

Original article (short paper)

Postural education program for elementary school: a one-year follow-up study

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Abstract—The objective of this study was to verify the short- and long-term effectiveness of the Elementary School Postural Program in the performance, generalization, and perception of daily school activities. The final sample consisted of 61 subjects divided into experimental (14 years \pm 0.93; ♀=22; ♂=10) and control group (15.38 years \pm 0.97; ♀=16; ♂=13), all participants attended a Brazilian public school in Porto Alegre, State of Rio Grande do Sul. The postural program included 20 sessions over a 10-week period. In each session, participants discussed and practiced routine actions that typically occurred at schools. Eight other meetings were required for the completion of the pre- and post-tests. The experimental group performed significantly better than the control group in the short-term evaluations, although there were no significant statistical differences in the long-term follow-up evaluations. The children demonstrated a good behavioral response to the postural program; nevertheless, the knowledge had not been completely mastered after a year.

Keywords: posture, postural balance, exercise movement techniques

Resumo—“Programa de educação postural para o ensino fundamental: um estudo *follow-up* de um ano.” O objetivo deste estudo foi verificar a eficiência em curto e longo prazo da escola postural para o ensino fundamental na performance, generalização e percepção das atividades escolares diárias. A amostra final foi composta de 61 participantes divididos em grupos experimental (14 anos \pm 0,93; ♀=22; ♂=10) e controle (15,38 anos \pm 0,97; ♀=16; ♂=13), todos provenientes de uma escola pública de Porto Alegre, RS. O programa postural foi composto de 20 sessões, totalizando 10 semanas. Em cada sessão os participantes do grupo experimental discutiram e praticaram as atividades escolares diárias. Além desses encontros outros 8 foram necessários para a realização dos pré e pós testes. O grupo experimental foi significativamente melhor que o controle nas avaliações em curto prazo, contudo não foi observada diferença significativa na avaliação de longo prazo. As crianças parecem apresentar boa resposta comportamental ao programa, mas esse conhecimento não foi incorporado ao longo de um ano.

Palavras-chave: postura, equilíbrio postural, técnicas de exercício e de movimento

Resumen—“Programa de educación postural para la escuela primaria: un estudio *follow-up* de un año.” El objetivo de este estudio fue verificar la eficiencia en corto y largo plazo del programa de educación postural para la escuela primaria en el rendimiento, generalización y percepción de las actividades escolares diarias. La muestra final consistió en 61 participantes divididos en grupo experimental (14 años \pm 0,93; ♀ = 22; ♂=10) y control (15.38 años \pm 0,97; ♀ = 16; ♂=13), todos de una escuela de Porto Alegre, RS. El programa postural consistió en 20 sesiones durante 10 semanas. En cada sesión, los participantes en el grupo experimental discutieron y practicaron las actividades escolares diarias. Además, otras 8 sesiones fueron requeridas para la realización de los testes. El grupo experimental fue significativamente mejor que el control en corto plazo, pero no en largo plazo. Los niños parecen tener una buena respuesta de comportamiento con el programa postural, pero este conocimiento no se ha sido incorporado más de un año.

Palabras claves: postura, balance postural, técnicas de ejercicio con movimientos

Introduction

Children and adolescents report a growing and alarming amount of back pain complaints. Growing pains might be a natural part of the aging process, and the pain could also be attributed to daily habits. Episodes of back pain were reported in 30% of a sample study ($n=1503$) carried out in Finland

(Salminen, Pentti, & Terho, 1992). In Iceland (Kristjánssdóttir, 1996), a weekly back pain prevalence was reported in 20.6% of a sample of school students ($n=2173$). Similar results were found in another study (Wedderkopp, Leboeuf-Yde, Andersen, Froberg, & Hansen, 2001), which indicated that 39% of the sample subjects had suffered from back pain during the month prior to the data collection. More recently,

Kedra and Czaprowski (2013) presented data from a Polish sample, showing that 12.8% of children and adolescents from 10–19 years of age frequently experienced back pain (more than 1–2 times per month). A meta-analysis conducted by Calvo-Muñoz, Gómez-Conesa, and Sánchez-Meca (2013) indicated that there is growing trend in the lifetime prevalence of low back pain among children and adolescents. In Brazil, there are not many studies about back pain in children and adolescents. Recently, Lemos *et al.* (2013) found that 31.6% of the participants (age from 7 to 17 years old) from a single school reported low back pain. The great increase of back pain reports may be attributed by the growing amount of sedentary children and adolescents over time, and the disagreement about its prevalence may be due to the great variety of methodologies of back pain questionnaires used in different studies.

These studies indeed confirm the early occurrence of painful syndromes of the vertebral column in elementary school students. Postural problems, and the resulting pain that they cause, are likely related to the sexual maturation process (Leresche, Mancl, Drangsholt, Saunders, & Korff, 2005), since great changes in body proportions take place in puberty and could lead to new arrangements that might bring physical discomfort during the adaptation process.

When ergonomics and biomechanical aspects are considered, it becomes clear that the occurrence of back pain may be connected to classroom posture, which might be aggravated by the frequency and duration, especially if it takes place during the period of body structure development (Gallahue & Ozmun, 2000). According to Murphy, Buckle, and Stubbs (2007), remaining seated for a long time, especially in an inadequate manner, can be harmful to the spine, as can picking up objects from the floor or from a lateral side, which could increase intra-disc pressure by 30% (Wilke, Neef, Caimi, Hoogland, & Claes, 1999). School children also often carry heavy school bags that are greater than 10% of their body mass (Hong, Li, & Fong, 2008); if done on a regular basis, this strain could also damage the spine.

Previous data have confirmed situations in which school students may face back pain due to certain movements. A program based on the Back School method (Souza, 1996), which combines theoretical and practical knowledge of the functional and biomechanical anatomy applied to activities of daily living (ADLs), may prove to be an excellent alternative once its contents have been adapted to the activities performed by school students. It would help improve the connection between the body mechanism and the environment and therefore prevent back pain.

Prevention of back pain in school students using a specific methodology is a relatively recent scientifically studied concern, but it can be a satisfactory and effective way to improve understanding of the mechanics and applicability of everyday school movements (Martínez-González, Gómez-Conesa, & Montesinos, 2008). In Brazil, back pain prevention programs for children and adolescents are also scarce. Noll, Candotti and Vieira (2012) presented, in a systematic review, the results of the studies they found. It's clear that a program concerning

back pain prevention is effective for children and adolescents, but it's not clear enough how permanent this knowledge is. It seems that children and adolescents are able to learn and perform all the new skills, but they are not able to repeat this performance some time later (Candotti, Nunes, Noll, Freitas & Macedo, 2011).

This study aimed to verify the short- and long-term efficacy of a postural education program for elementary school in the implementation, application, and awareness of different postures, such as remaining seated, picking up objects from the floor, and carrying school belongings. The contribution of this study is in the fact that its methodology tries to elucidate what happens in an artificial context as well as in a real classroom situation.

Methods

This was a quasi-experimental study in which experimental and control groups were evaluated prior to when the program began, right after it concluded, and one year later. However, only the experimental group took part in the postural education program for elementary school students.

Participants

The calculation of the minimum sample size considered the fact that this work aims to verify differences in at least two points (on a scale of a maximum four points in the evaluation of practical and *in situ* tests, which will be later described) with a .05 significance level and 80% power. Therefore, at least eight subjects were necessary in each sample group. Because a group already existed in a city school, it would have been inadequate and unfeasible to exclude participants. For this reason, a far greater number of subjects than eight were included in both groups, as shown in Table 1. The sample size calculation was done on line (<http://www.lee.dante.br/pesquisa.html>) using the guidelines proposed by Armitage, Berry, and Matthews (2001).

Table 1. Characteristics of the sample (gender and age).

Gender	Experimental Group		Control Group	
	<i>n</i>	Average Age	<i>n</i>	Average Age
Male	10	14.10 ± 0.78	13	15.41 ± 1.16
Female	22	13.95 ± 0.97	16	15.33 ± 0.78
Total	32	14.00 ± 0.93	29	15.38 ± 0.97

Ethics

The study protocol was approved by the Ethical Committee of the Federal University of Rio Grande do Sul (#2007744). Permission for all procedures was also granted from the school board. A consent letter informing students and parents of the study and offering them the option of withdrawing at any stage was signed by both the students and their parents.

Procedure

Postural education program for elementary school

The postural education program for elementary school included a 10-week program composed of 20 sessions of 50 minutes each that took place twice a week. Topics related to the school tasks were approached in theoretical and practical ways: the act of sitting down and remaining seated, the act of picking up light and heavy objects from the floor, and the act of carrying school objects. All meetings followed a specific scheme:

- a) Performing a stretching activity
- b) Evaluating the tasks performed at home
- c) Reviewing previous meetings
- d) Offering a theoretical introduction to the topic
- e) Developing practical applications for the topic
- f) Setting a task for the next meeting
- g) Evaluating the meeting

A description of the themes and objectives of each meeting are shown in Chart 1.

Chart 1. Description of themes and objectives of each meeting of the postural education program for elementary school.

Meeting	Theme/Main objective
I	<i>Evolution of man and his spine</i> Objective: Demonstrate that, when leaving the trees, apes did not undergo as many changes as necessary in their skeletal apparatus, specifically in the spine.
II	<i>The emergence of spinal curves in humans: from birth to adulthood</i> Objective: Enable participants to identify the fact that spine evolution is subject to the laws of gravity as well as to individual needs, such as a larger visual range.
III	<i>Role of spinal curves</i> Objective: Enable participants to identify the normal physiological curves of the spine (cervical, thoracic, lumbar, and sacral) in the context of their functions.
IV	<i>Spine structures</i> Objective: Analyze the spine joints, pointing out that rather than being an isolated entity in our body, the spine is actually closely connected to the hip.
V	<i>Recreational and associative activity</i> Objective: Improve the relationship within the group and the rapport with the tutor.
VI	<i>The spine and movements</i> Objective: Discuss the possibilities of movement of the spine and its joints and their consequences for the spinal curves.
VII	Review of the anatomy and mechanics of the spine
VIII	<i>The act of sitting</i> Objective: Discuss ways of sitting in a chair and the consequences of sustaining the spinal curvature.
IX	<i>Sitting and standing</i> Objective: Provide experiences that illustrate the difficulties and facilities of performing sitting and standing tasks under different body configurations.
X	<i>Sitting</i> Objective: Approach different ways to sit and their consequential sensations.
XI	<i>Sitting and rising from a chair</i> Objective: Engage participants in recreational activities involving the sit-to-stand practice.
XII	<i>Sitting position for writing</i> Objective: Propose alternative ways to keep the spinal curves in a sitting position for writing.
XIII	<i>Picking up objects from the floor</i> Objective: Approach similarities regarding the shape of the spine and the act of sitting or being seated, as well as lifting objects.
XIV	<i>How to pick up objects from the floor</i> Objective: Discuss appropriate and possible ways for picking up objects from the floor.
XV	<i>Review of everyday actions</i> Objective: Review the concepts and practices discussed so far to identify what is quite clear and what needs further reinforcement.
XVI	<i>Picking up objects from the floor</i> Objective: Talk about levers and their uses on a daily basis.
XVII	<i>Outdoor recreational activities</i> Objective: Foster closer ties between the group and mentor, meeting a group demand.
XVIII	<i>Carrying school bags</i> Objective: Discuss the effects on specific parts of the body, especially the spine, of carrying school bags.
XIX	<i>Carrying school bags</i> Objective: Suggest and talk about different ways of carrying school bags and their consequences.
XX	<i>Carrying school bags and overall evaluation of the program</i> Objective: Continue the previous debate and close the program with a special assessment.

Evaluation procedure

The evaluation procedure consisted of a practical test, an *in situ* test, and a questionnaire.

Practical test

The Observation of Daily Life Chores through video¹ (Rocha & Souza, 1999) was the protocol used to evaluate the acts of sitting, remaining seated, and lifting heavy objects from the floor, as well as the sitting for writing position, which is known here as the observation of the school student's ADLs. This laboratory test consists of a track of video-recorded tasks that can be analyzed afterwards. The tasks were graded on a scale of 0–4, depending on the asserted biomechanics arrangement.

This instrument was used to assess students' everyday activities and to analyze the appropriateness of their mechanical movements. Students who took part in this study were filmed performing all-task circuits from a side view. Performances were analyzed using the mechanical criteria. Since all the movements were subject to four mechanical evaluation criteria, each criterion that was properly executed by the participants added a point to the movement. Movements were then scored from 0 (nonappearance criteria) to 4 points (obeying all criteria).

The act of sitting in a chair should meet the following mechanical criteria: (1) maintenance of spinal curves: cervical and dorsal; (2) balance of the pelvis with hip flexion; (3) trunk flexion; and (4) lower limbs apart: measurement greater than or equal to the hip line. The evaluation of the act of remaining seated in a chair pursues the following criteria: (1) maintenance of the spine curves: cervical and dorsal; (2) neutral position of the pelvis: sitting on the ischia; (3) lower limbs apart: measurement greater than or equal to the hip line; and (4) soles of the feet resting on a base or the floor. To evaluate the act of picking up a heavy object from the ground, a 30-cm high, 30-cm deep, and 60-cm wide cardboard box with side handles that weighed approximately 5 kg was used. The criteria analyzed in this task were as follows: (1) maintenance of the spine curves: cervical and dorsal; (2) lower limbs apart: measurement greater than or equal to the hip line; (3) object close to the body; and (4) knee flexion: approximately 90°, with symmetric lower limbs. The last task of the video routine was the act of sitting at a desk to write. There were four criteria analyzed for this movement: (1) maintenance of spinal curves: cervical and dorsal; (2) sitting close to the desk; (3) neutral position of the pelvis: sitting on the ischia; and (4) lower limbs apart: measurement greater than or equal to the hip line. The furniture used in this evaluation was the same as that regularly used by the students in their classrooms.

¹ Although this evaluation protocol have its validity, consistency and reproducibility confirmed by its authors, its use with children and adolescents have some limitations, since the aim of its creation was to cover the adults' posture.

In situ test

The evaluation of the students' sitting posture in their classrooms, which was called the observation of the Seated Posture in the Classroom (SPC), used the same protocol previously described for the act of sitting at a desk to write. Despite using the same evaluation protocol, the video of the participants was recorded in the classroom during regular school hours and lasted 15 minutes for each participant. Postures assumed during this period were graded 0–4 depending on the biomechanical arrangement, as previously mentioned.

Questionnaire

The "Tool for Knowing How Students Perceive Posture in School Environment" (Ritter & Souza, 2006) was applied to determine the level of awareness of participants for their own posture while performing specific school activities (the act of sitting; the act of sitting to write at a desk; the act of carrying school possessions; and the act of picking up light and heavy objects from the floor), which was called the Level of School Students' Perception of ADL. Participants answered questions concerning their habits; later, these answers were rated mechanically from 1–3, depending on their postural adequacy.

Data analysis

The data analysis was accomplished using the Statistical Package for the Social Sciences (SPSS) for Windows (version 12.0). Descriptive statistics were used to present data. Wilcoxon signed rank was employed to detect any significant intragroup difference between pre-tests and post-tests, pre-tests and follow-up tests, and post-tests and follow-up tests. Mann-Whitney *U*-test, in its turn, was used to detect any significant intergroup differences in post-tests and follow-up tests. Regardless of the statistical test, the significance index used was $p < .05$.

Results

Practical test: Observation of the school students' ADL

The results of this observation were obtained by means of the variables: ADL1: the act of sitting down; ADL2: the act of remaining seated; ADL3: the act of picking up heavy objects from the floor; and ADL4: the act of remaining seated while writing at a desk.

A comparison between the control and experimental groups in the post-test indicated that the experimental group presented a statistically significant difference ($p < .05$) across all items. The average scores of the experimental group were better than the control group scores.

Although a significant difference between groups appeared right after the intervention, this result has not been confirmed despite the elapse of one year after its conclusion. The control

group showed no modification in any analysis, whereas the experimental group, which had significantly increased its mean from pre-test to post-test, presented a significant decline ($p < .05$) from the post-test to the one-year-follow-up, as well as going back to the scores obtained at the beginning of the postural program. Table 2 shows the mean and standard deviation (SD) for ADL in all tests and across every period of data acquisition.

Table 2. Observation of school students' ADL.

Groups	Test	Pre-test	Post-test	Follow-up test
Experimental (n=26)	ADL1	1.07±0.91	2.96±0.81**	1.70±0.79†
	ADL2	1.70±0.84	2.62±1.00**	1.60±0.93†
	ADL3	0.97±0.93	1.88±0.89**	0.60±0.77†
	ADL4	0.50±0.57	2.19±0.99**	0.43±0.50†
Control (n=23)	ADL1	0.78±0.95	1.14±0.85	1.32±0.78
	ADL2	1.52±0.79	1.14±0.79	1.73±0.46
	ADL3	0.26±0.69	0.48±0.68	0.36±0.90
	ADL4	0.48±0.66	0.43±0.68	0.59±0.80

* Significantly different from control ($p < .05$); † Significantly different from pre-test ($p < .05$); ‡ Significantly different from post-test ($p < .05$).

In situ test – Observation of the Seated Posture in the Classroom (SPC)

While analyzing the data on the SPC, a statistically significant difference ($p < .05$) was observed in the comparison between the control and experimental groups in the post-test. The experimental group showed a higher mean score in this comparison. In the SPC follow-up study, no difference was found between the groups. It is important to mention that the experimental group presented a statistically significant increase ($p < .05$) in the mean score from pre- to post-test and a statistically significant decrease ($p < .05$) in the mean score from post-test to follow-up. The mean and SD are shown in Table 3.

Table 3. Observation of the Seated Posture in the Classroom (SPC).

Groups	Test	Pre-test	Post-test	Follow-up test
Experimental (n=23)	SPC	1.00±0.79	1.83±0.72**	1.08±0.64†
Control (n=16)		0.67±0.72	0.75±0.93	0.76±0.59

* Significantly different from control ($p < .05$); † Significantly different from pre-test ($p < .05$); ‡ Significantly different from post-test ($p < .05$).

Questionnaire - Level of School Students' Perception of ADL

During the analysis of the comparison of the results between the control and experimental groups in the post-test of the questionnaire, statistically significant differences ($p < .05$) were detectable for the first question, "Which of the figures below best represents the way you normally sit?", as well as in the second question, "Which of the figures below best represents the way that you normally sit down to write?" In both questions, the experimental group showed better mean

scores. The other four questions did not exhibit any statistically significant differences. However, in the follow-up study, students from the experimental group did not maintain their higher post-test scores on questions one and two, and they presented a statistically significant decrease ($p < .05$) in the mean scores. Table 4 shows these results.

Table 4. Level of school students' perception of ADL.

	Test	Pre-test	Post-test	Follow-up test
Experimental (n=27)	Q1	1.59±0.67	1.77±0.43*	1.64±0.58+
	Q2	1.29±0.51	1.81±0.41*	1.36±0.49+
	Q3	1.27±0.45	1.32±0.48	1.33±0.48
	Q4	3.40±0.97	3.73±1.01	3.44±1.13
	Q5	1.25±0.51	1.36±0.49	1.19±0.40
	Q6	1.18±0.39	1.27±0.46	1.14±0.36
Control (n=22)	Q1	1.50±0.52	1.44±0.63	1.56±0.63
	Q2	1.19±0.40	1.31±0.48	1.56±0.51
	Q3	1.19±0.40	1.25±0.45	1.38±0.50
	Q4	3.67±0.82	3.60±0.89	3.55±1.04
	Q5	1.13±0.34	1.31±0.48	1.29±0.51
	Q6	1.31±0.48	1.25±0.48	1.19±0.40

* Significantly different from control ($p < .05$); † Significantly different from post-test ($p < .05$).

Discussion

Every evaluation used in this postural program indicated that immediately after the intervention, there was a statistically significant difference between the control and experimental groups in the post-test, with better results in the experimental group. However, this important distinction was lost when the one-year follow-up assessment was done. The experimental group, which had shown statistical improvement in scores from pre-test to post-test, had its pre-test scores restored in the final evaluation. The control group never showed any statistically significant difference in all three evaluations.

Based on these outcomes, it is possible to infer that the postural education program for elementary school successfully achieved the goal of changing participants' behavior as it approached its conclusion. At that time, the intervention program influenced the participants to reconsider how they performed some tasks in their day-to-day school life. However, this behavior pattern was not consistent enough, as it was not confirmed in the following year.

These results are similar to those found by Candotti, Nunes, Noll, Freitas and Macedo (2011) which used the same ADLs evaluation protocol but did not focused on classroom assessment. Their study concluded that students are able to perform all the tasks better than they did before to posture program, but these behaviors were not repeated eight months later. Results on the same way were mentioned by Fettweis, Henrist, and Vanderthommen (2014). Their experimental group (children

from 6–7 years old) produced a “better back behavior” right after receiving appropriate school furniture and postural education, but the students did not maintain the same performance one year later. The role of any kind of back education in a short-term evaluation is evident even when using simple strategies such as an “educational leaflet.” Springet and Wise (2007) noticed that students (from 11–12 years old) became more conscious about a healthier usage of backpacks after receiving this kind of back care information. Unfortunately, the authors did not perform a long-term evaluation, even though they assumed that it is extremely important to achieve back care effectiveness into adulthood.

Cardon (2000) has pointed out the necessity for long-term studies regarding back care education, specifically when dealing with young people, while Noll, Vieira, Darski, and Candotti (2014) agree, and also admit that there is a lack of long-term research in this field.

According to these opinions about long-term evaluations, this paper aimed to verify the repercussions of the postural education program one year after its conclusion. The results indicated that the intervention program was not efficient enough to maintain behavioral changes after one year. This result differs from that of the study of Méndez and Gómez-Conesa (2001), which focused on the evaluation of ADLs, where the experimental groups had scores significantly higher than those of the control groups even 12 months after the conclusion of their *hygiene program*. Besides investigators, teachers-tutors and physical education teachers took part in some way in the intervention.

In addition, similar results were presented by Cardon, De Bourdeaudhuij, and De Clercq (2001) in their practical test, which consisted of a sequence of ADLs, such as sitting down, standing up, and carrying and moving objects around. However, in their study, only the experimental group “plus,” which received the reinforcement of the teacher, presented a statistically significant difference in relation to the control group for all items of the test. Reinforcement is certainly a key technique when an attempt to change behavior is made.

Conclusions

In spite of all these efforts, the postural education program for elementary school was not thoroughly successful in all tasks in the year that followed its conclusion, but it did show that children in the targeted age group were able to understand and display healthier postural behavior.

Future research

To accomplish an efficient educational program concerning regular daily school activities, some changes must be made to this postural program. Frequent reinforcement should be part of a new approach. To achieve this goal, all school employees and teachers must be prepared so they can help children perform healthier practices. School communities must gather forces to deal with this potential problem. School boards should discuss

ergonomic solutions for each school, such as new chairs, desks, and lockers. Parents also will be required to learn about their children’s posture so they will be able to assist their children at home. Moreover, in this task, they must be assisted by school boards if proper furniture and education are to be attained.

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