



# Health-Related Quality of Life and Physical Activity in Children and Adolescents 2 Years after an Inpatient Weight-Loss Program

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**Objectives** To investigate changes in health-related quality of life (HRQOL), body mass index (BMI), physical activity, and sedentary behavior at 24 months after an inpatient weight-loss program and to examine correlations between changes in HRQOL and BMI or physical activity.

**Study design** This prospective study included 707 overweight and obese individuals (mean age, 14 ± 2 years; 57% girls) participating in a 4- to 6-week inpatient weight-loss program, 381 of whom completed a 24-month follow-up. HRQOL, physical activity, sedentary behavior, and BMI were assessed at baseline, at discharge, and at 6, 12, and 24 months after starting therapy. Longitudinal analyses were conducted using repeated-measures mixed models, adjusted for age, sex, and baseline outcome and accounting for attrition over time.

**Results** All variables improved over treatment and 6-month follow-up ( $P < .05$ ). At 24 months, overall HRQOL indicated improvements relative to baseline (3 points on a scale of 0-100; 95% CI, 1.68-4.47;  $P < .001$ ). Of the 6 HRQOL domains, the greatest improvement was observed for self-esteem (11 points; 95% CI, 8.40-13.14;  $P < .001$ ). BMI was 0.5 kg/m<sup>2</sup> lower than at baseline (95% CI, -0.92 to -0.02;  $P = .04$ ). Long-term changes in physical activity explained 30% of the variation in overall HRQOL ( $P = .01$ ), and change in BMI was not associated with a change in HRQOL.

**Conclusions** This inpatient weight-loss program was associated with positive changes in HRQOL over the long term, with particular improvements in self-esteem. The results indicate the potential role of physical activity in improving HRQOL without a substantial change in body composition. (*J Pediatr* 2014;165:732-7).

The prevalence of pediatric obesity has increased worldwide. Along with having a greater risk of cardiovascular disease,<sup>1</sup> obese children and adolescents often have impaired health-related quality of life (HRQOL),<sup>2-4</sup> comparable with that of youths diagnosed with cancer.<sup>2</sup> This seems to especially affect individuals who have been referred to or seek clinical treatment.<sup>5,6</sup>

HRQOL is an important indicator of an individual's own experience of his or her chronic condition, as well as overall psychosocial health and function. Thus, the assessment of HRQOL as a multidimensional construct including physical well-being, emotional well-being, social interactions, and performance in daily life is an essential criterion for the evaluation of pediatric obesity treatment strategies.<sup>7</sup> Previous studies have indicated that inpatient weight-loss programs induce short- and medium-term improvements in HRQOL in children and adolescents.<sup>8-13</sup> However, there are no studies investigating the effects of pediatric inpatient weight-loss programs on HRQOL for more than 1 year after therapy.

Although the negative relationship between body weight and HRQOL is well known, less is known about the other factors that can influence HRQOL in obese children over the long term.<sup>4</sup> One potential contributor to this relationship may be the level of physical activity, which has been shown to improve HRQOL in a dose-dependent manner in overweight and obese adults independent of weight changes.<sup>14</sup> Furthermore, physical activity has been suggested to positively affect HRQOL and psychosocial variables in normal weight<sup>15-18</sup> and overweight/obese children and adolescents.<sup>19</sup>

The aims of the present study were to investigate changes in HRQOL, body mass index (BMI), physical activity level, and sedentary behavior over the course of 24 months after completion of a 4- to 6-week inpatient weight-loss program and to explore the influence of both changes in physical activity level and BMI on HRQOL 24 months after program completion.

BMI	Body mass index
HRQOL	Health-related quality of life
LOGIC	Long-Term Effects of a Lifestyle Intervention in Obesity and Genetic Influence in Children
V	Visit

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## Methods

Participants in the prospective Long-Term Effects of a Lifestyle Intervention in Obesity and Genetic Influence in Children (LOGIC) trial were overweight and obese 7- to 20-year-olds who were consecutively referred to the Schoensicht rehabilitation clinic in Berchtesgaden, Germany for inpatient weight-loss treatment between 2006 and 2009. Exclusion criteria for the LOGIC trial were secondary obesity, monogenetic diseases such as Prader-Willi syndrome, and early withdrawal from the inpatient program (<3 weeks). Participants came to the clinic every 2 weeks and were recruited monthly.

All children and adolescents and their parents provided written informed consent for study participation. The study was conducted according to the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Medicine, Technische Universitaet Muenchen, Munich, Germany (1354/05).

The weight-loss program and follow-up procedures have been described in detail previously.<sup>20</sup> In brief, the standardized nonpharmacologic weight-loss program was conducted for 4-6 weeks, depending on health insurance allowances and the severity of obesity. Children were assigned to 1 of 4 treatment groups differing by sex and age (<15 or ≥15 years) or developmental stage and consisting of approximately 8-12 participants. The program focused on a calorie-restricted diet, adequate physical activity, and behavior therapy and was conducted according to German guidelines for inpatient weight-loss programs.<sup>21</sup> Energy intake was limited to 1200-1800 kcal per day, depending on height and sex including 30% total energy from fat, 15% from proteins, and 55% from carbohydrates. The exercise therapy consisted of approximately 10 hours of supervised physical activity per week (ie, ball games, swimming, hiking, and strength and posture training) in addition to 6 hours of recreational exercise. The children received theoretical and practical lessons on healthy eating, physical activity, and behavior change skills based on cognitive behavioral theory. These lessons were intended to support the children's adherence to physical activity recommendations after returning home. In addition, therapists and physicians recommended participation in organized physical activity (eg, sports clubs) after the children returned home.

Before the first follow-up examination (6 months after the start of the program), study investigators contacted the children's general practitioners to inform them of the study procedures and to obtain agreement on carrying out the upcoming follow-up examinations using a standardized examination sheet. In addition, before each visit, participants were contacted to remind them of the upcoming examination and to enquire about possible changes of address. They were requested to complete and return a questionnaire (sent by mail) and to visit their general practitioners. To maximize compliance, the families were contacted regularly.

All measurements were conducted at the start (visit [V] 1; V1) and the end (V2) of the inpatient weight-loss program in

the clinic by trained medical staff and at 6 months (V3), 12 months (V4), and 24 months (V5) after the start of the program by the children's general practitioners, according to standardized procedures. In the clinic (V1 and V2), height was measured with the children in underwear to the nearest 0.5 cm using a rigid stadiometer, and weight was measured to the nearest 0.1 kg using a digital scale (Tanita BC-420 P MA Profi; Tanita Europe, Amsterdam, The Netherlands). For the subsequent assessments of height and weight (V3-V5), the general practitioners followed standardized measurement procedures.

BMI was calculated as body weight in kilograms divided by the square of body height in meters. Based on age- and sex-specific cutoffs by the International Obesity Task Force, participants were classified as normal weight (percentiles corresponding to BMI >18.5-25 kg/m<sup>2</sup> at age 18 years), overweight (percentiles corresponding to BMI ≥25-30 kg/m<sup>2</sup> at age 18), moderately obese (percentiles corresponding to BMI ≥30-35 kg/m<sup>2</sup> at age 18), or severely obese (percentiles corresponding to BMI ≥35 kg/m<sup>2</sup> at age 18).<sup>22,23</sup> In addition, BMI was transformed into a BMI-SDS according to formulas developed by Cole and coworkers using national reference values.<sup>24,25</sup>

Questionnaires were administered to the children by clinic staff (V1 and V2) or mailed to their homes (V3-V5). The German KINDL questionnaire<sup>7</sup> was used to assess HRQOL in 6 domains: physical well-being, emotional well-being, self-esteem, friends, family, and school. An overall HRQOL was obtained by calculating the average of the domain scores. Potential scores for all domains range from 0-100, with higher values representing better HRQOL. The reliability and validity of this questionnaire have proven sufficient, with a Cronbach  $\alpha > 0.70$  and a correlation coefficient of  $r = 0.70$  obtained with instruments measuring similar concepts in previous research.<sup>7</sup> The level of physical activity was assessed by self-report questionnaire using the question: "On how many days last week have you been active for at least 60 minutes?" with possible scores ranging from 0-7 days. This question has been previously validated for use in young people and been shown to be reliable (intraclass correlation 0.77) and correlated with accelerometer data ( $r = 0.40$ ).<sup>26</sup> In addition, children were asked whether they were currently a member of a sports club. To assess sedentary behavior, the 3 questions with 2 subdomains were asked: "How many hours do you engage in (1) watching television, (2) using the computer, and (3) doing homework on (1a) weekdays and on (1b) weekend days?" Participants chose from 0.5, 1, 2, 3, 4, or >5 hours. The average weekly time (hours) spent in each behavior as well as total weekly sedentary time is reported here.

### Statistical Analyses

Descriptive statistics were used to summarize both demographics and study outcomes measured at each visit. Longitudinal data analyses were performed using repeated measures mixed models to evaluate changes in HRQOL,

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