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Effects of educational sessions on school backpack use among elementary school students

Efeitos de sessões educativas no uso das mochilas escolares em estudantes do ensino fundamental I

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Abstract

Objective: To evaluate the changes in loads carried, in the model of backpack used and in the way of carrying school backpacks after the implementation of an educational program. **Methods:** This study was performed on 99 children aged seven to 11 years at elementary school level in a private school in São Paulo, São Paulo, Brazil. The subjects' body mass (kg) and height (cm) and the loads carried in their backpacks (kg) were evaluated. The backpack models and the ways of carrying them were evaluated by filming before and after the intervention. The intervention program consisted of educational sessions offered to the children, parents and teachers. The sessions involved lectures about the spine and about the principles of load carrying. The children also received practical guidance relating to correct postures for load carrying. The children received monthly practical reinforcement for three months. The parents and teachers received reinforcement by means of information flyers and guidance on the school's home page. The data were analyzed by means of two-proportion equality and Wilcoxon statistical tests. The significance level was considered as α=0.05. **Results:** The use of a two-strap backpack model increased from 46.5% to 60.6% (p=0.046) and carrying it on two shoulders increased from 41.4% to 55.6% (p=0.047). The load carried in the backpacks decreased by 2.66kg (p<0.001) and the ratio between the subject's body mass and the load carried in the backpacks decreased by 7%. With regard to change per category, the number of subjects in the inappropriate group (load carried>15% of the subject's body mass) decreased (p<0.001). **Conclusions:** The educational sessions promoted changes in backpack use and it was observed a satisfactory adherence to the intervention program proposed. These results demonstrate the importance of Physical Therapy educational programs in schoolchildren's health.
Article registered in the Clinical Trials.gov under the number NCT00536354.

Key words: Physical Therapy (Specialty); primary prevention; schoolchildren's health; child; spine; load-bearing.

Resumo

Objetivo: Avaliar a modificação na quantidade de carga transportada, o modelo e o modo de transportar mochilas escolares após sessões educativas. **Métodos:** Estudo de uma série de casos, com 99 crianças de sete a 11 anos do ensino fundamental, em escola particular da cidade São Paulo, São Paulo. Foram avaliadas a massa corporal (kg) e estatura dos alunos (cm), quantidade de carga transportada nas mochilas (kg). Os modelos e os modos de transporte das mochilas foram avaliados por filmagem pré e pós-intervenção. Como medida de intervenção, os sujeitos (crianças, pais e professores) foram submetidos a uma sessão educativa, que consistiu de orientações teóricas sobre coluna vertebral e transporte de carga. Para os escolares foi adicionada orientação prática das posturas corretas no transporte de carga. Os escolares receberam um reforço prático mensal por três meses. Pais e professores receberam reforço em folheto informativo e orientações na homepage da escola. Os dados foram analisados pelos testes estatísticos de igualdade de duas proporções e Wilcoxon. O nível de significância adotado foi 5%. **Resultados:** O modelo de mochila modificou para duas alças de 46,5% para 60,6% (p=0,046), modo de transporte para ombro bilateral de 41,4% para 55,6% (p=0,047). A carga transportada nas mochilas diminuiu 2,66kg (p<0,001) e a relação massa corporal do sujeito e carga transportada nas mochilas diminuiu 7%. Na modificação por categorias, o número de alunos do grupo inadequado (carga transportada>15% da massa corporal do aluno) diminuiu (p<0,001). **Conclusões:** As sessões educativas promoveram mudanças na utilização de mochilas, revelando adesão satisfatória ao modelo de intervenção proposto entre os escolares e o importante papel da Fisioterapia na saúde escolar.
Artigo registrado no Clinical Trials.gov sob o número: NCT00536354

Palavras-chave: Fisioterapia (Especialidade); prevenção primária; saúde escolar; criança; coluna vertebral; suporte de carga.

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Introduction

In recent years, school health has been the object of attention in the scientific community, especially with regard to postural changes of the spine and back pain in children and teenagers. Due to the great number of spinal disorders in adults, researchers investigate children and adolescents to find the possible causes for these disorders[1].

Postural changes of the spine and back pain in children are considered multifactorial. Some of the most emphasized factors in scientific reports are habits related to school activities[1]. Long periods of time in the seated position, the load carried in school backpacks, and the backpack model and mode of transport have been studied[1-5]. Although the scientific community has yet to identify the backpack load limit for children and the best mode of transport, several authors agree that the load should not exceed 10% of the body mass and that the backpack should be carried on both shoulders[1,3-6]. Moreover, children should be guided regarding the correct use of backpacks[2,6].

Incorrect postural habits developed since elementary school can generate irreversible changes in children as ligaments and intervertebral discs suffer a degenerative process throughout life and do not have regeneration mechanisms[7]. These findings justify the creation of prevention programs to reduce the risk of postural changes and back pain in schoolchildren due to inadequate use and transport of school backpacks. The life goal of schoolchildren is to play, therefore any pain that deprives them of that is a source of worry[8].

Preventive training programs that combine education and movement have good repercussion as a form of improving posture[9-14]. Meta-analyses show evidence of a decrease in chronic low back pain after a training program known as Back School[15,16]. This method was developed by Mariane Zachrisson-Forsell in 1969 and proposes a group of measures to prevent the relapse of back pain in the working population. The program is usually applied in three to four weekly meetings of one hour each in which the anatomy, biomechanics and physiopathology of back pain are discussed. It also covers instructions on ergonomics and correct postures for occupational and daily activities combined with stretching and strengthening exercises[17].

The Back Schoolchildren program is held in classrooms[18-21] with the aim of preventing back pain and postural changes in children and adolescents. Cardon, De Clercq and De Bourdeaudhuij[18,19] investigated this type of postural education program by conducting a six-week intervention study with 129 fourth and fifth grade students. The program generated significant modifications in the knowledge of spinal care as confirmed by a one year follow-up[20]. Other studies also described significant modifications in the mode of transport, the load carried and the awareness of the relationship between backpack use and health[11,12,21,22].

Although the literature describes guidance and educational programs related to the use of school backpacks, there is weak evidence of the effect of these programs on low back pain prevention and postural changes in children and on low back pain in adults[14,23]. The systematic review of the European Guidelines for Prevention in Low Back Pain[14] classifies the postural education interventions in schoolchildren as C level of evidence, i.e. evidence from one randomized controlled trial or inconsistent findings from multiple weak scientific studies. They also recommend new studies on postural education based on biomedical and/or biomechanical[23] data in order to reach a consensus on intervention measures and reduce the number of back pain complaints that interfere greatly in the quality of life and health of the population[14]. With regard to children, the proportions are even higher as pain inhibits the sensorial experimentation that is so important for the development of posture and movement control and that causes premature motor limitation[8].

Physical therapists have been facing this growing problem in daily practice. The role of physical therapy in school health is still limited, and the focus of the physical therapy professional should be on the preventive aspects of postural care during school activities[6,7].

Thus, the aim of this study was to evaluate the effect of educational sessions with lectures on theoretical concepts, practical experience in correct posture for school backpack use, the right load and model, and the best mode of transport. The sessions were given to elementary schoolchildren of a private school in the city of São Paulo.

Methods

Study design

We conducted a case study with a four-month follow-up after approval from the Research Ethics Committee of Hospital das Clínicas and the Medical School of Universidade de São Paulo (HC-FMUSP), protocol number 669/05.

One hundred and seven students with mean age 8.98 (±1.23) years attending first to fourth grade at a private school in the city of São Paulo took part in the study. The inclusion criteria were: enrollment in first to fourth grade; age between

seven and 11 years; ability to read and write; no medical or physical therapy treatment for musculoskeletal disorders at the time of the study; attendance at the two evaluations; and signed parental or guardian consent. Eight students who were absent in the second evaluation were excluded from the research.

Methods

Evaluation charts were used to characterize the sample and record the measurements of the students and the equipment used, which included: a Filizola® anthropometric scale (model 31); a Toledo® scale (model 3400); a Sony® video camera (Handycam vision CCD-TRV65 Hi 8 XR) and tape (model CCD-TRV65); a tripod (Tripod model 950); and a Canon® digital camera and multimedia program.

After inclusion in the study, the students were submitted to pre- and post-intervention evaluations which consisted of taking video footage to assess the mode of transport of the backpack, recording the personal details, body mass (kg) and height (cm) of the students. We also recorded the load carried in the school backpack (kg), the backpack model and the amount of school material (kg) required for class each day.

Evaluation

- Mode of transport: a hidden video camera was installed by the school's main entrance without prior notice to film the schoolchildren at the moment of arrival for five consecutive days[9,17]. The video camera was removed after the footage was taken. The footage was classified according to four modes of transport (unilateral shoulder, bilateral shoulder, manual and manual/wheel transport)[2].
- Backpack model: students completed the personal details section of the evaluation chart and were photographed to facilitate the identification in the video recording. The backpack models were classified according to the three most common types (single strap, double strap and wheeled backpacks)[2].
- Load: the anthropometric scale was calibrated beforehand following manufacturer specifications, and the collected data was double-checked on a digital scale. The anthropometric scale was used to quantify the body mass (kg) and height (cm) of the subjects and to calculate the load percentage that the subjects could carry. After that, the backpack load (kg) was measured. Based on data from the first evaluation, the schoolchildren were divided into three categories for classification of the backpack load (adequate – load ≤10% of body mass; acceptable – load between 10 and 15% of body mass; inadequate – load >15% of body mass)[1-6,24].

Intervention

Educational sessions

After the initial evaluation, three lectures on postural education were held. The first session was aimed at parents and/or guardians, and the second at the school teachers and principals. The third lecture was aimed at the schoolchildren who took part in the study, and it was based on the Back Schoolchildren concept[18-21]. During the one-hour sessions, the following contents were discussed: concepts of the anatomy, biomechanics and physiopathology of spinal injuries; guidance on excessive backpack load, appropriate model and mode of transport; instructions on the amount of school material required each day and on the purchase of lighter material.

In the session aimed at the children, the content was divided into theoretical concepts and practical guidance on correct posture in the following situations: 1) standing with head and trunk upright, shoulder height, arms to the side and feet shoulder-width apart; 2) standing with double strap backpack, bilateral shoulder transport and load of 10% the body mass.

Monthly reinforcement

After intervention, children received reinforcement on the instruction for three months. In those 60-minute monthly meetings, the practical guidance was reinforced in the classroom. As reinforcement for parents and/or guardians, an A4-size pamphlet was created with a summary of the lecture content. This pamphlet was also displayed in poster form in the classrooms and teachers' lounge to serve as reinforcement to the teachers and the schoolchildren. The lecture content was included in the school website.

Four months after the initial evaluation and intervention, the children were re-evaluated.

Statistical analyses

The qualitative variables were summarized in simple and relative frequencies, and the statistical test for the equality of two proportions was used. The quantitative variables were expressed in terms of mean, median, standard deviation, quartiles, coefficient of variation and confidence interval, and the Wilcoxon test[25] was used. Non-parametric tests were used because the analyzed variables did not present normal distribution.

The change in backpack load was quantitatively analyzed through the following variables: absolute mass (kg), which corresponds to the student's body mass and the load carried in the backpacks (kg); and relative mass (%), which corresponds to the body mass-load ratio. For the qualitative evaluation of the change in backpack load, the following classification was used: adequate (≤10%), acceptable (between 10 and 15%) and inadequate (>15%)[1-6,24].

The α level considered for the analyses was set at 0.05; 95% confidence intervals were presented. The software Statistical Package for Social Sciences (SPSS) 11.0 was used for the analyses.

Results

The results of this study refer to 99 subjects, with mean age of 8.98 (±1.23) years, out of which 48.5% (n=48) were female and 51.5% (n=51) male; 23.2% (n=23) were in first grade, 20.2% (n=20) in second grade, 31.3% (n=31) in third grade and 25.3% (n=25) in fourth grade.

Table 1 shows changes in the backpack model. There was an increase in the number of students who carried the double-strap model (p=0.046), a reduction in the number of children who carried wheeled backpacks (p=0.021) and an increase in the number of those who carried the single-strap model, without statistical relevance (p=0.234).

Analysis of the video footage revealed modifications in the mode of transport. The bilateral shoulder mode increased from 41.4% to 55.6% (p=0.047), and the manual mode dropped from 5.1% to 0.0% (p=0.024). There was a decrease in the number of subjects who pulled the wheeled model from 44.4% to 32.3% (p=0.08). For the unilateral shoulder mode variable, the results indicated an increase from 9.1% to 12.1%, without statistical significance (p=0.489).

Table 2 shows the change in backpack load. There was a significant reduction in the absolute mass variable both for student body mass and for backpack load (p<0.001). The mean difference for the change in backpack load was 2.66kg (IC95%=2.36-2.96). There was also a significant reduction in the relative mass variable (p<0.001) with a mean difference of 7% (IC95%=6.1-7.8).

Figure 1 shows the change in the number of students per category according to backpack load. The results revealed a significant statistical difference in all of the assessed categories (p<0.001). There was a significant reduction in the percentage of subjects classified as inadequate (IC95%=7.4-8.4) and a percentage increase in the subjects classified as adequate (IC95%=3.4-9.1) and acceptable (IC95%=6.9-9.8). The greatest migration was observed in the subjects that went from the inadequate group to the acceptable group.

Table 1. Changes in the backpack model between evaluation and post-intervention.

Backpack Model	Pre-Intervention		Post-Intervention		p-value
	Qty	%	Qty	%	
Single Strap	4	4.0	7	7.1	0.234
Double Strap	46	46.5	60	60.6	0.046*
Wheeled Backpack	49	49.5	33	32.3	0.021*

*=significantly different from the pre-intervention values (p<0.05).

Discussion

The results of this study revealed significant changes in the schoolchildren's backpack use before and after the intervention in terms of backpack model, mode of transport and mainly in the backpack load.

Feingold and Jacobs[10] evaluated the effects of an educational program on backpack use and found higher adherence to the given recommendations in the intervention group (87.5%) than in the control group. Goodgold and Nielsen[12], in an intervention study with 242 subjects, showed that 52% of the subjects changed the way they used backpacks and 93% improved their knowledge of how to use backpacks. Although these studies show methodological differences in age, number of subjects, duration of instruction and model of intervention,

Table 2. Changes in the load carried inside the backpacks between pre- and post-evaluation considering the Absolute Mass (kg): body mass plus load carried inside the backpack, and the Relative Mass (%): body mass per load carried.

Absolute Mass (kg)	Body Mass (kg)		Load (kg)		Relative Mass (%)	
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention
Mean	37.26	36.17	6.92	4.26	19.3%	12.3%
Median	36.8	35.1	6.9	4.3	19.0%	12.3%
Standard Deviation	8.69	9.32	1.48	1.46	5.0%	4.6%
Confidence Interval	1.71	1.84	0.29	0.29	1.0%	0.9%
p-value	<0.001*		<0.001*		<0.001*	

*=significantly different from the pre-intervention values (p<0.05).

the conclusions show satisfactory adherence of schoolchildren to educational programs.

The changes in the backpack model and mode of transport are related to the instructions received in the educational session, which emphasized comfort and body symmetry during load bearing[2-6] and recommended the bilateral shoulder use of double-strap backpacks. This recommendation was a result of the findings of the first evaluation, including wheeled backpacks with a total mass of more than 10kg when the school material required for the day did not exceed 1.5kg (textbook, school diary and pencil case). The wheeled backpacks alone (between 5 and 7kg) already exceeded the safe load-bearing limit of 3.68kg. This limit was based on the mean values for the children's body mass found in the first evaluation. The video footage also revealed that the children had to climb a flight of stairs to reach the classrooms, and the wheeled backpack generated overload and asymmetry because the children stopped pulling the wheeled backpacks and had to carry them to overcome the obstacle.

During the educational sessions, the children, the parents/guardians and the teachers received guidance on the overload and asymmetry generated by the structure of the wheeled backpack while climbing the stairs. This fact may explain the change in backpack model between the two evaluations. Cardon et al.[21] and Méndez and Gómez-Conesa[22] claim that parent and teacher participation is an important reinforcement to the given recommendations. However, in this present study it was not possible to assess the role of the parents in the changes. Only five parents were present at the educational session, and in spite of the reinforcement through pamphlets and inclusion of the recommendations in the school website, there was no assessment of the effect of the intervention on parents and teachers.

Regarding the mode of transport, the results demonstrated significant statistical difference in the variables for manual and bilateral shoulder transport. An interesting piece of data observed in this study was that the fourth-grade children who did not adopt the use of backpacks on the shoulders switched to small bags and binders close to the body. This shows that they assimilated the concept of body symmetry and reduced the load. These results agree with Mackie et al.[2] whose study comparing the use of different backpack models for teenagers concluded that the acceptance of a backpack model and mode of transport are more closely related to image and personal style than to function and fitness.

Another important aspect related to mode of transport refers to the 60.6% increase in the use of the double-strap model. However, the bilateral shoulder transport variable rose to 55.6% and the manual transport variable decreased from 5 to 0% in the second evaluation. Therefore, the migration to a different backpack model did not determine the migration to the corresponding mode of transport. These results may be due to the various forms of carrying a backpack regardless of the model, i.e. children's wheeled backpacks that also had double straps as a transport option.

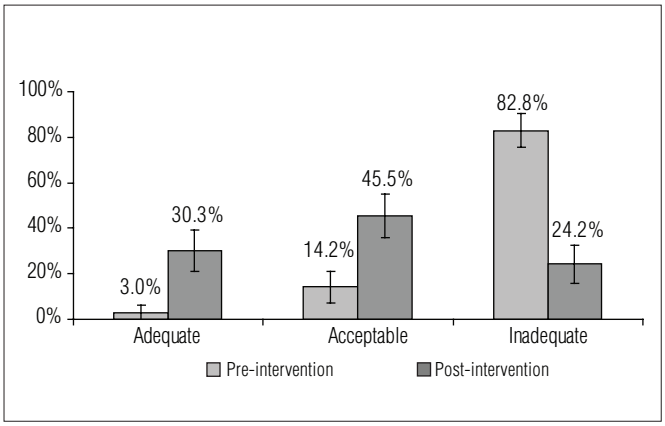

Figure 1. Changes in the percentage of students classified according to the load carried inside the backpack: adequate (<10%), acceptable (>10% up to 15%) and inadequate (>15%)±IC(95%) (p< 0.001).

The change in the backpack load results demonstrated significant statistical differences for all the assessed variables. Although the load carried in the backpacks had a mean decrease of 2.66kg, the schoolchildren's body mass values also decreased. That data could interfere in the analysis of the change in backpack load, therefore the relative mass variable, which also decreased, was chosen to confirm the findings. Other intervention studies found similar results for reduction in the backpack load[10,12,18,20].

In this study, the findings on backpack load were classified according to the relationship between load and risk of presence of pain or spinal changes described in the literature, i.e. safe load of up to 10% of the child's body mass[1-6] and back pain or spinal changes associated with loads greater than 15% of body mass[1,3-6,24]. The most significant change was observed in the inadequate group, with a 58.6% reduction, which demonstrates that the proposed program was effective in decreasing the load, considering the critical value given to the presence of pain and spinal changes due to excessive load bearing.

According to the School Census conducted by the Brazilian Health Department in 2000, there are 181,504 elementary schools in the country with students at the appropriate age to develop healthy habits and values. The Census also revealed the need to develop integrated and cohesive educational measures for this population to be successful and influential[26].

Based on this information and on the results of this study, we recommend the participation of physical therapists in

primary prevention programs aimed at educating the public about healthy postural habits. We also recommend that new studies be conducted using control groups and more extensive follow-up periods given the scarcity of studies on postural education in schoolchildren[14] and the fact that the references of the present study are from other countries with habits and health conditions that differ from those of the Brazilian population.

Conclusion

The results of this study demonstrated that intervention measures based on postural education promote significant changes in backpack use. This was especially evident in the decrease in backpack load and in the good acceptance on the part of the schoolchildren of educational programs proposed by physical therapists.

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