Predictors of the Psychosocial Health of Children and Adolescents With Obesity and Overweight: the Underappreciated Role of Physical Fitness

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Abstract

Background: Childhood and adolescent obesity impacts on various dimensions of psychosocial health, including health-related quality of life (HRQOL) and personal self-concept. Detecting inhibitory and promotive factors of psychosocial health could contribute to the development of more effective obesity management. In this context, the role of physical fitness among the predicting variables of psychosocial health has rarely been investigated.

Objective: To identify relevant predictors of weight-specific HRQOL and self-concept in the context of childhood and adolescent obesity.

Methods: The sample comprised cross-sectional data of 241 children and adolescents with obesity and overweight (12.5 ± 2.1 years; 51.9% girls) and their parents. Information on demographics and active/inactive lifestyle were assessed via parent report. Anthropometric data and physical fitness in relation to body weight (W/kg) were measured. Children and adolescents completed standardized questionnaires (GW-LQ-KJ, FSK-K) to assess HRQOL and five dimensions of self-concept (scholastic, social, physical, behavioral, and self-worth).

Results: Backward multivariable linear regression analysis showed that three subdomains of self-concept (physical, behavioral, self-worth) were negatively associated with increasing BMI Z-scores, age, physical activity (hours/week), low parental educational levels, or migration background. HRQOL, however, was only significantly related to relative physical fitness (W/kg; $\beta=8.02$, $P<0.05$) as were scholastic ($\beta=8.92$, $P<0.05$) and social self-concept (social $\beta=8.68$, $P<0.05$).

Conclusion: The results add physical fitness as a relevant predictor of HRQOL and self-concept of children and adolescents with obesity and overweight. Therapeutic and preventive weight management strategies should therefore consider physical fitness as an important additional outcome measure of psychosocial health.

Background

Childhood and adolescent obesity is a globally recognized public-health concern [1]. In addition to physical comorbidities, such as increased risk of developing metabolic syndrome, type 2 diabetes, cardiovascular diseases, sleep apnea, asthma, orthopedic complications, or increased rates of cancer, among others [2], a growing body of research has documented the psychosocial burden of overweight and obesity in affected children and adolescents. Psychosocial impairments, such as a negative self-perception or self-concept, poor self-esteem, stigmatization, social exclusion, bullying or depressive symptoms can result in a vicious circle of weight gain [3–7]. A negative self-concept has been found to mediate the relationship between BMI and health-related quality of life (HRQOL) [8], a multidimensional construct aggregating individuals' physical and psychological health, emotional state, and social functioning [3, 9]. In a review of HRQOL in children and adolescents with obesity, the authors concluded that scientific findings regarding the obesity-related impairment in all dimensions of HRQOL of children and youth were mostly congruent [10].

Consequently, in addition to weight reduction/stagnation and lifestyle counselling, improving psychosocial health, including HRQOL and self-concept, plays a central role in weight management programs [10]. To target preventive and therapeutic strategies accordingly, the identification of potential inhibitory and promotive factors for psychosocial health has become a research priority [4, 10, 11]. In this regard, evidence suggests that sex, age, socioeconomic status, and migration background not only affect the prevalence of obesity in children and adolescents but also their HRQOL [12–15]. Further key determinants of both weight status and psychosocial health are lifestyle patterns, such as level of physical activity, sedentary behavior, or screen-viewing activities [13, 16, 17]. An objective measure of physical activity levels and sedentary behavior is physical fitness [18]. Thus, prior research indicates that it is important to also include physical fitness into the analysis of psychosocial health [19, 20]. Studies with non-overweight children have yielded promising results in terms of psychosocial improvements associated with increased fitness [17, 21, 22]. Knowing that fitness is a mediator in the relationship between childhood and adolescent obesity and self-concept [23] and HRQOL [24, 25], supports the need to further investigate its role among the predictors of psychosocial health. Therefore, the aim of this cross-sectional analysis was to examine determinants of weight-specific HRQOL and subdomains of self-concept in the context of obesity in childhood and adolescence, while considering physical fitness as an additional potentially relevant predictor.

Methods

Sample Description

The data for this cross-sectional analysis came from the Children's Health InterventionaL TriaL (CHILT) III. CHILT III is an 11-months, family-based, multi-component program for obesity prevention and therapy. It was launched in 2003 at the German Sport University, Cologne. The target group were children and adolescents aged 8–16 years with obesity or overweight if displaying cardiovascular risk factors, such as arterial hypertension or hyperlipoproteinemia [26].

The minimum criteria for inclusion in this study were participation in the baseline CHILT III program between 2003 and 2020; complete height, weight, age, and body fat percentage data; and fully completed HRQOL and/or self-concept questionnaires. After excluding extreme values, a final data set of 241 children and adolescents (51.9% girls) and their parents (n = 459: 236 mothers, 223 fathers) remained (see Fig. 1).

Anthropometric Data

Standard calibrated scales and stadiometers were used to measure and weigh each child. Height and weight were measured with the child barefoot. Weight included clothing, such as light sportswear. Sex- and age-specific weight-for-height *Z*-scores (BMI ± SD) were calculated according to the German percentile graphs of Kromayer-Hauschild (2001) [27]. Children were then categorized as overweight (≥ 90 %) or obese (≥ 97th %). Body composition was determined by measuring skin-fold thickness to the nearest 0.2 mm in triplicate at the triceps (tric) and subscapula (subs) with a body fat caliper (Harpender Skinfold Caliper HSK-BI, British Indicators, West Sussex, England) following a standardized protocol [28]. The mean of the three measures was considered the final value. When tric + subsc was > 35mm (n = 230) the following sex- and age-specific

equations by Slaughter (1988) [29] were used to compute the body fat percentage, as these had also been used during previous studies on similar populations [30]:

Girls, %fat = 0.546 × (sum of tric and subs) + 9.7

Boys, %fat = 0.783 × (sum of tric and subs) − 1.7

When tric + subsc was ≤ 35mm (n = 11), Slaughter's fat-percentage equations were used, which can be found in Rodrígez et al (2005) [31].

Demographics and Lifestyle Patterns

At the beginning of the program, parents completed standardized questionnaires assessing demographics and lifestyle patterns of both themselves and their children. Demographic and lifestyle variables selected for inclusion in the study were children's sex, age, migration background, time spent in physical activity and on media consumption, and parent's educational background. Parents' educational background was dichotomized into two categories: "high," when both parents had completed secondary school (*Abitur/ Fachabitur*), and "low," when neither parent had an educational degree, a different other than secondary school, or only one parent had completed secondary school [32]. The migration background of the child was treated as a dichotomous variable assessed by the language spoken at home (German/non-German) [33].

Regarding the child's level of physical activity, parents were asked if and for how many minutes per week their child was physically active apart from time spent at school. Media consumption was assessed by asking parents to provide the total number of minutes spent by their child per day watching TV, playing a game console, using the computer/Internet, listening to music, and/or using their mobile phone. For this study, media consumption and physical activity were summed and transformed into continuous variables measured in hours per week.

Physical Fitness

Physical fitness was measured in peak mechanical power (PMP [W]) and peak oxygen consumption ($\dot{V}O_{2max}$ [mL/min], data not shown) using a bicycle ergometer (Ergoline Ergometrics 900) on which the children and adolescents exercised until exhaustion. Prior to testing, participants were familiarized with the test procedure and the bicycle ergometer was adjusted individually (height of seat and handlebar position). Testing began with a workload of 25 W and increased by 25 W every 2 minutes [26]. Throughout the testing session, the participant was verbally encouraged by staff to achieve maximal effort. Due to the comparably larger sample size, peak mechanical power (n = 238) was used as a proxy for physical fitness instead of $\dot{V}O_{2max}$ (n = 228). Test results were related to body weight as W/kg.

Health-Related Quality of Life

The weight-specific quality-of-life questionnaire for children and adolescents with overweight and obesity (Fragebogen zur gewichtsbezogenen Lebensqualität für übergewichtige und adipöse Kinder und Jugendliche [GW-LQ-KJ]) by Warschburger and Fromme (2004) [9] is a self-assessment tool specifically designed to assess the HRQOL of children and adolescents with obesity and overweight. In this study, we used version B

of the GW-LQ-KJ which consists of 11 items (eg, "Because of my weight, I was reluctant to go to the public swimming pool"). The children and adolescents were asked to evaluate the statements by estimating the frequency of occurrence in the last 2 weeks on a five-point Likert scale (ranging from "always" to "never"). The results were recoded so that high values indicated high HRQOL. A summed score was calculated and adjusted to be within a range of 0–100. Dividing the mean individual values by the number of completed questionnaires provided the relative mean. For reliability analysis, Cronbach's α was calculated. The internal consistency of the HRQOL score of the present sample (n = 226) was satisfying, with $\alpha = 0.82$.

Self-Concept

The FSK-K (Entwicklung eines Fragebogens zur Erfassung von Selbst — und Kompetenzeinschätzungen bei Kindern) is a German version of Harter's Self-Perception Profile for Children [34] and has been used in previous studies in the context of childhood obesity [35, 36]. It is a 30-item self-report to assess the multidimensional self-concept of children. Each item is scored on a scale of 1–4 in an alternative-statement format, with a positive statement on one side (eg, "I want to stay the way I am") and a negative statement on the other side (eg, "I would like to be someone else"). The child decided which side of the description was "sort of true" or "really true" for him/her.

The FSK-K integrates five scales for assessing perceived domain-specific self-concept: scholastic competence, social competence, physical appearance, behavioral conduct, and global self-worth. After recoding, the highest domain-specific competence was defined as a mean score of 100. Internal consistency of the domains of self-concept was $\alpha = 0.79$ for scholastic competence (n = 231), $\alpha = 0.82$ for social competence (n = 223), $\alpha = 0.76$ for physical appearance (n = 215), $\alpha = 0.77$ for behavioral conduct (n = 228), and $\alpha = 0.71$ for global self-worth (n = 215).

Statistical Analysis

Descriptive statistics for anthropometric data, demographics, lifestyle patterns, and physical fitness are provided. Continuous variables are shown as means ± standard deviation (SD), minimum (min), and maximum (max), and categorical variables as frequencies and percentages. The influence of the selected determinants on HRQOL and the dimensions of self-concept were explored by backward stepwise multivariable linear regression analysis, with $P > 0.05$ designating the removal of variables. Our dependent variables were the HRQOL scale and the scales of each of the five domains of self-concept. One model was used for each domain. Predictors included in the baseline model were age, sex, BMI *Z*-score, body fat (%), physical fitness (W/kg), physical activity (hours), media consumption (hours), migration background (German [yes/no]), and parental educational background (both with *Abitur* [yes/no]). A squared term for age was also included as a covariate given that the relationship between HRQOL/ (physical) self-concept and age is non-linear [5, 6]. Significance was set at $P < 0.05$. All analyses were performed using SPSS 27.0.

Results

The average BMI *Z*-score of the sample was 2.45 ± 0.46, with 212 participants classified as obese (88%) and 29 (12%) considered overweight. For a more detailed description of the sample characteristics, see Tables 1 and 2.

Table 1

Descriptive sample characteristics

Categoric variables	N	%
Sex		
Female	125	51.9
Male	116	48.1
Migration Background		
Yes/German	209	13.3
No/Non-German	32	86.7
Percentile		
Obese	212	88.0
Overweight	29	12.0
*Parent's Educational Degree**		
High	57	23.7
Low	184	76.3

*High, both parents have completed secondary school;

Low, only one parent/ neither mother nor father have completed secondary school

Table 2
Descriptive sample characteristics

Continuous variables	N	Mean (SD)	Min	Max
Physical variables				
Age (years)	241	12.5 (2.07)	7.3	17.1
Height (m)	241	1.58 (0.11)	1.23	1.89
Weight (kg)	241	76.7 (19.9)	37.4	148.4
BMI (kg/m^2)	241	30.9 (4.8)	20.5	56.6
BMI Z-score	241	2.45 (0.46)	1.43	3.80
Body fat (%)	241	42.1 (9.0)	26.1	83.2
Relative Physical fitness (W/kg)	238	1.7 (0.4)	0.9	3.3
Lifestyle variables				
Physical Activity (hours/week)	162	5.1 (4.1)	0	20.0
Media Consumption (hours/week)	190	17.2 (12.4)	0	59.5
Psychosocial variables				
HRQOL	232	77.7 (14.3)	29.1	100.0
Scholastic Competence	233	75.6 (16.7)	25.0	100.0
Social Competence	232	76.0 (18.6)	25.0	100.0
Physical Appearance	233	54.1 (15.6)	25.0	100.0
Behavioral Conduct	233	74.1 (16.4)	29.2	100.0
Global Self-Worth	233	72.3 (16.3)	25.0	100.0
HRQOL, Health-Related Quality of Life; SD, Standard Deviation; Min, Minimum; Max, Maximum; Psychosocial variables are based on scores ranging from 0 (lowest) to 100 (highest)				

Table 3 presents the six baseline multivariable linear regression models explaining HRQOL and the dimensions of self-concept, ie, scholastic competence, social competence, physical appearance, behavioral conduct, and global self-worth, adjusting for all independent variables. Table 4 summarizes the resulting final models after using backward stepwise multivariable regression analysis.

Table 3
Baseline Multivariable Linear Regression Models

Variables Coef ± s.e. (P-value)	HRQOL	Scholastic Competence°	Social Competence°	Physical Appearance°	Behavioral Conduct°	Global Self-Worth°
N	136	136	136	136	136	136
Age (years)	-3.755 ± 6.458 (0.562)	-5.039 ± 7.192 (0.485)	-4.942 ± 8.267 (0.551)	-0.8249 ± 6.834 (0.223)	-6.175 ± 0.7508 (0.412)	-12.603 ± 7.705 (0.104)
Age squared (years)	0.160 ± 0.264 (0.546)	0.157 ± 0.291 (0.590)	0.189 ± 0.335 (0.574)	0.247 ± 0.277 (0.327)	0.210 ± 0.304 (0.492)	0.448 ± 0.312 (0.153)
Female[a]	-4.300 ± 2.533 (0.092)	-2.779 ± 2.789 (0.321)	3.062 ± 3.205 (0.341)	-2.606 ± 2.650 (0.327)	-1.593 ± 2.911 (0.663)	-0.822 ± 2.987 (0.787)
BMI Z-score	-2.457 ± 3.585 (0.495)	0.590 ± 3.884 (0.880)	8.360 ± 4.465 (0.064)	**-10.031 ± 3.691 (0.008)**	4.845 ± 4.055 (0.234)	-4.678 ± 4.161 (0.263)
Body Fat (%)	-0.223 ± 0.159 (0.164)	-0.005 ± 0.176 (0.978)	-0.342 ± 0.202 (0.093)	-0.163 ± 0.167 (0.332)	-0.215 ± 0.184 (0.244)	-0.049 ± 0.188 (0.795)
High Parental Educational Level[b]	3.692 ± 2.906 (0.206)	**6.471 ± 3.098 (0.039)**	3.198 ± 3.561 (0.371)	0.031 ± 2.944 (0.992)	**6.814 ± 3.234 (0.037)**	**6.898 ± 3.319 (0.040)**
German/No Migration Background[c]	-3.170 ± 4.054 (0.436)	3.135 ± 4.373 (0.475)	-2.500 ± 5.027 (0.620)	-3.281 ± 4.155 (0.431)	8.332 ± 4.565 (0.070)	1.018 ± 4.685 (0.828)
Relative Physical Fitness (W/kg)	4.736 ± 3.750 (0.209)	7.769 ± 4.012 (0.055)	8.804 ± 4.612 (0.059)	-1.622 ± 3.812 (0.671)	5.485 ± 4.189 (0.193)	1.416 ± 4.298 (0.742)
Physical Activity (hours)	-0.309 ± 0.318 (0.334)	0.217 ± 0.341 (0.526)	0.278 ± 0.392 (0.479)	**-0.691 ± 0.324 (0.035)**	-0.156 ± 0.356 (0.663)	-0.192 ± 0.365 (0.601)
Media Consumption (hours)	-0.128 ± 0.103 (0.220)	0.012 ± 0.109 (0.910)	-0.171 ± 0.126 (0.177)	-0.146 ± 0.104 (0.164)	-0.120 ± 0.114 (0.297)	-0.028 ± 0.117 (0.811)

HRQOL, Health-Related Quality of Life; Coef, β-Regression Coefficient; s.e., Standard Error; Adj, Adjusted

°Subdomains of self-concept

Reference Categories: [a] Male, [b] low parental educational level (only one parent/neither mother nor father have Abitur), [c] Non-German

Variables Coef ± s.e. (P-value)	HRQOL	Scholastic Competence°	Social Competence°	Physical Appearance°	Behavioral Conduct°	Global Self-Worth°
R^2	**0.134 (0.045)**	0.114 (0.113)	0.103 (0.175)	**0.218 (< 0.001)**	0.122 (0.078)	0.114 (0.111)
Adj. R^2	**0.065 (0.045)**	0.043 (0.113)	0.031 (0.175)	**0.156 (< 0.001)**	0.052 (0.078)	0.043 (0.111)
HRQOL, Health-Related Quality of Life; Coef, β-Regression Coefficient; s.e., Standard Error; Adj, Adjusted						
°Subdomains of self-concept						
Reference Categories: [a] Male, [b] low parental educational level (only one parent/neither mother nor father have Abitur), [c] Non-German						

Table 4
Final Models from Backward Stepwise Multivariable Linear Regression Analysis*

Variables Coef ± s.e. (P-value)	HRQOL	Scholastic Competence°	Social Competence°	Physical Appearance°	Behavioral Conduct°	Global Self-Worth°
N	136	136	136	136	136	136
Age (years)				**-0.245 ± 0.641 (0.001)**		**-1.599 ± 0.719 (0.028)**
Age squared (years)						
Female[a]						
BMI Z-score				**-11.557 ± 2.726 (< 0.001)**		
Body Fat (%)						
High Parental Educational Level[b]					**7.165 ± 2.942 (0.016)**	**8.034 ± 3.005 (0.008)**
German/No Migration Background[c]					**8.983 ± 4.442 (0.045)**	
Relative Physical Fitness (W/kg)	**8.024 ± 3.128 (0.011)**	**8.916 ± 3.289 (0.008)**	**8.678 ± 3.786 (0.023)**			
Physical Activity (hours)				**-0.623 ± 0.301 (0.040)**		
Media Consumption (hours)						
R^2	**0.047 (0.011)**	**0.052 (0.008)**	**0.038 (0.023)**	**0.190 (< 0.001)**	**0.071 (0.008)**	**0.077 (0.005)**

*After excluding all insignificant variables. Significance was set at P < 0.05

HRQOL, Health-Related Quality of Life; Coef, β-Regression Coefficient; s.e., Standard Error; Adj, Adjusted

°Subdomains of self-concept

Reference Categories: [a] Male, [b] low parental educational level (only one/neither mother nor father have Abitur), [c] Non-German

Variables Coef ± s.e. (P-value)	HRQOL	Scholastic Competence°	Social Competence°	Physical Appearance°	Behavioral Conduct°	Global Self-Worth°
Adj. R^2	0.040 (0.011)	0.045 (0.008)	0.031 (0.023)	0.171 (< 0.001)	0.057 (0.008)	0.063 (0.005)
*After excluding all insignificant variables. Significance was set at P < 0.05						
HRQOL, Health-Related Quality of Life; Coef, β-Regression Coefficient; s.e., Standard Error; Adj, Adjusted						
°Subdomains of self-concept						
Reference Categories: [a] Male, [b] low parental educational level (only one/neither mother nor father have Abitur), [c] Non-German						

After all other factors had been accounted for in the final models explaining HRQOL, scholastic competence, and social competence, relative physical fitness remained the only significant predictor. Participants with high levels of relative physical fitness (W/kg) showed higher HRQOL (β = 8.024 ± 3.1283, P = 0.011; R2 = 0.040, P = 0.011) and perceived scholastic (β = 8.9162 ± 3.289, P = 0.008; R2 = 0.045, P = 0.008) and social competence (β = 8.6878 ± 3.7986, P = 0.023; R2 = 0.031, P = 0.023). While relative physical fitness explained approximately 3.1–4.75% of total variability in each of the first three models, it showed no significant association with the other domains of self-concept.

BMI *Z*-score, demographic variables, and lifestyle variables, were not significant predictors of HRQOL or social and scholastic competence. We found BMI *Z*-score and physical activity to be significantly associated with only one of the dependent variables investigated. More precisely, BMI *Z*-score (β=−11.557 ± 2.726, P< 0.001) and self-reported physical activity (β=−0.623 ± 0.301, P = 0.040) significantly predicted physical appearance. Jointly with age (β=−0.245 ± 0.641, P = 0.001), the three predictors accounted for approximately 17% of the total variability in the final physical appearance model (R^2 = 0.171, P< 0.001), which showed no further significant associations with the other observed predictors.

Concerning the first four regression models, predictors of parental educational background and migration background were not significant. In the fifth model explaining behavioral conduct, however, parents' educational background (β = 7.165 ± 2.942, P = 0.016) and migration background (β = 8.983 ± 4.442, P = 0.045) explained a significant proportion of variance (R^2 = 0.057, P = 0.008), indicating that children and adolescents with obesity and overweight who have a migration background or whose parents had comparatively low education assessed their behavioral conduct as worse than their German counterparts. Higher parental education was also positively associated with global self-worth (β = 8.034 ± 3.005, P = 0.008), and together with age (β=−1.599 ± 0.719, P = 0.028) accounted for approximately 6% of total variability in the final global self-worth model (R^2 = 0.063, P = 0.005). We were unable to find further significant predictors in the behavioral conduct and global self-worth models. Sex, body fat, age squared and media consumption were not significant predictors in any of the final regression models.

Discussion

Main Findings

In the context of weight loss and weight management of children and adolescents with obesity, psychosocial aspects such as HRQOL and self-concept play a crucial role [4, 10]. Thus, a comprehensive understanding of the dynamics between weight and determinants of psychosocial health and their possible influencing factors is a key step toward improving obesity prevention and care. In line with the literature, especially perceived physical appearance was inversely related to obesity and physical activity [4]. Additionally, the results demonstrate a negative association between subdomains of self-concept, migration background and low parental education in the context of childhood and adolescent obesity. Lastly, our results revealed that relative physical fitness was a major determinant of HRQOL and perceived social and scholastic competence.

Role of Demographic Variables Underlying the Relationship between Weight Status and Psychosocial Health

Consistently with the literature, we identified the physical self-concept to be significantly associated to BMI *Z*-scores [14, 35]. The higher the *Z*-score, the more dissatisfied participants were with their physical appearance. Many studies have concluded that girls with overweight or obesity are especially susceptible to body dissatisfaction [5, 7, 37], however, other studies have not yielded results containing differences between the sexes [38, 39]. While we did not find differences related to sex between any dimension of self-concept or HRQOL, we did find age to be a significant predictor in our study. These results are not surprising when considered in the context of the effects of puberty. Pubescent individuals are particularly vulnerable to low self-esteem and negative body image [5, 6, 37]. Our findings support those of earlier research, which suggested that addressing body image should be included in obesity-treatment agendas to improve patients' psychosocial well-being, particularly in adolescence [40].

Migration background and low socioeconomic status have also been identified as key determinants of obesity and are also associated with determinants of psychosocial health [12, 15, 33, 41, 42]. We found an adverse association between self-concept, migration background and parental educational degree in our sample of children and adolescents with obesity and overweight. This supports the relevance of interventions at an early stage in childhood to address children who — due to their familial background — are particularly at risk of developing obesity and psychosocial impairments [42–44]. Considering the observed age effect, the need for early action is especially evident. The strong influence of familial background and behavior-specific family variables (e.g. lifestyle patterns and nutrition) in the context of both obesity and the subdomains of self-concept underpin the need for parental involvement in intervention strategies [45, 46].

The Association between Physical Fitness, Physical Activity, Media Consumption and Psychosocial Health

Our results confirm and reemphasize previous findings on the positive association between physical fitness and HRQOL in childhood [20, 22], adolescence [21, 24, 47, 48], and in the context of childhood and adolescent obesity [24]. In the present analysis, we furthermore found relative physical fitness to be the strongest and only remaining determinant of two domains of self-concept: perceived scholastic and social competence.

It is important to note that objectively measured fitness played a greater role for the selected markers of psychosocial health than subjectively measured physical activity or self-reported media consumption in our sample. In comparison to relative physical fitness, self-reported media consumption was not significant and physical activity was negatively associated solely to perceived physical appearance. These results were not consistent with previous studies [16, 17, 49]. The negative relationship between physical activity and appearance may be explained by the fact that engaging in physical activity may reveal fundamental movement-skill difficulties compared to nonoverweight peers, leading to an impairment of physical self-concept [50]. Therefore, our findings indicate that interventions which — in addition to physical fitness improvements — focus on the motor skills of children and adolescents with obesity and overweight may be crucial [50, 51].

In weight management programs, most participating families focus on weight loss as the key determinant of program success [48]. Lifestyle changes and psychosocial health outcomes, however, should be regarded as equally important outcome measures – especially when considering the underlying causal relationships [9, 10, 34]. Our results demonstrate that physical fitness is an important factor in this relationship between physical and psychosocial health. Several studies have underlined the importance of physical fitness in therapy programs as an essential strategy, not only for weight loss but also for enhancing the emotional, physical, and social domains of HRQOL of children and adolescents with obesity [17, 19, 23, 49]. Because physical fitness is associated to both physical and psychosocial dimensions, a focus on improving fitness could lead to more sustainable therapy outcomes than short-term weight loss.

Strengths And Limitations

The primary limitation of our study is the cross-sectional design, which does not allow any conclusions to be drawn regarding the causal direction of the relationship between the observed variables. Furthermore, several obesity-relevant factors were not included in our study due to incomplete data such as dietary habits, type of school, single parenting, and parents' BMI. As such, there may be additional factors that could confound the association between the independent variables. Selection bias, information bias and social desirability bias, ie self-reports on physical activity and media consumption, are further limitations. As a treatment-seeking population, the participants potentially shared characteristics, such as motivation, that distinguished them from other groups. Besides, as some data were self-reported, the study is not free from information bias.

Despite these limitations, a major strength of our study is that physical fitness, body height, weight, and fat percentage were objectively measured by trained staff according to standardized methods. In addition to the large sample and the number of determinants analyzed, a further strength is the utilization of a weight-specific HRQOL-measurement tool that has been shown to have good psychometric properties.

Conclusion And Implications

This study identifies physical fitness as a key predictor of weight specific HRQOL and subdomains of self-concept in the context of childhood and adolescent obesity. The findings suggest that improvements in physical fitness may hold even more promise for positive psychosocial health outcomes in obesity treatment

and prevention programs than weight loss or participation in physical activity alone. Future longitudinal studies are required to investigate the robustness and causality of our findings.

Abbreviations

HRQOL Health-related Quality of Life

Declarations

Ethics approval

Ethics approval was granted by the Sports University of Cologne for the ethic request with the number 107/2014 (“Children’s Health InterventionaL Trial III – ein ambulantes Schulungsprorgamm zur Pravention und Therapie von Ubergewicht und Adipositas im Kindes- und Jugendalter”). It is provided as supplementary material.

Consent for Publication

All CHILT III participants and their parents were informed that their aggregated data would be anonymized and used for analysis and publication. Consent was provided by the participants’ parents.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors’ Contributions

NE analyzed the data and wrote the manuscript. CJ supervised the analysis, provided methodological guidance, and revised the manuscript. DF, MK, and FH (who work as sports scientists in the program) and LS and SV (who are responsible for the areas of nutrition and psychology in the program) conducted the medical tests and gathered the data. CJ is the leader of the CHILT III program and created the study design. All authors reviewed and approved the final version of the manuscript.

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Figures

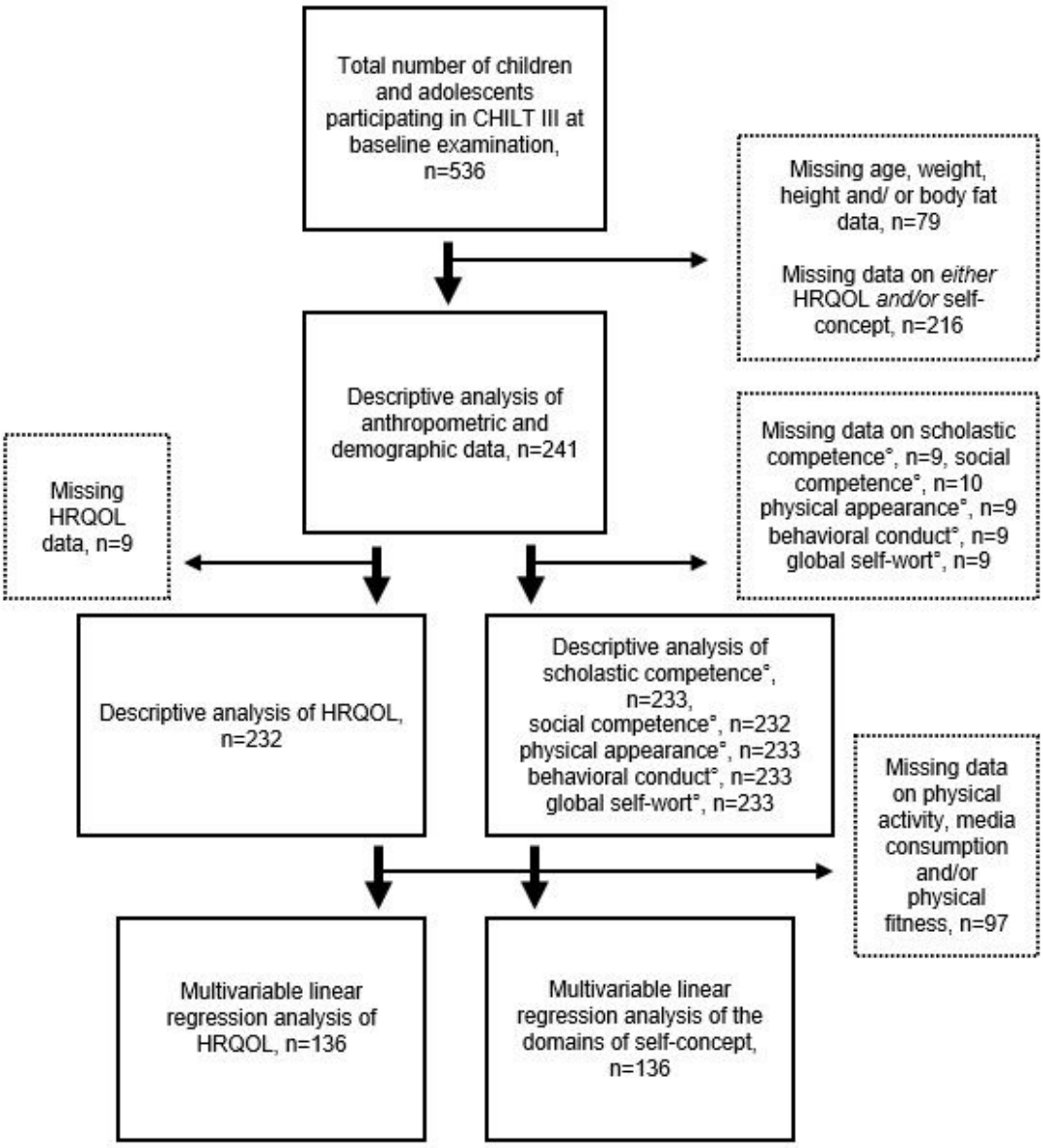

Figure 1

Flow Chart of Number of Participants in the Study HRQOL, Health-Related Quality of Life; CHILT, CHildren's InterventionaL Trial °subdomains of self-concept

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