence on youth physical activity. *Am J of Prev Med* 2003;25(4):277–82.
4. Bauer KW, Nelson MC, Boutelle KN, Neumark-Sztainer D. Parental influences on adolescents' physical activity and sedentary behavior: longitudinal findings from Project EAT-II. *Int J Behav Nutr Phys Act* 2008;5(1):12.
5. Beets MW, Cardinal BJ, Alderman BL. Parental social support and the physical activity-related behaviors of youth: a review. *Health Educ Behav* 2010;37(5):621–44.
6. Owen N, Sparling PB, Healy GN, Dunstan DW, Matthews CE. Sedentary behavior: emerging evidence for a new health risk [Internet]. Mayo Clinic proceedings. Mayo Foundation for Medical Education and Research,

- 2010 [cited 2019Sep26]. Available from:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2996155/>
7. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc* 2009;41(5):998–1005.
 8. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act* 2017;14(75):1–17.
 9. Kimiecik JC, Horn TS, Shurin CS. Relationships among children's beliefs, perceptions of their parents' beliefs, and their moderate-to-vigorous physical activity. *Res Q Exerc Sport* 1996;67(3):324–36.
 10. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *Am J Prev Med* 2011;41(2):197–206.
 11. Crooks DL. Food consumption, activity, and overweight among elementary school children in an Appalachian Kentucky community. *Am J Phys Anthropol* 2000;112:159–70.
 12. Wu T, Wilson JL, Flowers JW, Tudiver F, Glen L, Dunn MS. Assessment of health risk behaviors among teens in an Appalachian community. *Am J Epidemiol* 2004;159:S019.
 13. Christiana RW, Battista RA, James JJ, Bergman SM. Pediatrician prescriptions for outdoor physical activity among children: A pilot study. *Prev Med Rep* 2017;5(1):100–5.
 14. Godin G, Shephard RJ. (1997). Godin Leisure-Time Exercise Questionnaire. *Med Sci Sports Exerc* 1997;29(6):S36–S38.
 15. Lee SM, Nihiser A, Strouse D, Das B, Michael S, Huhman M. Correlates of children and parents being physically active together. *J Phys Act Health* 2010;7(6):776–83.
 16. State & county Quickfacts [Internet]. 2019 [cited December 15, 2019]. Available from:
<http://www.census.gov/quickfacts/table/PST045215/00>.
 17. Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates, 1998.
 18. Meyers LS, Gamst G, Guarina AJ. *Applied multivariate research: Design and interpretation*. Thousand Oaks CA: Sage, 2006.
 19. Tabachnick BG, Fidell LS. *Using multivariate statistics*. 5th ed. Boston, MA: Pearson, 2007.
 20. Norman GJ, Schmid BA, Sallis JF, Calfas KJ, Patrick K. Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics* 2005;116(4):908–16.
 21. Keith TZ. *Multiple regression and beyond*. Boston, MA: Pearson 2,006.
 22. Jago R, Fox KR, Page AS, Brockman R, Thompson JL. Parent and child physical activity and sedentary time: Do active parents foster active children? *BMC Public Health* 2010;10(194):1–9.

23. Welk GJ, Wood K, Morss G. Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatr Exerc Sci* 2003;15(1):19–33.
24. Dempsey JM, Kimiecik JC, Horn TS. Parental influence on children's moderate to vigorous physical activity participation: An expectancy-value approach. *Pediatr Exerc Sci* 1993;5(2):151–67.
25. Zarychta K, Mullan B, Luszczynska A. It doesn't matter what they say, it matters how they behave: Parental influences and changes in body mass among overweight and obese adolescents. *Appetite* 2016;96:47–55.
26. Fuemmeler BF, Anderson CB, Mâsse LC. Parent–child relationship of directly measured physical activity. *Int J Behav Nutr Phys Act* 2011;8(1):17.
27. Moore LL, Lombardi DA, White MJ, Campbell JL, Oliveria SA, Ellison RC. Influence of parents' physical activity levels on activity levels of young children. *J Pediatr* 1991;118(2):215–9.
28. Dunton GF, Liao YU, Almanza E, Jerrett M, Spruijt-Metz D, Chou CP, Pentz MA. Joint physical activity and sedentary behavior in parent–child pairs. *Med Sci Sports Exerc* 2012;44(8):1473.
29. Yao CA, Rhodes RE. Parental correlates in child and adolescent physical activity: a meta-analysis. *Int J Behav Nutr Phys Act*. 2015;12(1):10.
30. Brown HE, Atkin AJ, Panter J, Wong G, Chinapaw MJ, Van Sluijs EM. Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. *Obes Rev* 2016;17(4):345–60.
31. Topics & Objectives [Internet]. 2020 Topics and Objectives – Objectives A–Z | Healthy People 2020. [cited 2019Oct3]. Available from: <https://www.healthypeople.gov/2020/topics-objectives>
32. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity, and Obesity, 2019 [Available from: <https://www.cdc.gov/nccdphp/dnpao/data-trends-maps/index.html>.
33. County Health Rankings [Internet]. County Health Rankings & Roadmaps. Robert Wood Johnson Foundation; [cited 2019Sep26]. Available from: <https://www.countyhealthrankings.org/app/north-carolina/2019/measure/factors/70/map>
34. Why It Matters | Physical Activity | CDC [Internet]. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention; [cited 2019Sep26]. Available from: <https://www.cdc.gov/physicalactivity/about-physical-activity/why-it-matters.html>
35. Janicki DM, Sallinen BJ, Perri GG, Lutes LD, Silverstein JH, Brumback L. Comparison of program costs from parent-only and family based interventions for pediatric obesity in medically underserved rural settings. *J Rural Health* 2009;25:326–30.
36. Corder K, Crespo NC, van Sluijs EM, Lopez NV, Elder JP. Parent awareness of young children's physical activity. *Prev Med* 2012;55(3):201–5.