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Toward a Better Understanding of the Link between Parent and Child Physical Activity Levels: The Moderating Role of Parental Encouragement

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Abstract

Background—Research on adolescent physical activity is mixed regarding the role of parent activity. This study tested parent encouragement, direct modeling, and perceived influence as moderators of objectively-measured (accelerometer) parent and child moderate-to-vigorous physical activity (MVPA) associations.

Methods—Parent-child dyads (n = 423; M_{child} age = 11.33 yrs.) wore accelerometers for 7 days; parents completed surveys. Hierarchical linear regression models tested moderation using a product of constituent terms interaction.

Results—Parent-reported encouragement moderated the association between parent and child MVPA ($B = -.15$, p = .01, $\Delta R^2 = .02$, p < .01). Among parents with lower MVPA, child MVPA was higher for children receiving high encouragement ($M = 3.06$, $SE = .17$) vs. low ($M = 3.03$, $SE = .15$, p = .02) and moderate encouragement ($M = 3.40$, $SE = .09$) vs. low ($p = 0.04$).

Conclusions—Physical activity promotion programs may use parent encouragement as a tool to boost child activity, but must consider other child and parent characteristics that could attenuate effects.

Keywords

child obesity; prevention; moderate-to-vigorous physical activity; parent modeling

Introduction

In the United States, approximately 58% of children aged 6 – 11 years and over 90% of adolescents aged 12 – 19 fail to meet the recommended 60 minutes of physical activity per day, based on estimates derived from objectively-measured physical activity (i.e., accelerometer) [1,2] Yet physical activity in children and adolescents reduces risk for cardiovascular disease, overweight/obesity, higher adiposity and possibly adult cancer [4,5], and physical fitness is associated with better skeletal health and may improve psychological

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outcomes such as depression and anxiety [6]. Physical activity is a key component of short- and long-term childhood obesity prevention and reduction in conjunction with dietary modification and behavioral changes [7].

Parents may influence child and adolescent physical activity levels [8–15]. According to Bandura's Social Cognitive Theory, behavior is influenced by social contextual factors, such as behavior modeled by important others [16]. Parents, in particular, play an important role in shaping children's health behaviors and may do so through direct modeling (*i.e.*, engaging in physical activity behaviors observed by children), which increases the likelihood that children will emulate parents' actions [8,13,16,17]. While some evidence indicates that physically active mothers have children who engage in more physical activity [18,19], other reviews have failed to find support for an association between parent and child physical activity [11,20]. Possibly, certain circumstances suppress or magnify the association. For example, the effect could occur – or be moderated – by parenting factors such as parental support for physical activity.

A sizeable body of work has examined parental support for physical activity as an important determinant of child physical activity levels. Parents who provide greater encouragement, involvement, support, transportation, and believe in the importance of physical activity have more active children [7,9,13,21–25]. However, whether these types of parenting techniques act independently or in conjunction with parent's own physical activity remains unknown.

To address this gap, the current study tested the moderating effects of parent encouragement, modeling, and perceived influence on the relationship between parent and child physical activity levels. To our knowledge, this study is the first to examine the question using objectively-measured (*i.e.*, accelerometer) physical activity in parent-child pairs. The study aims were to 1) examine the association between parent and child physical activity levels as measured objectively during the same 7-day period and 2) determine whether this relationship was moderated by three parenting techniques— parental encouragement for physical activity, direct modeling of physical activity (*i.e.*, in the presence of children during adult physical activity), and parents' perceived influence over children's physical activity. The first hypothesis was that children whose parents had higher levels of objectively-measured physical activity would have higher levels themselves. The second hypothesis was that greater perceived influence, parental encouragement, and direct modeling of physical activity would strengthen the association between parent and child physical activity.

Methods

Recruitment and Procedure

The sample for this cross-sectional study consisted of parent-child dyads enrolled in a larger intervention study, called Healthy PLACES, investigating effects of a smart growth community on obesity risk. [26]. Recruitment strategies targeted families who had moved to The Preserve, a smart-growth community in Chino, California, as well as families living within a 30-minute drive (approximately 13 miles) of The Preserve who had similar demographics and income. Recruitment procedures have been reported in detail elsewhere [26–30]. Participant families included one parent and one child, aged 8–14 years. If a household had two eligible children wanting to participate, the child was selected with the next closest birthday to the date of the screening phone call. If a household had two parents wanting to participate, the parents selected the one having the greatest availability. Inclusion criteria were (a) having a child enrolled in grades 4 – 8, (b) both the child and the parent living in Chino, CA or surrounding communities, (c) ability to read English, and (d) annual household income < $210,000. For participants who met the eligibility criteria, data were collected either at a local community site or their home. The Institutional Review Board at the University of Southern California approved the study; written informed consent and minor assent were obtained from parents and children. For the current study, only baseline data were used, which were collected between March 2009 and December 2010. During that time, no data collection took place from late July through August and during January due to seasonal conditions that limit outside activity. Within the parent–child pairs, both wore an accelerometer over the same 7-day period.

Participants

From an initial baseline sample of 623 parent-child pairs, 200 pairs (32%) were excluded due to missing or invalid data for one or more demographic variables used as covariates in the model (n = 106, 17%), accelerometer (n = 130, 21%), or parenting questionnaire data (n = 26, 4%) (see Table 1). Some participants were missing data in more than one category. Participants were excluded for missing data on items either related to hypothesis testing (parenting items, accelerometer data) or to statistically adjust for potential confounders (demographic variables).

Measures

Parent and child MVPA—Parent and child daily moderate-to-vigorous physical activity minutes (MVPA) were recorded over 7 days using the ActiGraph, Inc. GT2M model activity monitor accelerometer (firmware v06.02.00). Participants were instructed to wear the accelerometer for 7 days during all waking activities except bathing and swimming. The device recorded physical activity information in 30 second epochs. Non-wear was defined as 60 consecutive minutes of 0 activity counts, and non-wear periods were removed from analysis. Valid days were defined as having at least 10 hours of wear. Participants with fewer than 4 valid days were excluded. Of the original 623, 55 children had fewer than 4 valid days, and an additional 32 had missing data. For parents, 51 had fewer than 4 valid days, and an additional 11 had missing data. As indicated, 130 participants overall were excluded for missing or insufficient accelerometer data, and demographic characteristics for excluded and non-excluded participants were similar except for parent gender and obesity status (Table 1). For participants with 4 or more valid days, average daily minutes of MVPA was calculated as (Total valid minutes)/(Total valid days). The MVPA cut-off for adults was >3 Metabolic Equivalent of Task (MET). Age-adjusted MET cut-offs were used for children consistent with national studies on youth physical activity based on the Freedson et al. prediction equation [31,32].

Parent perceived influence on child physical activity—Parent perceived influence on child physical activity was measured using three survey items adapted from prior research [33]: “Parent’s physical activity can have a lot of influence on children.”(reverse-coded), “Parent’s physical activity can help their children learn how to be active.” (reverse-coded), and “My children are either going to exercise or they are not, no matter what I do”. Response options ranged from 0 = Strongly Agree to 3 = Strongly Disagree. A score was created by averaging the responses on these three items, with higher scores indicating higher perceived influence. Internal reliability was moderate ($\alpha = 0.60$).

Parent-reported modeling of physical activity—Parent modeling of physical activity was assessed using five items adapted from prior research [33], and the Youth Risk Behavior Survey [34]. Example items included, “In the past 30 days, how often did your child see you do something physically active?” and “In the past 30 days, how often did your child see you use physical activity for relaxation or stress relief?” Response options ranged from 0 = Never to 4 = Always. A score was created by averaging the responses on these five items; higher scores indicated greater modeling. Reliability was moderate ($\alpha = 0.65$).

Parent-reported encouragement of child physical activity—Parent encouragement of child physical activity was assessed using seven items adapted from previous research [33]. Example items included, “In the past 30 days, how often did you verbally encourage your child to be physically active or play sports?” and “In the past 30 days, how often did you transport your child to a place where he/she can be physically active or play sports?” Response options ranged from 0 = Never to 4 = Always. A scale was created by averaging the responses on these seven items; higher scores indicated greater encouragement. Reliability was high ($\alpha = 0.81$).

Child BMI—Child height and weight were measured in duplicate using an electronically calibrated digital scale (Tania WB-11A) and a professional stadiometer (PE-AIM-101). Body Mass Index (BMI) was calculated as (weight in kilograms)/(height in meters^2). Child BMI z-score was calculated using Centers for Disease Control and Prevention standards and methods [35].

Data analysis

Distributions were examined for outliers and skew. Parent and child MVPA were positively skewed and were normalized through log transformations. A correlation matrix was generated for all variables to examine the bivariate relationships between hypothesized moderators and MVPA. Moderation tests were conducted as outlined by Frazier et al. 2004[36] using SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Predictor and moderator variables (parent MVPA, parent encouragement, parent modeling, parent perceived influence) were grand mean centered, and a product of constituent terms interaction was calculated for each moderator using the centered variables (parent MVPA * moderator)[36,37]. As recommended by Frazier et al. (2004), unstandardized estimates and standard errors were reported and interpreted. In Step 1 of a hierarchical linear regression, a predictor (parent MVPA) and moderator variable (*e.g.*, parent encouragement) were entered. In Step 2, the product of constituent terms interaction was added to the model. If the significance value of the F-statistic for the R-squared change from the 1st to 2nd Step was less than 0.05, moderation was indicated [38]. For each moderator, a second model (Model 2) was conducted that also adjusted for child gender, age, ethnicity, BMI *z*-score, parent gender, parent BMI, income and group (Preserve vs. control).

Results

Table 1 shows demographic characteristics for parent-child dyads who provided complete data (n = 423) versus those who did not (n = 200). Of the retained dyads, half of parents self-identified as Hispanic (51%), and most were mothers (83%). The mean age was 39.30 years (*SD* = 5.95). Twenty-four percent (24%) of parents had annual incomes of less than < $30,000 and 22% earned >$100,000. The child sample contained an even gender mix and had a mean age of 11.33 years (*SD* = 1.49). The retained group had a different distribution of parent BMI than the excluded group, with a lower percentage of obese parents (31% vs. 42%, $p < 0.05$).

Participants had between 4 and 7 valid days, except for two dyads that wore the accelerometer for one extra day due to delays returning it to researchers. The average number of valid days was around 6 (children M = 6.10 days, SD = 0.92; parents M = 6.30, SD = 0.86). Average wear time on valid days was approximately 13 hours per day (children M = 12.68, SD = 1.49, range: 7.99 – 22.78; parents M = 13.43; SD = 1.48, range: 8.82 – 17.74). For children, the median MVPA was 38.07 minutes per day (range: 2.17 to 135.86), and 22% met the guideline for an average of 60 minutes per day. For parents, the median MVPA was 22.08 minutes per day (range: 1.25 to 406.25), and 51% met the guideline for 150 minutes per week or 21.43 minutes per day. Two parents had very high average daily physical activity greater than 7 standard deviations above the mean. MVPA scores for parents and children were first log-transformed, which normalized the distribution and mitigated the effect of positive outliers. A sensitivity analysis was also conducted by re-running models without the two outliers; however, the pattern of results did not change. The average parent perceived influence score was 2.46 (*SD* = 0.53) on a 4-point scale (0 – 3), indicating that parents agreed “somewhat” to “strongly” that parent habits can influence child physical activity. On average, parents indicated that they modeled physical activity for their children “rarely” to “sometimes” (parent modeling score *M* = 2.28; *SD* = 0.68). The average parent encouragement score (*M* = 2.60; *SD* = 0. 75) indicated that parents encouraged children’s physical activity between “rarely” and “sometimes” in the past 30 days. As shown in Table 2, child MVPA was significantly and positively correlated with parent MVPA ($r = 0.27$), encouragement ($r = 163$), and modeling ($r = .142$) (*p*s < .01).

For parent encouragement, Model 1 results indicated that parent MVPA ($B = .23$, SE = .04, p < .001) and parent encouragement ($B = .13$, $SE = (.04)$, p < .01) were significantly and positively associated with child MVPA, ($R^2 = .09$, p < .001) (Step 1; see Table 3) and that their effects were interactive ($B = -.15$, $\Delta R^2 = .02$, p = .01; Step 2). The interaction term remained significant in Model 2, which adjusted for covariates ($\Delta R^2 = .01$, p = .02; Step 2), and the main effects of child gender and age were significant. Older children were less active than younger children ($B = -.21$, SE = .02, p <.001), and girls were less active than boys ($B = -.34$, SE = .05, p < .001).

For parent modeling, Model 1 results were that parent MVPA ($B = .22$, $SE = .04$ p < .001) was again significantly associated with child MVPA, but the main effect of parent modeling was not significant ($B = .07$, $SE = .05$, $p = .12$) (Step 1) suggesting that modeling does not increase child MVPA at average levels of parent MVPA. Although adding the interaction term did significantly improve the model ($B = -.13$, $\Delta R^2 = .01$, $p = .03$; Step 2), suggesting moderation, the interaction term became non-significant in Model 2 after adjusting for child age and gender, ($\Delta R^2 = .00$, $p = .15$; Step 2). Again, older children were less active than younger children ($B = -.21$, $SE = .02$, $p < .001$) and girls were less active than boys ($B = -.34$, $SE = .05$, $p < .001$).

Parent perceived influence was not significantly associated with child MVPA ($B = -.02$, $SE = .06$, $p = .68$; Step 1), and adding the interaction term did not significantly improve the model ($\Delta R^2 = .00$, p = .60; Step 2).

Significant interactions were further probed by examining child MVPA at different levels of parent MVPA and moderators. Parent variables were collapsed into categories based on high, average, and low levels according to scores that fell one standard deviation above the mean ("high"), 1 SD below ("low"), or between these values ("average"). Estimated means for child MVPA were graphed at levels of parenting variables, and pairwise comparisons were conducted, controlling for covariates. Fourteen percent (14%) of the sample fell into the "low active" group. Although this categorization was artificial, groups may help convey the clinical relevance of the findings. According to accelerometer data collected in 30 second epochs, these groups correspond to parents who engaged in average daily MVPA of 78 minutes, 24 min., and 7 min.

As shown in Figure 1, among parents who engaged in moderate and high levels of MVPA, child MVPA did not differ between levels of parental encouragement (*p*s > .05) for physical activity. Children of high MVPA parents had relatively high levels of MVPA across levels of encouragement. However, among parents who engaged in low levels of MVPA, child MVPA was significantly greater for those children receiving high ($M = 3.06$, $SE = .17$) vs. low ($M = 3.03$, $SE = .15$) parental encouragement (p = 0.02) and moderate ($M = 3.40$, $SE = .09$) vs. low parental encouragement ($p = 0.04$).

Discussion

The current study examined the relationship between parent and child physical activity levels and the moderating effects of parent encouragement, modeling, and perceived influence. Results indicated that parent and child MVPA were positively associated with each other. This study extended previous research by investigating the effects of parent modeling, parent encouragement, and parent perceived influence on the association. For less active parents, more encouragement for physical activity was associated with higher children's MVPA. For more active parents, these parenting factors did not increase children's activity higher than their already relatively high levels.

This study provides evidence that parent physical activity is positively associated with child physical activity, in contrast to findings from studies using self-report methods.[17,21,39] In addition, the current findings indicate how parenting behaviors may moderate the parent-child physical activity relationship. Parental encouragement of physical activity appears to strengthen the relationship between parent and child MVPA, especially for less active parents. To put these results in the context of prior research, they differ from at least one similar study. Spink et al. (2008) found that parent physical activity did *not* moderate the effect of parental encouragement on children's physical activity (Spink et al., 2008). In that study, *less* encouragement ("telling children to be physically active") was associated with *more* active children in highly active parents. The moderation analysis from that study was similar but interpreted in terms of parent MVPA moderating an encouragement-child MVPA link rather than encouragement moderating a parent MVPA-child MVPA link. Although that study's findings seem to contrast with the current results, the studies used different measures of encouragement/social control. Both measures seem to capture related communicative activity but had a different tone, possibly accounting for the discrepancy. In addition, Spink et al. used parent-reported child physical activity, which could have introduced an issue of same-source bias.

Current findings offer potential alternatives for obesity prevention and treatment programs. Low-active parents may be able to increase their children's moderate-to-vigorous physical activity through the strategic use of encouragement. Parents who find it difficult to increase their own activity levels due to physical, financial, or time restrictions may find this strategy particularly useful. Intervention programs using this strategy may have the added benefit of higher parent participation rates if parents find it easier to implement parenting practices than to increase their own physical activity. However, prevention programs that promote encouragement in combination with increasing parent physical activity would likely have the greatest impact.

Despite its methodological strengths, including an objective physical activity assessment deployed in parent-child dyads, the study had limitations. First, the data are cross-sectional. Temporal order of the effects between parenting and child MVPA is unknown. Possibly, children who are more active engage parents in physical activity in ways that boost parental encouragement. For example, active children may solicit parent encouragement during sports participation. Second, the study sample was mostly comprised of mothers (84%) and had lower obesity rates than those with missing data, raising questions of representativeness. Fathers are often under-represented in family studies, and some evidence indicates that those who do participate have more education, a more stable presence in the child's life, less traditional beliefs, and more positive parenting practices[40]. However, the effect of parent gender was not a significant in our model, indicating that, at least in this sample, the pattern for mothers and fathers was the same. Third, although both parent and child physical activity were measured objectively using accelerometers, parenting behaviors were assessed with self-reports. Potentially, parents' perceptions of their own encouragement did not reflect actual behavior, or a third unmeasured variable was responsible for both. For example, parents who had high expectations for their children's activity levels may have communicated these expectations, leading children to be more active. However, those same parents may have also felt pressure to provide socially desirable answers regarding their own encouragement, inflating their scores on these items. Longitudinal studies that include objective measures of parenting behavior, such as direct observation or video, would help address these unanswered questions.

Conclusions

Physical activity is important for children's health and lowers risk for subsequent obesity, heart disease, and diabetes. This study suggests that parents who are less active may potentially mitigate negative effects of their relative inactivity by strategically encouraging children's own physical activity.

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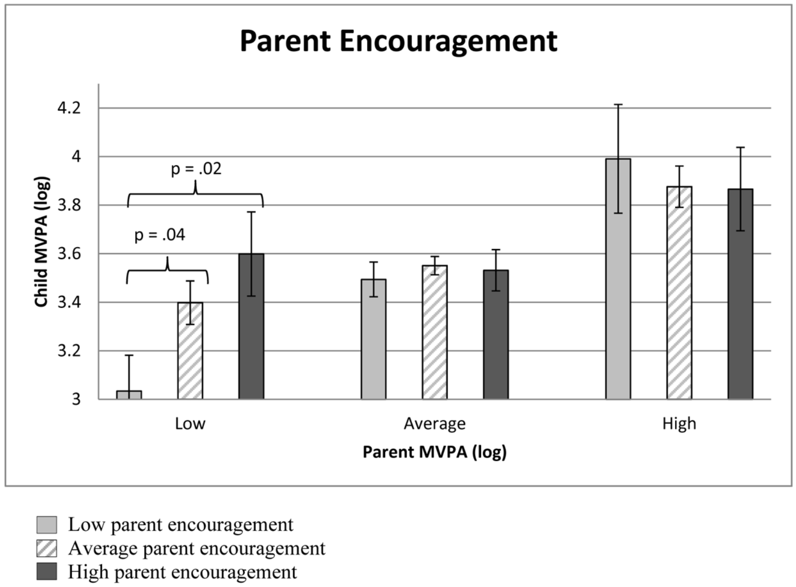

Figure 1. Estimated child MVPA (log) at levels of low, average, and high parent MVPA (log) and parent encouragement

Note: moderate-to-vigorous physical activity (MVPA). Control variables include child age, child gender, child ethnicity, child BMI z-score, parent gender, parent income, adult BMI and group (Preserve).

Table 1

Demographic, BMI, and MVPA for retained vs. non-retained participants

Characteristic	Retained (n= 423) % or M (SD)	Non-retained (n= 200) % or M (SD)	F or $\chi 2$
Child			
Age	11.33 (1.49)	11.55 (1.59)	2.01
Gender			1.04
Female	48.46	43.96	
Male	51.54	56.04	
Ethnicity			0.22
Non-Hispanic	58.63	56.59	
Hispanic	41.37	43.41	
BMI			0.59
Normal/underweight	62.17	59.35	
Overweight	18.20	17.89	
Obese	19.62	22.76	
MVPA	47.00 (42.77)	50.92 (43.68)	0.73
Parent			
Age	39.30 (5.95)	38.99 (6.11)	0.33
Gender			6.56 *
Female	83.22	74.16	
Male	16.78	25.84	
Ethnicity			0.14
Non-Hispanic	49.41	47.75	
Hispanic	50.59	52.25	
BMI			6.04 *
Normal/underweight	29.55	24.21	
Overweight	39.01	34.21	
Obese	31.44	41.58	
MVPA	28.73 (32.62)	33.39 (39.59)	1.77
Income			3.28
< 30,000	23.64	17.01	
30,000–60,000	28.84	28.57	
60,000–100,000	25.53	28.57	
>100,000	21.99	25.85	
Parent encouragement of PA	2.60 (0.75)	2.70 (0.82)	1.99
Parent modeling of PA	2.28 (0.68)	2.37 (0.70)	2.18
Parent influence on PA	2.46 (0.53)	2.47 (0.53)	0.01

* $p < 0.05$

Note: Body Mass Index (BMI), Moderate-to-vigorous physical activity (MVPA), Physical activity (PA); Missing data – *For children*; ethnicity (18), BMI (77), gender (18), age (75), MVPA (89); *For parents*; ethnicity (22), BMI (10), gender (22), age (22), MVPA (76), income (53), encouragement (24), modeling (22), influence (20)

Table 2

Correlations between Parent and Child MVPA, Parent PA Behaviors and Demographics

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Child MVPA (log)	1.00												
2. Parent MVPA (log)	.268**	1.00											
3. Encouragement for PA	.163**	.066	1.00										
4. Modeling of PA	.142**	.266**	.486**	1.00									
5. Perceived infl. for PA	−.006	.052	.120*	.158**	1.00								
6. Child age	−.468**	−.058	−.161**	−.046	−.023	1.00							
7. Child gender	−.221**	−.013	.038	.055	.019	−.068	1.00						
8. Child ethnicity	−.017	.011	.116*	.131**	−.068	.184**	−.046	1.00					
9. Child BMI (*z*-score)	−.039	.002	.108*	.019	−.051	.061	−.124*	.119*	1.00				
10. Parent BMI	−.037	−.057	.036	−.082	−.084	.008	−.064	.164**	.318**	1.00			
11. Parent income	.032	.022	.009	.006	.222**	−.124*	.022	−.300**	−.163**	−.169**	1.00		
12. Parent gender	.040	.124*	−.002	.060	−.023	−.088	−.043	−.069	.051	.000	.161**	1.00	
13. Group	.051	−.042	.053	.022	.055	−.100*	.039	−.196**	−.007	−.073	.192**	.167**	1.00

Note: moderate-to-vigorous physical activity (MVPA); physical activity (PA); Body Mass Index (BMI); (n = 423)

Gender coded: 1 = Male, 2 = Female; Ethnicity coded: 1 = Hispanic, 0 = Non-Hispanic; Group: 1 = Preserve, Control = 0

*** $p < 0.001$,

** $p < 0.01$,

* $p < 0.05$

Table 3

Regression models predicting child MVPA from parent MVPA, moderated by parent encouragement and modeling of physical activity

	Model 1 *B*	*(SE)*	*t*	*p*-value	Model2 *B*	*(SE)*	*t*	p-value
Encouragement								
Step 1		(R^2 = .093, p < .001)				(R^2 = .356, p < .001)		
Encouragement	.129	(.041)	3.144	.002	.071	(.036)	1.961	.051
Parent MVPA	.225	(.041)	5.553	.000	.206	(.035)	5.900	.000
Child age					−.204	(.018)	−11.178	.000
Child gender					−.338	(.052)	−6.444	.000
Child ethnicity					.056	(.058)	.971	.332
Child BMI z-score					−.032	(.025)	−1.292	.197
Parent gender					−.053	(.072)	−.733	.464
Parent BMI					−.004	(.004)	−.826	.409
Income					−.023	(.026)	−.886	.376
Group (preserve)					.043	(.064)	.662	.508
Step 2		(ΔR^2 = .019, p = .003)				(ΔR^2 = .009, p = .017)		
Enc. × Parent MVPA	−.150	(.051)	−2.959	.003	−.107	(.044)	−2.402	.017
Modeling								
Step 1		(R^2 = .077, p < .001)				(R^2 = .354, p < .001)		
Modeling	.073	(.047)	1.551	.122	.065	(.041)	1.602	.110
Parent MVPA	.216	(.042)	5.101	.000	.195	(.036)	5.406	.000
Child age					−.212	(.018)	−11.765	.000
Child gender					−.345	(.053)	−6.515	.000
Child ethnicity					.075	(.058)	1.287	.199
Child BMI z-score					−.025	(.025)	−1.001	.318
Parent gender					−.076	(.072)	−1.043	.298
Parent BMI					−.003	(.004)	−.649	.517
Income					−.014	(.026)	−.537	.592
Group (preserve)					.064	(.064)	.999	.318
Step 2		(ΔR^2 = .011, p = .028)				(ΔR^2 = .003, p = .149)		

	Model 1				**Model2**			
	B	***(SE)***	***t***	***p*-value**	***B***	***(SE)***	***t***	**p-value**
Encouragement								
Modeling × Parent MVPA	−.125	(.057)	−2.199	.028	−.070	(.048)	−1.444	.149

Moderate-to-vigorous Physical Activity (MVPA); Body Mass Index (BMI); Gender: 1 = boy, 2 = girl

Model 1 contained only predictor and moderator variables, grand mean centered; Model 2 adjusted for covariates