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Influence of 12-week exercise training on fat mass percentage in adolescents with Down syndrome

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Summary

Background: Current findings suggest that more attention needs to be given to the increase in body mass achieved by disabled populations, especially by individuals with mental retardation, to minimize long-term negative health consequences. Accordingly, it would be of interest to design adequate strategies based on physical activities that may be easily performed to ensure adherence as a healthy lifestyle choice for these populations.

Material/Methods: To attain this goal, 22 male adolescents with Down's syndrome (mean age: 16.2±1.0 years) underwent a 12-week physical exercise intervention consisting of three sessions of one hour per week in both water and on land for 12 weeks. Fat mass percentage was calculated from anthropometric measurements according to the Durnin-Womersley equation. A paired t test was performed to evaluate possible differences in antropometrical characteristics between before and after the physical exercise intervention.

Results: According to the body mass index, it was observed that 31.8% of the studied individuals presented overweight and 27.3% of them were obese before starting our experiment. The mean value of the percentage of fat mass was reduced significantly, from 31.8±3.7% to 26±2.3%, at the end of the study (p=0.021).

Conclusions: We may conclude that the adolescents with Down's syndrome were able to reduce their fat mass percentage significantly when performing a 12-week training program, which could have important impact on the comorbidity associated with obesity and on the quality of life of this population.

key words: **Down syndrome • physical activity • obesity • fat mass percentage**

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Background

In the United States the latest survey data show that the prevalence of serious obesity doubled between 1980 and 1991 and continue to increase [1]. Accordingly, fighting obesity must be recognized as a key target that requires ambitious goals to obtain substantial reductions, given that the American experience provides no grounds for optimism regarding the developing epidemic of obesity in the rest of the world. It must also be considered that current trends encourage a sedentary lifestyle among adolescents, and this habit is particularly dangerous for people suffering from disability, such as mental retardation [2]. In this respect, Pitetti et al. [3] reported that a disproportionate number of adults with mental retardation carry a percentage of body fat that is considered unhealthy, and a high prevalence of obesity was reported by Harris et al. [4] even among Special Olympics athletes.

In any case, this fact is of great importance given that obesity is one of the most significant avoidable risk factors for a number of life-threatening diseases and for serious morbidity, representing an important percentage of all annual illness costs [5,6]. Therefore, one would expect a keen sense of urgency among researchers to develop training regimens targeted specifically at people with mental retardation that include the necessary components of an exercise program (i.e. frequency, duration, intensity) that would ensure its adherence. In this respect, Down's syndrome, defined cytogenetically by trisomy 21, is the most common chromosomal disorder associated with mental retardation, with a prevalence of 1.66 per 1000 live births [7]. Recently, Myrelid et al. [8] and Roizen [9] reported a high prevalence of obesity and metabolic disorders, respectively, in young Down's patients. This fact is quite important given that these individuals had a 4- to 16-fold excess risk of mortality from ischemic heart disease, cerebrovascular disease, and venous thromboembolic disorders [10]. In addition, it has been published several times that they have a high prevalence of congenital cardiovascular anomalies [11]. For the reasons mentioned we designed a 12-week physical activity program for young individuals with Down's syndrome with the main objective of reducing their fat mass percentage. This may eventually lead to a notable improvement in the comorbidity associated with obesity and in the quality of life of this population.

Material and Methods

Twenty-two Down's syndrome male adolescents, 166.4±4.5 cm tall, weighing 78.7±4.8 kg, and 16.2±1.0 years old, were enrolled in this study. None had taken part in a regular exercise program for at least six months before entering our study. All parents were informed about the research design and objectives and signed a consent form. In accordance with Pastore et al. [12], all participants underwent clinical and cardiorespiratory assessment before taking part in our study.

Our 12-week physical activity program consisted of three sessions per week in both water and on land. The intensity level was prescribed and monitored on the basis of heart rate [13]. The duration of each session was set at 30 min for the first two weeks, 45 min for the next two weeks, and 60 min for the remaining eight weeks. All sessions were under the direct supervision of a sports physician.

Table 1. Impact of a 12-week moderate aerobic training program on body composition of male adolescents with Down's syndrome.

	Pre-test	Post-test
Weight (kg)	78.7±4.8	75.1±4.2*
Fat mass (%)	31.8±3.7	26.0±2.3*
Fat-free mass (%)	68.2±3.9	74.0±2.4
Fat mass (kg)	25.03±1.6	19.53±0.9*
Fat-free mass (kg)	53.67±3.0	55.47±3.1

Results are expressed as mean ±*SD*. * Significance was ascertained at $p<0.05$. N=22.

Before and after the implementation of our aerobic exercise program, we evaluated the body mass index (BMI) and fat mass percentage by measuring skin-fold thickness [13]. The body mass index (BMI) was calculated for every subject by means of the equation weight (kg)/height (m^2), being classified as: underweight (BMI ≤19.99 kg/m^2), normal (20 ≥BMI≤ 24.99 kg/m^2), overweight (25 ≤BMI ≤29.99 kg/m^2), and obese (BMI ≥30 kg/m^2) [14]. Body weight was measured using a SECA electronic weighing scale (model 770 alpha; SECA, Hamburg, Germany). The scale was calibrated before each weighing session by using the calibration procedures described by the manufacturer. Height was measured using a microtoise (CMS Weighing Equipment Ltd., London). Subjects stood on a horizontal surface, chin tucked in, stretched upwards to full extent holding the head in a Frankfurt plane. Heels, buttocks, and shoulders were in contact with the wall to which the microtoise was attached [15].

The Durnin and Womersley equation [16] was used to assess body fat percentage, i.e. fat mass percentage = (4.57/density – 4.142) × 100), where density = 1.1765–0.0744 × log(bicipital + tricipital + subscapular + suprailiac skin-folds). Tricipital, bicipital, subscapular, and suprailiac skin-fold thickness were measured by a trained researcher on the left side of the body in triplicate using a Holtain lipometer (Holtain Ltd., Crymych, Dyfed, Wales, UK).

Results are expressed as mean ±*SD*. A paired t test was performed to compare mean values prior to and after the program using SPSS/PC 11.0.

Results

At baseline the mean fat mass percentage was 31.8±3.7% in the male adolescents with Down's syndrome. After the 12-week aerobic training program it was reduced to 26±2.3%. The paired t test demonstrated significant differences between them (p=0.021), indicating the validity of our program. It should also be mentioned none of participants left the program. These results are summarized in Table 1.

Discussion

Relatively little is known about the physical activity patterns of handicapped persons, but existing data clearly show a

disturbing pattern of low levels of physical activity in most populations who have disabilities, specially those who suffer from mental retardation [17]. Considering the important health consequences of physical activity, current guidelines recommend that all individuals should be physically active all or most days of the week. However, an individual with Down's syndrome is characterized by apathy towards physical exercise, which may be explained by lack of motivation as well as by physiological impairments [18].

In agreement with Fernhall and Unnithan [19], we considered more research is needed on all populations who have disabilities, not only documenting current levels of physical activity, but also investigating potential strategies for improvement. Consequently, the development and implementation of programs designed to increase physical activity levels should be recommended to ensure quality of life and functional independence of these individuals [17]. This fact is of great interest given the high prevalence of obesity in this population, as reported by Rubin et al. [20] and Davim and de Franca [21]. In line with this, 31.8% of the individuals in the present study were overweight and 27.3% were obese according to their BMIs at the beginning of our study.

Regarding the fat mass percentage, during the past decade several new technological developments have introduced alternative methods to determine the percentage of body fat in order to get a more accurate and precise assessment of body composition. However, they require sophisticated and expensive equipment and experienced, well-trained personnel [22]. On the other hand, equipment suitable for use under field conditions, such as skin-fold callipers, should be easily transportable, relatively simple to use, and the measurement should be non-invasive and not too time consuming. In addition, no significant differences in estimates of fat were observed between the field and laboratory methods [23].

As was hypothesized, we found at baseline a high fat mass percentage in adolescents with Down's syndrome. Similarly, Bronks and Parker [24] reported abnormally high percentages of body fat in subjects with Down's syndrome compared with age- and sex-matched non-retarded groups. However, these percentages are lower than those described in other populations with mental retardation, such as Prader-Willi syndrome patients [25].

Fortunately, at the end of our experiment, fat mass percentage was significantly reduced, indicating the validity of our program. In this respect it should be pointed out that our physical intervention was effective lasting only 12 weeks. This short period, as well as the mixture of water and land aerobic physical activities, allowed the participants to complete its execution easily, which may contribute to increasing the interest of our program. It should also be mentioned that none of the participants left the program, which may suggest that it was not only effective, but also easy to follow. On the other hand, no significant changes in weight or body composition after a 10-week aerobic exercise program were reported by Pommering et al. [26].

Another point of interest is that nowadays the proportion of young people who are not physically active is also increasing enormously. In this respect, the percentage of adolescents who participate in vigorous physical activity at least three times a week has declined from 61.7% to 36.1% [27]. The early education of the trisomic child, through simple and often-repeated advice, makes it possible to avoid the recurrence of educational errors linked to parental uncertainties. In addition, Bronks and Parker [24] concluded that body fat did not increase with age, but was consistently high at all age levels within the Down's syndrome population, suggesting that the elevation in body fat levels occurs prior to adulthood. Accordingly, we selected for this study adolescents with Down's syndrome with the main objective that they acquire a healthy lifestyle as soon as possible to promote functional independence and their interaction with others, which may eventually improve their social integration. In any case, the current findings suggest that more attention needs to be given to the increase in body mass achieved by individuals with Down's syndrome in order to minimize the long-term negative health consequences of this.

CONCLUSIONS

We may conclude that the adolescents with Down's syndrome were able to reduce significantly their fat mass percentage when performing a 12-week aerobic training program. Our findings also emphasize the importance of introducing these programs as a healthy lifestyle choice at early stages in life in order to obtain their demonstrated benefits as soon as possible. Further studies on this topic are highly required.

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