Effects of a two-school-year multi-factorial back education program in elementary schoolchildren.

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Abstract

The present study evaluated the effects of a two-school-year multi-factorial back education program on back posture knowledge and postural behavior in elementary schoolchildren. Additionally, self-reported back or neck pain and fear-avoidance beliefs were evaluated. The study sample included 193 intervention children and 172 controls (baseline 9-to-11 year olds). The intervention consisted of back education and the stimulation of postural dynamism in the class. Evaluation consisted of a questionnaire, an observation of postural behavior in the classroom and an observation of material handling. The intervention resulted in increased back posture knowledge (P<.001), improved postural behavior during material handling (P<.001) and decreased duration of trunk flexion (P<.05) and neck torsion (P<.05) during lesson time. Fear-avoidance beliefs were not increased and there was a trend for decreased pain reports in boys of the intervention group (P<.09). The long term effect of improved postural behavior at young age on back pain prevalence later in life is of interest for future research.

Keywords: children, back education program, school environment, back pain, primary prevention

1. Introduction

Epidemiological studies over the last 20 years report mounting non-specific back pain prevalence among youngsters [1,2,3]. The multi-factorial nature of the risk for developing back pain in childhood is widely accepted [4] and complicates the determination of predisposing factors and preventive measures. In order to provide evidence on early prevention in low back pain, the determination of modifiable risk factors and the results of school-based interventions are essential [5].

Recent studies have demonstrated that psychosocial factors play an important role in children‘s self-reported back pain [2,3]. Epidemiological evidence [1,2,3,4] and biomechanical argumentation related to the concepts of spinal loading [6] suggest that biomechanical factors might also be related to back pain occurrence at young age. The limited literature supports the presumption that the school environment exposes children to possible loading factors related to prolonged poor sitting [7], absence of appropriate furniture [8] and backpack use [9]. In consequence, the school is an ideal setting for back pain prevention since it has the potential of optimizing environmental conditions and giving prolonged feedback reaching a large percentage of the population.

Focusing on school-based interventions, a limited number of multi-factorial intervention studies could be located [5]. In the study of Cardon et al [10] the implementation of a six-week back education program had a significant impact on the use of back education principles up to one year. However, a transfer of postural principles into the daily unconscious sitting behavior of the child was not found. In a supplementary study, extra support formulating specific guidelines for class teachers in order to enhance the implementation of learned principles turned out to be efficacious [11]. The intervention study performed by Mendez [12], established increased back-care-related knowledge and improved general postural habits. Three other intervention studies had methodological restrictions, like limited participants [13], a non-randomized study design [14] and a relatively short implementation time [15]. It was concluded that intervention studies in the elementary school are promising but too limited to formulate evidence-based guidelines [5]. However, in contrast to the promising aspects of early back education, Burton [16] warned for a possible increase of children's fear-avoidance beliefs due to increased awareness. Moreover, the lack of evidence for the direct impact of primary prevention on back pain prevalence, certainly in children, is a critical point in the prevention discourse [17].

Therefore, the purpose of the current intervention study was to investigate the effects of an optimized two-school-year multi-factorial back education program on knowledge and postural behavior in elementary schoolchildren in Flanders. An additional aim was to evaluate self-reported back and neck pain at young age and fear-avoidance beliefs. The comprehensive intervention was a multi-factorial program during two school-years with additional focus on sitting in the school context and with interactive involvement of external experts, physical education teachers and class teachers.

2. Material and methods

2.1. Subjects

Eight Flemish elementary schools were selected by simple randomization. Children were randomized at school-level into the intervention and the control group (10 intervention class groups out of 4 schools, 10 control class groups out of 4 schools). Identical standard furniture was used in all classes. At baseline, the study sample consisted of 398 schoolchildren. Thirty-three children dropped out as they changed school. At posttest the intervention group consisted of 193 participants (93 boys, 100 girls; age 11.3 ± 0.8 years) and the control group included 172 children (82 boys, 90 girls; age 11.4 ± 0.8 years).

Before the start of the intervention, all parents signed an informed consent form. The study protocol was approved by the Ethical Committee of the University Hospital of the Ghent University.

2.2 Intervention

The multi-factorial intervention consisted of a back education program and the stimulation of postural dynamism in the class. 'Postural dynamism' stands for frequent posture changes in addition to variable and dynamical activities.

2.2.1 Back education

The basic program consisted of six back education lessons at one-week interval, taught by a physical therapist to one class group at a time. Pupils were taught anatomy and pathology of the back and the basic principles of biomechanical favorable postures. Besides back posture theory, skills related to good body mechanics were taught and practiced.

Additionally, the current intervention included intensifying components in order to optimize the integration of back posture principles into the daily classroom routine. Therefore, teachers were asked to be present during all sessions and received a comprehensive manual including the six lessons and back ground information. Besides, didactic material was provided and guidelines were presented.

2.2.2 Support and environmental influence

Another optimization included the focus on postural dynamism during daily class activities. Two basic principles were elaborated: stimulation of dynamical sitting and prevention of prolonged static sitting. Stimulating dynamical sitting, active and variable sitting were reinforced by providing two pezzi balls, a dynair and a wedge in each classroom. The children passed the elements systematically in the recess after two lessons. In order to interrupt prolonged static sitting, short movement breaks between the lessons were introduced. Twice a day movement breaks were organized in the class, supplementary to the recess. Finally, class teachers were encouraged to teach following an activating approach (e. g. distribution of handouts systematically through children, variable work organizations) and to change structural class organizations, (e. g. decentralized storing places for textbooks and schoolbags).

2.3 Procedure

2.3.1 Evaluation

Pre-testing occurred during September and October 2002. The intervention started in November 2002. Post-testing was performed from April until June 2004. For the total sample, pre- and post-test evaluation consisted of a questionnaire and of an observation of material handling. Additionally, in each class group three children were selected by simple randomization in order to observe postural behavior in the classroom. The same subjects were observed at baseline and at post-test. However, due to technical limitations and absence on day of testing, the intervention group included less classroom observations.

2.3.2 Intervention

The intervention started with the 6 sessions back education. Subsequently, class teachers were involved in the promotion of good body mechanics implementing intervention guidelines. All parents of intervention children were informed about the program through an information session and a brochure.

Teacher's application of guidelines was not encouraged externally. However, 6 activities related to good body mechanics were organized by the test leader for the teachers and the children (e.g. quiz, contests).

2.4 Instruments

2.4.1 Questionnaire

Children completed a questionnaire at school under supervision of the class teacher. The questionnaire was based on previous research in 9 to 11 year olds [18], representing good test-retest stability.

One part evaluated specific back posture knowledge and included 10 questions directly corresponding to the content of the back education program. Another part evaluated 11 general back posture items. Additionally, the questionnaire evaluated prevalence of back and neck pain within the last week. Severity of back or neck pain was indicated on a 5-point-scale (a little bit pain, a bit pain, modest pain, much pain, very much pain) and frequency on a 4-point-scale (once, several times, frequently, continuous). Moreover, fear-avoiding beliefs were evaluated analyzing 5 questions on a 5-point-scale (definitely yes to definitely no on questions related to physical activity). A high score represented low-fear-avoidance.

2.4.2 Observation of material handling

During recess a movement session was organized in order to observe the use of back posture principles, based on previous research [19]. The observation of 'material handling' was organized in the gymnasium and presented to the children as an evaluation of throw and catch skills. Children were not told that the use of back posture principles was being tested.

A side-view positioned camera registered the children during lifting, carrying and putting down a bench, picking up a light object (shuttle) and moving a heavy object (medicine ball). Afterwards, children's postural behavior performing the latter tasks was encoded qualitatively (0-4) with high scores representing performances conform the learned back posture principles.

2.4.3 Portable Ergonomic Observation method (PEO)

Using the Portable Ergonomic Observation method [7], children's body postures and activities in the classroom were recorded with unmanned cameras. Children were observed during 30 minutes of a regular lesson. The categorizing of 'postures' and 'activities' from a previous study demonstrating good test-retest and inter-test reliability was used (Geldhof et al. in press). For all postures and activities, the percentages of the observed time interval (duration to the nearest 1 second) were recorded by the PEO software package.

2.5 Data analysis

Data analysis was performed using SPSS 11.0. Repeated Measures ANOVA were used to evaluate intervention effects in a pre-post design. Time was included as within-subjects factor (pre versus post) and condition as between-subjects factor (intervention versus control group). Gender was analyzed as second between-subjects factor (boys versus girls).

3. Results

The changes in back posture related knowledge, postural behavior in the classroom and postural behavior during material handling are respectively presented in table 1, table 2 and table 3. None of the three-way interactions (gender x time x condition) were significant, which means that the intervention effects were similar in boys and girls.

pain).

Table 1 Mean scores on the knowledge for the intervention and the control groups at baseline and in the posttests

Knowledge *(theoretical maximum)*	Score (x ± SD)				Interaction-effect
	Pre		Post		F
	Intervention	Control	Intervention	Control	T x C
General back posture knowledge *(11)*	1.0 ± 3.9	0.7 ± 3.4	5.1 ± 2.9	2.7 ± 3.0	18.984**
Specific back posture knowledge *(10)*	4.9 ± 7.4	5.0 ± 7.2	7.5 ± 4.6	6.3 ± 4.2	12.594**

x= mean, SD= Standard Deviation T x C = time x condition
intervention group n=156, control group n=161 ** P <.001

Table 2 Postural behavior during lesson time for the intervention and the control groups at baseline and in the posttests

Postural behavior in the class		Duration in % (x ± SD)				Interaction-effect
		Pre		Post		F
	Postural aspects	Intervention	Control	Intervention	Control	T x C
Activities	Reading and writing	66.3 ± 21.2	67.8 ± 32.3	66.4 ± 27.2	60.7 ± 21.3	.559
	Static sitting	86.8 ± 9.9	84.3 ± 9.1	76.5 ± 9.8	77.9 ± 10.3	1.383
	Dynamic sitting	8.8 ± 6.1	8.7 ± 5.1	17.5 ± 7.1	15.6 ± 7.6	.641
	Standing	2.4 ± 3.5	3.1 ± 4.0	1.2 ± 2.5	1.3 ± 2.5	.410
	Walking around	0.9 ± 1.5	1.5 ± 1.5	1.3 ± 1.6	1.1 ± 1.6	2.590
Postures	Trunk flexion	36.0 ± 26.7	16.5 ± 19.4	18.1 ± 27.3	25.5 ± 31.4	8.931*
	Trunk torsion	4.2 ± 4.7	2.3 ± 3.6	1.1 ± 1.6	1.3 ± 2.2	3.452$
	Neck flexion	50.4 ± 15.6	45.8 ± 19.1	51.4 ± 16.1	48.1 ± 15.7	.040
	Neck torsion	15.9 ± 9.6	9.8 ± 7.8	13.9 ± 9.4	14.5 ± 7.4	4.207*
	Use of backrest	31.1 ± 25.4	35.4 ± 25.2	67.8 ± 26.8	75.2 ± 29.3	.114
	Arm support	86.3 ± 12.1	83.2 ± 12.3	82.9 ± 13.2	85.8 ± 9.3	2.736

x= mean, SD= Standard Deviation T x C = time x condition
intervention group n=26, control group n=35 * P <.05; $ P <.07

Table 3 Postural behavior during material handling for the intervention and the control groups at baseline and in the posttests

Postural behavior during material handling	Score per item (x ± SD)				Interaction-effect
	Pre		Post		F
Items *(maximal encode score)*	Intervention	Control	Intervention	Control	T x C
Back position while lifting bench *(4)*	0.99 ± 1.23	0.55 ± 0.97	2.99 ± 1.10	2.52 ± 1.28	.027
Knee bending while lifting bench *(4)*	1.65 ± 0.97	1.58 ± 1.08	3.10 ± 1.25	1.85 ± 1.26	40.797**
No twisting while lifting bench *(4)*	3.34 ± 1.23	3.52 + 1.08	3.64 ± 1.00	3.35 ± 1.35	6.065*
Body posture while moving bench *(4)*	3.10 ± 1.29	2.98 ± 1.46	3.81 ± 0.63	3.11 ± 1.17	9.115*
Knee and back position putting down bench *(4)*	1.51 ± 1.29	1.28 ± 1.19	2.78 ± 1.36	1.06 ± 1.39	55.299**
No twisting while putting down bench *(4)*	2.91 ± 1.78	3.35 ± 1.49	3.85 ± 0.77	3.14 ± 1.65	21.855**
Picking up light object *(4)*	2.25 ± 1.00	2.00 ± 0.96	2.51 ± 0.83	2.20 ± 0.96	.167
Knee bending while lifting heavy object *(4)*	0.64 ± 1.14	0.45 ± 1.04	1.23 ± 1.77	0.25 ± 0.93	14.264**
No twisting while moving heavy object *(4)*	0.96 ±1.25	0.74 ± 1.27	1.54 ± 0.99	1.00 ±1.06	2.770
Total score on good body mechanics *(36)*	17.36 ± 4.82	16.46 ± 4.20	25.44 ± 4.66	18.48 ± 5.43	72.130**

x= mean, SD= Standard Deviation T x C = time x condition
intervention group n=153, control group n=124 ** P <.001; * P <.05

The change in back and neck pain prevalence is presented in table 4. Additionally, at baseline, 53% of the intervention children and 62% of the controls reported low intensity of pain (very little or a little bit

At posttest, respectively 75% and 77% reported low intensity of pain. Furthermore, at pretest 78% of the intervention children and 89% of the controls reported that the pain occurred only once or several times. At posttest, 80% of the intervention children and 83% of the controls mentioned that their pain occurred only 'once' or 'several times' within the last week.

No significant time by condition interaction was found for fear-avoidance beliefs (F=1.527, ns). At pretest, the mean score (range 5-25) was 13.2 (± 5.2) in the intervention group and 11.8 (± 4.6) in the control group. At posttest, the mean score was 13.3 (± 4.2) in the intervention group and 12.7 (± 4.2) in the control group. The three-way-interaction on fear-avoidance beliefs was not significant (F=2.284, ns).

flexed postures and trunk torsion were associated with self-reported lumbar pain. Moreover, in a previous intervention study sitting postures during lesson times did not improve [18]. The present intervention was optimized by implementing several ergonomic elements encouraging active and variable sitting in the classroom. Due to randomized selection, all children were sitting on traditional material during the class observation. Nevertheless, even when children used traditional furniture, several aspects in postural behavior improved due to the intervention.

Table 4 Self-reported pain in boys and girls of the intervention and the control groups at pretest and at posttest

Prevalence	Prevalence in %						Interaction-effect
	Pre			Post			F
	Intervention	Control	Total	Intervention	Control	Total	T x C
Total (n=331)	31%	31%	31%	30%	34%	32%	.331
Boys (n=158)	32%	22%	27%	27%	34%	31%	2.933$^{\$\$}$
Girls (n=173)	29%	39%	34%	33%	34%	34%	.853

intervention n=166, control n=165

T x C = time x condition

$^{\$\$}$ P <.09

4. Discussion

The present back education program in elementary schoolchildren resulted in improved general and specific back posture knowledge, in line with previous research [10,12,18]. In the current study design a control group and interference check were incorporated to minimize the influence on factors unrelated to the intervention. Back posture promotion through the school curriculum seems to be an effective strategy to teach back posture related principles in a young population.

Furthermore, postural behavior during material handling improved more in the intervention group compared to the controls. The positive change of the total score during material handling in a play situation showed that the learned skills became generalized. The latter study finding corresponded to the study of Mendez and Gomez-Conesa [12] pointing out that some positive changes as a result of a postural hygiene program were generalized in natural situations.

The two-school-year promotion of good body mechanics resulted also in decreased duration of trunk flexion and neck torsion during sitting. Moreover, there was a trend for a decrease in the mean duration of trunk torsion in the intervention group. These are important findings since in previous research in 8 to 11 year olds and according to the study of Murphy et al [7] in 11 to 14 year olds, it was demonstrated that

An additional purpose of the current study was to evaluate intervention effects on self-reported back and neck pain and on fear-avoidance beliefs. In line with the literature [4], pain reports reflected mainly mild pain occurring only once or several times within the last week. There was a tendency for boys in the intervention group to report less back or neck pain (pre 32%, post 27%) compared to an increase of self-reported pain in the control group (pre 22%, post 34%). Conversely, in girls the pain reports did not differ significantly between the intervention (pre 29%, post 33%) and the control group (pre 39%, post 34%). Gender specific effects on back pain prevalence could not be explained by the intervention effects on back posture related knowledge or on postural behavior as the change over two school-years did not differ between boys and girls. Since feeling pain is a subjective phenomenon and children are in the middle of a learning process experiencing their body and reporting their aches [20], results on back pain prevalence and differences in pain reports between boys and girls need to be interpreted with caution. Furthermore, one could question whether self-reported back or neck pain is the right outcome of a back education program in elementary schools. In the scope of intervention studies, back pain prevalence could better be approached as a long term effect while the evaluation of a back education program should focus on the direct effects like better back posture knowledge and modifications in risk factors related to spinal loading in the school environment. However it is relevant to examine whether fear-avoidance beliefs increase as a result of the attention for pain. The present intervention did not indicate increased fear-avoidance beliefs in the intervention group compared to the controls. Since about eighty percent of the western children will experience back or neck pain once in their lifetime, it is important that early back education in children does not result in increased fear-avoidance beliefs.

In conclusion, the current study findings demonstrated that the optimized promotion of good body mechanics with focus on postural dynamism in the class improved several postural aspects related to daily biomechanical load. The long term effect of improved postural behavior at a young age on back pain prevalence later in life needs to be adopted in future research.

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