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Differences in body posture, strength and flexibility in schoolchildren with overweight and obesity: A quasi-experimental study

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ABSTRACT

Background: Body posture and its components have been widely discussed, given the high prevalence of musculoskeletal disorders in children and adolescents. Among children and adolescents with overweight and obesity issues, these changes can be pronounced.
Objectives: This study sought to investigate whether a global exercise routine could result in positive changes in the angles and distances measured in postural assessments and in the number of abdominal and flexibility exercise repetitions performed by children and adolescents with overweight or obesity.
Methods: A quasi-experimental design including an experimental group (EG) and a control group (CG) was used. The primary outcome variables included ratings of body posture (using SAPO software) and measures of abdominal muscle strength (number of sit-ups) and flexibility. The EG received an interdisciplinary intervention the included 48 sessions of global postural exercises performed three times a week.
Results: Of the 46 schoolchildren evaluated (EG, $n = 23$ and CG, $n = 23$), significant changes were observed in the EG from pre-to post-test in the thoracic angle ($p = 0.001$) and abdominal muscle strength ($p = 0.016$) for boys and in the thoracic angle ($p = 0.010$), abdominal muscle strength ($p = 0.003$) and flexibility ($p = 0.010$) for girls.
Conclusions: Overall, the exercise program led to changes in the angle and distance measurements obtained in postural evaluations and contributed to increases in the number of repetitions of abdominal and flexibility exercises, indicating improvements in the EG group's body posture and health indicators.

1. Introduction

Postural deviations affect students of various ages and are considered a public health problem (Detsch, 2005). Posture has therefore been a focus of study among various health professionals seeking to integrate healthy habits into people's lifestyles and prevent future spinal-related health complications (Detsch and Candotti, 2001). The incidence of postural changes is high among school-aged children; while some are typical of human growth and development, others are harmful and can negatively affect quality of life (Penha et al., 2005). It is worth emphasizing that in many children, musculoskeletal injuries are aggravated by obesity; consequently, physical activity and lifestyle changes should be strongly encouraged to prevent such injuries (Esposito et al., 2013).

In Brazil, the association between postural changes and obesity has been studied most recently (Silva et al., 2011), because it is believed that an increase in body mass due to being overweight or obese increases the risk of changes in the musculoskeletal system. Such changes can be clinically significant because they frequently initiate pathological processes that can result in early lesions (Calvete, 2004).

One means of treating postural deviations is through stretching exercises, such as those used in rehabilitation and sports activity

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programs. These exercises can improve flexibility (Kubo et al., 2001) and aid in the treatment of spinal problems and related illnesses, such as postural scoliosis (Weiss et al., 2008), can alleviate growing pains and reduce related back pain (Rocha and Pedreira, 2001).

Different methods and techniques, active or static, are employed to promote muscle stretching (Moreno et al., 2007). The static technique is used to lengthen a targeted group of muscles, focusing on a particular muscle segment (Cabral et al., 2007). In contrast, the active form, also called overall stretching, works to elongate various muscles simultaneously and is based on the concept that a deficit in muscle stretching creates compensation for other muscular structures (Rosário et al., 2004).

Good posture is defined by its mechanical aspect, such as a state of equilibrium among the musculoskeletal components (Kendall et al., 1995; Shumway-Cook and Woollacott, 2002). The trunk flexors and extensors are some of the muscles responsible for sustaining and maintaining good posture. Dysfunctions that affect these muscles can cause disorders of the spine, especially the lower back. To prevent such problems, strengthening exercises for the trunk extensors and flexors are pertinent (Kolyniak et al., 2004). Such exercises aim to strengthen muscles in the trunk, utilizing training with stable or unstable bases to improve health-related components of physical fitness (strength, flexibility) and ability (balance, coordination and speed) (Granacher et al., 2014).

The hypothesis is that an intervention involving global postural exercises can lead to positive changes in the angles and distances identified through positional evaluation using photogrammetry and can increase the number of abdominal sit-ups and flexibility exercises performed by children with overweight and obesity in a school-based sample.

2. Methods

2.1. Study design

This research project was part of a cross-sectional and population-based study developed at the University of Santa Cruz do Sul – UNISC in 2012 that evaluated schoolchildren. Of the 605 schoolchildren evaluated, 16.4% were identified as overweight, and 12.1% were obese. Given the high prevalence of schoolchildren who were overweight, a decision was made to conduct intervention research with this specific population, incorporating global postural exercises.

The present study was approved by the Research Ethics Committee of the University of Santa Cruz do Sul (nº 447353/2013), constituting a quasi-experimental design comprising pre- and post-tests administered to both an experimental group (EG) and a control group (CG).

To calculate the targeted sample size, we used the G*Power program (Faul et al., 2007). We designated a power value of 0.80, an effect size of 0.30 and a 95% significance level. Based on these parameters, the program indicated a need for at least 12 subjects in the EG and 12 subjects in the CG.

2.2. Participants

Our sample contained male and female subjects, ranging in age from 7 to 17 years. Subjects were classified as children or adolescents based on the World Health Organization (WHO) criteria (World Health Organization, 1986), which designate individuals up to 9 years old as children and those 10–20 years old as adolescents. This was a convenience sample of children and adolescents who had presented as overweight or obese, showing a body mass index (BMI) percentile greater than 85.

2.2.1. Inclusion criteria

To be included in this study, the subjects could not have been participating in any exercise program other than physical education classes or physical therapy treatment.

2.2.2. Exclusion criteria

Students with orthopedic impairments, those who used orthoses/prostheses or orthopedic equipment, and any subject with a history of orthopedic surgical treatment were excluded.

2.3. Interventions

Three schools in rural communities of the city of Santa Cruz do Sul-RS were selected, and the children were allocated to the EG ($n = 23$) or CG ($n = 23$). The schools in question were selected based on their similar characteristics to avoid confounding sociodemographic differences and so that the children could maintain full-time activities (as the intervention was developed in proximity to the school).

For subjects in the EG, the intervention program lasted for four months and comprised three 30-min sessions per week, totaling 48 sessions overall. During the program, participants were instructed to perform stretching and strengthening exercises using different equipment such as sleeping mats, tennis balls, volleyballs, basketballs, Swiss balls (Pilates), pool floats (spaghetti) and elastic bands, always with the supervision of a professional physical education teacher and physical therapist.

The sessions were scheduled to alternate between dynamic and isometric exercises for muscle strengthening and stretching. The same session was repeated twice per week so that subjects would be familiar with the activity. Initially, the exercises consisted of 3 series of repetitions with an interval of 15 s between them. For the dynamic exercises, the series included 10 repetitions, whereas the isometric exercises were maintained for 10 s. During the intervention period, an added degree-of-difficulty was incorporated into the implementation. Specifically, in the second month of the experiment, the number of repetitions of exercises in a series rose to 15, while the isometric maintenance time increased to 15 s; the 15 s intervals between sets was kept constant. By early into the third month, the interval of 15 s between sets remained constant, while the number of repetitions for active exercises increased to 20 and the duration for maintaining isometric exercises was increased to 20 s. In the second half of the third month, the number of series, number of repetitions of active exercises and the time of isometric exercises remained the same, but the rest time between series decreased to 10 s. Whenever necessary, researchers intervened so that the subjects remained in proper postures. They also encouraged the subjects to complete the desired number of repetitions. The control group only performed the pre- and post-test and did not participate in any type of intervention.

2.4. Outcome

Evaluations included examinations of photogrammetry to identify angles and distances in body posture as well as assessments of physical fitness and health. According to Jerry et al. (2007), quasi-experimental studies seek to apply the research model to real-life settings, and in these cases, randomization can be difficult. Thus, in our study, the groups were previously defined for convenience, as the three participating schools had similar characteristics: a rural location, participants of similar ages and the presence of students with overweight and obesity. Consequently, the Student t test ($p < 0.05$) was used for statistical analysis to determine the presence of differences among the subjects. If no significant differences were found, the participating schools could choose whether they wanted to belong to the EG or the CG.