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Maternal Physical-Activity-Related Parenting Behaviors May Influence Children's Physical Activity Levels and Relative Weight

Richard R. Rosenkranz, Kansas State University & University of Western Sydney
David A. Dzewaltowski, Kansas State University

CONTACT INFORMATION:

Ric Rosenkranz, Ph.D.
University of Western Sydney
Locked Bag 1797
Penrith, NSW, 2751

E–mail:
r.rosenkranz@uws.edu.au

Phone:
+61 02 4620 3625

Abstract

Previous studies have demonstrated that parents may influence the physical activity (PA) levels of children. The present study sought to determine whether PA-related parenting behaviors were associated with the physical activity and relative weight of children, controlling for other covariates. A community sample of mothers (n = 193) of after-school-program attendees completed questionnaires assessing parental social support for PA, sedentary behavior, and moderate-to-vigorous physical activity. Children (N = 193, 51% girls) were objectively assessed for height and weight via stadiometer and digital scale, and the data were converted to body mass index (BMI) percentile via Centers for Disease Control and Prevention (CDC, 2010a) growth charts. Linear regression analysis revealed that maternal encouragement for child PA was positively related to both child PA and BMI percentile. However, mother-child shared physical activity was negatively related to child BMI percentile. Therefore, varying types of PA-related parenting behaviors may have differential relationships with child PA and relative weight.

Current recommendations indicate that children should attain 60 minutes or more of moderate-to-vigorous physical activity (PA) per day (Strong et al., 2005). Many children do not get sufficient amounts of PA (Troiano et al., 2008), and may therefore be more vulnerable to negative health outcomes, including overweight and obesity (Anderson & Butcher, 2006). According to recent surveillance data (Ogden et al., 2008), 33.6% of U.S. kids ages two to 19 are overweight or obese (85th percentile or higher on weight relative to height, adjusted for age and gender), and 17.1% are obese (95th percentile or higher). Among the potential determinants of children's PA levels and weight status, parents emerge as an important influence (Golan & Crow, 2004; Gustafson & Rhodes, 2006; Trost et al., 2003). Recent sur-

veillance data also show that a majority of U.S. adults (many of whom are parents) are insufficiently physically active (Troiano et al, 2008), and about two-thirds are overweight or obese (Ogden et al, 2006). Looking specifically at female adults (many of whom are mothers), about one-third are obese, and fewer than 5% obtain sufficient levels of PA.

Physical activity levels of children frequently resemble those of their parents across socio-economic status and weight status (Salmon et al 2005), and given the adult surveillance data stated above, this has implications for overweight and obesity in children. Although parent-child resemblance could partly be due to the influence of children on parents, there is strong evidence that parents, particularly mothers, influence their children through various PA-related parenting behaviors (PARPB; Davison, Cutting, & Birch, 2003; Davison, 2004; Hovell, Kolody, Sallis, & Black, 1996; Krahnstoever Davison, Francis, & Birch, 2005; Trost et al., 2003). Physical-activity-related parenting behaviors are often described in terms of social support for PA, which may include instrumental and direct support, emotional and motivational support, or observational support (Prochaska, Rodgers, & Sallis, 2002). In one exploratory study, Hovell and colleagues (1996) operationally defined PARPB as the frequency of PA encouragement, parent-child shared PA, and transportation for PA (Hovell et al., 1996). In a later study, Trost and colleagues (2003) conceptualized parents' own PA level as separate from an omnibus social support for PA scale, and showed how parents' PA indirectly influenced children's PA through social support. Davison and colleagues (2003) developed a questionnaire to assess how parents promote PA, and found that their items grouped into two factors: logistic support and explicit modeling. Logistic support included such behaviors as enrolling children in sport programs, and mothers were stronger than fathers in this type of support. Explicit modeling included parents using their own PA behavior to encourage activity, and fathers were stronger than mothers in this type of support. In a subsequent study, PARPB were grouped similarly into logistic and modeling factors (Davison, 2004).

Although the positive relationship between several dimensions of PARPB and children's PA has been fairly well established, (Gustafson & Rhodes, 2006; Sallis, Prochaska, & Taylor, 2000), a review of the literature shows a lack of consistency on PARPB dimensions and measurement. In a meta-analysis by Pugliese and Tinsley (2007), results showed a small positive association between parent behavior and child PA, with moderation of the association by type of parent behavior, sample age, and measurement. Consistent with Trost and colleagues (2003), parental PA modeling showed the weakest relation with child PA. Although numerous studies have assessed the relationship between dimensions of PARPB and children's PA, few studies (e.g., Hovell et al., 1996) have examined the association of specific dimensions of PARPB with objectively measured relative weight of children in a community sample. Therefore, the purpose of this cross-sectional study was to determine the level of association between multiple PARPB and children's PA and relative weight. The hypotheses based on the findings of Pugliese and Tinsley (2007), Trost and colleagues (2003), and Hovell and colleagues (1996), were: (1) that all social-support PARPB dimensions (encouragement, logistic support, emotional/motivational support, and parent-child shared PA) are positively related to children's PA, (2) that all social-support PARPB dimensions are inversely related to children's BMI percentile, and (3) that both parent PA and sedentary behavior dimensions are not related to children's PA or BMI percentile. The reasoning, in line with Trost and colleagues (2003), was that parents who reported healthier PARPB would generally have children who were more physically active and with lower BMI percentiles, but that additional PARPB beyond explicit modeling of PA behavior would be needed to show protective effects relative to BMI percentile.

Methods

Participants and Setting

As part of a randomized controlled trial, participants for this study were recruited from seven after-school programs operating in one school district in the U.S. Midwest. The children from the after-school programs and their parents were assessed prior to an intervention.

Parents of program attendees completed questionnaires assessing potential influences on children's PA and relative weight, and gave consent for their child to participate. In the seven schools hosting the programs, average enrollment was 309, with minority students making up 31.2% of enrollment. In these schools, the proportion of students eligible for free or reduced lunch (indicating lower socio-economic status) averaged 43%. Parents who signed consent forms for their child's participation (N = 404) were offered a five-dollar reduction in program fees for completing the questionnaire, and 241 (60%) chose to take part. For the present study, self-report data from all mothers (N = 193) and BMI data of children (N = 193, mean age = 9.5, SD = 0.8) were obtained before the intervention activities. All data collection procedures and measures were approved prior to data collection by the institutional review board at the authors' university.

Measures

Relevant measures of PARPB included parental social support, PA levels, and sedentary behavior. Social support was assessed using a previously published five-item scale (ranging from "never" to "daily") that encompassed the PARPB dimensions of logistic support, encouragement, emotional/motivational support, and parent-child shared PA (Trost et al., 2003). In a previous study, Trost and colleagues (2003) reported test-retest reliability for these five social-support items to be good (R = .81). Another study (Rosenkranz, Dzewaltowski, & Geller, 2008) provided validity evidence for these five items by showing that children and parents meeting PA guidelines manifested higher levels of PA social support than children and parents not meeting PA guidelines. Physical activity was defined as "Any play, game, sport or exercise that gets you moving, breathing harder, and your heart beating faster. It can be done in sports, work, playing with friends, or walking from place to place. Some examples of physical activity are running, brisk walking, yard work, rollerblading, biking, skateboarding, dancing, swimming, soccer, basketball, football, and volleyball." Parental self-reported PA was assessed using four relevant items from the Behavioral Risk Factor Surveillance System (BRFSS; Centers for Disease Control and Prevention [CDC], n.d.). These items provided an index for whether or not parents met current ACSM guidelines for moderate-to-vigorous PA. In a previous study by Yore and colleagues (2001), the test-retest reliability of BRFSS physical activity items was substantial–kappa = 0.35-0.53 for moderate activity, kappa = 0.80-0.86 for vigorous activity, and kappa = 0.67-0.84 for recommended activity–while validity of the items was moderate, kappa = 0.40-0.52 for recommended activity (compared to criterion referent physical activity log). Because children under age 10 are unable to report PA levels accurately or reliably (Saris, 1985), child PA levels were assessed via parent proxy report using two items inquiring about the number of days in the past week, and in a typical week, that the child was physically active for a total of at least 60 minutes (Prochaska, Sallis, & Long, 2001). The two items were averaged, and results at or exceeding five days per week were deemed to meet current PA guidelines for children (CDC, 2010b). In a previous study (Prochaska et al 2001), this two-item instrument showed substantial test-retest reliability (ICC = 0.77) and showed concurrent validity by correlating significantly with accelerometer-based measures of PA (r = .40). Parental sedentary time was assessed with one item stating, "How many hours each day does the mother/female adult typically spend sitting down while doing things like visiting friends, driving, reading, watching television, or working at a desk or computer?" This sedentary time item was modified in wording from a previously published study (Brown, Miller, & Miller, 2003), which reported good test-retest reliability with their measurement of time spent sitting (ICC = 0.71). Parents reported their own height and weight, educational level, and their child's eligibility for free or reduced school lunch. Children in grades three through six with parental consent were objectively assessed for height and weight in a private setting with light clothes and no shoes. Height was measured to the nearest millimeter, using a portable stadiometer (Seca Corp, Model #214- Road Rod, Hanover MD). Weight was measured to the nearest 0.1 kg with high-precision electronic scales (Seca Corp, Model #770, Hanover, MD). Body mass index was calculated for both self-reported parent data and objectively assessed child data. For parents, the following BMI ranges were used to determine each relative weight category: Underweight <

18.5; Normal weight = 18.5-24.9; Overweight = 25-29.9; Obese > 30. For children, BMI scores were converted to percentiles using the age- and sex-specific LMS parameters from the CDC growth charts (2010).

Analysis

All data were reduced and analyzed using the SPSS statistical software package (version 15.0, SPSS Inc., Chicago, IL). To test the first hypothesis a Pearson product moment correlation between PARPB dimensions and children's PA was performed to analyze zero-order association. Then a hierarchical linear regression was performed to assess associations between each PARPB dimension and PA, while controlling for all other variables (all PARPB dimensions were entered in the first step, and demographic covariates of child BMI percentile, ethnicity, socio-economic status, maternal education and BMI were entered in the next step). To test hypotheses two and three, the correlation and regression procedures were repeated with children's BMI percentile as the dependent variable.

Results

Table 1 presents characteristics of participants. Children were nearly evenly split between genders, and about 72 percent of the sample was non-Hispanic Caucasian. Thirty-eight percent of children were at or above the 85th percentile for BMI, corresponding to overweight or obese status. Roughly 50% of mothers reported height and weight corresponding to either overweight or obese status.

On the PARPB dimension social-support measures, mothers encouraged PA at a frequency scale value equivalent to 4 to 5 times per week, (scale mean=4.5, SD=1.3). Mothers reported being physically active with their child about 2 to 3 times per week, (scale mean=3.4, SD=1.4), transporting their child for PA about 2 to 3 times per week (scale mean=3.5, SD=1.4), and watching their child participate in PA about 2 to 3 times per week (scale mean = 3.4, SD=1.3). Mothers also reported telling their child that PA was good for them about 4

Table 1

Participant Characteristics

	Children	Parents
Percent female	51[a]	100[a]
Percent male	49[a]	0[a]
BMI Percentile Rank (mean ± SD)	68.4 ± 27.3[b]	–
BMI	–	26.7 + 7.0[c]
Percent underweight	1.6[b]	1.1[c]
Percent normal weight	60.1[b]	48.4[c]
Percent over weight	17.1[b]	28.2[c]
Percent obese	21.2[b]	22.3[c]
Percent meeting PA recommendations	58[d]	55[a]
Percent eligible for free/reduced lunch	49[d]	–
Percent ethnic minority	>28[d]	–
Percent with some college education	–	76.1[a]

a = self reported; b = computed from objective assessment; c = computed from self-report; d = proxy report by parent

to 5 times per week, (scale mean=4.5, SD=1.5). On the other PARPB dimension measures mothers reported about 5 hours of sitting per day (SD=3.3) and 55% of the sample's mothers had sufficient PA levels to meet adult guidelines.

Table 2 addresses the first hypothesis by presenting associations between PARPB dimensions and children's days per week of meeting PA guidelines. Bivariate Pearson correlations showed significant associations between PA and: (1) mother's encouragement for PA ($r = .293$, $p < .004$), (2) mother-child shared PA ($r = .370$, $p < .001$), (3) mother's transporting for PA ($r = .237$, $p = .001$), (4) mother's watching child do PA ($r = .321$, $p < .001$), (5) mother's telling child that PA is good ($r = .274$, $p < .001$), and (6) free or reduced lunch status ($r = -.179$, $p < .014$). For the linear regression, the overall model explaining 17% of the variance in children's days per week of > 60 minutes PA was significant, $F (12,162) = 3.85$, $p < .001$. Within the overall model, significant standardized β coefficients were found for mother's encouragement of physical activity ($\beta = .293$, $p < .004$), and child BMI percentile ($\beta = -.187$, $p = .022$), while all other variables were non-significant contributors to the model.

Table 3 addresses the second and third hypotheses by presenting associations between PARPB dimensions and children's relative weight. Bivariate Pearson correlations revealed significant associations between BMI percentile and: (1) mother's encouragement for PA ($r = .234$, $p = .001$), (2) mother's telling child PA is good for them ($r = .157$, $p = .030$), and (3) maternal BMI ($r = .271$, $p = .001$). For the linear regression, the overall model explaining 16% of the variance in children's BMI percentile was significant, $F (11,161) = 3.729$, $p < .001$. Within the overall model, significant standardized β coefficients were found for mother's encouragement of PA ($\beta = .251$, $p = .012$), mother-child shared PA ($\beta = -.183$, $p = .05$), mother's meeting moderate-to-vigorous

Table 2

Relationships between PARPB Dimensions and Children's PA

Variables	Pearson r	Standardized beta coefficient	F
PARPB Dimensions			(12,162) 3.85*
PA Encouragement	.357*	.293*	
Mother-child shared PA	.370*	.120	
Transport for PA	.237*	.051	
Watch child do PA	.321*	.120	
Tell child PA is good	.274*	-.048	
Mother meeting PA standards	.121	.071	
Mother sedentary time	-.132	-.110	
Demographic Covariates			
Mother education	-.072	-.021	
Child Non-Hispanic Caucasian	-.082	.000	
Free/reduced lunch status	-.179*	-.053	
Mother BMI	-.007	.039	
Child BMI Percentile	-.075	-.187*	

*$p < .05$

PA standards (β = .190, p = .018), along with mother's education level (β = -.204, p = .014) and maternal BMI (β = .263, p = .001). All other variables were non-significant contributors to this model.

Discussion

This study sought to determine the distinct association levels between each PARPB dimension and both child PA and child BMI percentile. The findings indicated equivocal support for the first hypothesis that all social-support PARPB dimensions would have a positive relationship with children's PA levels. In fact, all PARPB dimensions were positively related to child PA only for the bivariate Pearson correlations. However, the regression analysis allowed the authors to observe the unique influence of any one PARPB dimension on child PA variance, while the other PARPB dimensions were held statistically constant. Thus, the regression showed that maternal encouragement was the only social-support PARPB dimension significantly related to child PA, when controlling for other PARPB and demographic variables in the model. This is an interesting finding, as it is possible that mothers' encouragement for their children to do PA or to play sports is the primary means of maternal influence on child PA, and that other dimensions of PARPB (including logistic support, emotional/motivational support, and parent-child shared PA) are less influential than encouragement. However, it is also possible that encouragement is a more global dimension that encompasses or overlaps heavily with some of the other PARPB dimensions for influence on child PA. Further studies are needed with experimental or longitudinal designs to elucidate the influence of different dimensions of social support on physical activity. If further work supports the importance of encouragement, then intervention strategies can be developed to promote child PA through finding effective ways for mothers to encourage their children to be active.

Regarding the second hypothesis that all social support PARPB dimensions would have an inverse relationship with children's BMI percentile, the direction of association was not as hypothesized, as maternal encouragement and telling children that PA is good for

Table 3

Relationships between PARPB Dimensions and Children's BMI Percentile

Variables	Pearson r	Standardized beta coefficient	F
PARPB Dimensions			(12,162) 3.85*
PA Encouragement	.234*	.251*	
Mother-child shared PA	-.058	-.183*	
Transport for PA	.072	.093	
Watch child do PA	.051	.004	
Tell child PA is good	.157*	-.006	
Mother meeting PA standards	.099	.190*	
Mother sedentary time	-.036	-.102	
Demographic Covariates			
Mother education	-.144	-.204*	
Child Non-Hispanic Caucasian	-.043	.017	
Free/reduced lunch status	-.017	.144	
Mother BMI	.271*	.263*	

*$p < .05$

health both had positive associations with child BMI percentile in the bivariate correlations. In the regression model, encouragement remained positively related to BMI percentile when controlling for other PARPB dimensions and demographic covariates, but telling children PA was good for health no longer had a significant relationship in the model. In contrast, parent-child shared PA emerged as having a protective relationship for child BMI percentile, when controlling for other PARPB dimensions and demographic covariates. Higher levels of mother-child shared PA were associated with lower BMI percentiles, when controlling for socioeconomic status, educational level, and parent BMI. In contrast, higher levels of maternal encouragement for PA were associated with higher BMI percentiles.

The third hypothesis, that both parent PA and sedentary behavior dimensions would not be related to child PA or child BMI percentile, was partially supported. In both bivariate and regression analyses, the relationships between maternal sedentary behavior or PA and child PA was not significant, and the relationship between maternal sedentary behavior and child BMI percentile was not significant. However, the regression analysis revealed a significant relationship between maternal PA and child BMI percentile, in a positive direction. Mothers who reported meeting PA standards had children with higher BMI percentiles. These results are similar to those of Trost et al. (2003), in that a significant positive relationship between maternal PA level and child PA level was not identified (in either the bivariate correlations or the regression model). However, it is noteworthy that the frequency of encouragement, shared PA, and other socially supportive PARPB dimensions were higher in this study's sample than in the sample of Trost's (2003) study, possibly due to the much younger age of the children in this study, or the fact that the previous study included both mothers and fathers.

In this study, greater maternal encouragement was associated with greater child physical activity and with greater relative weight. Again, this suggests a need for further study with longitudinal or experimental design, because the data indicate that maternal encouragement was related positively to both child PA and child BMI percentile. Heavier children had more active and more encouraging mothers, while lighter children had less active and encouraging mothers. Although this is somewhat puzzling, it is important to bear in mind that these are cross-sectional associations, and that the other side of the energy balance equation that determines relative weight (i.e., energy intake) was not assessed. A potential explanation could be that mothers of heavier children recognized their child's and their own risk for overweight and obesity, and were taking preventative steps for themselves and their children. Or, perhaps these findings result from method-variance issues or bias associated with mothers of heavier children having a greater awareness of their child's need for PA. Another possibility could be that active and supportive mothers were inadvertently contributing to the development of heavier children through other behavioral avenues, such as feeding practices. It is conceivable that parental feeding or other food-related practices could be subverting maternal encouragement for PA and higher levels of PA among these children. Results differ from those of Hovell and colleagues (1996) who found a significant negative relationship between nine-year-old girls' BMI values and logistic support for PA. However, similar to what was found in Hovell's (1996) study, these findings also showed an inverse association between mother-child shared PA and child relative weight. The observed inverse relationship between mother-child shared PA and BMI percentile was as hypothesized. This suggests that in the context of other demographic influences and behavioral dimensions, the behavior of mothers being active with their children may be a potentially protective behavior against overweight and obesity. If that is the case, interventions could promote mother-child shared PA as a mediator of obesity prevention.

Strengths & Limitations

The main strength of this study is the use of objective measures of children's relative weight. Other strengths include the novelty of focusing solely on maternal parenting behaviors related to children's BMI percentile, which revealed associations that may have been hidden in a study not assessing potentially differential effects of male and female caregivers. Despite these strengths, the present study has a number of limitations, which may

temper the interpretation and conclusions. First, the study's design is strictly cross-sectional, so any causal inference is unwarranted. As noted by Sirard and Pate (2001), using parent report for children's PA could be useful for avoiding recall errors from children's cognitive limitations, but may introduce additional sources of bias. The degree to which parent report likely differs from objective measures of child PA has not fully been answered, although reported levels of PA are frequently higher than objectively measured PA (Welk, Corbin, & Dale, 2000). Also, although the participant sample was fairly representative of the project's target population, non-participants may differ in important ways. The sample is limited to one city's school district, and findings may or may not generalize to other locales. Further, the authors relied on subjective self-report measures of parenting behaviors and relative weight, which may be subject to biases such as social desirability. Also, the single-item measure of maternal sedentary time and the five socially supportive dimensions may not demonstrate adequate psychometric properties for each of these important PARPB, although previous studies have shown some evidence of reliability and validity. Finally, it is possible that parental age or child gender may moderate influence of parenting behaviors, and the current study did not assess the age of participating mothers.

In conclusion, this study demonstrated that some dimensions of PARPB were related to children's relative weight. Placed in the context of other relevant literature, these findings first suggest a need for theoretical and empirical refinement of measures of PARPB.

Future Research Directions

Some studies have grouped the PARPB dimensions of parental PA together with mother-child shared PA as "modeling," but the results presented here show that these dimensions have differential association with child relative weight. Future research on the dimensions of PARPB may reveal ideal measurement and operational use of these constructs relevant to PA, relative weight, and obesity. More research is warranted to assess the relationships between PARPBs and relative weight, as it is unclear which dimensions may serve as potential mediators for the promotion of PA and the prevention and treatment of obesity and overweight. The present study did not assess whether child self efficacy mediated the relationship between PARPB dimensions and child PA, nor whether child PA mediated the relationship between PARPB dimensions and child BMI percentile. Future studies should use path analytic modeling to determine potential causal pathways, which could better inform intervention strategies aimed at promoting child PA and preventing obesity. However, the present study's findings are useful for further hypothesis generation regarding the influence of mothers' PARPB on children's PA and relative weight. Subsequent studies can advance from the data presented here by incorporating objective measures of PA and sedentary time for both parents and children, or by developing and validating better, but still practical measures.

Future studies with large and diverse samples may also reveal differential relationships between boys and girls, or perhaps differences by race or ethnicity. Further studies will benefit by using longitudinal or interventional designs to uncover the nature of relationships between parenting influences and children's PA and relative weight. Given the current prevalence of overweight, obesity, and lack of PA in both children and adults, there is great need for research addressing the modifiable determinants of these public health issues.

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