Body Perception: Parents Poorly Perceive Children's Fitness Characteristics

E.J. Lieber, C.B. Swain

Introduction

Childhood obesity is an increasing public health concern. At least 155 million school-age children worldwide are overweight or obese, according to a major report from the International Obesity Task Force (7). Childhood obesity has tripled since 1980, with 1 in 3 children in the United States categorized as overweight and 18% of youth categorized as obese (7, 17, 14). The Office of the Surgeon General reports that an obese teenager has a greater than 70% chance of becoming an obese adult (4). The rate of overweight boys and girls has significantly increased from 2000 to 2004, with an increase of 14% to 18% in boys and 14% to 16% in girls (11). Overweight children are at increased risk for many chronic conditions such as diabetes, cardiovascular disease, and certain cancers (13, 18, 15, 10). Thus, there is an elevated concern surrounding the impact obesity will have on the next generation and its effects on the already strained American health care system (1).

Primary prevention is the key means for controlling the rise in obesity (8). Stopping the problem before it starts could solve problems on many levels. Behavior-based weight loss programs and subsequent weight maintenance efforts have shown to be expensive and thus out of reach for many Americans. Medication and surgery are both options for obesity treatment but carry side effects and possible health risks. For these, and other reasons, it is widely agreed that prevention of obesity should be a public health focus.

Parents, specifically maternal parents, have been viewed as the "gatekeepers" to the health of the family unit. They play a large part in the primary prevention role, through their influence on the diet and physical activity behaviors of their children (7).

A parent's knowledge and understanding of their child's weight status is imperative. However, research has shown that adults have a poor ability to identify children as overweight or obese. The most common error made by parents is under-estimating their child's weight status, (i.e. misclassifying an overweight child as having a normal or healthy weight). Parents serve as role models for their children's physical activity habits and diet patterns. Children who have been previously categorized as overweight are significantly more successful in achieving healthy weight changes when parents engage and participate in their child's diet and physical activity programs (9, 19, 17).

Previous research shows parents have a poor perception of children's Body Mass Index (BMI), a value calculated by using a person's height and weight, to stratify individuals into categories that describe their weight status as underweight, normal, overweight or obese. A 23-study meta-analysis examined parental recognition of their child's overweight status, based on BMI. This examination included 16,128 child-parent dyads. Based on their inclusion criteria, 3,864 children-parent sets, classified as overweight or obese were examined: parental recognition ranged from 6% to 73% for this group (13). Consequently, in 19 of the 23 studies, less than half of parents whose children were overweight could identify their child as being overweight (13).

As a means of controlling obesity, parents are responsible for seeking assistance for their overweight children. Investigation efforts indicate that giving parents of elementary aged students objective information on a child's weight increases the accuracy of weight status identification (12). Evidence suggests that parents who are aware of their child's weight status

as a health problem are significantly more likely to make changes in the lifestyle of their child than those unaware of the problem (14).

Research has yet to examine parental perception of body composition or fitness characteristics. Physical activity characteristics are an important aspect to be considered when examining childhood obesity. Therefore, this study aimed to explore maternal perception of fitness characteristics (BMI, body composition, aerobic fitness, muscular strength, and flexibility) in their children. The primary purpose of this study was to determine the relationship between maternal parent's perception of their child's fitness score and their children's actual fitness scores. It was hypothesized that parents would have a poor ability to perceive their child's fitness characteristics. Secondly it was hypothesized that a weak to moderate correlation would exist between maternal perceived fitness characteristics and child actual fitness characteristics.

Methods

The study was reviewed and approved by Ohio State University's Institutional Review Board (IRB). Research was conducted at Ohio State University's exercise physiology laboratories located in a top rated science museum over a seven-month period. An internal study determined the population of visitors to this museum represents the population of surrounding counties. Subjects were identified during their visit to the museum or learned about the study through advertisement. To meet study requirements, subjects were between the ages of 8 and 17 years, low risk as determined by the Exercise and Physical Activity Readiness Assessment for Children and Adolescents, and accompanied by their maternal parent.

Data for this investigation was obtained from a survey given to the maternal parent, and a fitness assessment administered to her child. Parents completed an informed consent and the Exercise and Physical Activity Readiness Assessment for Children and Adolescents prior to data

collection. Maternal perception of fitness was assessed from a subjective estimation on five different fitness characteristics (BMI, body composition, aerobic fitness, muscular strength, and flexibility).

Maternal parents were placed in a private room and given a questionnaire to assess the perception of their child's fitness characteristics. Each fitness characteristic was described in detail. Mother's were instructed to estimate, to the best of their ability, how their child compared to his or her peers on a categorical basis. Categories were described according to a descriptive name (e.g., needs work) and the ranking it corresponded to in the normative population (e.g. 1-39 percentile).

Mothers were asked if they considered their child to be underweight, normal weight, overweight or obese based upon their BMI percentile. They were also asked to rate their child as underweight, normal weight (low, medium, high), or obese based upon their body composition (i.e. percentage body fat). For aerobic fitness, muscular strength, and flexibility, mothers estimated their child to be in the category of needs work, fair, fit, or excellent (see Table 1) and a corresponding percentile ranking within the category. For example, if the maternal parent scored their child's flexibility as 65th percentile this classified them as "fit" (60th to 79th percentile) and put them in the third of four categories. Maternal perceptions were considered accurate if they identified their child to be in the correct category as determined by the child's fitness assessment and normative data. A consultation followed the survey and fitness assessment to provide physical activity recommendations.

Procedures

Body Composition: Body volume was determined by air displacement plethysmography (ADP) using the BodPod (BP), (Life Measurement Instruments, Concord, California). BP is a

fast, accurate method to measure percentage body fat that required the subject to sit for approximately two minutes inside an enclosed chamber. The BP was calibrated prior to each test according to manufacturer's instruction. Height was measured using a stadiometer and recorded to the nearest 0.5 cm; weight was measured to the nearest 1.0 g using the BP system scale. Subjects wore tight fitting swimsuits or spandex shorts and swim caps provided by the lab. Lung volume was predicted by BP software, which calculated body density and an estimated body composition for each subject. Density models were chosen based upon the subject's sex, age, and ethnicity (see Table 2). All measurements were completed according to the manufacturer's instructions.

Body Mass Index (BMI): Using BP data, gender-specific BMI percentile-for-age was calculated using Centers for Disease Control and Prevention growth charts (6). Children were then classified as underweight ($<5^{th}$ percentile), normal weight (5^{th} to $<85^{th}$ percentile), overweight (85^{th} to <95 percentile) or obese ($\geq 95^{th}$ percentile). Maternal perceptions of weight status were compared with calculated weight status classifications based on category.

Fitness Assessment: The fitness assessment was performed using the MicroFit Comprehensive Fitness Testing with Exercise Prescription. The MicroFit system is an FDA approved device and was used to measure flexibility, muscular strength, and aerobic capacity. Results were compared to normative data.

Aerobic Fitness: The aerobic capacity test was performed on an electronically braked cycle ergometer: MicroFit Ergomedic 828 E. A multi-stage submaximal protocol was utilized based upon subject age (8-11 years, 12-15 years, 16-17 years). Heart rate was measured using Polar heart rate monitors; resistance was measured in wattage (W). The subject maintained a constant revolution per minute (RPM) speed, until the subject reached a sufficient submaximal

heart rate. An estimate of aerobic fitness was determined by the heart rate response at 85% of subject's estimated maximum heart rate. A maximal volume of oxygen (VO_2max) score was calculated based on the linear relationship established between heart rate and VO_2max. This relative VO_2max value measured in ml/kg/min was then compared to normative data.

Strength Test: Bicep strength was assessed using the MicroFit FAS-2 strength scale, a static strength-testing device. The subject was instructed to stand on the force plate; the strap for the bicep curl attachment was adjusted so that his or her elbow joint was at 90 degrees when pulling up on the bar. Subjects were instructed to use only their biceps, with no assistance from shoulders, back, or legs, and hold a maximal pull for 3-4 seconds. The bicep strength score was then compared to normative data.

Flexibility Test: Flexibility was assessed using a standard sit-and-reach test via the MicroFit Flexometer SP. The subject was instructed to take off his or her shoes, sit on the floor and place heels in the appropriate place on the Flexometer. Participants were instructed to keep legs straight, place one hand on top of the other, palms down, and reach forward as far as they could. This method was repeated three times and recorded on the fourth trial, when they held one number for four seconds. The flexibility score was then compared to normative data.

Data Analysis: Data associations were examined using descriptive statistics and Pearson correlation. The child's measured score was categorized, according to normative data rankings and compared to the maternal parent estimate. Correct and incorrect responses were determined.

Results

A total of 370 children aged 8 to 17 years participated in this study, consisting of 200 males (10.8 ± 2.16 years) and 170 females (11.2 ± 2.44 years). Seven subjects were excluded from data analysis for failing to complete the study in its entirety (2 males, 5 females). The final

sample for evaluation included 363 child volunteers with accompanying maternal survey data. Descriptive characteristics of subjects are found in Table 3. Subjects ranking according to BMI are found in Table 4.

BMI, body composition, and fitness characteristics ranged categorically from poor to excellent. Maternal parents were able to correctly identify fitness characteristics by categorical selection as follows, BMI: 75.14%, body composition: 46.49%, aerobic fitness: 38.11%, muscular strength: 31.08% and flexibility: 27.57%.

Parents more accurately estimated BMI and body composition categories for subjects between the ages of 13-17 years (n=96). For the same age group, maternal parents less accurately predicted flexibility, muscular strength, and aerobic fitness categories as compared to parents' subjects between 8-12 years of age (see Table 5).

Results for the total subject population show that three-fourths (75.14%) of maternal parents were able to correctly identify the BMI category for their child as underweight, normal weight, overweight, or obese. Less than half of maternal parents were able to identify the correct category for body composition and aerobic fitness (46.49% and 38.11% respectively). Less than one-third of maternal parents were able to identify the correct category for muscular strength and flexibility (31.08% and 27.57% respectively). When examining gender-specific variables, maternal parents more accurately estimated all fitness characteristics for female children except for BMI percentile (see Table 5).

There was a strong correlation of maternal parents' ability to estimate their child's BMI category (r=0.6765) and body composition category (r=0.6034), and moderate correlation of maternal parents' ability to estimate their flexibility category (r= 0.4069), and aerobic fitness

category (r=0.3892). The lowest correlation of parents' accurately estimating their children's physical fitness category was seen in perception of muscular strength (r=0.2508).

There was a significant difference in the percentage of maternal parents correctly identifying the BMI category for overweight (n=53) and obese (n=30) subjects. Only 34.52% of maternal parents correctly identified their overweight or obese child's BMI category, as compared to 75.14% of maternal parents for the total subject population. The percentage of maternal parents that correctly identified their overweight or obese child's category for other fitness characteristics was similar to results for the total subject population: body composition (44.05%), aerobic fitness (39.29%), muscular strength (33.33%), and flexibility percentile (29.76%). Correlations between subject score and parental perception for overweight and obese subjects are found in Table 6.

Discussion

In this investigation the accuracy of maternal perception for BMI was significantly different when comparing children of normal weight to those of overweight or obese status as defined by BMI. The results of the study are consistent with prior research when examining parental perception scores for BMI of overweight/obese children.

With 14% of subjects overweight, and 8% of subjects obese, this research examined a diverse population based on height to weight status for children 8-17 years of age. While only 3% of subjects met BMI underweight criteria, this matches the small segment also found in the population. Although not a perfect match, the large number of subjects and variety in this subject population allow for generalizations to the general public.

The data showed three-quarters of parents are able to accurately identify the correct category for children's BMI (underweight, normal weight, overweight, obese). We attribute this high success rate to the wide range allowable for normal BMI weight percentile (5^{th}-84^{th}). For example, if a subject was rated in the 80^{th} percentile, and their maternal parents estimated 20^{th} percentile, while the estimate was off by a large amount (60 percentiles), using a categorical measuring technique, the maternal parents' estimate would still be considered correct.

When data from overweight and obese subjects (based on BMI) was examined separately, maternal parents were significantly less accurate in determining the correct category for their child's BMI (34.52% of maternal parents as compared to 75.14% for all subjects). This finding corresponds with research of overweight and obese children, in which it has been shown that parents of these children have a poor ability to estimate BMI. While parents of normal weight children were able to report BMI category significantly more accurately, their ability to perceive their child's other fitness characteristics was on par with that of the parents of overweight/obese children.

Maternal parents were more accurate in perception of female children's attributes compared to male children in all fitness categories, except for BMI (table 8). This finding could be related to the same sex identity of mother and child. Further research into this finding and also paternal perception of children's attributes may be warranted.

When examining maternal perception based on the age of subjects (Table 5), an increased percentage of parents with children aged 13-17 correctly categorized their children's BMI and body composition than parents with children aged 8-12. For aerobic fitness, muscular strength,

and flexibility the perception of parents appears to be equally poor regardless of the age of their child.

This increased ability to estimate BMI and body composition may be due to older adolescent body types beginning to more closely resemble adults and thus easier for maternal parents to accurately assess. Additionally this may be due to children becoming more involved in organized sport or activities, giving maternal parents a greater opportunity to observe their child in comparison to their peers.

Study Limitations

Study limitations include the disproportionate amount of younger subjects. The average age of male subjects was 10.8 ± 2.16 years, and female subjects 11.2 ± 2.44 years. This mirrors the age of the general population of children visiting the science museum where data collection was administered. The majority of the subjects (74.06%) in this study were 8-12 years old; therefore the results are more applicable to a younger population. Although this is a study limitation, a large proportion of the subject population in a younger age range is pertinent, as parents tend to have a greater influence on physical activity behaviors and habits in early childhood.

Despite study explanation, it is possible that parents lack an understanding of fitness characteristics or classification system of comparing their children to other peers. For example, parents may not understand the importance of aerobic fitness for children, leading to inaccurate estimates of their child's aerobic fitness score. There was no part to this study that examined the reason for maternal misclassification. This may be a possibility for future research.

Conclusions

Research findings show parents have a poor ability to recognize their child as at-risk according to body composition and other fitness characteristics. As such, it may be recommended that measurement and evaluation of these characteristics should be performed regularly. Understanding these findings is imperative in the battle against childhood obesity and poor fitness. By identifying an unhealthy characteristic early, parents can play a greater role in seeking appropriate help or initiating behavior change in their child.

The importance of physical activity and diet to combat childhood obesity is largely a parental responsibility. This popular preventative approach may be lacking a critical component - parental judgment. This study justifies amending current approaches for combating obesity to focus upon family-based educational programming that incorporates the maternal parent. Educational programming for the mother with a focus upon how to appropriately judge children's fitness and weight characteristics is key. This may help lead to earlier detection of obesity or poor fitness, and thus the earlier adoption of a healthier lifestyle for their children.

Tables:

Table 1: Parental Perception Questionnaire Category Divisions

BMI				
Underweight	Normal Weight	Overweight	Obese	
1^{st}-4^{th} percentile	5^{th}-84^{th} percentile	85^{th}-94^{th} percentile	95^{th}-100^{th} percentile	
Body Composition-Male				
Underweight	Normal Weight (Low)	Normal Weight (Mid)	Normal Weight (Upper)	Obesity
<5%	5%-10%	11%-25%	26%-31%	>31%
Body Composition-Female				
Underweight	Normal Weight (Low)	Normal Weight (Mid)	Normal Weight (Upper)	Obesity
<12%	12%-15%	16%-30%	31%-36%	>36%
Muscular Strength, Flexibility and Aerobic Fitness Scores				
Needs Work	Fair	Fit	Excellent	
1^{st}-39^{th} percentile	40^{th} -59^{th} percentile	60^{th}- 79^{th} percentile	80^{th} -100^{th} percentile	

Table 2: Equations for Estimating % Fat from Body Density Based on Age and Gender

Age (Years)	Males		Females	
	C1	C2	C1	C2
7-8	5.38	4.97	5.43	5.03
9-10	5.30	4.89	5.35	4.95
11-12	5.23	4.81	5.25	4.84
13-14	5.07	4.64	5.12	4.69
15-16	5.03	4.59	5.07	4.64
18	4.95	4.50	5.05	4.62

Note: C1 and C2 are the terms in percent fat equation to substitute in the Siri (1956) equation for the calculation of percent fat:

$$\% \text{ BF} = [C1/Db - C2] * 100.$$

From "Assessment of Body Composition in Children," by T.G. Lohman, 1989, *Pediatric Exercise Science*, 1(1), pp. 19 – 30.

Table 3: Subject Descriptive characteristics

	Male	Female
Age (year)	10.8 ± 2.16	11.2 ± 2.44
Height (inches)	58.46 ± 5.73	58.47 ± 5.05
Weight (pounds)	94.21 ± 35.37	95.99 ± 29.63
Body Mass Index	19 ± 4.10	19.5 ± 3.94
Body Composition (percentage body fat)	21.30 ± 10.68	23.74 ± 8.53

Table 4: Weight Categories Based on BMI

Category	Number of Subjects	Percentage of Total Subjects
Underweight	11	2.97
Normal Weight	276	74.60
Overweight	53	14.32
Obese	30	8.11

Table 5: Percent of Parents Correctly Identifying Fitness Characteristic Categories Based On Age

Age	8-12	13-17
BMI	72.99	81.25
Body Composition	44.53	52.08
Flexibility	27.74	27.08
Muscular Strength	31.39	30.21
Aerobic Fitness	38.69	36.46

Table 6: Relationship Between Subject's Scores and Parental Perception of Scores

Correlation (R-value)	Male	Female	Total
BMI Percentile	0.6400	0.7239	0.6765
Body Composition (body fat percentage)	0.6027	0.5985	0.6034
Flexibility Percentile	0.2678	0.5035	0.4069
Muscular Strength Percentile	0.2486	0.2617	0.2508
Aerobic Fitness Percentile	0.3660	0.4149	0.3892

Table 7. BMI Weight Status

Weight Status Category:	Percentile Range:
Underweight	Less than the 5th percentile
Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

Table 8: Percentage of Maternal Parents Correctly Identifying Fitness Characteristics Categories

	Male	Female	Total
BMI Percentile	76.00	74.12	75.14
Body Composition (percent body fat)	41.00	52.94	46.49
Flexibility Percentile	26.50	28.82	27.57
Muscular Strength Percentile	28.86	33.53	31.08
Aerobic Fitness Percentile	35.50	41.18	38.11

Table 9: Relationship Between Subject's Scores and Parental Perception of Scores Based off of Categories for Overweight and Obese Subjects (Percentage Correct)

	Male (n=43)	Female (n=40)	Total (n=83)
BMI Percentile	41.86	27.50	34.52
Body Composition (percent body fat)	37.21	52.50	44.05
Flexibility Percentile	34.88	25.00	29.76
Muscular Strength Percentile	27.91	40.00	33.33
Aerobic Fitness Percentile	39.53	40.00	39.29

Table 10: Correlation Between BMI and Other Fitness Characteristics

	Male	Female	Total
Body Composition (body fat percentage)	0.5511	0.6464	0.5846
Flexibility	0.0517	0.0208	0.0390
Muscular Strength	0.3116	0.2832	0.2997
Aerobic Fitness	-0.4703	-0.3798	-0.4209

Table 11: Relationship Between Subject's Scores and Parental Perception of Scores Based off of Categories for Overweight and Obese Subjects (Percentage Correct)

	Male (n=43)	Female (n=40)	Total (n=83)
BMI Percentile	41.86	27.50	34.52
Body Composition (percent body fat)	37.21	52.50	44.05
Flexibility Percentile	34.88	25.00	29.76
Muscular Strength Percentile	27.91	40.00	33.33
Aerobic Fitness Percentile	39.53	40.00	39.29

Table 12: Percent Body Fat Standards for Children

	Underweight	Low	Mid	Upper	Obesity
Males 6-17 yr	<5	5-10	11-25	26-31	>31
Females 6-17 yr	<12	12-15	16-30	31-36	>36

Data from: Lohman, T.G., Houtkooper, L, and Going, S.B.

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