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THE EFFECT OF SCHOOL PHYSICAL EDUCATION PROGRAMMES ON LOW-BACK PAIN IN SCHOOLCHILDREN

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Abstract

Objective: to evaluate the efficacy of a 32-week school physical education programme on low-back pain in elementary and secondary schoolchildren. Material and methods: Forty-one elementary school children (fifth-grade, mean age of 10.27 ± 0.31 years) and 43 secondary school adolescents (two-grade, mean age of 13.46 ± 0.68 years) were assigned to the control (n = 40) or intervention group (n = 44). The intervention subjects were involved in an organised physical education programme including hamstrings stretching, endurance strength of the abdominal and lumbar muscles, and pelvic tilt during the two-weekly school physical education classes over 32 weeks. The control group was not subjected to the organized programme. Low back pain was registered and pain intensity was recorded using the Visual Analogue Scale. Results: The experimental group showed a statistically significant decrease of low back pain frequency while the control group evidenced an increase. For pain intensity no significant differences were found. Conclusion: The children and adolescents who were subjected to the school physical education programme showed a reduction of low back pain frequency, while a tendency toward the rising frequency of low back pain was detected for the control subjects.

Key words: *spine, physical exercises, children, adolescents.*

Introduction

Low back pain (LBP) is a common condition in adults, and in recent years it has also been frequently observed among children and adolescents [23]. The incidence has steadily increased in recent decades, with the greatest increase in recent years. Surveys in the literature also report a high prevalence of LBP in children and adolescents that increases with age. The prevalence varies from 10% to 70%, according to different studies and definitions of back pain [5].

Low back pain in adolescence has been linked with continuing pain in adulthood. It is important to prevent and treat LBP in children and adolescents because it has been shown that they also suffer from this condition as adults [16]. The consequences of recurrent LBP in children and adolescents include the use of medication, medical practitioner visits, and loss of participation in physical activity [17, 21, 33]. When back pain in young people is assessed, and the different anatomic areas (cervical, dorsal, and lumbar) are compared, a predominance of low back pain is found [4, 7].

The risk for developing LBP is multifactorial. Decreased muscle flexibility and trunk strength have been postulated as risk factors for low back pain [22]. Poor hamstring flexibility has been associated with low back pain in cross-sectional studies in both adolescents and adults [10, 28]. Other cross-sectional studies have found associations between LBP and reduced strength in abdominal and lumbar muscles, reduced range of lumbar extension mobility, increased range of lumbar flexion mobility [35], and reduced extensibility of the hamstrings muscles [28]. Jones et al. [19] found that hip range of motion, abdominal muscle endurance, lumbar flexibility, and lateral flexion of the spine were the best predictors of recurrent LBP in a group of adolescents. These risk indicators identify the potential for exercise as a primary or secondary prevention method.

Several authors have advocated early back pain prevention through the school system [3, 8, 23, 42] since the school is the primary societal institution with the responsibility for health promotion. Different approaches have been used to prevent back pain in schoolchildren. Primarily,

there have been attempts to prevent back pain by modifications of the school furniture since sitting is found to be strongly associated with back pain in children and adolescents [5, 38] and since inadequate school furniture is frequently taken to be the reason of posture problems and back complaints [40].

Besides modifications of the school furniture a second approach has been used to prevent back pain in schoolchildren, consisting of a variable number of hours of back education [27]. Supervised exercise therapy, brief educational interventions, and back schools have been recommended for reducing pain and improving function in subjects with sub-acute and chronic lumbar pain. Thus, the objective of this study was to evaluate the efficacy of a 32-week school physical education programme on low-back pain in elementary and secondary schoolchildren.

Material and methods

Subjects

Forty-one elementary school children (fifth-grade, mean age at baseline of 10.27 ± 0.31 years) and 43 secondary school adolescents (two-grade, mean age at baseline of 13.46 ± 0.68 years) were randomly assigned to control (n = 40) or intervention group (n = 44). Exclusion criteria included: (1) to participate in any structured physical exercise programme or sport training during the past year, and (2) if the child had physical therapy for lumbar pain during the past month before participation in the study.

Class groups of intervention and control subjects were selected by simple randomization from all class groups of three comparable schools with similar curricula. The physical education teacher and parents were blind regarding the children's groups. Because the physical education teachers collaborated during the intervention, they knew the group to which their pupils belonged, but were not aware of the study's hypotheses. The study protocol was approved by the Ethical Committee of the University of Murcia, and all the parents gave written consent for their children to take part in the study.

Procedures

Pre-test was performed at the beginning of the school year, between September and October, and post-test at the end of the school year, between May and June. The children and their parents filled in self-assessment questionnaire about the week prevalence of low back pain before and after the programme. The children completed the questionnaires at school under the supervision of their class teacher. Low back pain was defined as pain in the area from below the ribs to the hips. Week prevalence was defined as the occurrence of pain or discomfort, continuous or recurrent, at some point in the past week. The children were told that pain or discomfort due to fatigue related to a single exercise was not considered back pain. Pain intensity was recorded using a Visual Analogue Scale (VAS).

Intervention programme

Intervention subjects were involved in organised physical education programme administered by school teachers that included 3 minutes of hamstrings stretching maintaining the spine in a neutral position, 5 minutes of endurance strength of the abdominal (curl-up and isometric side support), and lumbar (lumbar extension and supine bridge) muscles, and 5 minutes of activities for anterior and posterior pelvic tilt during the two-weekly school physical education classes over 32 weeks. However, the control group was not subjected to the intervention programme.

Hamstring stretching

The stretching exercises were performed seated with knees remaining fully extended. The subjects flexed forward at the hip, maintaining the spine in a neutral position until a gentle stretch was felt in the posterior thigh. In all the stretching exercises, the stretched positions were assumed gently and slowly until the end-point of range. Once this position was achieved, the subjects held it for 20 seconds. The physical education teacher instructed them to feel a strain of the hamstring muscles without feeling pain.

Abdominal exercises

Curl up

Subjects were positioned in supine with the knees flexed to 90° and hands over the chest. Instructions were given to gently lift the head and

shoulders off the floor (keeping the head and neck as a rigid block, leaving the elbows on the floor and avoiding head/neck protraction) and concentrate on pivoting the upper body through the mid thoracic region. A normal breathing pattern was maintained throughout the ten repetitions of the curl up.

Isometric side support

Subjects rested on their right elbow and hip (with knees flexed to 90°) and braced their abdominal muscles before lifting the pelvis off the floor to achieve a position where the torso formed a straight line between the bottom shoulder, hip and knee. Verbal cues were given to form a plank with the trunk between the shoulder and knee without allowing rotation of the body. The position was maintained during 10 s in each side.

Lumbar extension

Subjects were asked to lie in a prone position. The subjects lift their shoulder-blades off the floor while holding the trunk around 15° of extension. Ten repetitions were performed.

Supine Bridge

Subjects began by lying supine on the floor with their feet flat on ground, knees bent 90 degrees, toes facing forward and hands on the floor by their sides, palms facing down. Pushing through the heels, subjects lifted their pelvis off the ground to form a plank. Subjects aimed to keep their spines in a neutral position with their legs parallel to their trunk during the bridging exercises.

Pelvic tilt

Several activities for improving anterior and posterior pelvic tilt in standing and supine resting were performed.

Data analysis

The frequencies of low back pain between groups were compared using the chi-squared test. The Mann-Whitney U test was used to compare the intensity of low back pain between groups. Data analysis was performed using SPSS for Windows, version 15.0 (SPSS Inc., Chicago, IL). The level of statistical significance was set at 5%.

Results

A decrease of low back pain frequency in the intervention group and an increase in the control group were found. In the pre-test, eight schoolchildren (9.5%) of the intervention group and ten schoolchildren (11.9%) of the control group referred low back pain. In the post-test (32 weeks after), only two schoolchildren in the intervention group (2.4%) had low back pain at the past month although this reduction was no significant. In the control group nineteen schoolchildren (22.6%) suffered low back pain at the past month ($\chi 2 = 4.43$, $p < 0.05$). For pain intensity no significant differences were found.

Discussion

The main objective of this study was to determine the influence of school postural programme in low back pain. The subjects of intervention groups showed a decrease in the frequency of low back pain, while the subjects of control groups evidenced an increase. Both groups participated in their physical education classes, with similar activities, although the intervention group performed an organized and structured programme including hamstring stretching, trunk exercises and pelvic tilt activities.

The reduced frequency of low back pain in the intervention group may be related to specific activities of the postural programme and its effects about hamstring extensibility, trunk muscles resistance and more control of pelvic tilt. However, the control group with similar curricula but without a specific postural programme showed a tendency to increase the frequency of low back pain.

In children and adolescents, Salminen [33] found a correlation between weakness of the abdominal muscles, decreased hamstring extensibility and back pain. Mierau et al. [1989] found an association of back pain with decreased extensibility of the hamstring muscles among boys aged 14 to 18 years. However, Feldman [11] found no association between LBP and hamstring flexibility measured by the sit-and-reach test.

Some studies have found an improved hamstring extensibility in subjects involved in a postural programme, while the control subjects showed a reduction [31, 36]. Modifications in the hamstring extensibility have been related to changes in the lumbo-pelvic rhythm. The

subjects with lower hamstring extensibility have shown greater thoracic kyphosis and more posterior pelvic tilt when maximal trunk flexion is performed [12, 25, 26, 32]. The higher thoracic kyphosis has been related to greater compressive and shear forces [6,20] and this fact could increase the risk of back pain. An improved control of anterior and posterior pelvic tilt in combination with higher hamstrings extensibility could be associated to healthy lumbo-pelvic posture. More neutral thoraco-lumbo-pelvic postures have been associated with less back pain [39].

The importance of trunk muscles in providing adequate spine stability has been well established. An integrated back stability programme on a chronic low back pain population has been related to significantly reduced pain and disability [29]. Theoretically the trunk exercises of the intervention programme could be related to improved muscle endurance. However, the main limitation of this study was that no measures of trunk muscle strength and endurance were done. Geldhof et al. [13] evaluated the effects of back education in elementary schoolchildren on back function. The intervention lasting two school-years consisted of a back education programme and the stimulation of postural dynamism in the class. Their results showed an increase in trunk flexor endurance in the intervention group compared to a decrease in the controls and a trend towards significance for a higher increase in trunk extensor endurance in the intervention group. In adolescents, Salminen [34] found a correlation between lower physical activity and decreased endurance of the spinal muscles. Andersen et al. [1] found that children with high isometric muscle endurance were less likely to report back pain. Back pain was associated with low isometric muscle endurance in the back extensors. However, Balagué et al. [2] did not show any correlation between isokinetic trunk muscle strength and low back pain history.

Several studies have investigated the influence of postural intervention on low back pain. Two studies found that a back school programme that teach subjects home exercises and self care techniques was related to less pain and perceived disability after the programme than control groups that did not have the training [24, 30]. Geldhof et al. [15] investigated the effects of a 2-school-year multifactorial back education programme on back posture knowledge and postural behaviour in elementary schoolchildren. They also included a control group, and found a trend for decreased pain reports in boys of the intervention group. Chometon et al. [9] showed decreased back pain prevalence and improved body mechanics in a practical test 2 years after 10–11-year-old children had followed back education. Mendez and Gomez-Conesa [35] found improved postural habits and a slight tendency to decreased medical treatment for low back pain, after following a postural hygiene programme.

Because postural habits and body mechanics are impacted on early in life, it seems reasonable that back education should begin during childhood. Geldhof et al. [14] found that multifactorial back education programme in the elementary school curriculum is effective. Whereas the obligatory curriculum provided basic postural knowledge, a back posture programme added important improvement.

School centres should promote correct posture habits, considering that physical education programme seeks to obtain the adequate musculoskeletal development of school children. The school is an ideal setting since it has the potential of optimizing environmental conditions and giving prolonged feedback that reaches a large percentage of the population [31]. Schools hold enormous potential for helping students develop the knowledge and skills they need to be healthy [18]. Because postural habits and body mechanics are impacted upon early in life, it seems reasonable that back education should begin during childhood [37, 41]. More intervention studies are needed to allow the formulation of evidence based guidelines for the prevention of back pain in schoolchildren.

Conclusion

The children and adolescents who were subjected to the school physical education programme showed a reduction of low back pain frequency, while for the controls group a tendency toward rising frequency of low back

pain was detected. These findings should alert education professionals to the need for specific health promotion programmes in schools for prevent low back pain. This observation may have important practical implications in designing school curricula, with more attention on spine health.

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