University of Pécs
Faculty of Health Sciences
Doctoral School of Health Sciences

Head of Doctoral School: Prof. Dr. József Bódis MD, Ph.D., D.Sc.

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Head of Programme: Dr. habil Erzsébet Rétsági, Prof. dr. Pongrác Ács

Research Topic S-4
The preventive, therapeutic and rehabilitative role of regular physical activity

EXAMINATION AND DEVELOPMENT OF BACK CARE KNOWLEDGE AND SPINE DISEASE PREVENTION AMONG 6-10 YEARS OLD CHILDREN

Ph.D. Dissertation

Brigitta Szilágyi

Supervisor:

Dr. habil Melinda Járomi

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INRODUCTION

In Hungary, the age of 6-7 means the start of primary school. Going to school significantly increases the number of hours spent on sitting, which causes static overload on the spine (Tóthné & Tóth, 2015). This age group is exposed to a variety of intrinsic and extrinsic risk factors during daily activity, that contribute to the development of muscle weakness, inappropriate flexibility of muscles, later poor posture, and finally to postural impairments and disorders (Geldhof, 2006). The prevalence of posture deformities and musculoskeletal weakness among preschool-age children is 60-62%. In primary school-age children, the prevalence of spinal problems and posture deformities continues at a high rate, 50-65% (Yamaguchi, et al., 2016). The high prevalence of musculoskeletal problems implies a high social and economic charge and restrains a considerable part of the population in their personal psychosocial and functional life (Geldhof, 2006). According to Hungarian and international research, in order to prevent spine deformities and damage at a later age, but even at a young age, we need to raise awareness of correct spine use at a younger age, in which the back school programs can have a prominent role (Tóthné & Tóth, 2015).

The back school programs are frequently used methods for prevention, applied in numerous countries, develop special knowledge and skills in primary, secondary, and tertiary prevention among adults and children, healthy and ill (Szilágyi, et al., 2019). Nowadays back school programs for children are primary prevention programs developed as an educational intervention, intending to develop a lifestyle favorable to spine protection, promotion of the correct posture (Tóthné & Tóth, 2015). The content of the back school programs may be necessary to ensure children have sufficient back care knowledge and adequate trunk state for more effective prevention (Szilágyi, et al., 2019).

Our habits determine our health, as does back care knowledge and spine disease prevention, which also has a direct impact on the activity of daily living, posture, and muscle state, and can also affect the evolution of good habits and aid in the prevention of spine problems (Miñana-S, et al., 2021). Child back school programs are recommended from the age of 4, during which back care knowledge is developed, thus it would be useful to examine children's back care knowledge at an early age. Questionnaires are suitable tools for examining back care knowledge (Szilágyi, et al., 2021). There is no validated questionnaire in the literature examining the back care and spine disease prevention knowledge of children aged 6–10 years.

OBJECTIVES OF THE STUDY

The study aimed to develop a questionnaire examining back care knowledge and spine disease prevention for children aged 6–10 years and testing its psychometric properties, which includes the main groups of the content of back school programs: anatomy, biomechanics, ergonomics, spine use habits, spine-friendly lifestyle, besides our purpose was to assess the back care knowledge and spine disease prevention of children in this age group, among those who attended back school program, e-learning back school program or none.

We aimed to evolve a 1-school year back school program with theoretical and practical education for 6-7 years old children.

Besides we aimed to measure the back care knowledge and spine disease prevention, habitual posture and posture deemed correct, the trunk static muscle strength, the lower limb flexibility, and the lumbar motor control ability of 6-7 years old primary school children and examine the change of the measured parameters after the 1-school year back school program.

In addition, we aimed to compare the scores of back care knowledge and spine disease prevention, and the measured physical parameters of the back school program (intervention) and control groups.

HYPOTHESIS

1) We assume, that the Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children is a suitable tool for the measurement of back care knowledge and spine disease prevention among 6-10 years old children.
2) The back care knowledge and spine disease prevention, the habitual posture and posture deemed correct, the trunk static muscle strength, the lower limb muscle flexibility, and the lumbar motor control ability are not appropriate for 6-7 years old primary school children.
3) In the intervention group, the back care knowledge and spine disease prevention will significantly improve after the 1-school year back school program.
4) In the intervention group, the habitual posture, and posture deemed correct, the trunk static muscle strength, the lower limb muscle flexibility, and the lumbar motor control ability will significantly improve after the 1-school year back school program.
5) In the control group, the back care knowledge and spine disease prevention will not significantly improve after the 1-school year back school program.
6) In the control group, the habitual posture, and posture deemed correct, the trunk static muscle strength, the lower limb muscle flexibility, and the lumbar motor control ability will not significantly improve after the 1-school year back school program.

7) There will be significant differences between the intervention and control groups in the results measured at the end of the back school program regarding the back care knowledge and spine disease prevention.
8) There will be significant differences between the intervention and control groups in the results measured at the end of the back school program regarding the habitual posture and posture deemed correct, the trunk static muscle strength, the lower limb muscle flexibility, and the lumbar motor control ability.

MATERIALS AND METHODS

Study design and setting

The development and psychometric evaluation of the back care knowledge and spine disease prevention questionnaire and the implementation and examination of the 1-school year back school program were conducted between 2016 and 2020 in Pécs, Hungary.

Study groups

In the development and psychometric evaluation of the Health Questionnaire of Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children

Data of 463 children (220 boys, 243 girls) were processed in the study, their mean age was 7.51±1.32 years. During the survey, we distinguished three groups according to age and grade, and three subgroups accordingly took part in a back school program, e-learning back school program, or none of them (Table 1).

Table 1 – Groups and subgroups in the examined population

Age, Class	Participated in BSP (persons)	Participated in e-learning BSP (persons)	Did not participate in BSP (persons)	Total (persons)
6-7 years, 1. grader	26	0	204	230
7-8 years, 2. grader	28	0	91	119
9-10 years, 4. grader	26	27	61	114
6-10 years, 1.- 4. grader	80	27	356	463

BSP: back school program

In the implementation and examination of the 1-school year back school program

Data were collected at the baseline and the end of the intervention. At the baseline examination, 102 (52 boys, 50 girls) primary school first-grader (age: 6.549±0.500 years) children were tested. 26 children (11 boys, 15 girls) were chosen in the intervention group, who took part in the back school program. In the control group, 22 (12 boys, 10 girls) children were included, who did not participate in the back school program, they only took part in the regular physical education classes (Table 2).

Table 2 - Mean values of the age, body height, body weight, and the body mass index (BMI) of the examined population

	The examined population (n=102)		**Intervention group (n=26)**				**Control group (n=22)**			
	mean pre	SD	mean pre	SD	mean post	SD	mean pre	SD	mean post	SD
Age (years)	6.549	0.500	6.577	0.504	7.308	0.679	6.591	0.503	7.318	0.716
Body height (cm)	126.549	5.140	126.558	5.013	130.654	7.322	126.500	5.198	131.364	6.433
Body weight (kg)	26.135	3.467	26.377	3.515	27.531	5.459	26.118	3.405	27.600	4.642
BMI (kg/m^2)	16.291	1.766	16.445	1.827	15.968	1.723	16.311	1.879	15.867	1.426

SD: standard deviation; BMI: body mass index; pre: baseline, before the program; post: after the program

The development procedure of the Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children (HEQBACK-6-10)

Development of the Hungarian version of the questionnaire "*Gerinchasználattal és -prevencióval kapcsolatos tudást felmérő kérdőív 6-10 éves gyerekek számára (GEPT-6-10)"* was based on using the validity criteria of the Delphi method, which phases were the following (Figure 1) (B Mokkink, et al., 2010):

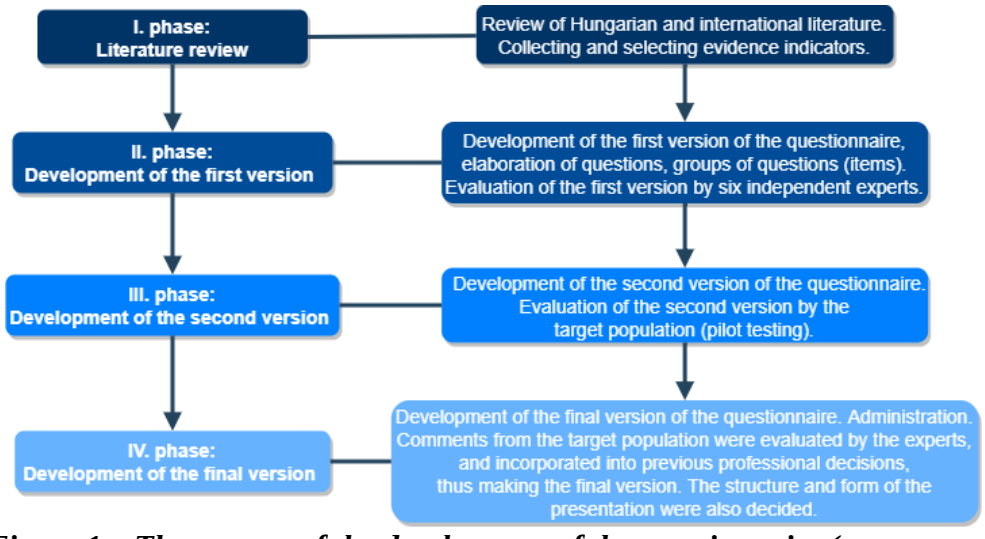

Figure 1 – The process of the development of the questionnaire (own source)

Data collection

Back care knowledge by Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children

Those who took part in the development procedure of the questionnaire, and did not take part in any back school program, filled the questionnaire once and a week apart (test-retest). Those who participated in a back school program (personal back school program or e-learning back school program) filled the questionnaire after the program once and a week apart.

Habitual posture and posture deemed correct by New York Posture Rating Chart

Three pictures were taken from the children, one from the back view and two from the side views. While taking the photo, children had to be barefooted, in a tight fit, or with a naked upper body; for girls, long hair had to be tied to avoid covering the neck and shoulders. Children were standing in front of a black background and behind a plumb line that almost reached the ground. From the back view, the plumb line had to go through the head, spine and had to end between the two legs in the middle. From the side view, the plumb line had to go through the ear, lumbar I. and V. vertebrae, and the lateral ankle. Pictures were taken 3.048 m far from the student, with a NIKON D3400 camera.

For showing habitual posture, we asked the children to stand in front of the screen, to show how they usually stand in everyday life. For posture deemed correct, we asked the children to stand in front of the screen as they think it was correct (McRoberts, et al., 2013).

Trunk muscle strength and lower limb flexibility by Lehmann test

Trunk flexor static muscle strength

Children are supine lying on a mattress, the hips and knees are in 90^{o} flexion at both lower limbs. Shoulders stay on the ground, upper limbs have an angle of 45^{o} with the trunk, they are straight, lifted 3-5 cm from the ground, palms are looking upwards. The position of the head: stretch with the head, the face is looking to the ceiling, the chin does not approach the chest. The head is lifted 3 cm from the ground, beside the kept of the upper and lower limbs in the correct position, the lumbar part is pressed down to the ground and must be kept on the ground during the examination. We measure the time in seconds to maintain the correct posture during the examination (Lehmann, 1998).

Trunk extensor (scapula retractors) static muscle strength

Children are prone on a mattress, the lower limbs are straight and in a little straddle, the foot leans on the floor, knees are on the floor. Upper limbs are at the level of the shoulder, the elbow

is in 90^0 flexion, the palms face each other, the fingers are straight, the thumb looks upwards. The head (nose-ground) is lifted 2 centimeters from the ground, the upper limbs are lifted 5 centimeters from the ground. During the examination, we measure the time in seconds to maintain the correct posture (Lehmann, 1998).

Hip flexor muscle flexibility

The child is sitting at the end of the treatment bed, embracing the left lower limb from below, slowly leaning back to supine, the left hip is in 90^o flexion. The right lower limb is relaxed, the knee is in 90^o flexion. In this case, the right lower limb is tested. We perform the test on the other lower limb (Lehmann, 1998).

Knee flexor muscle flexibility

The child is supine, both legs are on the floor. Arms are straight beside the body. The right leg is straight raised to 90^o hip flexion, while the left leg is loosely on the ground. In this case, we examine the flexibility of the right knee flexor (Lehmann, 1998).

Lumbar motor control ability by Sitting Forward Lean test

The child is sitting on a treatment bed or chair, the soles do not touch the ground, the knee bend touches the edge of the bed, the hip and knee are in 90^o flexion, the spine, including the lumbar part, is in the neutral position. We help the child to have the correct posture. We sign the upper endplate of the first sacral vertebra and measure 7 centimeters upwards in the middle of the spine, that point is also signed. After the checkmarks, we ask the child to pull up the lower limbs after each other five times, equally raise the upper limbs straightly together beside the ear. After the exercises, we ask the child to have the correct sitting posture, then we measure the distance with a tape measure between the two markers, the obtained value is recorded in millimeters. The obtained value is the difference between the two values, given in millimeters, results are calculated by the absolute value of the numbers obtained (Enoch, et al., 2011).

The applied back school programs

The material of the back school program was registered as a "voluntary scientific work" in the Hungarian Intellectual Property Office. The material was published as a book in Hungarian and English, under the name of “Mesés Gerinctúra”, “The Amazing Spinal Trip”. The book was made by physiotherapists, a writer, a nursery school governess and instructress, and an infantile clinical psychologist, family therapist (Szilágyi, et al., 2019).

The content and material of the e-learning back school program was based on the book, and was available on the website of https://gerincsuli.hu/, which has been developed by us (https://gerincsuli.hu/, 2019).

Data analysis

Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children

The scores of the questionnaire were calculated, the mean and standard deviation values of the questions and categories were obtained. The normality of the continuous variables was tested by Kolmogorov Smirnov tests, a p-value higher than 0.05 was considered a normally distributed score (Kruskal & Wallis, 1952). We used SPSS (v.27) software for Windows to make different statistical analyses.

Validity and reliability testing

Internal consistency was examined by calculating Cronbach's alpha value, which was considered acceptable for $\alpha \geq 0.7$ (Taber, 2018).

Test-retest reliability was tested by intraclass correlation coefficients (ICC), using 95% of confidence interval). The ICC values can range from 0 and 1 and, the values of less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively (Koo & Li, 2016).

The Bland–Altman plot was used to visually examine the 95% limits of agreement (LoA) between the test and retest total scores, where narrower LoAs suggested better agreement at the individual level. This association was examined by linear regression analysis.

The convergent validity was tested by Spearman's rank correlation coefficients (Carlson & Herdman, 2012).

The discriminant validity was tested to compare the results of the questionnaire's scores between the non-back school and back school groups of different age groups to examine the difference between them, during which we used Mann-Whitney and Kruskal Wallis tests (Groten, et al., 2018).

1-school year back school program

SPSS software (*v.27*) was used for statistical analyses. The results are presented in frequency and confidence interval, as well as in mean±standard deviation, median and interquartile range values. Based on the results of the normalcy tests (Kolmogorov-Smirnov test), the distribution of the data does not imply normal. Differences between the intervention and control group were

examined by chi-square test and the Mann-Whitney U test, while the effectiveness of the program was examined by chi-square test and Wilcoxon test. The results were considered significant at $p<0.05$ level.

RESULTS

Validity and reliability

Content validity questionnaire

Development of the questionnaire started with the selection of topics related to back care and spine disease prevention knowledge included in back school programs, specified by several back schools, back education programs, and questionnaires examining back care knowledge.

Main topics included in a back school program: anatomy, biomechanics, ergonomics mainly focusing on the spine, spine use, and spine-friendly lifestyle. Formulation of the items started accordingly, and ten preliminary items were prepared for the questionnaire. According to the suggestions of the experts, we minimalized the numbers of the questions for this age group, not to overload them, and we highlighted the most essential issues, for this reason, seven questions were left.

Linguistically, the first wording of the seven questions has been transformed, which developed as follows: Question 1 “Draw the spines in the pictures!” “Draw all the spinal columns in the pictures!”, Question 2 “Completely color all the vertebrae blue and all the discs red!” “Color one vertebra to blue and one disc to red!”, Question 3 “What are the correct postures while watching TV? More answers are possible!” “Mark 2 correct postures during watching TV!”, Question 4 “Circle the correct postures! More answers are possible!” “Mark 3 correct postures!”, Question 5 “Connect those with similar hardness!”, Question 6 “Circle where the boy lifts the bag correctly!” “Mark where the boy is correctly lifting the bag!” and Question 7, “What holds and moves the spine?” “Mark what holds and moves the spinal column?”. As the questionnaire can be filled by children who cannot read or write, we have provided pictures and symbols at most of the questions for choosing the answer. After the changes, the assessment of 15 children followed. In their opinion, the last question where children had to figure out for themselves what holds and moves the spine, instead, it would be better if they could choose the correct answer from two drawn symbols. They also confirmed that the questions were understandable. An adult read aloud the questions, that already included the instructions, highlighting what to do, how to answer, if more than one answer were correct, it was given how many.

The accepted final version included a total of 7 questions, of which question 1, 2, 5, 7 goes under the category of "anatomy and biomechanics (category 1)", and question 3, 4, 6 are in the category of "spine use, ergonomics and spine friendly lifestyle (category 2)". There are questions, with more correct answers, for every correct answer a point can be given, thus who can find all the correct answers a total of 7 points can be given for question 1, 2 points for question 2, 2 points for question 3, 3 points for question 4, 2 points for question 5, 1 point for question 6, and 1 point for question 7. For the wrong answer, 0 point was given. A maximum of 18 points can be obtained in the questionnaire and a minimum of 0 point.

Internal consistency

The internal consistency of the questionnaire was determined using Cronbach's alpha values. For the total 7 items, Cronbach's alpha was α=0.797 (0.768–0.824), the questions correlated well with each other, confirming our hypothesis. The results corroborated, that the questionnaire showed good internal consistency.

Test-retest reliability

The reliability of the questionnaire was also examined using the test-retest method by intraclass correlation coefficient (ICC). The correlation coefficient was strong (0.989) for the total scores, and ranged from moderate to strong (0.742–0.975) for the questions ($p<0.001$), with minimal standard error of measurement (SEM) and minimal detectable change at 95% (MDC95) (0.606 and 1.680 respectively) (Table 3).

Table 3- Test-retest reliability of the Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children

	Mean test (SD) (point)	Mean retest (SD) (point)	Difference between test, retest (SD) (point)	ICC	CI 95 % lower	CI 95 % upper	p	SEM (point)	MDC95 (point)
1	2.063 (2.639)	2.413 (2.558)	-0.350 (0.808)	0.975	0.970	0.979	p<0.001	0.411	1.139
2	0.851 (0.950)	0.952 (0.910)	-0.102 (0.456)	0.936	0.923	0.947	p<0.001	0.235	0.652
3	0.706 (0.830)	0.877 (0.830)	-0.171 (0.482)	0.908	0.889	0.923	p<0.001	0.252	0.698
4	1.240 (1.214)	1.382 (1.182)	-0.143 (0.544)	0.946	0.935	0.955	p<0.001	0.278	0.771
5	0.849 (0.951)	0.937 (0.906)	-0.089 (0.459)	0.935	0.922	0.946	p<0.001	0.237	0.656
6	0.788 (0.409)	0.801 (0.399)	-0.013 (0.254)	0.890	0.868	0.908	p<0.001	0.134	0.372
7	0.330 (0.471)	0.564 (0.496)	-0.233 (0.438)	0.742	0.690	0.785	p<0.001	0.246	0.681
Total	6.827 (5.979)	7.927 (5.577)	-1.099 (1.218)	0.989	0.987	0.991	p<0.001	0.606	1.680

CI: confidence interval, ICC: intraclass correlation coefficient, SEM: standard error of measurement, MDC95: minimal detectable change at 95%

Convergent validity

Convergent validity was examined using Spearman's rank correlation analysis between total score and age, where we found a weak but significant association ($R=0.171$, $p<0.001$).

Discriminant validity

Discriminant validity was tested among children who took part in a back school program or not among different age groups. The Kolmogorov-Smirnov test results showed non normally distributed scores of the questionnaire ($p>0.05$). We found significant differences in the back care knowledge between 6 and 7 years old ($p<0.001$), 7–8 years old, and also 9–10 years old groups. Table 12 summarizes the results of back care knowledge in the examined population. The highest total score was 17.115±0.909 points among 9–10 years old children in the back school program group. The second highest total score was 16.308±2.429 points among 6–7 years old children, who took part in a back school program. E-learning back school program seemed to be similarly effective according to the total scores among 9–10 years old children (15.926±3.037 points), than the back school program for 7–8 years old children (15.714±1.802 points) (Table 4).

Table 4 - The results of the back care knowledge and spine disease prevention in the examined population

		6-7 years, 1.grader		7-8 years, 2.grader		9-10 years, 4.grader			6-10 years, 1-4.grader
		No participation in BSP (n=204)	Participation in BSP (n=26)	No participation in BSP (n=91)	Participation in BSP (n=28)	No participation in BSP (n=61)	Participation in BSP (n=26)	Participation in e-learning BSP (n=27)	Total of participants (n=463)
Q1 (point)	Mean	1.088	6.231	0.319	5.643	0.705	6.808	6.074	2.063
	SD	1.623	1.142	0.880	1.367	0.803	0.492	1.662	2.639
Q2 (point)	Mean	0.691	1.923	0.187	2.000	0.525	1.962	1.741	0.851
	SD	0.946	0.392	0.469	0.000	0.721	0.196	0.526	0.950
Q3 (point)	Mean	0.505	1.615	0.176	1.536	0.443	1.885	1.741	0.706
	SD	0.691	0.637	0.437	0.637	0.671	0.326	0.594	0.830
Q4 (point)	Mean	1.054	2.654	0.286	2.679	0.721	2.885	2.593	1.240
	SD	1.037	0.977	0.583	0.476	0.897	0.326	0.747	1.214
Q5 (point)	Mean	0.637	1.923	0.341	1.929	0.557	1.654	1.889	0.849
	SD	0.902	0.392	0.619	0.378	0.904	0.629	0.423	0.951
Q6 (point)	Mean	0.765	1.000	0.681	1.000	0.689	0.962	0.963	0.788
	SD	0.425	0.000	0.469	0.000	0.467	0.196	0.193	0.409
Q7 (point)	Mean	0.118	0.962	0.099	0.929	0.311	0.962	0.926	0.330
	SD	0.323	0.196	0.300	0.262	0.467	0.196	0.267	0.471
C1 (point)	Mean	2.534	11.038	0.945	10.500	2.098	11.385	10.630	4.093
	SD	2.432	1.280	1.508	1.427	1.630	0.898	2.041	4.256
C2 (point)	Mean	2.324	5.269	1.143	5.214	1.852	5.731	5.296	2.734
	SD	1.608	1.343	0.973	0.876	1.389	0.452	1.354	2.031
Total score (point)	Mean	4.858	16.308	2.088	15.714	3.951	17.115	15.926	6.827
	SD	3.500	2.429	2.053	1.802	2.156	0.909	3.037	5.979
p		•p<0.001		•p<0.001		••p<0.001			

•Mann-Whitney test results, ••Kruskal-Wallis test results, BSP: back school program, Q: question, C1: category 1; C2: category 2; SD: standard deviation

Back care knowledge and spine disease prevention in the intervention and control groups

In the intervention group, the total score ($p<0.001$), the anatomical, and biomechanical ($p<0.001$), and the spine use, ergonomics knowledge ($p<0.001$) significantly improved after the program. According to the total score in the intervention group, the back care knowledge and spine disease prevention before the program was 18.162±18.563%, which was inappropriate, after the program it got into the appropriate category with 90.385±13.477%, the improvement in the percentages was significant ($p<0.001$).

Besides, there were significant differences between the intervention and control groups at the end of the program regarding the total score ($p<0.001$), the anatomical, and biomechanical ($p<0.001$), the spine use, ergonomics knowledge ($p<0.001$).

Habitual posture and posture deemed correct in the intervention and control groups

The total score of the habitual posture ($p<0.001$), the head ($p<0.001$), the shoulders ($p<0.001$), the spine ($p<0.001$), the hips ($p=0.003$), the ankles ($p=0.033$), the neck ($p<0.001$), the upper back ($p=0.005$), the trunk ($p<0.001$), the abdomen ($p<0.001$), and the lower back ($p<0.001$) significantly improved in the intervention group regarding the results at the end of the program.

In addition, there were significant differences between the intervention and control groups at the end of the program in the total score of the habitual posture ($p<0.001$), the head ($p<0.001$), the shoulders ($p=0.001$), the spine ($p=0.006$), the ankles ($p=0.004$), the neck ($p=0.004$), the upper back ($p<0.001$), the trunk ($p=0.007$), the abdomen ($p<0.001$), and the lower back ($p<0.001$).

The total score of the posture deemed correct ($p<0.001$), the head ($p<0.001$), the shoulders ($p<0.001$), the spine ($p<0.001$), the hips ($p<0.001$), the ankles ($p=0.013$), the neck ($p<0.001$), the upper back ($p<0.001$), the trunk ($p<0.001$), the abdomen ($p<0.001$), and the lower back ($p<0.001$) significantly improved in the intervention group for the end of the program.

Additionally, there were significant differences between the intervention and control groups at the end of the program in the total score of the posture deemed correct ($p<0.001$), the head ($p<0.001$), the shoulders ($p<0.001$), the spine ($p<0.001$), the hips ($p=0.001$), the ankles ($p=0.004$), the neck ($p<0.001$), the upper back ($p<0.001$), the trunk ($p<0.001$), the abdomen ($p<0.001$), and the lower back ($p<0.001$).

Trunk static muscle strength in the intervention and control groups

The trunk flexor ($p<0.001$) and extensor ($p<0.001$) static muscle strength significantly improved in the intervention group for the end of the program.

There were significant differences in the results of the post-test of the trunk flexor ($p<0.001$) and extensor ($p<0.001$) static muscle strength between the intervention and control groups.

Lower limb muscle flexibility in the intervention and control groups

The flexibility of the right hip flexor ($p=0.004$), the left hip flexor ($p=0.002$), the right knee flexor ($p<0.001$), and the left knee flexor ($p<0.001$) significantly improved in the intervention group after the program.

Significant improvements were between the intervention and control groups regarding the post-test results of the right hip flexor ($p=0.024$), the left hip flexor ($p=0.024$), the right knee flexor ($p=0.001$), and the left knee flexor ($p=0.002$).

Lumbar motor control ability in the intervention and control groups

There were significant ($p<0.001$) differences between the pre- and post-test lumbar motor control ability results in the intervention group, and also between the intervention and control groups' post-test results ($p<0.001$).

DISCUSSION

Development and psychometric evaluation of the Health Questionnaire of Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children

The most important results of the study show that we have developed a valid and reliable (Cronbach 0.797) questionnaire for assessing the back care and spine disease prevention knowledge for 6–10 years old children. The instrument was validated on the Hungarian population, but an English version is also available. The validation procedure was according to the Delphi method, involving experts and children from the target population, thus helping to make interpretable and professionally relevant questions. Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6–10 Years Old Children is the first questionnaire validated by professionals for children at that early age to assess the back care and spine disease prevention knowledge.

Back care knowledge and spine disease prevention

It is interesting to look at how low is the back care knowledge of children not participating in any back school or posture education program.

In the recent study children who did not participate in back school program reached 4.86 ± 3.500 points (1st grader) (27.0%), 2.09 ± 2.05 points (2nd grader) (11.6%), and 3.951 ± 2.16 points (4th grader) (22.0%) compared to the maximum 18 points. If we look at the

percentage of correct answers, it can be deduced that children's back care knowledge is between 20 and 60%, most are closer to 20%, which is inadequate. The knowledge measured after the applied back school programs reached a high level, they have a remarkable impact on back care knowledge. The back care and spine disease prevention knowledge need to be developed in addition to posture habits for the improvement of more effective spine prevention.

Physical parameters during the 1-school year back school program

The habitual posture $p_{total\ score}<0.001$, posture deemed correct $p_{total\ score}<0.001$, trunk flexors' $p<0.001$ and extensors' $p<0.001$ static muscle strength, lower limb muscle flexibility $p<0.05$, lumbar motor control ability $p<0.001$ significantly improved in the intervention group for the end of the back school program. We can say that the 1-school year back school program was effective in terms of the measured physical parameters. The improvement in physical condition can also help prevent the possible development of spinal diseases later on.

INTERPRETATION OF THE NEW RESULTS

Nationally, Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6–10 Years Old Children is the first questionnaire developed and validated by professionals for children to assess the back care and spine disease prevention knowledge, and proved to be a valid and reliable tool (Cronbach 0.797).

Internationally, Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6–10 Years Old Children is the first questionnaire developed and validated by professionals for children at that early age to assess the back care and spine disease prevention knowledge, and proved to be a valid and reliable tool (Cronbach 0.797).

We developed the content of a child back school program, that was registered as a "voluntary scientific work" in the Hungarian Intellectual Property Office.

The content of the child back school program was published as a book, in Hungarian (96 pages, 7 chapters, 7 tales, 159 pictures, 39 figures, 51 playful tasks, practice).

The content of the child back school program was published as a book, in English (100 pages, 7 chapters, 7 tales, 159 pictures, 39 figures, 51 playful tasks, practice).

A website was developed and designed for the content of the child back school program, thus ensuring the availability of materials and providing an opportunity for 6-10 years old children to become familiar with the content of the back school program and practice (10 animation videos, 10 theoretical videos, 8 practical videos, 9 conversations).

The efficacy examination of the 1-school year back school program among 6-7 years old children proved to be effective among children aged 6-7 years, based on our results (back care knowledge $p_{total\ score}<0.001$; habitual posture $p_{total\ score}<0.001$, posture deemed correct $p_{total\ score}<0.001$; trunk flexors' $p<0.001$ and extensors' $p<0.001$ static muscle strength; lower limb muscle flexibility $p<0.05$; lumbar motor control ability $p<0.001$).

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LIST OF PUBLICATIONS

Related to the topic of the dissertation

Original article:

Szilágyi B, Makai A, Tardi P, Kovácsné Bobály V, Simon-Ugron Á, Járomi M. Back School Program: Development of Back Care Knowledge and Spine Disease Prevention and Trunk State Among 6-7 Year-Old-Children. Studia Universitas Babes-Bolyai Educatio Artis Gymnasticae. 2021;LXVI(3):77-93.

Szilágyi B, Tardi P, Magyar B, Tanács-Gulyás N, Romhányi F, Vida E, Makai A, Járomi M. Health questionnaire on Back care knowledge and spine disease prevention for 6–10 years old children: Development and psychometric evaluation. BMC Musculoskeletal Disorders. 2021;22:820. ***(imp: 2.362)***

Járomi M, Szilágyi B, Velényi A, Leidecker E, Raposa LB, Hock M, Baumann P, Ács P, Makai A. Assessment of health-related quality of life and patient's knowledge in chronic non-specific low back pain. BMC Public Health. 2021;21(1):1479. ***(imp: 3.295)***

Tardi P, Kovács I, Makai A, Szilágyi B, Hock M, Járomi M. Az Osteoporosis Health Belief Scale kérdőív magyar nyelvű validálása = The Hungarian adaptation and validation of the Osteoporosis Health Belief Scale. Orvosi Hetilap. 2021;162(37):1494-1501. ***(imp: 0.540)***

Tardi P, Szilágyi B, Makai A, Gyuró M, Ács P, Járomi M, Molics B, Hock M. The development of a reliable and valid instrument to measure the osteoporosis-related knowledge: validation of the Hungarian version of Osteoporosis Knowledge Assessment Tool (OKAT). BMC Public Health. 2021;21(1):1515. ***(imp: 3.295)***

Szilágyi B, Makai A, Tardi P, Kiss G, Kovácsné Bobály V, Járomi M. Testtartásért felelős izomcsoportok és lumbális motoros kontroll képesség fejlesztése 6-7 éves gyermekek körében. Fizioterápia. 2020;29(1):13-20.

Kovács-Babócsay B, Makai A, Szilágyi B, Tardi P, Ács P, Velényi A, Rébék-Nagy G, Járomi M. Egy deréktáji fájdalommal kapcsolatos betegségspecifikus tudást felmérő külföldi kérdőív hazai, magyar nyelvű validálása. Orvosi Hetilap. 2019;160(42):1663-1672. ***(imp: 0.497)***

Szilágyi B, Makai A, Kovácsné Bobály V, Tardi P, Kukla A, Ács P, Járomi M. Evaluation and development of knowledge of spinal function and posture with back school program among primary school children. Sport- és Egészségtudományi Füzetek. 2019;3(3):39-53.

Kiss G, Kovácsné Bobály V, Tóth ÁL, Jeges S, Makai A, Szilágyi B, Ács P, Járomi M. Efficiency examination of a 6-month trunk prevention program among recruitment kayak-canoe athletes: randomized control trial. Journal of Back and Musculoskeletal Rehabilitation. 2018;32:367-378. ***(imp: 0.814)***

Járomi M, Kukla A, Szilágyi B, Ugron Á, Kovácsné Bobály V, Makai A, Linek P, Ács P, Leidecker E. Back School programme for nurses has reduced low back pain levels: a randomized controlled trial. Journal of Clinical Nursing. 2018;27(5-6):895-902.

Kovácsné Bobály V, Szilágyi B, Makai A, Koller Á, Járomi M. Új low back pain prevenciós mozgásprogram, amely javítja a törzsizmok állapotát és a lumbalis motoros kontrollt. Orvosi Hetilap. 2017;158(2):58-66. ***(imp: 0.322)***

Kovácsné Bobály V, Szilágyi B, Kiss G, Leidecker E, Ács P, Oláh A, Járomi M. Application and examination of the efficiency of a core stability training program among dancers. European Journal of Integrative Medicine. 2016;8(2):3-7. ***(imp: 0.801)***

Kovácsné Bobály V, Makai A, Kiss G, Szilágyi B, Ács P, Járomi M. The Examination of Muscle Balance in Dancers. Universal Journal of Public Health. 2016;4(4):171-178.

The total impact factor value of the publications related to the topic of the dissertation: 11.926.

Book, book chapter:

Szilágyi B, L Molnár E, Járomi M. The amazing spinal trip. Pécs, Magyarország; Szilágyi Brigitta. 2019:1-102. ISBN: 9781789555875

Szilágyi B, L Molnár E, Járomi M. Mesés gerinctúra. Pécs, Magyarország; Szilágyi Brigitta. 2019. ISBN: 9786150052946

Presentation, poster (abstract):

Horváth R, Tardi P, Járomi M, Papp Zs, Ács P, Boncz I, Szilágyi B. Preventive Exercise Program for Trunk Stabilization, Posture Correction and Functional Asymmetry Among Amateur Football Players. Value in Health. 2020;23(2):S602-S602.

Szilágyi B, Makai A, Tardi P, Hock M, Kovácsné Bobály V, Kiss G, Ács P, Járomi M. Testtartás, törzsizomerő és lumbalis motoros kontroll vizsgálata 6-7 éves gyermekek körében. In: Oláh A, Molics B, Ács P, Kránicz J, Járomi M, Hock M, Császár G, Leidecker E, Bohner-Beke A, Kovácsné Bobály V. 20 Éves a Pécsi Gyógytornász Képzés (1999-2019): Jubileumi Emlékülés és Szakmai Továbbképzési Konferencia. Pécs, Magyarország: Pécsi Tudományegyetem Egészségtudományi Kar (PTE ETK). 2019:30-30.

Járomi M, Szilágyi B, Tardi P, Makai A, Ács P. Gerinciskola programok. In: Oláh A, Molics B, Ács P, Kránicz J, Járomi M, Hock M, Császár G, Leidecker E, Bohner-Beke A, Kovácsné Bobály V. 20 Éves a Pécsi Gyógytornász Képzés (1999-2019): Jubileumi Emlékülés és Szakmai Továbbképzési Konferencia. Pécs, Magyarország: Pécsi Tudományegyetem Egészségtudományi Kar (PTE ETK). 2019:18-18.

Halasz D, Szilagyi B, Hock M, Jaromi M, Acs P, Boncz I, Tardi P. Examination of sport-specific dynamic core stability programme among female acrobatic rock and roll dancers. Value in Health. 2019;22:S694-S694

Horvath K, Szilagyi B, Tardi P, Acs P, Boncz I, Jaromi M. Efficacy examination of pilates training among healthy women ont he change of trunk state, posture lumbar motor control ability and balance. Value in Health. 2019;22:S695-S695.

Bogos V, Jaromi M, Bogos E, Boncz I, Szilagyi B. Examination of core training program on the change of low back pain, muscle strength and lumbar motor controll among professional firefighters. Value in Health. 2018;21:305-306.

Szilágyi B, Makai A, Betlehem J, Ács P, Járomi M. Evaluation and development of trunk muscle strength, lower limb muscle felxibility and lumbar motor control ability with back school program among 6-7 years old children. In: Potočníková, J Bakalár P (szerk.) Rekreačnỳ Šport, Zdravie, Kvalita Života IV.: Zborník Abstraktov Z Med Zinárodnej Vedeckej Konferencie. Kassa, Szlovákia: Univerzita Pavla Jozefa Safárika v Kosiciach. 2018:54-54.

Járomi M, Makai A, Szilágyi B, Ács P. Gerinciskola: Gerincprevenciós tudás fejlesztése általános iskolás gyermekek körében. Magyar Sporttudományi Szemle. 2017;18(2):47-47.

Szilagyi B, Makai A, Acs P, Boncz I, Jaromi M. Evaluation and development of habitual posture and posture deemed correct with back school program among primary school children. Value in Health. 2017;20(9):542-543.

Szilágyi B, Makai A, Járomi M, Ács P. Izombalance és lumbalis motoros kontroll képesség vizsgálata 6-7 éves gyermekek körében. Magyar Sporttudományi Szemle. 2017;70(2):80-80.

Szilágyi B. Gerinciskola programok alkalmazása 6-7 éves gyermekek körében. XXXIII. Országos Tudományos Diákköri Konferencia Orvos és Egészségtudományi Szekciója; Primer Prevenció Tagozat. Pécs. 2017. április 18-21. **(I. place)**

Szilágyi B. Gerinciskola programok alkalmazása 6-7 éves gyermekek körében. PTE ETK I. Kari TDK Meghallgatás. Pécs. 2016. november 29. **(III. place)**

Kovácsné Bobály V, Szilágyi B, Kiss G, Ács P, Járomi M. Törzsstabilizációs edzésprogram alkalmazása és hatékonyságának vizsgálata táncosok körében. Magyar Sporttudományi Szemle. 2016;17(4):71-71.

Kovácsné Bobály V, Makai A, Szilágyi B, Kiss G, Ács P, Járomi M. Status Measurement of Trunk in Dancers. In: Molnár, Andor; Balogh, László; Viorel, Ardelean Petru; Alattyányi, István; Győri, Ferenc (szerk.) Sporttudományi Kaleidoszkóp: Sportszakmai tanulmány-, és szakcikk gyűjtemény. Szeged, Magyarország: Szegedi Tudományegyetem Juhász Gyula Pedagógusképző Kar. 2016:27-51.