



Effect of water- versus land-based exercise training as a component of a multidisciplinary intervention program for overweight and obese adolescents

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HIGHLIGHTS

- Water- and land-based exercises led to similar improvements after the intervention.
- Land-based group dropped out more for demotivation and preference for other activities.
- Only land-based exercise intervention group improved social dimension of HRQoL.

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ABSTRACT

To compare water- versus land-based exercise programs, as part of a multidisciplinary intervention, on physical fitness and health-related quality of life in overweight and obese adolescents. A total of 151 overweight and obese adolescents (age: 13.2 ± 1.8 years) were divided into: 1) a water-based intervention (WB; $n = 28$); 2) a land-based intervention (LB; $n = 57$); and 3) a control group (CG; $n = 66$). Anthropometric measures, body composition, flexibility, abdominal strength/endurance, cardiorespiratory fitness and health-related quality of life were assessed prior and by the end of a 16-week intervention. Both the water- and land-based interventions were part of a multidisciplinary program focusing on behavioral changes. Fat Mass (%) was significantly reduced in both intervention groups and a higher progression was observed in the WB group ($-9.8 \pm 7.2\%$ versus $-6.1 \pm 6.2\%$; $p < 0.05$ for pre-to-post changes within-groups). However, LB increased more abdominal strength than WB ($69.6 \pm 165.8\%$ versus $53.4 \pm 83.4\%$; $p < 0.05$) and significantly increased social ($19.7 \pm 88.8\%$), psychosocial ($5.1 \pm 15.1\%$) and total score ($6.3 \pm 14.8\%$), which was observed in neither WB nor CG. The intervention groups did not change body weight (WB: $-1.7 \pm 5.3\%$; LB: $0.1 \pm 3.4\%$; $p > 0.05$ for both groups) and increased ($p < 0.05$) fat-free mass (WB: $4.6 \pm 4.0\%$; LB: $4.4 \pm 4.1\%$), $VO_{2\max}$ (WB: $9.3 \pm 7.8\%$; LB: $11.0 \pm 13.4\%$), and physical dimension of quality of life (WB: $9.2 \pm 17.2\%$; LB: $8.9 \pm 18.0\%$) differently of what was observed in CG. The physical dimension improvement observed in the land-based and water-based samples was associated with decreased percentage fat mass ($r = 0.282$ and 0.229 ; $p < 0.05$). We suggest water- and land-based physical exercises within a multidisciplinary program promote similar improvements in body composition, physical fitness and health-related quality of life in overweight and obese adolescents.

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1. Introduction

Obesity has reached alarming rates all over the world, which underlines the need for new and effective treatment strategies [1–3]. Pediatric obesity has been associated with several metabolic, physical, and psychosocial disorders, such as reduced health-related quality of life and impaired physical fitness [4,5]. Obesity interventions have to face this

multifactorial dimension of the disease and, therefore must rest on multidisciplinary approaches (e.g., psychological, dietetic, social and physical) [6–8], where physical activity plays a central role [9].

Many researches have been discussing the effects of physical activity interventions varying in duration, intensity or modality on obese youth's body composition, physical fitness and overall health. Moderate-intensity aerobic training has been recommended among overweight and obese children and adolescents [10–11], showing however limited adherence and compliance; mainly because of the higher rate of perceived exertion and low enjoyability it generates compared to high-intensity interval training that may increase enjoyment and then engagement [12]. Studies have raised the importance of resistance training and showed its beneficial effects on both biological and psychological dimensions among adolescents with obesity [13,14]. Lately, studies have focused on the results promoted by high intensity interval training [15]. Although such intervention shows limited impacts on body weight, it seems to have positive effects on body composition (mainly central fat mass) and physical fitness among obese patients, showing also high enjoyability [15].

Unfortunately, these traditional modes of exercises (mainly if walking and running are used) have been associated with increased risk for musculoskeletal injuries and pain in patient with obesity, reducing then the rate of adherence [16,17]. To avoid such musculoskeletal complications, the American College of Sports and Medicine suggests the use of non-weight bearing activities in overweight and obese patients [18] that have been shown to induce lower perceived exertion in obese adolescents [19]. Aquatic exercises could offer a great alternative thanks to its non-weight bearing nature and its hydrostatic and thermic properties, but this remains poorly explored so far [9].

The actual literature provides limited evidence regarding the effect of water-based versus land-based interventions on body composition and physical fitness in both adult [9,20] and youth with obesity [21]. In their recent study, Boidin et al. [22] found similar effects of a 9-month high intensity program using water- or land-based exercises on body composition, metabolic profile and physical fitness among obese adults [22]. To date, we found only one study that performed aquatic exercises 3 times per week for 12 weeks in overweight and obese adolescents (10 to 16 years old) [21]. According to their results, the water-based intervention (i.e., deep running) had beneficial effects on body mass index and body composition, however swimming classes (for beginners' level) did not present the same results.

To our knowledge, there are no study that tested the effect of such aquatic-based program on physical fitness and health-related quality of life in adolescent with obesity. Land-based exercise interventions are predominant in the literature as an alternative for pediatric obesity treatment [21] and, although aquatic exercise may be considered an alternative to prevent musculoskeletal injuries [18], it may also be attractive to overweight and obese adolescents, since it changes the environment in which they are used to perform their daily activities, including physical exercises (i.e., physical education classes that are mostly performed as a land-based activity). We believe that the attractiveness provided by the aquatic environment may reduce the rates of adolescents who drop out of the intervention due to demotivation compared to a land-based activity.

Thus, the aim of the present study was to compare the effects of water- versus land-based physical activity on body composition, physical fitness, and health-related quality of life in adolescents with overweight and obesity.

2. Methods

2.1. Experimental design

This study is characterized as a pragmatic trial with control group, designed to evaluate effectiveness of interventions and its practical application in real settings (i.e., a program offered in fixed days and times

by the University and the University Hospital as a public health service to the community). Pragmatic trials can produce more generalized results and are more representative of individuals' routine [23]. After a medical appointment to elaborate anamnesis and perform a clinical assessment of the participants, they were allocated to one of the following groups: i) Multidisciplinary intervention based on water-based exercises (WB); ii) Multidisciplinary intervention based on land-based exercises (LB); iii) a control group (CG) that did not receive any kind of intervention for obesity management during the study period and were oriented to keep their regular daily routine. The multidisciplinary approach consisted in a 16-week program combining physical activity; nutritional and psychological interventions. Anthropometric measures, body composition, physical fitness and health-related quality of life were assessed prior and by the end of the 16 weeks.

2.2. Participants

The inclusion criteria in the intervention group are: age between 10 and 18 years, presence of overweight or obesity based on Cole and Lobstein [24] cut-off points, availability to participate in the intervention activities through the treatment period. The exclusion criteria were: endocrine, metabolic and genetic abnormalities associated to the use of glucocorticoids and psychotropics that could also affect appetite regulation, compliance lower than 70% in the multidisciplinary interventions.

The main objective of the team was to favor the establishment of proper and adequate eating and exercise behavior changes through cognitive behavioral therapy [25]. Thus, adolescents were stimulated to be more physically active in their daily routines; however, if they opted to be engaged in other systematic and regular exercise training program, they were not included in the analyses (for all three groups).

Initially, 210 adolescents looked for the intervention. They were allocated within three different groups according to their time availability following a list of interested adolescents that is built after the program is advertised by the University and University hospital with support of the local media: LB ($n = 90$); WB ($n = 35$); and CG ($n = 85$). Eighty seven adolescents (33 from the LB, 7 from the WB, and 19 from the CG) did not complete the protocol due to transportation issues (2 from LB, 3 from WB, and 0 from CG), preference for other activities in the same period (23 from LB, 2 from WB, and 0 from CG), demotivation to continue in the multidisciplinary intervention (8 from LB, 2 from WB, and 0 from CG), and/or they did not attend the last assessment session (0 from LB, 0 from WB, 19 from CG). Of the 151 adolescents who participated in the study (body mass index: 30.0 ± 4.7 kg/m²; age: 13.2 ± 1.8 years), 57 (28 girls – 60.7%) were allocated in LB, 28 (17 girls – 60.7%) were in WB and 66 (30 girls – 45.5%) were in CG.

The study was approved by the local Ethics Committee (protocol 463/2009) and is in accordance with the guidelines in the Declaration of Helsinki.

2.3. Description of the multidisciplinary obesity treatment program

The multidisciplinary obesity treatment program lasted 16 weeks. The intervention team of pediatric health professionals included physical educators, nutritionists, psychologists and a pediatrician.

2.3.1. Psychological intervention

This intervention was conducted by a psychologist specialized in cognitive behavioral therapy, as well as psychology students in University and consisted in an hour of group session per week, which was carried out from 4:00 to 5:00 pm in the LB and from 6:00 to 7:00 pm in the WB. The intervention was conducted with roughly 20–30 adolescents in the session and the exact same approach was used. The aim of these meetings was to discuss the following topics: a) setting goals; b) self-observation of own behaviors and consequences (immediate, short- and long-term); c) identification of feelings and emotional analysis;

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