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A multicomponent, school-initiated obesity intervention to promote healthy lifestyles in children

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ABSTRACT

Objectives: In the context of a 6-mo obesity program, incorporating school- and family-based components, nutritional education, fun-type skill-learning physical activities, and exercise training, this study examined relationships among changes in nutritional status, physical fitness, and some psychosocial and behavioral treatment-related outcomes, using a before and after comparison.

Methods: Eighteen obese and overweight children ages 10 to 12 y were assessed with respect to body weight, height, circumferences, skinfold thickness, and fat mass. Health-related fitness tests, and self-reported physical activity enjoyment and perceived physical ability also were administered. Health-related quality of life (HRQoL) was evaluated using the Pediatric Quality of Life Inventory; dietary habits were collected using a 7-d food diary. The WinFood software was used for the estimation of nutrient and caloric intake.

Results: After treatment, children showed decreases in body mass index *z*-score ($P = 0.001$), body fat percentage ($P < 0.001$), arm ($P = 0.003$) and waist circumferences ($P = 0.004$), and skinfold thickness ($P < 0.008$). Actual ($P < 0.001$) and perceived ($P < 0.03$) physical abilities, physical activity enjoyment ($P = 0.03$), and psychosocial HRQoL ($P < 0.05$) also improved from pre- to postintervention. Participants reported reductions in total and commercial food caloric intakes ($P < 0.001$), with higher protein and lower fat consumptions ($P < 0.001$) after the program.

Conclusions: The findings from the present study highlight the importance of combined dietary–behavioral–physical activity interventions in overweight children, and place emphasis on directing such interventions toward improving perceived physical competence that could lead to increased exercise adherence and promotion of the health benefits associated with it.

Introduction

Obesity in children is a global issue related to physical and psychosocial health consequences, affecting their quality of life [1]. Health-related quality of life (HRQoL) is a multidimensional construct that encompasses physical, mental, and social functioning and reflects individuals' perceptions of enjoyment, fitness, life satisfaction, and well-being [2]. Existing reviews report an inverse relationship between body mass index (BMI) and HRQoL, and significant improvements in HRQoL with weight loss [1,3–5]. In particular, increasing weight status has a detrimental effect on actual and perceived physical competence (i.e., the individual's perception of physical condition, sport, and strength competence), mainly due to functional impairments, including deficits in motor performance of weight-bearing tasks [1,3,4].

Cross-sectional studies have previously demonstrated that improved actual motor skill competence is associated with decreased BMI [6] and increased physical fitness [7] and is related to higher perceived physical competence [8], which has been shown to predict enjoyment of [9] and participation in [10] physical activity (PA). Unfortunately, there is a paucity of experimental or longitudinal research examining these specific obesity-related factors and their contribution to physical and psychosocial difficulties of obese children [1,3,11].

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Different theories of motivation and behavioral change that have been applied to understanding PA participation highlight enjoyment as a key focus for interventions aimed at encouraging healthy lifestyle habits and enhancing individuals' QoL [12,13]. Enhancing intrinsic motivation through PA enjoyment could increase exercise adherence and promote the health benefits associated with it [14]. This issue is particularly important for obese children who typically have negative attitudes toward PA and consequently fewer movement opportunities to improve their actual and perceived physical competence [11]. Although there is extensive literature on psychological benefits of increased PA [15,16], little is known about the effect of obesity interventions on psychosocial determinants of activity behavior [17]. Furthermore, most of the programs have focused on changes in both diet and PA [18], but conflicting results have been reported concerning the relation of psychosocial changes with weight reduction [3], and the effects of multimodal treatments on the psychological domain of HRQoL in pediatric obesity [19].

To improve HRQoL of obese children, there is an urgent need to adopt a comprehensive, multilevel approach for the evaluation over time of the specific factors associated with their reduced physical and psychosocial functioning [1]. Therefore, in the context of a 6-mo, multicomponent, school-initiated obesity program focused on educational and behavioral interventions, the study was designed to examine relationships among treatment-related outcomes—changes in body composition, physical fitness, and some psychosocial and behavioral self-report measures (i.e., HRQoL, perceived physical ability, enjoyment of PA, and dietary habits)—and to analyze sex differences using a before and after comparison.

Materials and methods

Participants

Eighteen obese and overweight children (9 boys and 9 girls, ages 11.3 ± 0.4 y) were recruited from a larger sample (N = 95) through an urban middle school (Parisi-De Sanctis, Foggia, Italy) located in a low socioeconomic status area in Puglia, one of the regions in southern Italy most affected by the prevalence of childhood obesity [20]. Participants (ages 10–12 y) who attended the outpatient clinic of the Centre for Pediatric Obesity at the University of Foggia, Italy, satisfied the following inclusion criteria:

- BMI ≥85th percentile for age and sex according to the Centers for Disease Control and Prevention (CDC) growth reference [21];
- No medical problems that would limit PA; and
- Not currently involved in organized exercise programs outside the school.

Informed, written consent was obtained from all parents or guardians before participation. The Parisi-De Sanctis Institute consented to the intervention components being incorporated into the school curriculum. The study was performed according to the Declaration of Helsinki and approved by the University of Foggia and the local School Council Institute (03-2015/1227/B32 c).

The Healthy Lifestyles Intervention for Obese Schoolchildren program

After admission to the hospital outpatient clinic of the Centre for Pediatric Obesity at the local university, participants followed a 6-mo, school-initiated obesity treatment program. The Healthy Lifestyles Intervention for Obese Schoolchildren (HeLIOS) program incorporated school- and family-based components, nutritional education, structured fun-type skill-learning PAs, and exercise training.

The exercise program was conducted by a single specialist instructor at the school gymnasium, and included two 2-hr sessions per week of indoor and outdoor activities (i.e., mini and sport games, circuits, individual tasks) based on health-related fitness components (i.e., muscle strength, speed, agility, aerobic fitness, flexibility, motor skill). These activities were selected to increase enjoyment of movement and adapted to enable participants to experience success in their performance.

Additionally, children were encouraged to be active during free time and invited to keep a 1-wk activity diary for self-monitoring adherence to the recommended lifestyle changes. PA diaries were reviewed during behavioral skills training sessions (30-min/wk in group format), which were provided to participants to educate them about the importance of regular PA. Training objectives also included discussion of appropriate goals, recruiting social support, and promoting awareness of the benefits of PA and fitness. Drawing on Italian dietary guidelines and suggestions recommending the reduction of salt, sugar, and fat levels [22,23], children were instructed to eat the appropriate amount of each type of food by teaching them to identify low-calorie, high-nutritional-value foods. Therefore, healthy eating behaviors (e.g., regular meal distribution; reduced consumption of low-quality, high-energy, salt-rich foods and sugar-sweetened beverages; and increased overall fruit and vegetable intake) were discussed and encouraged as part of the intervention at the baseline medical examination and with three individualized nutritional counseling sessions conducted during and at the end of the program by the same experienced dietitian. In particular, when children were admitted to the hospital outpatient clinic, parents received practical advice and specific written instructions in the form of a booklet [24] and were instructed on how to complete a 7-d food diary to record details (i.e., type, amount, portion size) of everything their children consumed at and between meals for 1 wk. Parents also were encouraged to monitor completion of the activity diary and to support the children's efforts by stimulating them to be physically active outside of the program through access to and use of green spaces, ride parks, walking paths, biking trails, and outdoor rinks.

Participants were assessed at baseline (T1) and at the end (T2) of the program. Further details of the treatment program have been reported elsewhere [25,26].

Anthropometrics

Children were measured without shoes and the minimum clothes to the nearest 0.1 cm (Seca 220, Hamburg, Germany) and weighed to the nearest 0.1 kg (Seca 761, Hamburg, Germany) by a highly experienced hospital pediatrician. BMI was calculated as weight divided by height squared (kg/m^2); BMI centiles and *z*-scores were derived according to the CDC growth charts [21]. Waist, hip, and arm circumferences were measured to the nearest 0.1 cm using a flexible nylon tape measure. Skinfold thickness was determined to the nearest 0.1 mm in triplicate at the biceps, triceps, subscapular, and suprailiac sites with a skinfold caliper (Holtain Ltd, Crymych, UK). The mean of the three measures was considered as the final value. The Brook's equation was used to assess total body density from skinfold thickness [27]. The total body density was then converted into the percentage of fat body mass via Siri's equation [28].

Physical fitness evaluation

Health-related physical fitness was assessed using the following Eurofit and Fitnessgram tests, which were accepted as reliable and valid measures in childhood and adolescence [29–31]:

- The standing long jump was used to evaluate the power of lower limbs, requiring participants to jump as far as possible from a standing position. The test was performed twice and the longest distance jumped was reported.
- The medicine ball throw was used to assess the power of upper limbs, requiring children to perform a two-handed overhead throw with a 1 kg medicine ball from a standing position with both feet together. The highest value of two performance measures was scored.
- The agility test (4 × 10 m) evaluated speed of movement, agility, and coordination. Participants were instructed to run back and forth four times along a 10-m distance at the highest speed possible. The test was performed twice and the best performance was used for statistical analyses.
- The 10-m sprint assessed speed and anaerobic power, requiring children to cover the distance of 10 m as fast as possible. Participants were allowed two trials and the lowest sprint value was recorded.
- The trunk lift measured trunk extensor strength and flexibility. Children were instructed to lift the upper body off the floor and hold the position to allow for the measurement from chin to the ground. The highest score of two performance measures was scored.
- The sit-up test assessed abdominal muscular endurance, requiring participants to achieve the maximum number of sit ups in 30 s. The number of successful repetitions was recorded.

Evaluation of perceived physical ability and PA enjoyment

Individuals' perceptions of strength, speed, and agility were evaluated using the Perceived Physical Ability Scale for Children [32], which is composed of six items structured in statements on a 1- to 4-point scale. Participants are asked to