

# Role of parents in determining children's physical activity

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**Background:** Parents' physical activity was reported to influence children's physical activity. We hypothesized that parents of 10- to 14-year-old children could influence their children's level of physical activity in ways other than providing logistical support.

**Methods:** Clinical observational study was conducted in a General Clinical Research Center. Normal weight (body mass index [BMI]  $\leq$ 85th percentile) and at-risk of overweight (BMI  $>$ 85th percentile) children aged 10 to 14 years were recruited. Sports and leisure indices were derived from the results of Baecke physical activity questionnaires administered to parent-child dyads. Children's habitual activity was determined by a 7-day pedometer log.

**Results:** Of 109 subjects enrolled, 48% were normal weight and 52% were at-risk of overweight. A significantly higher proportion of normal weight children (67%) versus at-risk of overweight children (49%;  $P=0.02$ , adjusted intrafamily correlation) reported patterning their physical activity after that of an adult. The mother's physical activity was more beneficial than the father's in influencing children to begin and continue physical activity.

**Conclusions:** The influence of parents (predominantly mothers) on their children's physical activity extends beyond enrolling children in activities and providing them with transportation to and from those activities. These findings suggest that primary prevention and intervention strategies for those at-risk of overweight children should be directed at increasing not only children's physical activity but also that of their parents, especially mothers.

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## Introduction

Whether parental physical activity is better than their physical inactivity at predicting their children's level of physical activity remains controversial. For most children, parents are important sources of support: they play crucial roles in their children's health by reducing or eliminating barriers to good health, overseeing opportunities for healthier choices, and modeling appropriate behavior.<sup>[1]</sup> Studies have found that when parents reinforce their children's physical activity, the physical fitness level of low-fitness children increases,<sup>[2]</sup> as does the level of physical activity and fitness of overweight children.<sup>[3,4]</sup>

Although self-efficacy, exercise intention, social influence, physical fitness, television viewing, and access to equipment and facilities influence the level of physical activity among youths,<sup>[5,6]</sup> parental support is also important. Such support may consist of explicit modeling, through which the parent's behavior encourages the physical activities of children, or of logistical support, such as transporting children to and from activities.<sup>[7]</sup> Usually, explicit modeling is attributed to fathers, whereas logistical support is ascribed to mothers.<sup>[7]</sup>

Between 1980 and 2004, the percentage of youths aged less than 18 years who lived in single-parent households increased from 23% to 32%.<sup>[8]</sup> This increase in single-parent families may change the role of mothers in determining the level of their children's physical activity. We designed a study aimed at determining the extent to which children perceive that their parents influence their day-to-day physical activity. We hypothesized that parents of 10- to 14-year-old children could influence their children's level of physical activity in ways other than providing logistical support.

## Methods

### Subjects

The study was approved by the University of Kentucky (UK) Institutional Review Board (IRB) and the Scientific Advisory Committee of the General Clinical Research Center (GCRC). Subjects were children aged 10 to 14 years, drawn from public and private

schools in the greater metropolitan area of Lexington, Kentucky. Subject recruitment involved distribution of an IRB-approved flyer in UK's general pediatrics and adolescent medicine clinics and in local churches; referrals by participants and investigators; and an advertisement posted on the UK clinical research website. Subjects were excluded from the study if they had any medical or physical conditions that would impair physical activity or were using medications that would interfere with daily physical activity. Informed consent for the child's participation was obtained from parents or guardians; assent was obtained from the children themselves. The recruitment period was planned to last for one year. Allowing for 10% attrition, the recruitment goal was 60 normal weight subjects and 60 at-risk of overweight subjects, equally divided between girls and boys.

### Data collection

For each child, a complete medical history was elicited and a physical examination was performed. Trained clinical personnel used standard anthropometric procedures to obtain anthropometric measurements. Each subject's body mass index (BMI;  $\text{kg}/\text{m}^2$ ) was determined, and results were used to place subjects into one of two groups: normal weight (BMI  $\leq$ 85th percentile for age and sex) or at-risk of overweight (BMI  $>$ 85th percentile for age and sex). We combined the at-risk (BMI  $>$ 85th percentile) and the overweight (BMI  $>$ 95th percentile) as defined by the 2000 BMI-for-age percentile charts from the Centers for Disease Control and Prevention.<sup>[9]</sup>

The parent-child dyad completed Baecke physical activity questionnaires<sup>[10]</sup> so that work, sports, and leisure scores could be determined. Parents' responses to 17 questions were scored on a five-point scale and resulted in three scores reflecting physical activity at work, sports participation during leisure time, and physical activity during leisure time excluding sports participation. Children's responses to 13 questions were scored on a five-point scale and resulted in two scores (the work score was omitted for children). The validity of the Baecke questionnaire in assessing physical activity has been previously reported,<sup>[11-16]</sup> and the modified version excluding the work score has previously been used with children.<sup>[17]</sup>

Children's habitual level of physical activity was determined by having them maintain a 7-day pedometer log with the Yamax SW-200 Digi-Walker step counter (NEW-LIFESTYLES, Inc., Lee's Summit, MO). This tool is suitable for measuring the daily steps of children and adults for most research purposes,<sup>[18-24]</sup> and the 7-day monitoring protocol has demonstrated acceptable estimates of daily participation in moderate

to vigorous physical activity.<sup>[25]</sup> For the 7-day pedometer measurement, the principal investigator instructed subjects in the proper use, zero calibration, and wearing of the pedometer. Subjects were to wear the pedometer on the waist band half-way between the umbilicus and the anterior iliac spine; to choose which side of the waist to use; and to wear the pedometer on the same side each day. The subjects were instructed to zero the pedometer only at the beginning of the 7 days and to record the number of steps noted on the pedometer at the end of each day just before getting ready for bed.

The children were also asked to complete a brief questionnaire that included the following four questions: Do you exercise regularly (20 minutes a day at least three times a week)? Do you have a role-model for participating in regular physical activity? If yes, who is it? Who do you believe would help you the most if you decided to start an exercise program? (mom, dad, friends, others [please list]) Who do you believe would help you the most in continuing your exercise program year-round? (mom, dad, friends, others [please list])

### Statistical analyses

The study was designed to have a power of 0.80 to detect an effect of 0.52 (e.g., mean pedometer readings of normal weight children would exceed those of at-risk of overweight children by 50%) at a statistical significance (alpha) of 0.05. Linear mixed models (LMM) were used to compare mean pedometer readings between normal weight and at-risk of overweight children and to compare mean sports scores, work scores, and leisure scores between normal weight and at-risk of overweight children and their parents. Because 15 of the 88 participating families had enrolled more than one child in the study (2 to 5 children), the LMM accounted for the correlation between the responses of two children of the same parent. This correlation was based on Pearson's correlation coefficient after the clustering effect of family had been taken into consideration. A logistic regression model was used to compare the proportions of children in each group (normal weight and at-risk of overweight) who reported role models for exercise participation; this model also accounted for the intrafamily correlation. Significance was set at the level of  $P < 0.05$ . Data analysis was performed with PC SAS, Version 8 (SAS Institute Inc., Cary, NC).

### Results

One hundred and nine children (55 boys, 54 girls; mean age, 12.0 years) of 88 parents completed the study;

58% were white, 31% were black, and 11% were from other racial or ethnic backgrounds (Table 1). Of the 109 children, 48% were normal weight (48% boys; 52% girls) and 52% were at-risk of overweight (53% boys; 47% girls). The mean BMI of all 109 subjects was 24.9 (mean BMI for the normal weight group, 19.0±0.30; mean BMI for the at-risk of overweight group, 30.3±0.84).

The 7-day pedometer readings indicated that the normal weight children were more physically active than the at-risk of overweight children. The normal weight children recorded a significantly higher mean number of steps (30 833±2728 steps) during the 7-day pedometer test than did the at-risk of overweight children (20 523±2712,  $P<0.038$  by LMM). In other words, normal weight children on average recorded 50% more steps than at-risk of overweight children during the 7-day test period.

Sixty-seven percent of normal weight children and 49% of at-risk of overweight children reported a role model for participating in regular physical activity (Table 2;  $P=0.02$  when adjusted for intrafamily correlation; odds ratio, 2.3; 95% confidence interval, 1.1-4.8). Not all children had a parent as a role model. Nonparental role models included other adults, friends, and siblings. The BMI of the children was inversely associated with their having a role model. Children who had role models were less likely to be at-risk of overweight (odds ratio, 0.42; 95% confidence interval, 0.9-0.91).

**Table 1.** Characteristics of enrolled children

Variables	Data
Total enrolled	109
Mean age (y)	12.0
White	58%
Black	31%
Others	11%
Boys	50%
Girls	50%
Normal weight	48% (48% boys; 52% girls)
At-risk of overweight	52% (53% boys; 47% girls)
Overall mean body mass index (BMI)	24.9 kg/m <sup>2</sup>
Mean normal weight BMI	18.99±0.30 kg/m <sup>2</sup>
Mean at-risk of overweight BMI	30.34±0.84 kg/m <sup>2</sup>

**Table 2.** Role models (normal weight versus at-risk of overweight)

Subjects	Percentage (%)		
	No role model	Non-parent role model	Parent role model
At-risk of overweight boys	50.0	37.5	12.5
Normal weight boys	33.4	33.3	33.3
At-risk of overweight girls	51.9	14.8	33.3
Normal weight girls	33.3	37.1	29.6

In the at-risk of overweight group, 48% of girls and 50% of boys reported having role models; in the normal weight group, 67% of girls and 68% of boys reported having role models (Table 2). Overall, 39% of girls reported that their mother was their role model (33% normal weight girls; 46% at-risk of overweight girls). In contrast, only 33% of normal weight boys and 12.5% of at-risk of overweight boys had a parent as a role model for physical activity (Table 2).

Approximately 30% of the participating families were single-parent families. Of the 88 parents who completed the physical activity questionnaire, 91.7% were mothers. The mean activity scores for all mothers

**Table 3.** Summary of pedometer log and physical activity scores

Variables	Group	Mean daily steps ± SEM	P value
7-day pedometer log	Normal weight	30 833±2228	<0.038
	At-risk of overweight	20 523±2712	
Mean steps by sex	Boys	27 995±3033	0.0015
	Girls	15 776±2927	
Mean steps by race	White	29 771±2369	0.0118
	Black	16 521±5789	
Sports score (children)	Normal weight	3.76±0.09	<0.0001
	At-risk of overweight	3.13±0.10	
Leisure score (children)	Normal weight	3.17±0.09	0.0313
	At-risk of overweight	2.91±0.08	
Sports score (parents)	Normal weight	2.57±0.11	0.11
	At-risk of overweight	2.35±0.11	
Leisure score (parents)	Normal weight	2.93±0.08	0.13
	At-risk of overweight	2.77±0.09	
Actual BMI	Normal weight	19.0±0.30	<0.0001
	At-risk of overweight	30.34±0.84	

**Table 4.** Correlation between parents' and children's physical activity levels\* (adjusted for intrafamily correlation)

Variables	Sports score (children)	Leisure score (children)	Average of pedometer logs
Sports score (parents)	$r=0.17$ ( $P=0.13$ )	$r=0.03$ ( $P=0.7581$ )	$r=0.28$ ( $P=0.008$ )*
Leisure score (parents)	$r=0.40$ ( $P<0.0001$ )*	$r=0.59$ ( $P\leq 0.0001$ )*	$r=-0.11$ ( $P=0.2822$ )

Notes: The activity levels for parents and children were derived from the results of Baecke physical activity questionnaires. Parents' responses to 17 questions were scored on a five-point scale and resulted in three scores: physical activity at work, sports participation during leisure time (sports score), and physical activity during leisure time, excluding sports participation (leisure score). Children's responses to 13 questions were scored on a five-point scale and resulted in two scores: sports score and leisure score (the work score was omitted for children and is not included in this table). Children's habitual physical activity level was determined by having them maintain a 7-day pedometer log by using the Yamax SW-200 Digi-Walker step counter. The cells marked with an asterisk indicate statistically significant correlations. Because 15 of the 88 participating families enrolled more than one child in the study (2 to 5 children), the linear mixed model accounted for the correlation between the responses of two children of the same.

were  $2.62 \pm 0.06$  (work),  $2.41 \pm 0.06$  (sports), and  $2.91 \pm 0.07$  (leisure). There was no significant difference between normal weight and at-risk of overweight children in the mothers' work scores. However, the mean sports score of normal weight children's mothers ( $2.57 \pm 0.11$ ) was higher than that of at-risk of overweight children's mothers ( $2.35 \pm 0.11$ ;  $P=0.11$ ), as was their mean leisure score (normal weight children's mothers,  $2.93 \pm 0.08$ ; at-risk of overweight children's mothers,  $2.77 \pm 0.09$ ;  $P=0.13$ ) (Table 3).

Boys and girls in both groups were significantly ( $P<0.0001$ ) more likely to report that their mothers would be beneficial for both starting and continuing an exercise program than they were to report that their fathers or other role models. Eighty percent of girls and 67% of boys believed that their mothers would be beneficial in helping them start an exercise program (69% normal weight girls; 88% at-risk of overweight girls; 69% normal weight boys; 67% at-risk of overweight boys). Seventy-seven percent of both girls and boys believed that their mothers would be beneficial in helping them continue an exercise program (73% normal weight girls; 80% at-risk of overweight girls; 70% normal weight boys; 82% at-risk of overweight boys).

There was a significant positive correlation between 1) mean child's pedometer reading and parent's sports score, 2) parent's leisure score and child's leisure score, and 3) parent's leisure score and child's sports score (Table 4). Normal weight children were more likely than at-risk of overweight children to be active during leisure and sports and to have parents who were active during leisure time.

## Discussion

The results of our study support the importance of explicit modeling of physical activity for children. We found that, in contrast to normal weight boys, normal weight girls, and at-risk of overweight girls, only 10% of at-risk of overweight boys had a parental role model for physical activity. No previously published study has reported this specific finding.

After evaluating the determinants of physical activity for fifth- and sixth-grade children and their mothers, Stucky-Ropp and DiLorenzo<sup>[1]</sup> determined that enjoyment of the physical activity, mother's perception of barriers to exercise, and mother's report of family social support were crucial for both boys and girls. Additionally, they suggested that support of exercise by friends and family members was important for boys, whereas parental modeling and the number of exercise-related pieces of equipment at home were important for girls. However, the authors did not report

the BMI of the children or their mothers, nor did they discuss the relationship between the children's BMI and their level of physical activity.

Fogelholm and colleagues<sup>[26]</sup> demonstrated that parental inactivity was a strong positive predictor of children's inactivity, whereas parental activity scores were weaker predictors of the children's time spent in vigorous activity and their level of total physical activity. Our results support the finding that parental activity is a strong predictor of children's physical activity. We found a significant positive correlation between the leisure scores of parents and children and between the leisure scores of parents and the sports scores of children. Similarly, parents' sports scores were weaker predictors of the children's total physical activity, as derived from their 7-day pedometer reading. We also found that children with adult models of physical activity were less likely to be at-risk of overweight. The effect size, adjusted for intrafamily correlation, was summarized by an odds ratio of 2.3; this ratio represents a moderate effect size. At-risk of overweight children were less likely than normal weight children to have an adult after whom they could pattern their physical activity.

Moore and associates<sup>[7]</sup> found that children of active mothers were twice as likely to be active as were children of inactive mothers; children of active fathers were 3.5 times more likely to be active than were children of inactive fathers. When both parents were active, the children were 5.8 times more likely to be active than were children of two inactive parents. These findings imply that fathers tend to have a greater influence than mothers on their children's physical activities. In contrast, our findings demonstrate that mothers exert a substantial influence on their children's level of physical activity. The mother's influence was significant for both boys and girls. Unfortunately, we could not address the question of whether mothers exerted more influence than fathers, because 92% of our parental physical activity questionnaires were completed by mothers.

Davison and coworkers<sup>[27]</sup> reported that fathers were more likely than mothers to be explicit models of support for their 9-year-old daughters' physical activity, whereas mothers were more likely than fathers to support their daughters' activity by enrolling them in physical activities and transporting them to events. The results of our study support the importance of explicit modeling of physical activity by mothers. Our parental sports scores were significantly positively correlated with children's physical activity (i.e., mean 7-day pedometer reading). However, unlike those of Davison and associates, our results suggest that mothers exert a crucial influence on their children's starting and



continuing physical activity. This finding implies that mothers play a role beyond that of providing logistical support. The mothers of normal weight children appear to be verifiable explicit models of regular physical activity for their children. Compared to the mothers of at-risk of overweight children, the mothers of normal weight children had higher sports scores and higher leisure scores. This finding implies that mothers should engage in physical activity if they desire to influence their children's physical activity.

Although some studies demonstrated that the level of parental support was positively correlated with girls' self-reports of their physical activity level,<sup>[7,27]</sup> other studies found no association with self-reported activity.<sup>[1,6]</sup> Adkins and colleagues<sup>[28]</sup> questioned whether black girls perceived their parental support differently than did white girls. The authors found that parental support for their daughters' activity was positively correlated with the daughters' level of activity; they suggested that parental involvement may be a key component of increasing physical activity levels among black girls. Our study found no racial differences in the mothers' influence on their children in starting and continuing physical activity. However, the small number of black parent-child dyads may have prevented us from detecting racial differences.

The strengths of our study include its high retention rate; the presence of equal numbers of children in each group; and the equal distribution of children of each sex in subgroups. In addition, our study had good statistical power and a moderate effect size, and it produced several results congruent with those of previously published studies. However, our study also had several limitations. Because the subjects were recruited primarily through university-based clinics with approximately 60% Medicaid patients, our findings may not be generalizable. Additionally, our study is subject to the standard limitations associated with self-report questionnaires; however, the use of self-report questionnaires among children aged 10 to 16 years has been shown to produce reasonably reliable and valid estimates of physical activity.<sup>[12,29]</sup> Also, because we did not determine the height and weight of parents, we were unable to determine whether the parent's BMI was correlated with the child's BMI.

Overall, our results support the recommendation that parents who want to increase their children's physical activity may need to alter their own lifestyle.<sup>[26]</sup> Because our study found that the mothers of normal weight children were more physically active during leisure time than the mothers of at-risk of overweight children, we recommend that primary at-risk of overweight prevention and intervention strategies should be directed at increasing the role of mothers as

explicit models for children's physical activity rather than being limited to logistical support, especially in view of the evolving composition of families.

Further research would be beneficial in determining specifically what children believe their mothers could do to assist them in starting and continuing physical activity. Likewise, if we are to provide universal guidelines for improving physical activity among children, it would be important to determine whether the results of our study are reproducible in other populations.

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**Ethical approval:** The study was approved by the University of Kentucky (UK) Institutional Review Board (IRB) and the Scientific Advisory Committee of the General Clinical Research Center (GCRC).

**Competing interest:** None of the authors has any financial or conflicts of interest to disclose.

**Contributors:** GJR proposed the study and wrote the first draft. KRJ analyzed the data. All authors contributed to the design and interpretation of the study and to further drafts. GJR is the guarantor.

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