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ORIGINAL COMMUNICATION

Self-perception of physical competences in preadolescent overweight Chinese children

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Objective: To compare self-perceptions of physical competences in overweight and in normal weight preadolescent Chinese children.
Design: Cross-sectional study.
Setting: Three primary schools and a university hospital in Hong Kong.
Subjects: A total of 634 children, comprising 558 (462 normal weight, 96 overweight) aged 8–12 y randomly sampled from three primary schools, and 76 similar age overweight children recruited from the community for a diet and exercise intervention programme.
Measurements: Height, weight and percentage body fat were measured. Self-perceptions of physical competences were determined by Physical Self-Descriptive Questionnaire (PSDQ). Corresponding actual physical competences were measured by physical fitness tests.
Results: Overweight children perceived themselves to have significantly more body fat than normal weight children, with poorer appearance, sports competence, endurance, coordination, flexibility, overall physical self-concept and self-esteem, but to be no less healthy, no less physically active and no less strong. Overweight children performed less well than normal weight children in measures of endurance, coordination and flexibility but better in strength. Poor self-perception of physical competences appeared only partly related to deficiencies in actual physical competences.
Conclusion: Overweight children have poorer self-perception of their physical competences but do not perceive themselves to be less strong, healthy or physically active than normal weight children. Exercise programmes for overweight children could be more effective if designed with the knowledge of these self-perceptions.
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Introduction

Exercise plays an important role in the prevention and treatment of childhood obesity (Gortmaker *et al*, 1990; Maffeis *et al*, 1997; Epstein & Goldfield, 1999). Motivation of overweight children to participate in regular exercise can, however, be difficult for physical, social and psychological reasons. Excess body fat adds to the burden of weight-bearing aerobic exercise (Rowland, 1991). Urbanization with a prevalent sedentary lifestyle and lack of parental support for sports activities may further discourage obese children from exercise (Perusse *et al*, 1989; Moore *et al*, 1991; Sallis *et al*, 1992)—considerations particularly relevant to children in Hong Kong where sports facilities are limited and cultural priorities favour sedentary educational activities (Johns & Dimmock, 1999). Critical comments about their excess weight during physical activity can also adversely influence physical activity (Pierce & Wardle, 1997; Faith *et al*, 2002). Whether and how poor self-perception of their physical competences may influence overweight children's motivation

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to participate in physical exercise is unknown but relevant to the development of optimally effective exercise programmes.

Few studies have investigated the effect of being overweight on children's self-perception of physical competences (Banis *et al*, 1988; Phillips & Hill, 1998; Israel & Ivanova, 2002) and then only in general terms, as based on the Perceived Competence Scale for Children (PCSC) Questionnaire (Harter, 1982). No study, to our knowledge, has measured self-perceived physical competences in respect of specific components such as general health, coordination, strength, flexibility and endurance, and none has been carried out in Chinese children. The present study was accordingly undertaken to compare these components of self-perceived physical competences in overweight Chinese children with those of normal weight, using a more comprehensively detailed questionnaire.

Subjects and methods

The study comprised 634 Chinese children aged 8–12 y—558 from 18 randomly selected classes in three local primary schools ('subjects') and 76 overweight similar age children ('patients'), randomly selected from a group of 151 overweight children from the same community who had already registered for a diet and exercise intervention programme (Sung *et al*, 2002) (Table 1). The 558 subjects from the schools were those remaining after exclusion of 88 children who declined to participate and 34 whose body mass index (BMI) was < the 5th percentile of the normal range of BMI age and gender-specific levels (Leung *et al*, 1998). Of these 558 children, 96 were overweight and 462 were of normal weight. The study thus comprised a tota1 of 172 children (96 'subjects' and 76 'patients') who were overweight, of whom 126 (78 boys and 48 girls) were overweight and 46 (37 boys and 9 girls) were obese.

Children were classified as overweight or obese by reference to published criteria of age- and gender-specific BMI (Cole *et al*, 2000), adapted to local BMI data for the Chinese population and corresponding to BMI >25 and >30 kg/m^2, respectively, at age 18 y.

The study protocol was approved by the Ethics Committee of the University. Written informed parental consent was obtained from all participants and their parents.

Body weight was measured using an electronic body weight scale (Seca Delta Model 707) with subjects dressed in light T-shirt and shorts. Height was measured using a Harpenden stadiometer. Percentage body fat was assessed by the bio-impedance (BIA) method using a Tanita BIA body fat analyzer (TBF-401, Tanita Co, Tokyo, Japan), as previously validated (Sung *et al*, 2001).

Questionnaires to assess self-perceptions relating to physical competence and appearance were completed in the classroom for all children from the three schools, and in the hospital for those overweight children who were awaiting the exercise programme. The same two research assistants helped in the completion of all the questionnaires. The questionnaire used was the Physical Self-Descriptive Questionnaire (PSDQ) (Marsh *et al*, 1994), initially developed for Western adolescents, translated into Chinese by the usual translation–back translation method and validated for use in 8–12 y-old Chinese children (Hau *et al*, 2002). It comprises 70 items designed to measure nine specific components—health, appearance, body fatness, level of physical activity, sports competence, strength, endurance, coordination and flexibility—together with an overall assessment of general physical competence and global self-esteem. Each of the 11 items is a simple declarative statement, the response to which is made on a 6-point true–false scale (1–6 in ascending order of assessment as true). The original Western factorial structure was supported by confirmatory factor analyses of the Chinese children's responses in the present study, showing satisfactory reliabilities and similarity of factor patterns.

Physical fitness was measured using a total of six tests supervised by two certified trainers to examine (i) muscular strength (bilateral hand grip), (ii) endurance (flexed leg sit-ups, dips, and squat), (iii) coordination (shuttle run) (The Cooperative Cross-Disciplinary Research Group in Hong Kong, 1985; Baumgartner & Jackson, 1999), and (iv) flexibility (sit and reach, using Sit-and-Reach 5111 testing kit, Takei & Co Ltd, Tokyo, Japan)—as previously validated (Klesius, 1968; Marmis *et al*, 1969; Jackson & Baker, 1986; Safrit & Wood, 1987; Baumgartner & Jackson, 1999). These tests were performed after 5 min preliminary warm-up stretching exercises. A 3-min rest was allowed between

Table 1 Characteristics of normal weight and overweight children

	Boys			*Girls*			*Total*	
	Normal	*Overweight*		*Normal*	*Overweight*		*Normal*	*Overweight*
	N = *241*	*Subjects* N = *62*	*Patients* N = *53*	N = *221*	*Subjects* N = *34*	*Patients* N = *23*	N = *462*	N = *172*
Age (y)	10.5 (1.9)	10.4 (1.7)	10.4 (0.9)	10.4 (1.7)	10.4 (1.8)	10.4 (1.2)	10.5 (1.8)	10.4 (1.4)
Height (cm)	139.0 (12.8)	140.1 (12.0)	144.9 (7.0)*	140.0 (12.5)	141.0 (13.5)	145.2 (7.7)	139.5 (12.7)	142.4 (10.7)*
Weight (kg)	32.8 (8.3)	45.2 (12.0)*	53.9 (9.6)*†	32.6 (7.9)	46.5 (14.9)*	52.9 (7.3)*†	32.7 (8.1)	49.1 (12.1)*
BMI (kg/m^2)	16.7 (1.9)	22.6 (2.7)*	25.5 (3.0)*†	16.4 (1.7)	22.8 (3.8)*	25.0 (2.3)*†	16.5 (1.8)	23.8 (3.3)*
Body fat%	16.3 (4.1)	26.8 (6.0)*	32.6 (7.9)*†	17.1 (4.3)	29.4 (3.8)*	33.2 (5.2)*†	16.6 (4.2)	30.3 (6.8)*

Mean (standard deviation). Subjects = school samples. Patients = intervention volunteers. *P<0.05 cf normal weight, †P<0.05 cf subjects; Student's t-test.

each test. Children were verbally encouraged to produce maximal effort.

Statistical analysis

Data are given as the mean (standard deviation) and regarded as significantly different where $P<0.05$.

Anthropometric measurements, PSDQ scores, SMT scores and physical fitness were compared between normal and overweight children, also taking account of gender and of source of the overweight children. Anthropometric data were compared using Student's *t*-test. PSDQ and physical fitness scores were analysed by multivariate and 2-Way ANOVA as a function of weight (overweight cf normal weight), gender (boys cf girls), and source of referral ('subjects' sampled from the schools cf 'patients' already enrolled for intervention).

Associations between perceived and corresponding measured actual competences were tested using Pearson's correlation analysis, fitting ANCOVA models with the actual competences as the covariates. The effect size (the standardized difference between normal and overweight children) was measured by partial η^2 (Cohen, 1988). All analyses were performed using SPSS.

Results

Table 1 shows the characteristics of normal weight and overweight children. The age of the normal and overweight groups was similar, both for boys and for girls. BMI, weight and body fat were predictably greater in overweight than normal weight children, and also greater in the overweight children awaiting the intervention programme ('patients') than in those selected from schools ('subjects').

Self-perceptions of physical competences

Overweight children scored significantly differently from normal weight children in 10 of the 11 indices of self-perception given by the PSDQ, all the differences being in the negative direction except for their perceptions of health and strength (Table 2). Analysis by ANOVA showed no effect of gender or source of referral (except that self-perception of body fatness in 'patients' was greater than in 'subjects' consistent with greater BMI, body weight and fat in the 'patients'. Data from the overweight children could thus be compared with those from normal weight children, irrespective of gender and source of referral.

Actual physical competences

Eight physical fitness tests (representing four types of physical competence) were performed in overweight and in normal weight children to assess the extent to which the differences in self-perception of physical competences might be associated with corresponding actual differences. The results are shown in Table 3. Endurance, coordination, and flexibility were significantly poorer in the overweight than the normal weight children, whereas strength was better. The findings were thus in accord with the self-perceptions shown in Table 2.

Correlation of perceived and actual physical competences

Correlations achieved significance, albeit with low coefficients, between the four actual physical competences and their corresponding self-perceived competences in the total pool of normal and overweight children combined (Table 4). Correlations between actual and perceived competences also achieved significance in the overweight group and/or the normal weight group in respect of some of the competences. After allowing for differences in actual physical competences, however, self-perceived coordination and flexibility remained significantly poorer in overweight than normal weight children while endurance was also slightly but not significantly poorer (Table 5). Strength was correctly perceived to be no less in the overweight children. These

Table 2 PSDQ scores in normal weight and overweight children

	Normal N = *462*	*Overweight* N = *172*	*Overweight cf normal weight*		
			Difference	*95% CI*	
Health	4.54 (1.00)	4.74 (0.89)	0.18*	0.37	0.00
Appearance	3.48 (1.13)	3.06 (1.15)	−0.43*	−0.22	−0.64
Body fat	4.94 (1.15)	2.47 (1.26)	−2.51*	−2.29	−2.72
Level of physical activity	3.68 (1.15)	3.52 (1.07)	−0.15	0.06	−0.35
Sports competence	3.94 (1.29)	3.28 (1.27)	−0.68*	−0.45	−0.92
Strength	3.82 (1.05)	4.04 (0.98)	0.19*	0.38	0.00
Endurance	3.53 (1.16)	3.17 (1.15)	−0.38*	−0.17	−0.59
Coordination	4.31 (1.09)	3.77 (1.04)	−0.54*	−0.34	−0.74
Flexibility	4.39 (1.01)	3.89 (0.95)	−0.48*	−0.30	−0.67
General physical self-concept	4.27 (1.29)	3.36 (1.27)	−0.94*	−0.70	−1.18
Global self-esteem	4.25 (0.98)	4.03 (1.01)	−0.22*	−0.03	−0.40

The score represents a position on the range from 1 (minimal or no confidence) to 6 (high or complete confidence). Difference: score of overweight *minus* score of normal weight.
Data are presented as mean (standard deviation). *$P<0.05$ cf normal weight. Two-way ANOVA.

Table 3 Physical fitness in normal weight and overweight children

	Normal N = *313*	*Overweight* N = *153*	*Overweight cf normal*		
			Difference	*95% CI*	
Strength					
Handgrip (dominant hand) (kg)	14.32 (4.74)	16.78 (5.02)	2.62*	3.79	1.45
Handgrip (nondominant hand) (kg)	13.58 (4.53)	15.61 (4.61)	2.34*	3.43	1.24
Mean score of handgrip (kg)	13.95 (4.57)	16.20 (4.72)	2.48*	3.60	1.36
Endurance					
Sit-up (per min)	23.56 (10.50)	18.25 (8.79)	−5.16*	−2.82	−7.51
Dips (per min)	20.29 (10.85)	13.53 (11.02)	−7.36*	−4.76	−9.95
Squat (s)	84.27 (45.97)	64.63 (35.57)	−22.97*	−12.62	−33.31
Coordination					
Shuttle run (s)[a]	13.39 (1.49)	14.64 (1.93)	1.34*	1.71	0.97
Flexibility					
Sit & reach (cm)	26.70 (5.80)	25.60 (6.23)	−1.57*	−0.17	−2.98

Conventions as in Table 2.
[a]N.B. shorter time = better performance.

Table 4 Correlation coefficients (*r*) between perceived and corresponding actual competences

Perceived competence	*Corresponding actual competence*	*Normal weight* (n = *292*)	*Overweight* (n = *149*)	*Total*
Strength	Handgrip (dominant hand) (kg)	0.079	0.148	0.112*
	Handgrip (non-dominant hand) (kg)	0.065	0.154	0.103*
	Mean score of handgrip (kg)	0.073	0.154	0.109*
Endurance	Sit-up (per min)	0.048	0.194*	0.130*
	Dips (per min)	0.097	0.309*	0.187*
	Squat (sec)	0.157*	0.080	0.165*
Coordination	Shuttle run (s)	−0.117*	−0.209*	−0.221*
Flexibility	Sit and reach (cm)	0.176*	0.151	0.180*

*$P < 0.05$ cf normal weight. Pearson's correlation analysis.

Table 5 Comparison of perceived competence between normal and overweight children, after allowing for differences in actual competence

	Normal weight (n = *292*)	*Overweight* (n = *149*)	*Effect size*
Strength	3.82 (1.05)	4.04 (0.98)	0.001
Endurance	3.53 (1.16)	3.17 (1.15)	0.006
Coordination	4.31 (1.09)	3.77* (1.04)	0.030
Flexibility	4.39 (1.01)	3.89* (0.95)	0.063

Values are unadjusted mean PSDQ score (standard deviation).
*$P < 0.05$ cf normal weight. Effect size measured by partial η^2 obtained by fitting an analysis of covariance model with weight as fixed factors and measurements of actual competence as the covariates.

findings suggest that poor self-perceptions of physical competences are partly but not adequately explicable on the basis of poor actual physical competences.

Discussion

This study of overweight Chinese children was designed to address their self-perceptions of specific components of physical competence—as relevant to designing optimal exercise programmes to reduce the growing prevalence of childhood obesity. It is, to our knowledge, the first such study to assess specific domains of physical competences as distinct from the generalities of their self-perceptions, and the only study undertaken in Chinese children. Previous studies (Mendelson & White, 1985; Hill *et al*, 1994; French *et al*, 1995; Manus & Killeen, 1995; Braet *et al*, 1997; Pierce & Wardle, 1997; Phillips & Hill, 1998; Strauss, 2000; Israel & Ivanova, 2002) have focused on global self-esteem (with varying conclusions), bodily attractiveness, and general negativity of physical self perceptions, and have been conducted in children of Western nations.

The children in this study were of similar age and divided into normal and overweight groups by reference to age- and gender-specific BMI levels, a quarter of the overweight children being obese. The overweight children were drawn from two referral sources to increase their number, but ANOVA showed no relevant differences in their self-perceptions, justifying comparison of overweight with normal weight children irrespective of gender and source of referral.

The main finding of the study was that the overweight children had a significantly lower self-perception of their physical competences than normal weight children—specifically of their appearance, body fatness, sports competence, endurance, coordination, flexibility and general physical self-concept, as well as to a smaller extent, their global self-esteem, *without* feeling significantly disadvantaged in their general health, levels of physical activity or strength. Notably, they perceived themselves to be significantly stronger.

Measures of four categories of physical competence, corresponding to four self-perception PSDQ categories, showed that overweight children were indeed disadvantaged in endurance, coordination and flexibility but were significantly stronger. This suggests that there was some physical basis for their self-perceptions. Some associations between physical and perceived competences were indeed demonstrable but with low correlation coefficients. Moreover, perceived competence in coordination and flexibility remained significantly lower after normalization for their actual competence. This suggests that poor self-perceptions are only partly explicable on the basis of poor actual physical competences.

The finding that overweight children did not perceive themselves to be less healthy despite generally low self-perception of physical competences, suggests that impaired sports performance at this age does not extend to an awareness of its risks to long-term health, or of concurrent medical and psycho-social problems (Braet *et al*, 1997; Berenson *et al*, 1998; Dietz, 1998; Goran and Gower, 1999; Reilly *et al*, 2003). Many parents of overweight children do not perceive their children as being overweight (Baughcum *et al*, 2000) while others accept increased weight as healthily normal in their children—attitudes likely to influence their children's perceptions—and are ill-informed about the long-term risks of childhood obesity (Huxley, 2002). Such considerations emphasize the need for health education of parents and teachers as well as children.

Exercise has an important part to play in preventing and reducing excess weight which even in childhood is becoming a major health hazard. Children tend to avoid those physical activities for which they lack confidence in favour of other more successful activities (Ulrich, 1987). A notable finding of the present study was that poor self-perception of physical competences did not extend to strength. This suggests that motivation for overweight children to improve their body weight and image could be optimized by exercise programmes which emphasize strength training.

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