Effects of a 6-Month Resistance Training Program on Overweight Children

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Abstract

School-age children's health may be improved through physical education programs that include resistance training. Obesity in children has been linked to health issues like type II diabetes and hypertension. Designing and implementing efficient and useful therapies for the management of overweight children and who are prone to experiencing medical issues is a serious concern. Adults who are overweight generally embrace resistance training as a safe and efficient way to lose weight. Therefore, the aim of our study was to look into the effects of a 6-month resistance training program in overweight or obese children. Fifty children (n = 28 girls and 22 boys; mean age = 7.38 years) took part in a six-month periodical resistance training program 2 days per week. Body mass index (BMI), strength, anthropometric measures, and activity levels of subjects were assessed prior to and following the training program. No training injuries or severe muscular pain were reported at any point of the exercise regimen, although the individuals did experience substantial variations in height, weight, body mass index, and total fat mass. Substantial increases occurred in 1-rep maximal squat (72%), number of push-ups (80%), countermovement jump (10%), static jump (9%). Although it is likely that some of the observed changes were the result of growth

and maturation throughout the course of the research period, the data show that the resistance training program induced large and persistent increases in body mass index, measures of strength, and body fat. These findings indicate that the participants training program was well received by the participants and had a significant impact on their body mass index and strength. In youngsters who are overweight or obese, a periodic undulation program enhances strength, decreases body fat percentage, provides variety, and notably increases lean body mass.

***Key Words**: - School-age children, obesity, physical activity, BMI*

Introduction

Recent research has found that adequate levels of physical activity (PA) reduce vulnerability to a number of illnesses (such as type 2 diabetes and heart diseases) and help to build the musculoskeletal system, cardiovascular system, and neuromuscular awareness. These benefits of PA on children's health and wellbeing are well established (Chief Medical Office, 2019). Regular involvement in physical exercises has the potential to increase the child's emotional, social, and cognitive well-being (Faigenbaum et al., 2014). Obesity is one of the most common outcomes of not being physically active enough. Childhood obesity is linked to an increased risk of adult obesity, untimely mortality, and disability. Obese children have difficulty breathing, are more prone to fracture, have hypertension, show first signs of cardiovascular diseases at an early age, have insulin resistance, and significant psychological consequences, in addition to other potential (Di Cesare et al., 2019). Hills et al. (2011) observed that because of the increased likelihood of overweight kids becoming obese adults, engaging young people in physical exercise is a critical component in preventing obesity. The increasing rise in the frequency of childhood obesity has generated a multidisciplinary discussion on the best ways to combat this epidemic. While no agreement has been reached, it is probable that preventative initiatives will take precedence, with programs that can reach all children at an early age.

Obesity is caused by a complex etiology in both children and adults. Obesity in children and accompanying metabolic issues are linked to lack of physical exercise, excessive sedentary time, and improper eating habits, all of which contribute to an unhealthy lifestyle. Primary prevention programs, which are frequently centered on interventions in schools, emphasize the benefits of physical exercise and healthy food habits. These broad population strategies are beneficial in avoiding excess body fat buildup and promoting physical fitness in children. Obese children, on the other hand, may require more organized programming.

The majority of research so far have demonstrated that increasing physical activity while decreasing calorie consumption will improve body composition and health in overweight or obese children. Until recently, physical activity programs have been mostly oriented on endurance exercise, either alone or in combination with nutritional management, and weight training has just lately acquired popularity. Endurance exercise, often known as aerobic exercise, is defined as activity that is conducted over a long period at a low to moderate intensity and depends mostly on aerobic metabolism. Resistance exercise, commonly known as strength training or weightlifting, includes muscular strength and primarily consists of isometric, isotonic, or isokinetic movements. Resistance training is intended to increase resistance in order to increase muscular strength and anaerobic endurance. According to the concept of energy balance, when energy intake exceeds energy expended, weight gain occurs. As a result, promoting physical activity in children and adolescents is seen as a strategic approach to treating childhood obesity (Valerio et al., 2018), physical activity patterns that form in childhood and persist into maturity. Economy is expanding in developing countries, which among other things, is giving way to significant alterations to the traditional eating patterns, and reorienting the diet towards Western countries. Eventually, these changes have contributed to increased obesity levels. With infectious diseases associated with malnutrition, middle-income countries typically face an additional cost of disease as a result of the so-called nutritional shift, particularly among in obese children or those suffering from chronic diseases associated with obesity (Popkin & Adair, 2012).

Childhood eating and physical activity patterns are not easily altered during life. As a result, preventing and limiting the increase of among children, is an urgent public health priority nowadays as it is very challenging to cure obesity, the likelihood of becoming obese as a teenager or at an older age is elevated, and it is tough to kick off unhealthy eating habits developed as children (Pearson & Biddle, 2011).

The majority of empirical investigations have revealed that increased physical activity paired with diet contributes to enhance the body composition and general well-being of obese or overweight children. However, because overweight and obese children have increased levels of body fat mass as compared to non-obese children, most exercise regimens that involve aerobic training may not be tolerated by them (Watts et al 2005). Despite substantial research on the involvement of parents and schools in the prevention of children obesity, the use of resistance training to change body composition in this group is a relatively recent notion that deserves additional investigation (Benson et al., 2008), (Falk et al., 2003). Resistance exercise is well established to be safe for younger populations (Faigenbaum et al., 2001), (Faigenbaum et al., 2003), (Faigenbaum et al., 1999), but research investigating its

impact on obese children is relatively scarce (Benson et al., 2008), (Sothern et al., 1999), (Treuth et al., 1998). Because of the growing popularity of young people participating in resistance training, as well as the increased prevalence of obesity levels among children, more studies are necessary be conducted in order to assess in the long run the benefits of resistance training on the well-being and physical fitness of obese children, especially concerning the time span of the intervention necessary to trigger change. Because there is insufficient data on young people, it is especially relevant to know whether these training-induced effects may be sustained throughout a period of detraining in this population (Tsolakis et al., 2004).

Material & methods

The sample consisted of fifty schoolchildren (28 girls and 22 boys) with an average BMI of 21.4 kg/m2. Besides obtaining official authorization from the school's Ethics Committee, parents or legal guardians supplied written informed permission. The purpose was to look at the impact of a 6-month resistance training in overweight or obese children, as well as to determine how long the advantages last after organized exercise regimens are discontinued.

The following were the inclusion criteria: 1) age from 7 to 8 years, 2) obese or overweight, 3) sedentary children, while the exclusion criteria were: 1) nephropathy or hypertension, 2) usage of any medicine to regulate weight, hyperglycemia, or blood pressure, and 3) self-reported frequent physical activity in addition to curricular physical education.

Prior to and following the exercise regimen, subjects' BMI, strength, power, and activity levels were assessed. Before testing and training started, the subjects were acquainted with the measurement and exercise protocols. They were also instructed to keep track of any substantial physical activity they did during the training period, including the kind, duration, and intensity (as measured by the rate of perceived exertion [RPE]). At weeks 0, 4, and 6, activity data were examined to keep track of significant shifts in activity levels. At these stages, participants were also subjected to anthropometric measures of height and weight performed in accordance with standard protocols. Height was measured using a wall-mounted audiometer to the closest millimeter, with children wearing light clothing and no shoes. Fat folds were measured using a picometer in four tissues (triceps, suprailiac, suprascapular, and pulp muscles). All anthropometric measurements were taken by the same person. A machine squat exercise was used to evaluate maximum lower body strength. Warm-up tests were performed using 25% (8–10 repetitions), 45% (4–6 repetitions), 80% (2–4 repetitions), and 90% (1 repetition) of each subject's

estimated 1-repetition maximum (1RM). The load was then increased to a point at which the child had 2–3 maximal efforts to determine the 1RM, with adequate rest allowed between trials (5 minutes). Earlier studies have demonstrated that 1RM strength testing may be performed safely by children if adequate protocols are followed (Faigenbaum et al. 2003).

The exercise regimen comprised complete body training employing a variety of varied body weight and strength exercises, along with various types of training gears such as dumbbells, elastic bands, medicine balls, and weight bags. The regimen involved training with varied workloads across each week as well as increased intensity over 6 months. Every week, the first exercise session involved 3 sets of 4 exercises each. Moderate 10RM strength, exercises used included squats, lunges, push-ups and sit-ups. The second session included high-volume training sessions, with three sets of squats, straight leg raises, static jumps and abdominal crunches performed using 10-12RM. The third included moderate to high-intensity training sessions including explosive power exercises; three sets each with body reps of squat jumps, countermovement jumps (CMJs), jumping jacks and jumping lunges were performed using training loads of 3 to 5 repetitions.

TABLE 1. Training Program

Training Program						
Day	Order	Exercise	Set	Min Reps	Max Reps	Min Rest
1	1	Squat	3	8	10	90s
	2	Lunges	3	8	10	90s
	3	Push-ups	3	8	10	90s
	4	Abdominal sit-ups	3	12	15	90s
2	1	Squat	3	10	12	60s
	2	Strait leg raise	3	10	12	60s
	3	Static jump	3	10	12	60s
	4	Abdominal crunch	3	12	15	60s
3	1	Squat jump	3	5	7	3 min
	2	Countermovement Jump	3	3	5	3 min
	3	Jumping jacks	3	5	7	3 min
	4	Jumping lunges	3	5	7	3 min

Results

There were no reports of physical injuries or significant muscular pain at any point of the training program. Compliance with training was 79 $\pm$ 6%. Initially, 73 children enrolled in the study, but 23 withdrew before the end of 6 months. Figure 1 depicts shifts in the mean body weight throughout time.

FIGURE 1. Changes in mean body weight

No substantial reduction in absolute percentage body weight of 2.6% (p = 0.003) was observed. Table 2 shows the prior to and following values for various body weight measurements.

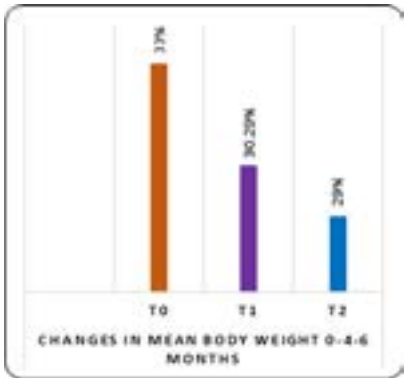


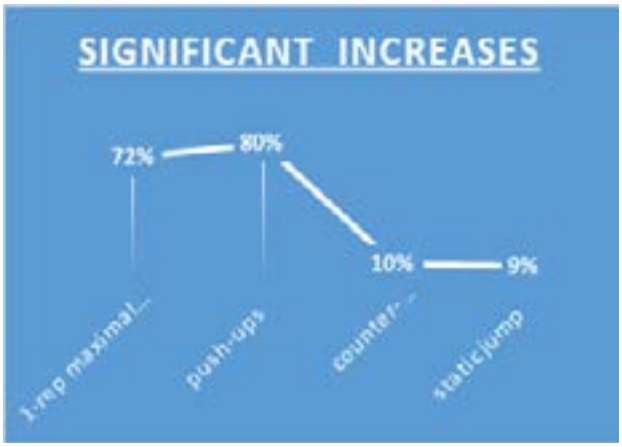
TABLE 2. Measures of body weight (0-4-6 months)

There were significant increases in the 1-rep maximal squat (72%), number of push-ups (80%), countermovement jump (10%), and static jump (9%), as shown in Figure 2.

T0/kg	T1/kg	T2/kg
37	35	33.2
42.2	40	38
35.4	34	33
30.2	29	27.3
25.4	24	22
30.3	28.5	26
27.6	27	25
36	34	33

38.1	37	36
38.3	37	35.8
33.6	32	31
31	30	28.6
26	24	23
27.4	25	24
40.6	38	37
28	26.5	26
31	28.5	28
27.6	24	23
30	27.5	26.3
42.5	40	28
31.5	30	29
40.6	38.6	38
29.3	28	27
34.3	33	32
26	24	22
25.7	23	21
27.8	26	25.5
33	31.4	31
33.2	30	29
29.2	27.3	27
34	32	31
30.4	28	26
32.4	30	29
45	42	41.2
30	28.3	28
29.3	27	26
40	37	36.4
27.3	26.3	26
26	24	23
25.7	23	22
32	30	28
32.5	31	30
33	32.3	32
27.8	25	24
28	26	25
26.8	24	23
29.7	26	25
37	35	34
39	37.3	37
40	38.2	38

FIGURE 2. Increases in the number of repetitions, push-ups, countermovement jumps and static jumps



Discussion

This study looked at impact of three different lengths of a resistance training intervention on body mass index, strength, power, and body fat in overweight or obese children. Benson and colleagues discovered similar results (Benson et al 2008). In recent years, the teaching process at educational institutions has been oriented toward non-linear pedagogy. Such education promotes significant student autonomy as well as the utilization of research aimed at the advancement of an academic subject. Physical Education is no different, since it aims not only at the physical perfection of the child but also at the development of numerous abilities required for daily living. Physical education is important in educational institutions because it facilitates the successful reduction of physical inactivity, which is common among young people. According to research by De Meester et al. (2018) and Huang et al. (2019), more than half of primary school-age physical activity does not match to the recommended amount of daily physical activity. Obesity (Denisova, 2019), diabetes, high blood pressure, and mortality (Ding et al., 2020) are all caused by the considerable prevalence of inactivity among today's children and young adults. Our study aimed at investigating the time course of changes, if different lengths of resistance exercise resulted in different impacts, and how effectively those changes would be sustained when the training was stopped.

One weakness of the present study is the absence of a control group and the small number of individuals. It is impossible to differentiate the measurable alterations happening during the research from those resulting naturally from growth and maturation. However, the implication is that the resistance training

program was capable of producing noteworthy and long-term changes in body mass index, strength measurements, and body fat. We employed a periodized wave program that included strength exercise to elicit changes in body mass index, strength, power, and body fat in obese or overweight children. Based on the findings from our study, resistance exercise may now be included in regimens aiming at treating childhood obesity. Resistance training in children is recommended by the World Health Organization and several national and international organizations that focus on physical fitness, such as the National Strength and Conditioning Association. The exercise regimen should incorporate whole-body activity and be conducted at a moderate to submaximal intensity for at least 8 weeks with 2-3 sets of 8 to 20 repetitions. This sort of exercise has a good degree of compliance (about 84%) and a low incidence of injury in children. However, it should be noted that a similar rate of compliance between 80 and 100% can also be achieved for aerobic exercise interventions.

Conclusions

The rising frequency of childhood obesity highlights the need of primary prevention. More research is needed to assess whether these trends are continuing to accelerate and to investigate potential causes for these changes, such as eating habits and daily exercise. Finally, this study supports the inclusion of overweight/obese children in a resistance training exercise program. Significant gains in body composition, strength, and power were reported, suggesting that resistance exercise programs may be chosen over additional resistance training regimens in this group.

However, further research is needed to investigate if these improvements can be sustained over a longer span of time (i.e., longer than 6 months) and the impact of long-term resistance training programs, including a control group, as well as nutritional interventions in this population.

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