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Original Article

Effects of an 8-week physical activity program on body composition and physical fitness on obese and pre obese female students

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Abstract
The aim of the current study was to evaluate the effects of a physical activity-training program on body composition and physical fitness in female obese and pre obese students. An experimental group of eight students (12.13±0.99 years-old) and a control group of eight students (13.25±1.16 years-old) were selected. The experimental group was involved in a three-day physical activity per week (aerobic and strength training), during eight weeks. Fitnessgram protocol was used to evaluate both groups body composition and physical fitness, before and after the eight-week training program. Non-parametric tests were used to evaluate differences between groups and assessment moments. The experimental group presented a trend to maintain body composition values and to increase physical fitness. In contrast, the control group presented a trend to increase body composition and to decrease fitness levels. These data seem to demonstrate that an eight-week physical activity-training program allows only the maintenance of body composition and physical fitness of overweight children. As such, apart from physical exercise, eating habits should also be checked as a mean to improve health and physical fitness of obese children.
Key words: Obesity, Fitnessgram, Students, Female, Training.

Introduction

Obesity has been considered by several authors (Antonogeorgos, Papadimitriou, Panagiotakos, Priftis, & Nicolaidou, 2011; Graf et al., 2005) as one of the epidemics of the twenty-first century, with increasingly higher rates in relation to children and adolescents.

These data led to a growing concern over young people's health and their daily habits of physical activity. This is not a frivolous concern as several studies (Costa, Ferreira, & Amaral, 2010; DeBoer, 2010; Jin, Liang, Fu & Wang, 2011) have shown that obesity, including childhood obesity, is associated with the prevalence of cardio-vascular diseases and the onset of diabetes mellitus II and other health problems (Visness et al., 2010). In this context, how children spend their free time is, today, the factor that appears to contribute more to the increase of the childhood obesity (Stellino, Sinclair, Partridg, & King, 2010). In this context, we should underline the fact that children spend much of their free time sitting in front of the TV or computer (Bener et al, 2011; Hills, Obkely & Baur, 2010). Thus, in the opinion of several authors (In-Iw & Biro, 2011; Mascarenhas, Salgueirosa, Nunes, Martins, Neto, & Campos, 2005), obesity can be fought with increased physical activity (by changing their sedentary lifestyle) and by promoting healthy eating habits. Following this assumption, Netteler and Sprogis (2011) recommend for children and adolescents sixty minutes of moderate to vigorous physical activity at least three days a week. Beyond these recommendations, children and adolescents should be educated to appreciate the importance of physical activity and their health benefits. However, there is an important practical issue that deserves to be considered: what is the best place to promote the importance of physical activity, in particular its role in combating obesity? According to Della Torre Swiss, Akré and Suris (2010), school will be the best scenario to implement such recommendations. These authors also emphasize the importance of healthy meals in the school canteen and the participation of overweight children in extra-curricular programs of physical activity.

The prevalence of obesity in schools is commonly studied using non-invasive parameters such as the body mass index (BMI), the abdominal perimeter and the estimated percentage of fat body mass (FBM) by different techniques (Balaban & Silva, 2001; Mascarenhas et al., 2005; Sardinha et al., 2010). Notwithstanding the importance of studying the prevalence of childhood obesity, we should highlight the initiatives that seek to implement programs to combat this problem. Indeed, the study published by Greening, Harrell, Low and Fielder (2011) is a recent example of the benefits we can expect from implementing physical activity a program (9 months) to such overweight children, especially when applied in parallel with nutritional support. The 450

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students studied showed substantial improvements ($p<0.05$) on body composition in relation to a control group who did not undergo the exercise program.
In the school context, nutritional support is not always possible or effective, since it is often necessary to change the habits of the child's family. Despite the importance of ensuring the nutritional education, increased physical activity will be at least one measure to combat obesity that schools can and should offer. Hence, this study aims to examine the effects of an 8-week physical activity-training program on body composition and physical fitness of female obese and pre obese students.

Methods

Study Sample

A sample of 684 Portuguese high school students (14.48 ± 1.93 years) were evaluated in the following parameters considered by the National Health and Nutrition Examination Survey III (NHANES, 2007) as relevant to the study of obesity: the BMI, the abdominal perimeter and the estimated percentage of FBM. Individuals with values above the 85th percentile of BMI and the 90th percentile of abdominal perimeter and/or FBM (values depend on subject's sex and age) were identified.
Hence, based on these criteria, 111 overweight students (13.90 ± 1.58 years) were recognized. Of those 111 students, only 8 (all females, 12.13 ± 0.99 years; 59.88 ± 8.73 kg; 1.58 ± 0,05 m) were allowed by their parents to participate in extra-curricular physical activity. Eight other female students were selected and allowed to incorporate the control group (13.25 ± 1.16 years; 62.38 ± 11.46 kg; 1.57 ± 0.06 m), which was not subjected to additional physical activity. Efforts were made to recruit subjects for making comparable groups. Maturity level based on Tanner stages was self-assessed. There were no significant differences ($p>0.05$) between groups for age or Tanner ratings, neither in body composition, strength or endurance fitness performances at the beginning of the protocol. This study fulfills the principles of research set out in the Helsinki statement. An informed consent was obtained prior to all testing from parents or legal tutor of the adolescents.

Physical fitness assessment:

The Fitnessgram physical fitness assessment program was applied in both groups. The program includes a variety of health-related physical fitness tests designed to assess cardiovascular fitness, muscle strength, muscular endurance, and flexibility (Welk & Meredith, 2008). With effect, the following tests were applied at the beginning and end of the 12-week exercise program: (i) the aerobic capacity was estimated by the Pacer test; (ii) the muscular strength, endurance and flexibility was assessed by the curl-up, the truck lift, the 90 degree Push-Up and the back saver sit and reach. The procedures followed in carrying out each test can be found at Welk and Meredith (2008) study.

Anthropometric and body composition assessment

Total height (m) was assessed according to international standards for anthropometric assessment (Marfell-Jones, Olds, Stewart & Carter, 2006), with a Seca 264 Stadiometer (Hamburg, Deutschland). The body weight of individuals was measured by a digital floor scale (Jata Hagar, Model A4165) in kilograms with an accuracy of ±100 g. These two parameters were assessed prior to any physical performance test. Subjects were measured wearing shorts and t-shirts (shoes and socks were asked to be removed). The subject's BMI number was then calculated using standard formulas weight (kg) / [height (m)]^2. The BMI has been shown in epidemiological studies for its relative ease of measurement and correlation with body fat (Himes & Dietz, 1994). However, because the amount of fat alters with age and differs between girls and boys, the BMI-for-age percentile was used to interpret the BMI number. The *National Health and Nutrition Examination Survey* (NHANES, 2007) BMI-for-age growth charts for girls and boys take into account these differences and allow us the translation of a BMI number into a percentile for all subjects. As such, overweight children were equal to or greater than the 95th percentile and at risk of overweight were those between 85th to less than 95th percentile.
Triceps and geminal skin folds were measure on the subject's right side according to the literature (Lohman, 1995), using a Slim Guide body fat caliper (Creative Health Products, Plymouth, MI, USA. This caliper has the capacity to measure up to 85 mm with a precision of ±0.5 mm. The FBM was determined according to the equations proposed by Slaughter et al. (1988) for girls.

Finally the abdominal perimeter was also assessed in all subjects according to the literature (Lohman, 1995), using a valid tape measure. The abdominal perimeter and percentage of FMB were then compared with the references provided by the NHANES (2007), which allowed the identification of individuals with values above the 90th percentile.

Physical-fitness training program:

The program consisted of three days of physical activity per week (on Mondays, Wednesdays and Fridays) for eight weeks, corresponding to a total of 24 sessions. As can be seen in table 1, the experimental group performed combined resistance and endurance training.

Table 1 – Physical-fitness training program.

	Frequency	Weeks 1 and 2	Weeks 3 and 4	Weeks 5 and 6	Weeks 7 and 8
Resistance training:					
- Curl ups - Back extensions - Squats - Push ups	Every session: Mondays, Wednesdays and Fridays	2x30 2x30 2x10 2x5	3x30 3x30 2x12 3x5	3x35 3x35 2x15 3x8	3x40 3x40 3x15 3x10
Endurance training:					
- Bicycle ergometer - Rowing ergometer - Treadmill	On Mondays	6 min 6 min 6 min (2 min rest) (Heart Rate: 160±5 bpm)	7 min 7 min 7 min (2 min rest) (Heart Rate: 160±5 bpm)	8 min 8 min 8 min (2 min rest) (Heart Rate: 160±5 bpm)	10 min 10 min 10 min (2 min rest) (Heart Rate: 160±5 bpm)
Collective sports games:					
Soccer, basketball or handball	On Wednesdays	45 minutes of practice			
Group fitness session:					
Aerobics or step aerobics	On Fridays	30 minutes of practice (Heart Rate: 160±5 bpm)			

Is important to note that the playful feature was always taken into consideration in all program sessions. In that perspective, endurance work alternated between: (i) traditional methods using cardio machines (on Mondays); (ii) practicing several collective sports games such as soccer, basketball or handball (on Wednesdays) and; (iii) group fitness sessions such as step aerobics (on Fridays). During all sessions the heart rate was monitored by a cardio frequency meter (Sport Tester PE 3000, Polar Electro, Kemple, Finland), set so that subjects would exercise within 160 ± 5 bpm. In practice collective sports games (Wednesday), heart rate showed higher amplitude, since the effort is clearly intermittent, alternating between intense and moderate (Montgomery, Pyne & Minahan, 2010).

Given that all subjects are students, both groups attended physical education classes twice a week, with duration of 90 min each class. In these classes, students approached various sports (gymnastics, soccer, basketball and volleyball) with a clear pedagogical focus. As such, the physical activity intensity is considered low to moderate.

Statistics

All analyses were done with SPSS Statistics version 19.0. Standard statistical methods were used for the calculation of the means and standard deviations (SD). The normality and homoscedasticity assumptions were checked respectively with the Shapiro-Wilk and the Levene Tests. All differences between groups were calculated by a Mann-Whitney test, and within group differences between pre and post training were assessed by a Wilcoxon matched-pairs signed-ranks test. The $p \leq 0.05$ criterion was used for establishing statistical significance.

Results

Figures 1, 2, 3, 4, 5, 6 and 7 present data of body composition (height, weight, body mass index, geminal skinfold, triceps skinfold, % of fat mass, abdominal perimeter, respectively), where one can observe changes on the experimental group (G1) and on the control group (G2), between first evaluation (T1) and second evaluation (T2). Although there were no significant differences, there is a trend in the control group to increase body composition values, in opposition to experimental group, which tends to maintain the same values between evaluation moments.

It is also important to underline that both groups presented significant differences in height and that the control group presented a significant increase on % of body fat. There were no differences between groups in both evaluation moments.

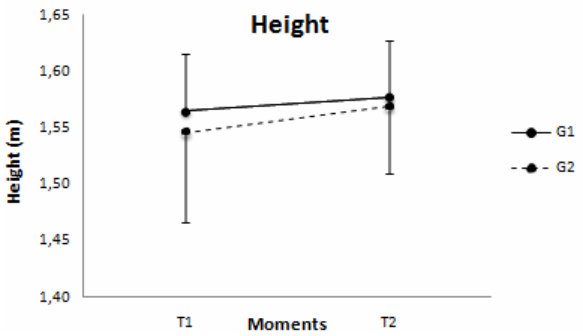

Figure 1 – Mean values of Height. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation. *p<0.05.

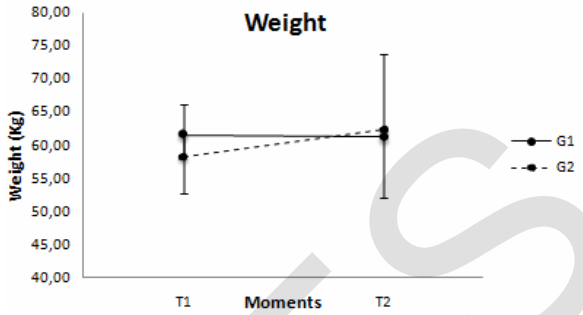

Figure 2 – Mean values of Weight. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

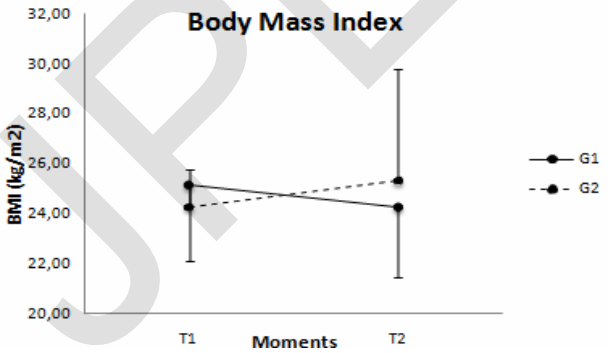

Figure 3 – Mean values of BMI. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

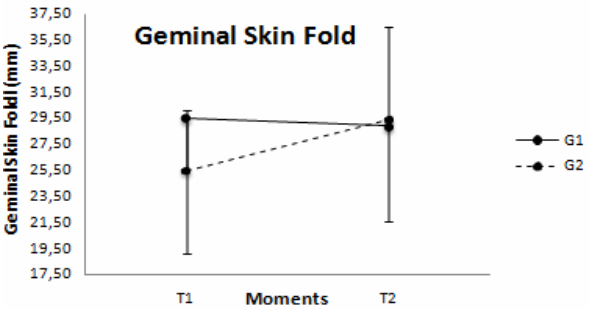

Figure 4 – Mean values of Geminal skinfold. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

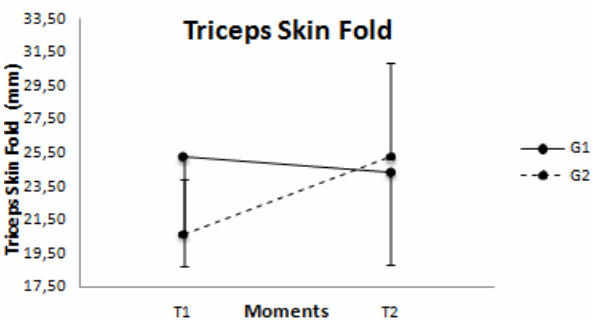

Figure 5 – Mean values of Triceps skin fold. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

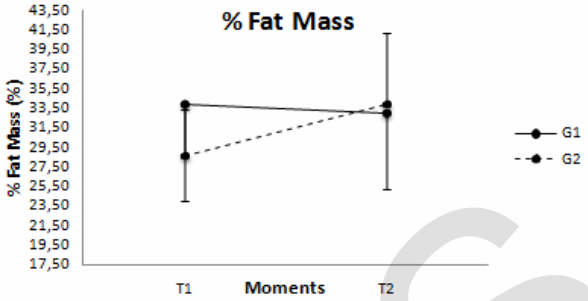

Figure 6 – Mean values of % of Fat Mass. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation. *p<0.05.

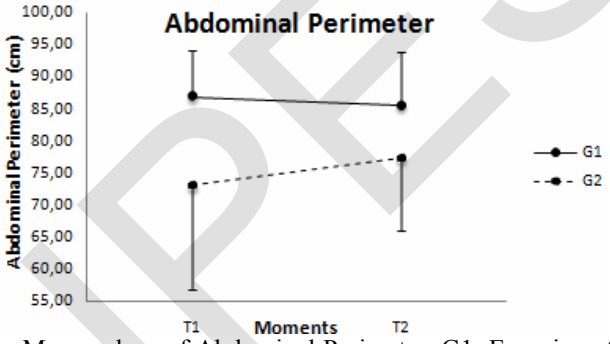

Figure 7 – Mean values of Abdominal Perimeter. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

Figures 8, 9, 10, 11 and 12 present data of physical fitness (abdominal resistance, trunk resistance and flexibility, shuttle test, shoulder flexibility, and arms resistance, respectively) of the experimental (G1) and the control group (G2), between the first evaluation (T1) and the second evaluation, after the application of the training program (T2). There were no differences between groups neither between evaluation moments (intra group). Nevertheless, in general, one can verify that experimental group presents a trend to improve physical fitness. In opposition, control group seems to maintain or even to decrease the performance in the abovementioned tests between evaluation moments.

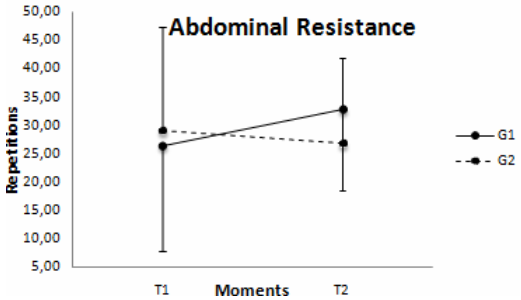

Figure 8 – Mean values of Abdominal Resistance. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

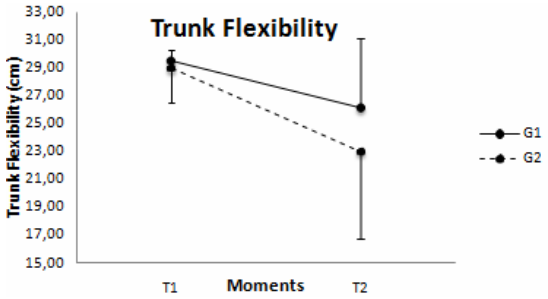

Figure 9 – Mean values of Trunk Resistance and Flexibility. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

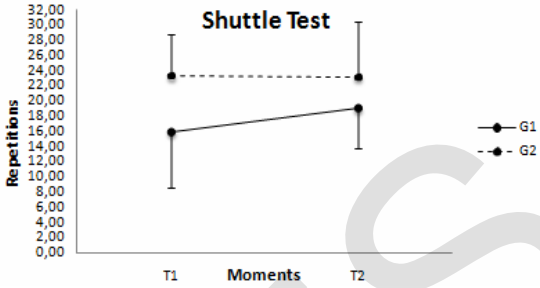

Figure 10 – Mean values of Shuttle test. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation

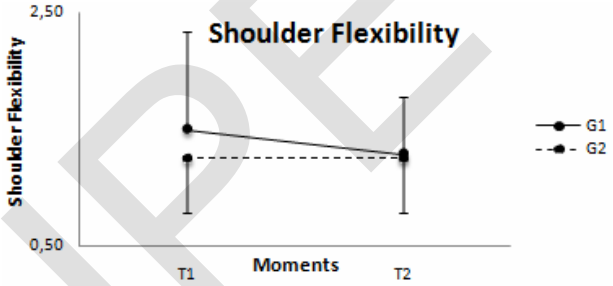

Figure 11 – Mean values of Shoulder Flexibility. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

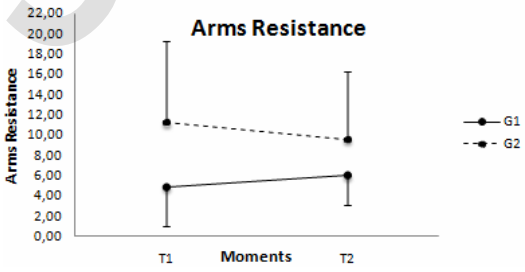

Figure 12 – Mean values of Arms Resistance. G1: Experimental group; G2: Control group; T1: First evaluation; T2: Second evaluation.

Discussion

The aim of the current study was to evaluate the effects of a physical activity-training program on body composition and physical fitness in female obese and pre obese students. These data seem to demonstrate that a physical activity-training program allows maintaining body composition and physical fitness in a sample of obese students.

In general, low levels of physical activity are associated to high levels of obesity (Antonogeorgos, Papadimitriou, Panagiotakos, Priftis & Nicolaidou, 2010; In-Iw & Biro, 2011). However, the majority of the research conducted under this scope chooses often to characterize in a specific moment a sample/population,

attempting to find patterns of physical activity associated to levels of body composition (Mascarenhas et al., 2005; Nettle & Sprogis, 2011). For instance, in students, Antonogeorgos et al. (2011) identified, applying questionnaires, that vigorous physical activity plays an important role to maintain healthy body composition levels. Vanhelst et al. (2011) verified that obese students presented lower values of physical activity, when compared to non-obese colleagues. Although the importance of physical activity, it seems less attention of the scientific community is done on monitoring and controlling the effects of a physical activity program on the levels of body composition in obese and pre obese people (Mota, Ribeiro, Carvalho, Santos & Martins, 2009; Vanhelst et al., 2011). Additionally, to the best of our knowledge, the evaluation of body composition and physical fitness in this population (obese/pre obese students) is scarce. Hence, with this work an attempt was done to better understand this topic of interest.

Regarding body composition, data found in this work are similar to others presented in the literature, evaluating samples of the same age (Lang, Kipping, Jago & Lawlor, 2011; Sun et al., 2011). Regarding physical fitness, this comparison is not so easy. On one hand, different testing protocols have been applied in different studies (Dorgo et al., 2009; Greening et al., 2011) and, on the other hand, even those that used Fitnessgram protocol (Cooper, 2010; Mota et al., 2010) not always the selected tests were the same that we used in the current study.

When the differences between the experimental group, involved in the physical activity program, and the control group, not involved in this program, were analyzed, no differences between groups were observed in both evaluation moments. This situation could be do to the small size of the sample and to the fact that this physical activity program was applied only during eight weeks, which could not have been enough to lead to differences between groups (Garrido et al., 2010), situation that should be considered in future studies. Similar trend occurred when we analyzed the evolution of the values of body composition and physical fitness between the beginning and the end of the physical activity program, where no differences between moments were observed. However, it was verified a trend to: (i) maintain the values of both body composition and physical fitness, in the experimental group, and (ii) increase the values related to body composition (increasing obesity levels) and a decrease of physical fitness, in the control group. In the control group it is important to underline the increase of the % of body fat, between the first and second evaluation moments (T1: 28.65±4.68%, T2: 33.83±7.37%, $p<0.05$), which seems to reinforce the abovementioned trend, where physical activity lead to overcome the trend to increase obesity levels, especially in young people, involved in development process. This fact can be confirmed by the significant increase, in both groups, of height ($p<0.05$). Greening et al. (2011) verified, in 450 obese students who participated in physical activities, during eight months, twice a week, that the experimental group significantly improved physical fitness, decreasing also body fat mass. These authors (Greening et al., 2011), added to physical fitness, also applied nutrition programs. This aspect seems to be very important to be included in further investigations, since in this paper it was not consider, but could have contributed to explain some of the data found during this research.

Previous studies under this scope also observed some changes in body composition and physical fitness in people involved in physical activity programs. Vanhelst et al. (2011), after the application of a twelve-month physical activity program, verified significant differences in body mass index, decreasing in the experimental group and increasing in the control group, not involved in this physical activity program. Dorgo et al. (2009) verified that physical activity programs allowed increasing physical fitness levels, although no differences were observed in body composition.

As main limitation of the current work: (i) the small size of the sample, which make difficult to transfer these results to other samples/populations, (ii) this program was only applied during eight weeks, which could not be enough to allow differences between evaluation moments and between groups, and (iii) nutrition aspects were not evaluated, which should be considered in the future.

These data can be important to organize physical activity programs in school, allowing maintaining body composition and physical fitness. Although in the current study no significant differences were observed concerning the application of a physical activity program, there is a trend to maintain body composition and physical fitness in obese students involved in these physical activities.

Conclusion

These data seem to demonstrate that a physical activity-training program allows maintaining body composition and physical fitness in a sample of obese students. These data suggest that physical activity-training program should be applied in school and, preferably, alongside with nutritional support.

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