J Community Health (2017) 42:1233–1239
DOI 10.1007/s10900-017-0375-y

ORIGINAL PAPER

Associations Between Parental BMI and the Family Nutrition and Physical Activity Environment in a Community Sample

Joel E. Williams[1] · Brian Helsel[1] · Sarah F. Griffin[1] · Jessica Liang[1]

Published online: 6 June 2017
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Abstract The purpose of this study was to examine the relationship between parental BMI and the family environment and determine if differences exist in child diet and physical activity related parenting behaviors by parental BMI in a community sample of families recruited through elementary schools in a local school district. We found an association between parental BMI category and family nutrition and physical activity (FNPA) score. Families with an underweight or normal weight parent had a larger proportion (64.3%) of high (indicating a healthier family environment) FNPA scores and families with an overweight or obese parent had a smaller proportion (45.2%) of high FNPA scores ($\chi^2 = 5.247$, $P = 0.022$). Families with a parent who was overweight or obese had 2.18 times the odds (95% CI 1.11–4.27) of being in the low FNPA ("less healthy" environment) group. Further, underweight/normal weight parents reported higher levels of monitoring of child diet ($Z = -3.652$, $P < 0.0001$), higher levels of parental monitoring of child physical activity ($Z = -3.471$, $p < 0.001$), and higher levels of parental limit setting related to child sedentary activities compared to overweight/obese parents ($Z = -2.443$, $P = 0.01$). Parent BMI and parenting behaviors are known to have a major impact on childhood obesity. In this study, lower parent BMI and authoritative parenting behaviors were associated with a less obesogenic home environment and a positive parenting style related to child eating and physical activity behaviors.

✉ Joel E. Williams
joel2@clemson.edu

[1] Department of Public Health Sciences, Clemson University, P.O. Box 340745, Clemson, SC 29634-0745, USA

Keywords Parenting · Body mass index · Physical activity · Diet · Obesity

Introduction

Childhood is an appropriate time to promote physical activity and healthy eating because the adoption of lifestyle behaviors occur during this developmental stage [1, 2]. Families can provide a major social learning environment for children and certain parental behaviors and attitudes will significantly impact a child's self-image and health practices [3–5]. Dietary and activity behavior patterns have been shown to aggregate in families [6, 7], although the significant sources of social support for these behaviors may vary by socioeconomic status (SES), race, ethnicity, or cultural group [8]. Family-based programs intended to treat children who are overweight are among the most effective approaches to preventing obesity in adulthood [9].

Family, the most influential aspect of a young child's immediate environment, significantly shapes a child's behavior [2, 10]. Early human development takes place largely within the context of the family, who molds the attitudes, beliefs, and values of children. The family can influence children's dietary behavior in at least five areas: availability and accessibility of foods [11–14], meal structure [15, 16], adult food modeling [10, 17], food socialization practices [18] and food-related parenting style [19]. Early childhood and the social environment in which the child is fed are widely assumed to be critical to the establishment of lifelong healthful eating habits.

Eating is a social event that often times occurs in the presence of parents, other adults, older siblings and peers. In these contexts, children observe the behaviors and preferences of others around them. The social context in which

a child is introduced to or has experiences with food is instrumental in shaping food preferences because the eating environment serves as a model for the developing child [20]. Families are important referents in establishing health behaviors in children, and there are broader social and physical environmental factors that have strong associations with the development of obesity [18, 21, 22]. For example, young adult eating habits such as eating all food on the plate, using food as an incentive or threat, eating dessert, and eating regularly scheduled meals were related to the same feeding practices reportedly used by their parents during their childhood [23]. Consideration of nutrition by young adults when selecting food was related to the memory of their parents talking about nutrition during childhood [24]. Additionally, child-feeding practices that control what and how much children eat can also affect their food preferences. Studies have determined that parents who attempt to encourage the consumption of food(s) may inadvertently cause children to dislike the food(s). Whereas parents that attempt to limit food(s) may actually promote increased preference and consumption of the limited food(s) in children [20]. Internal cues by parents during the initial phases of the meal (i.e., are you hungry? thirsty?), middle (i.e., you can have more food if you are still hungry), and toward the end of the meal (i.e., are you full?) should be used to help focus the child's attention toward the internal states of hunger and fullness [25]. The family can impact children's habits and preferences in ways that continue to influence behavior even if the family is not physically together, e.g., meals away from the family.

Recent research on family-based obesity prevention programs has shown that programs incorporating access, parenting skills, or child management, and family functioning had positive effects on food choices. Dev et al. [26] found that children of parents who used restrictive feeding patterns were more likely to be overweight or obese. However, Ostbye et al. [27] found that limited access to unhealthy foods in the home and increased access to fruits and vegetables were linked to healthy food intake measures. Kitzman-Ulrich et al. [28] and Ostbye et al. [27] found that parent role modeling was associated with healthy eating behaviors.

Parents are important social referents and can influence their children's physical activity by participating with them, encouraging them to be active, and taking them to places where they can be active [29]. Loprinzi and Trost [30] found that parental support for physical activity in preschool children was a significant influence on children's physical activity levels in the home. Although parent modeling can be used as a successful technique to influence physical activity levels in children, most parents or adults don't achieve the recommended amounts of physical activity. It is important that interventions used to increase a child's physical activity also focus on identifying exercise or recreational opportunities for the parents [31]. Certain parenting styles can have an impact on child obesity and sedentary behavior. Parenting styles based on responsiveness (nurturing) and demandingness (establishing and enforcing boundaries) can be separated into authoritative, authoritarian, permissive, and negligent parenting styles. Kakinami, Barnett, Séguin, and Paradis [32] found that children with authoritarian parents, who were not responsive but demanding, had consistently higher rates of obesity. Conversely, authoritative parenting, that is both responsive and demanding, has been found to lower the BMI in children. In our previous research, we found that parents with a laissez-faire parenting style report lower levels of family nutrition and physical activity. Further, parent BMI moderated the relationship between laissez-faire parenting and family nutrition and physical activity such that the association between laissez-faire parenting and family nutrition and physical activity was not significant among overweight or obese parents [19]. Factors such as, SES, age, or ethnicity, may alter the effect of parenting styles on child obesity, but the exact effect is still unclear and should receive further attention [32]. The purposes of this study were to globally examine the relationship between parental BMI and general family behaviors associated with child obesity and to determine if differences exist in parenting behaviors specific to child diet and physical activity in a community sample.

Methods

Procedures

Families for this study were recruited from all elementary schools in a county adjacent to our university. Upon Clemson University Institutional Review Board approval for our study, we contacted the district office to request permission to contact each school. Next, after review and approval by the Director of Assessment and Evaluation at School District of Oconee County, SC, we contacted each school principal and discussed the study in detail either in-person or by phone. All ten principals granted permission to conduct the study in their school. As explained in the informed consent/parental permission form, families with complete data were eligible to participate in an incentive lottery to receive a debit card worth $75; one family from each of the ten participating elementary schools was randomly selected to receive the incentive.

Measures

Parents provided family demographic information including: parent/child age, parent/child gender, parent educational attainment, marital status, family household income, child free or reduced price lunch status. Parents provided self-reported height and weight. Parent BMI was calculated using the Quetelet index: weight (kg)/[height (m)]^2 [33]. For analyses in this study, we dichotomized BMI as underweight/normal weight when BMI < 25.0 and overweight/obese when BMI ≥ 25.0.

The Family Nutrition and Physical Activity (FNPA) measure includes ten items representing multiple domains including: family diet, physical activity, screen time, sleep, and family schedule to provide a comprehensive evaluation of a family environment [34, 35]. For each category, the parent circled one of four statements, ordered from left to right—from least desirable to most desirable, that best described the family. As an example, under the category the parent would select from, Column 1 = I rarely participate in physical activity (e.g. walking) and our family does not play games outside, ride bikes, or walk together very often, Column 2 = I participate regularly in physical activity (e.g. walking) but our family does not play games outside, ride bikes, or walk together very often, Column 3 = I rarely participate in physical activity (e.g. walking) but our family plays games outside, ride bikes, or walk together fairly frequently, or Column 4 = I participate regularly in physical activity (e.g. walking) and our family plays games outside, ride bikes, or walk together fairly frequently. An FNPA score was computed by: (1) summing the total number of circled items in each column, (2) multiplying the first (left) column total by one (as these are the least desirable behaviors), (3) multiplying the middle two column totals by two (these columns are equally moderately desirable), (4) multiplying the last (right) column by 3 (as these are the most desirable behaviors), and lastly, (5) summing across the weighted column values, with higher weighted total scores equating to a healthier family environment. In some analyses presented in this paper we performed a median split on the FNPA score to produce a dichotomous variable.

A measure developed by Arredondo et al. [36] was used to assess parental behavior associated with their child's diet and physical activity. The original measure includes 26 items (16 for diet and 10 for activity) with five subscales. Monitoring: Seven items (five for diet and two for activity) assess the frequency with which parents monitor child eating and activity. Discipline: Five items (three for diet and two for activity) assess the frequency with which parents disciplined their children for unhealthy eating (e.g. drinking soda) and engaging in sedentary behaviors (e.g. watching TV) without their permission. Control: Six items (five questions for diet and one question for activity) assess parents' use of control styles. Limit setting: Six items (two for diet and four for activity) assess parents' use of appropriate boundaries with unhealthy eating and sedentary behavior. Reinforcement: Two items (one for diet and one for activity) assess parent use of praise when their children eat healthy snacks or engage in activity. Parents answered using the following response options for the monitoring, discipline, reinforcement sub-scales using an ordered response format: 1 = *Never*, 2 = *Sometimes*, 3 = *Most of the time*, 4 = *Always*. Parents answered using the following response options for the control and limit setting subscales using a Five-point Likert scale response: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*. Subscale variables were created by averaging responses to items for the physical activity related parental monitoring, discipline and limit setting subscales. Cronbach's alpha for the monitoring, discipline and limit setting subscales in this study were, 0.63, 0.95, 0.89, respectively. As described above, physical activity related parental control and reinforcement subscales were single-item measures.

Sampling and Data Collection

Recruitment packets, including a support letter from the school principal, and a university approved informed consent/parental permission form were sent to all (N = 2392) third through fifth grade students in the school district via school-home folders. Parents, or legally authorized representatives, who demonstrated their agreement to family participation by returning a signed consent/permission form to the school (n = 266) were then sent separate parent and child surveys in the school-folder. A total of 148 surveys were returned to us. As surveys were returned, a graduate student contacted families as needed to resolve missing survey data. One student participant was excluded from the final dataset because the student had Down's syndrome; two additional students were missing all or significant amounts of parent survey data. The final data set contains 145 parent/child dyads and the analytic sample for this paper includes 143 dyads due to listwise deletion based on missing data. Sample characteristics are presented in Table 1.

Data Analysis

Data analysis was performed using the PASW Statistics software v.18. Pearson's chi-squared test was conducted to determine if dichotomized FNPA scores (median split) were distributed evenly by dichotomized parental BMI category (underweight/normal weight vs. overweight/obese). The odds ratio and associated 95% confidence interval were calculated to determine the strength of association between

Table 1 Sample demographics

Characteristic	$N = 143$ dyads
Parent mean age ± SD	37.6 ± 6.6
Parent mean BMI ± SD	26.84 ± 6.64
Parent female gender, *N* (%)	132 (91.0%)
Parent employed, *N* (%)	73 (50.3%)
Parent married, *N* (%)	113 (77.9%)
Parent tech school degree or higher, *N* (%)	76 (52.4%)
Reside outside of city limits	101 (69.7%)
Family income less than $50,000/year, *N* (%)	67 (47.9%)
Free or reduced lunch status, *N* (%)	83 (57.2%)
Child female gender, *N* (%)	87 (60.0%)
Child white race, *N* (%)	123 (84.8%)
Child mean age ± SD	9.5 ± 0.9

Association between Parental BMI and the family nutrition and physical activity environment

FNPA score and BMI category membership. Due to the parental behavior data being measures on an ordinal scale and not normally distributed, we used the Mann–Whitney *U* test (non-parametric version of the independent sample *t* test) was used to determine if parenting behaviors specific to diet and physical activity were related to parental BMI category. The Mann–Whitney test ranks all values from low to high, paying no attention to which group each value belongs. The smallest value is ranked as 1 and the largest value is ranked as *N*, where *N* is the total number of values in the two groups. If two values are identical, then each is given the average of the two ranks for which they tie. Mann–Whitney sums the ranks in each group and computes *U* scores for each group. Since the sampling distributions for the *U* statistic approaches that of a normal curve (when $N > 20$) one can use the computed *Z*-score and associated *P* value to judge the asymptotic (based on the normal distribution) significance of group differences in ranks [37]. In our study, we had two sets of five hypothesis tests at a time representing the variables created by the five Arredondo sub-scales for diet related parent behavior (presented in Table 2), and physical activity related parent behavior (presented in Table 3), respectively. Therefore, a Bonferroni-corrected significance level of 0.01 was used to account for the increased possibility of type-I error [38].

Results

Demographics

As can be seen in Table 1, our sample was mostly Caucasian, slightly lower than the proportion of Whites (89.4%) in the Appalachian County [39] from which families were recruited, and included predominantly married mothers in the dyads. Average parent age was in the mid to late 30 s, and average weight for height was in the overweight range but varied such that the parents were nearly equally distributed in the overweight/underweight and overweight/obese categories. Half of the parents reported being employed, just above half had education beyond high school, more than half reported they received free or reduced price lunch, and seventy percent reported living outside of the city limits. Slightly more than half of the child participants were female with an average age between 9 and 10 years old.

Table 2 Descriptives, test statistics and significance for diet related parenting behaviors

Variable group	n	Mean (SD)	Median (IQR)	Mean rank	*Z*	*P*
Monitoring: diet						
Under or normal weight	70	3.28 (0.62)	3.0 (3.0–4.0)	84.66	−3.652	< 0.0001
Overweight or obese	73	2.87 (0.71)	3.0 (2.25–3.25)	59.86		
Discipline: diet						
Under or normal weight	70	2.50 (0.76)	2.3 (2.0–3.0)	78.29	−1.793	0.073
Overweight or obese	73	2.26 (0.87)	2.3 (1.67–2.67)	65.97		
Control: diet						
Under or normal weight	70	2.41 (1.00)	2.4 (1.55–3.25)	65.50	−1.829	0.67
Overweight or obese	73	2.72 (0.95)	2.6 (2.0–3.4)	78.19		
Limit setting: diet						
Under or normal weight	70	4.35 (0.89)	4.5 (4.0–5.0)	77.88	−1.744	0.08
Overweight or obese	73	3.97 (1.22)	4.0 (3.5–5.0)	66.36		
Reinforcement: diet						
Under or normal weight	70	3.34 (0.68)	3.0 (3.0–4.0)	75.41	−1.048	0.295
Overweight or obese	73	3.18 (0.82)	3.0 (3.0–4.0)	68.73		

SD standard deviation, *IQR* interquartile range, *Z* *z*-statistic associated with Mann–Whitney test, *P* p value associated with Mann–Whitney test

Table 3 Descriptives, test statistics and significance for physical activity related parenting behaviors

Variable group	n	Mean (SD)	Median (IQR)	Mean rank	*Z*	*P*
Monitoring: physical activity						
Under or normal weight	70	3.31 (0.69)	3.25 (3.0–4.0)	83.77	−3.471	0.001
Overweight or obese	73	2.95 (0.64)	3.0 (2.5–3.5)	60.71		
Discipline: physical activity						
Under or normal weight	70	2.05 (0.96)	2.0 (1.0–3.0)	71.69	−0.092	0.926
Overweight or obese	73	2.01 (0.85)	2.0 (1.25–2.25)	72.30		
Control: physical activity						
Under or normal weight	70	1.91 (1.25)	1.0 (1.0–3.0)	65.79	−1.900	0.57
Overweight or obese	73	2.34 (1.42)	2.0 (1.0–4.0)	77.95		
Limit setting: physical activity						
Under or normal weight	70	4.10 (1.05)	4.375 (3.75–5.0)	80.56	−2.443	0.01
Overweight or obese	73	3.76 (1.04)	4.0 (3.0–4.625)	63.79		
Reinforcement: physical activity						
UNDER or normal weight	70	2.36 (0.68)	2.0 (2.0–3.0)	72.67	−0.208	0.835
Overweight or obese	73	2.27 (0.85)	2.0 (2.0–3.0)	71.36		

SD standard deviation, *IQR* interquartile range, *Z* *z*-statistic associated with Mann–Whitney test, *P* p value associated with Mann–Whitney test

The Pearson's chi-squared test of the two-by-two table containing parent BMI and FNPA score indicated an association between parental BMI category and FNPA score ($\chi^2 = 5.247$, $P = 0.022$). Figure 1 shows that in general, dyads with an underweight or normal weight parent had a larger proportion (64.3%) of high FNPA scores (i.e., a "more healthy" environment) and dyads with an overweight or obese parent had a smaller proportion (45.2%) of high FNPA scores. Stated another way, the strength of association between parental BMI group membership and FNPA score category was substantial; dyads with a parent who was overweight or obese had 2.18 times the odds (95% CI 1.11–4.27) of being in the low FNPA (i.e., a "less healthy" environment) group.

Association Between Parental BMI and Child Diet and Physical Activity Specific Parenting Behaviors

Using adjusted *P* values, we found one significant difference in the five parent behaviors specific to child diet (Table 2). Underweight/Normal weight parents reported higher levels of monitoring of child diet where the mean ranks of underweight/normal weight parents compared to Overweight/Obese parents were 84.66 and 59.86, respectively ($Z = -3.652$, $P = < 0.0001$).

Based on Rosenthal's calculation of effect size: $r = \frac{|Z|}{\sqrt{N}}$, we find that $r = \frac{|3.562|}{\sqrt{143}} = 0.31$, indicating a medium effect size of lower parent BMI category on level of parental

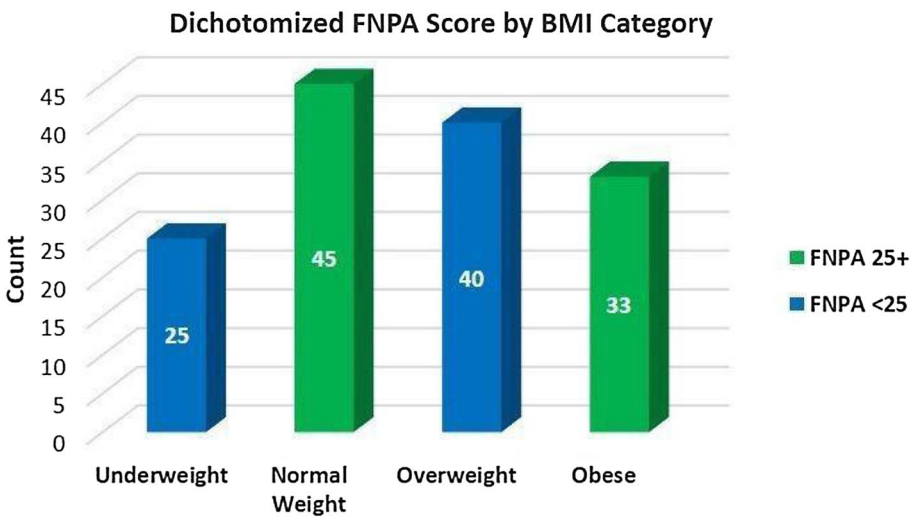

Fig. 1 Family nutrition and physical activity score by parent BMI category

monitoring of child diet. Using adjusted P values, we found two significant differences in the five parent behaviors specific to child physical activity (Table 3). First, underweight/normal weight parents reported higher levels of parental monitoring of child physical activity where the mean ranks of underweight/normal weight parents compared to Overweight/Obese parents were 83.77 and 60.71, respectively ($Z = -3.471$, $P = 0.001$). Second, Underweight/normal weight parents reported higher levels of parental limit setting related to child physical activity where the mean ranks of Underweight/normal weight parents compared to Overweight/Obese parents were 80.56 and 63.79, respectively ($Z = -2.443$, $P = 0.015$). Based on Rosenthal's calculation, we find that $r = \frac{|3.471|}{\sqrt{143}} = 0.29$, indicating a medium effect size of lower parent BMI category on level of parental monitoring of child physical activity, and we find that $r = \frac{|3.471|}{\sqrt{143}} = 0.20$, indicating a small effect size of lower parent BMI category on level of parental limit setting for child sedentary behavior.

Discussion

As summarized in the "Introduction" section, families (more specifically parents/guardians) significantly contribute to eating and physical activity behavior of children within their family. This influence is done through a variety of means such as shaping the child's environment; influencing children's attitudes, beliefs, and values; serving as a social referent providing a variety of types of support; and serving as a role model. This study builds on previous research by exploring the relationship between parent weight status and specific strategies to influence child eating and physical activity behaviors. We found an association between parent weight status and family nutrition and physical activity environment, and an association between parental weight status and parenting behaviors related to monitoring child's diet, monitoring child physical activity, and setting limits for physical activity.

Study limitations are primarily related to the sample and measurement. Due to logistical restrictions we were limited to a convenience sample of parents/children. While we had widespread support from within the school we only received usable completed surveys from 143 dyads. A second limitation is with measurement. Parents and children completed the surveys at home via self-report with limited guidance and instruction from the research team. Thirdly, while we were able to collect height and weight data from parents along with data focused on shaping child behaviors we did not include additional measures related to parent self-regulation of their own diet and physical activity.

Our next step in this research area is to explore the relationship parent weight management behaviors and parenting behaviors to influence child's eating and physical activity and/or weight. Research already indicates that it is good practice to include parents in weight management programs for children [40–42]. Further understanding the relationship between parent weight status, parent personal health behavior and parenting behaviors could enhance/improve how parents are involved in child weight management treatment. For example, findings could indicate that it is not enough to simply include parents in childhood weight treatment programs but to also target reducing parent weight, and changing parent behaviors for personal weight management as a means to assisting children.

Funding This study is the result of unfunded independent research.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval IRB: The Clemson University Institutional Review Board approved the study protocol.

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