**Evaluation and development of knowledge of spinal function and posture with back school program among primary school children**

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**Abstract**

**Purpose:** To assess the knowledge of spinal function and posture of primary school-aged children. To develop and apply an educational curriculum, exercise program and workbook for children, who can not read or write yet. To examine the efficiency of the 10-week child back school program.

**Material and methods:** 48 primary school first-grader children (23 boys, 25 girls) were chosen for our prospective research. Knowledge of spinal function was examined by self-designed questionnaire, habitual posture and posture deemed correct by photogrammetry test. The statistical analysis was performed with SPSS software version 22.0. The results were considered significant, at p<0.05 level.

**Results:** The complete knowledge of spinal function (p<0.001), habitual posture (p<0.001) and posture deemed correct (p<0.001) significantly improved after the implementation of the back school program.

**Conclusions:** The child back school program improves the preventative awareness of spinal conditions and the posture among school-aged children. Primary school first-grader children without writing and reading skills need a specifically developed theoretical educational curriculum, exercise program and workbook. The back school program should also be further tested in kindergarten.

**Keywords:** primary school children, spine- back school, knowledge of spinal function, posture

**Introduction**

Children around the world have been developing postural deformities due to lack of physical activity for decades. However little is known about the interventions that promote both proper posture and develop knowledge in school age children who are not able to read or write yet. An early report of postural deformities in Hungary by Peller appeared in 1977, putting the prevalence of posture deformities to 62% in preschool age children, which has not decreased much in later decades either (Peller, 1977). In the same year, Seyffarth also made a holistic musculoskeletal examination among primary school children (1-7. classes), he found posture problems at 80% of the children (Seyffarth, 1977). Based on a report by Fejerdy in 1999, 88% of primary school age children have suffered from postural deformities andother orthopedic abnormalities (Fejérdy, 2001). In recent reports by Somhegyi et al. (2014) in 2009-2010 among 530 children (aged: 7-12 years), posture problems occured in 64,5% of the examined children. Internationally the situation is not better either, in 2004 Weiss found 60% of German preschool children have developed musculoskeletal weakness (Weiss et al., 2004). Recent research around the world in 2015 and 2016 showed similar results. Inrimary school age children, the prevalence of of spinal problems and posture deformities continues at a high rate, 50-65% (Yamaguchi et al., 2016, Motylewski et al., 2015, Selma et al., 2016).

The back school program for children is a primary prevention program developed as an educational intervention, with a goal of developing a lifestyle favorable to spine protection, promotion of the correct posture (Tóthné et al., 2015). Back school programs mosty consist of either theoretical knowledge related to the function of the spine or exercise, but rarely both. The theoretical part contains anatomy, ergonomics and biomechanics, which are presented to the children in playful form. The exercise includes primarily muscle strengthening and muscle stretching exercises as well as posture improvement exercises (Leszek et al., 2004, Tóth et al., 2007). According to Hungarian and international researches, in order to prevent spine deformities and damage at a later 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 (Günter, 1998, Somhegyi et al., 2003, Tóth et al., 1998).

The primary prevention program of the Hungarian Spine Society, contains special exercises and tests for controling and developing muscle strength and felxibility of the muscles responsible for biomechanically correct posture (Somhegyi et al., 2003). Porci Berci is Searching for Friends is a health preservation program aimed at schoolchildren contains six parts of theoretical knowledge and exerxises, providing guidance to schoolchildren for the correct use of the spine (Tóth et al., 2000). The back school program named Conscious Seating for Primary Schoolchildren, is an another complementary back school program by the Hungarian Spine Society. The programs provides instructions to primary school teachers on how to integrate proper seating techniques into thephysical education curriculums. Tóthné et al. (2015)**,** Lehmann (1998) and Kollumβ (2001) authors of German child back school books have included theoretical knowledge, a practical exercise parts and tests for muscle strength and flexibitlity responsible mainly for the muscles responsible for the posture by (Günter, 1998, Sabine et al., 2001).

Several international researches have examined the efficacy child back school programs provided for different time intervals. One such intervention was done by Geldhof et al. examining the effect of a back education program at 2-year follow-up, among 94 youngsters aged 13–14 years, on back posture knowledge, fear-avoidance beliefs and self-reported pain. An other purpose of the study was to evaluate which aspects of postural behavior were integrated in youngsters’ lifestyles (Elisabeth et al., 2007).

Although the research has addressed how to interventions aimed at spinal deformities in school age children, little was known about school age children who are not able to read and write yet and follow workbook instructions from the book.

**Purpose**

The purposes of the study was to measure the knowledge of spinal function, the habitual posture and posture deemed correct among primary school children ages 6-7 years. An addition aim was to develop and test a back school program intervention, that consits of an educational curriculum, exercise program and workbook for children, who cannot read or write yet. Finally we wanted to assess the efficiency of the 10- week back school program on development of posture and knowledge of spinal function.

**Material and methods**

**Setting and subjects**

The study was conducted in Pécs, Hungary at Apáczai Csere János Primary School No.1, at University of Pécs, Primary Elementary School, High School and Secondary Technical School- High School and Primary School of Deák Ferenc and was approved by IRB of the Regional Research Committee of the Clinical Center, Pécs, Hungary (No.: 6125). The two mentioned schools were randomly chosen from six primary schools in Pécs. The director of the school provided a Declaration of Support. All the parents received information about the purpose and advantages of the back school program and have provided a written consent permitting the children to participate in the study (special consents to examination,, photography and videography were also obtained). The parents were assumed of the anonymity and confidentiality based on the Data Protection Act of Hungary.The back school program was completed between September of 2016- November of 2016.

**Inclusion and exclusion criteria**

Inclusion criteria: 6-7 years old primary age children.

Exclusion criteria: Congenital or acquired spinal cord disease, severe locomotor, internal or neurological illness, and non- mature child for school(Günter, 1998, Sabine et al., 2001).

**Participants**

We conducted a prospective, quantitative longitudinal study. Schools and classes were randomly chosen, and classes were randomly divided to intervention and control groups. Data was collected at week 0 and 10 of the intervention. Fourty eight children (23 boys, 25 girls) participated in the research. In the intervention group there were 26 children (11 boys, 15 girls), mean 6,8 (6,4-7,0) years. In the control group there were 22 children (12 boys, 10 girls), mean age 6,7 (6,2-7,0) years.

**Data collection**

***Questionnaire about knowledge of spinal function***

The questionnaire was filled out by the children before the start of the intervention and after the comppletion of the back school program. We used a self-developed questionnaire, that was validated by X number of subject matter experts. The questions were based Hungarian and international questionnaires of spine use habit found in the literature and adopted for school age children who are unable to read. Five questions addressed the anatomical and biomechanical properties of the spine, three questions were about spine utilization and ergonomics. In Hungary, primary school starts at the age of 6-7 years, when children begin to learn reading and writing. As the questionnaire was used for 6-7 years old children who couldn’t read, the questions were illustrated by drawings, pictures and figures. For anatomical, biomechanical questions, we asked where the spine was, how long it was, it consisted of what, what kind of properties vertebra and disc had, and finally what was holding and moving the spine. For assessing knowledge of spine use and ergonomic issues, children had to find the right pictures, that represented the correct posture during watching TV and playing, as well as they had to recognize a correct lifting technique.

Scoring:

1. question: Children had to draw in the spine on five different pictures. A maximum 8 points could be scored in case of the spine was fully drawn from head to pelvis.
2. question: Children had to color 3 vertebrae blue, 2 discs red. A total of 5 points could be scored.
3. question: Children had to circle the correct body positions for TV watching. Two pictures were correct from five, so they could score a maximum of 2 points.
4. question: Children had to choose a correct positions during playing. Four correct playing positions were hidden between seven pictures, so 4 points could be scored.
5. question: Children had to link vertebrae and discs with a toy, that has similar hardness properties. According to task, three vertebrae needed to be linked with lego and 2 discs with ball, for a maximum of 5 points.
6. question: Children had to circle the picture, where the disc had enough place between the vertebrae, where the boy was demonstrating the correct movement, and where he performs lifting with straight back. Eachright answer was scored 1 point.
7. question: We asked children to circle the drawing showing that shows what was holding and moving the spinal column. For the c answer showing a orrectmuscle, 1 point could be scored.

The total possible score was26 points, for anatomical and biomechanical questions (1,2,5,7) 19 points, for spine use and ergonomical questions (3,4,6) 7 points could be awarded (Tóth et al., 2000, Sabine et al., 2001, M Jordá et al., 2014, Elisabeth et al., 2007, Matias et al., 2017).

***Examination of habitual posture and posture deemed correct***

We made photos of children before at week 0 and after the ending of the 10 week program. Three photos were taken, one from the front view and two from the side views. During the photo shooting, the subjects had to be barefoot, in close- fitting dress or tops and long hair should be tied off to avoid the cover of the neck and shoulders. The photos were taken in front of a symmetry grid, at a distance of 2 meters, with NIKON D3400 digital camera. The height of the symmetry grid was 2 meters, width was 1 meter and each grid size was 6.5x6.5 centimeters.

For showing habitual posture, we asked the subjects to stand in front of the symmetry grid, to show how they usually stand in everyday life.

For posture deemed correct, we asked the subjects to stand in front of the symmetry grid as they think it wascorrect (Kovácsné BV et al., 2016, Ormos et al., 2010, Penha et al., 2009, Babócsay).

Scoring:

For habitual posture and posture deemed correct, the same characteristics, curvatures and symmetries were examined, scored and accordingly evaluated. In the frontal plane, we cheked if the line of gravity crossed the nose, the navel and touched the ground in the center between the two feet, as well we examined the symmetry of the shoulders and the pelvis. In the sagittal plane we cheked if the line of gravity crossed the ear, the first and fifth lumbar vertebra and reached the lateral ankle and also checked the curvature of the cervical-thoracal-lumbal spine. 1 point was given for a parameter to be correct-good-physiologic, 2 points if it was not correct-not good-not physiologic and 3 points if it is extremely not correct-not good- not physicologic (before program) or it worsened (after program). If all values were physiologic, a total of 7 points were given (Kovácsné BV et al., 2016, Ormos et al., 2010, Penha et al., 2009, Babócsay).

***Adapted back school program***

*Theoretical, educational curriculum*

Children were provided with 15 minutes of theoretical curriculum each week, totalling, 150 minutes of theory during the 10 weeks. We started the lessons with easy introductory games, followed by theoretical knowledge, with the aid of devices designed for demonstration of spine functions. Children had to show the bony markers on themselves and each others through play. During the theoretical course we taught anatomical, biomechanical, ergonomical and spine-related knowledge to the children (Günter, 1998, Tóth et al., 1998, Greet et al., 2007, Anna et al., 2016).

*Exercise program*

We met children once a week. The exercise sessions lasted 30 minutes each, under the leadership of two physiotherapists. Adittionally, children spent four times a week, 10 minutes in physical education classes, under the leadership of the teacher, the exercise program was designed by the physical therapists. Finally, seven times a week, we asked them to spend 10 minutes of exercisesing based on instructions included in the workbook (Günter, 1998, Tóth et al., 1998, Greet et al., 2007, Julia et al., 2015).

*Home workbook*

The home workbook included review questions from the theoretical curriculum learned on the previous lesson, as well as the exercise material of games played during lessons. In the workbook, children had to indicate how many times a week, with how many repetitions and how many minutes they did each exercises.

The control group didn’t take part of the back school program, only the regular physical education classes.

**Statistical analysis**

SPSS software version 22 was used for statistical analyses. Based on to the results of the normalcy tests (the distribution of the variables could not be considered normal) nonparametric tests were used. Wilcoxon test to compare the values before and after the program and Mann Whitney U test to compare the intervention and control group. The results were considered significant at p<0.05 level.

**Results**

***Results of knowledge of spinal function*** (Table 1)

Table 1: The results of knowledge of spinal function in the intervention and control groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | Intervention group  (n=26) | | Control group  (n=22) | | Differences between the intervention and control groups |
| Median (point)  (IQR) | p-value | Median (point)  (IQR) | p-value | p-value |
| Total score | week 0 | 1.500  (1.000-3.250) | <0.001 | 2.000  (1.750-2.250) | 0.579 | 0.551 |
| week 10 | 22.000  (20.750-23.000) | 1.000  (1.000-4.000) | <0.001 |
| Anatomical, biomehanical | week 0 | 0.000  (0.000-1.250) | <0.001 | 1.000  (0.000-1.250) | 0.832 | 0.172 |
| week 10 | 16.000  (14.750-17.250) | 0.000  (0.000-2.000) | <0.001 |
| Spine utilization, ergonomics | week 0 | 1.000  (1.000-2.000) | <0.001 | 1.000  (1.000-2.000) | 0.896 | 0.757 |
| week 10 | 6.500  (5.000-7.000) | 1.000  (1.000-2.000) | <0.001 |
| 1. question | week 0 | 0.000  (0.000-0.000) | <0.001 | 0.000  (0.000-1.000) | 0.066 | 0.015 |
| week 10 | 5.500  (4.000-6.250) | 0.000  (0.000-2.000) | <0.001 |
| 1. question | week 0 | 0.000  (0.000-0.000) | <0.001 | 0.000  (0.000-0.000) | 0.854 | 0.853 |
| week 10 | 5.000  (5.000-5.000) | 0.000  (0.000-0.000) | <0.001 |
| 1. question | week 0 | 0.000  (0.000-0.000) | <0.001 | 0.000  (0.000-0.000) | 0.564 | 0.798 |
| week 10 | 2.000  (1.000-2.000) | 0.000  (0.000-0.000) | <0.001 |
| 1. question | week 0 | 0.000  (0.000-1.000) | <0.001 | 0.000  (0.000-1.000) | 0.782 | 0.798 |
| week 10 | 4.000  (2.750-4.000) | 0.000  (0.000-1.000) | <0.001 |
| 1. question | week 0 | 0.000  (0.000-0.500) | <0.001 | 0.000  (0.000-0.000) | 0.655 | 0.273 |
| week 10 | 5.000  (4.750-5.000) | 0.000  (0.000-0.000) | <0.001 |
| 1. question | week 0 | 1.000  (0.750-1.000) | <0.001 | 1.000  (0.000-1.000) | 0.655 | 0.318 |
| week 10 | 1.000  (1.000-1.000) | 1.000  (0.000-1.000) | 0.025 |
| 1. question | week 0 | 0.000  (0.000-0.000) | <0.001 | 0.000  (0.000-0.000) | 0.998 | 0.358 |
| week 10 | 1.000  (1.000-1.000) | 0.000  (0.000-0.000) | <0.001 |

IQR: interquartile range

## *Results of posture measurements*

After the competion of the program, the total score of posture deemed correct showed greater improvement than the habitual posture, which means, when we asked the children to stand as they think it was correct, more were able to do so, likely as a result of theposture improvement exercises (Table 2).

Table 2: The results of total score of habitual posture and posture deemed correct in the intervention and control groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | Intervention group  (n=26) | | Control group  (n=22) | | Differences between the intervention and control groups |
| Median (point)  (IQR) | p-value | Median (point)  (IQR) | p-value | p-value |
| Total score of habitual posture | week 0 | 14.000  (13.750-15.000) | 0.001 | 14.000  (13.000-14.000) | 0.028 | 0.013 |
| week 10 | 10.500  (7.000-11.000) | 13.000  (12.000-14.000) | <0.001 |
| Total score of posture deemed correct | week 0 | 16.500  (13.750-18.000) | <0.001 | 17.000  (15.500-18.000) | 0.009 | 0.572 |
| week 10 | 8.000  (7.000-9.000) | 13.500  (11.750-17.250) | <0.001 |

IQR: interquartile range

Table 3 shows the mean percentage of normal parameters of posture in the intervention and control goup (Table 3).

Table 3: The mean percentage of normal parameters of habitual posture and posture deemed correct in the intervention and control groups

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | Intervention group  (n=26) | | Control group  (n=22) | | Differences between the intervention and control groups |
| Frequency (%)  (CI lower-upper) | p-value | Frequency (%)  (CI lower-upper) | p-value | p-value |
| Habitual posture | Front view  line of gravity | week 0 | 3.846  (1.070-6.622) | 0.001 | 4.545  (1.539-7.552) | 0.011 | 0.904 |
| week 10 | 53.846  (46.651-61.042) | 40.909  (33.813-48.006) | 0.371 |
| Front view shoulder symmetry | week 0 | 3.846  (1.070-6.622) | 0.007 | 0.000  (0.000-0.000) | 1.000 | 0.353 |
| week 10 | 61.538  (54.516-68.561) | 0.000  (0.000-0.000) | <0.001 |
| Front view pelvis symmetry | week 0 | 3.846  (1.070-6.622) | <0.001 | 4.545  (1.539-7.552) | 0.317 | 0.904 |
| week 10 | 61.538  (54.516-68.561) | 13.636  (8.683-18.590) | 0.001 |
| Side view line of gravity | week 0 | 11.538  (6.927-16.150) | <0.001 | 18.182  (12.615-23.749) | 0.655 | 0.230 |
| week 10 | 73.077  (66.675-79.479) | 13.636  (8.683-18.590) | <0.001 |
| Side view cervical part | week 0 | 23.077  (17.000-29.158) | 0.197 | 9.091  (4.941-13.240) | 0.198 | 0.195 |
| week 10 | 61.538  (54.516-68.561) | 22.727  (16.679-28.776) | <0.001 |
| Side view thoracal part | week 0 | 0.000  (0.000-0.000) | <0.001 | 0.000  (0.000-0.000) | 0.157 | - |
| week 10 | 61.538  (54.516-68.561) | 9.091  (4.941-13.240) | <0.001 |
| Side view lumbar part | week 0 | 7.692  (3.846-11.538) | <0.001 | 4.545  (1.539-7.552) | 0.317 | 0.654 |
| week 10 | 61.538  (54.516-68.561) | 0.000  (0.000-0.000) | <0.001 |
| Posture deemed correct | Front view  line of gravity | week 0 | 42.308  (35.177-49.439) | 0.002 | 36.364  (29.420-43.307) | 0.808 | 0.790 |
| week 10 | 88.462  (83.850-93.073) | 18.182  (12.615-23.749) | <0.001 |
| Front view shoulder symmetry | week 0 | 42.308  (35.177-49.439) | <0.001 | 31.818  (25.095-38.541) | 0.101 | 0.536 |
| week 10 | 96.154  (93.378-98.930) | 36.364  (29.420-43.307) | <0.001 |
| Front view pelvis symmetry | week 0 | 7.692  (3.846-11.538) | <0.001 | 4.545  (1.539-7.552) | 0.013 | 0.901 |
| week 10 | 96.154  (93.378-98.930) | 18.182  (12.615-23.749) | <0.001 |
| Side view line of gravity | week 0 | 15.385  (10.177-20.592) | <0.001 | 13.636  (8.683-18.590) | 0.012 | 0.967 |
| week 10 | 73.077  (66.675-79.480) | 18.182  (12.615-23.749) | <0.001 |
| Side view cervical part | week 0 | 30.769  (24.108-37.431) | <0.001 | 27.273  (20.844-33.701) | 0.085 | 0.957 |
| week 10 | 88.462  (83.850-93.073) | 36.364  (29.420-43.307) | 0.001 |
| Side view thoracal part | week 0 | 23.077  (17.000-29.158) | <0.001 | 13.636  (8.683-18.590) | 0.012 | 0.691 |
| week 10 | 76.923  (70.842-83.004) | 18.182  (12.615-23.749) | <0.001 |
| Side view lumbar part | week 0 | 7.692  (3.846-11.538) | <0.001 | 18.182  (12.615-23.748) | 0.015 | 0.253 |
| week 10 | 61.538  (54.516-68.561) | 13.636  (8.683-18.590) | <0.001 |

CI: confidence interval

**Discussion**

A 10 week back shool program for children was conducted among 6-7 years old children. The efficacy of the back school program was measured by a questionnaire of knowledge of spinal function and by photogrammetric analysis of posture. Our results showed similar results to the improvements of the Hungarian and international back school programs.

*Knowledge of spinal function*

Tóthné and Tóth measured the knowledge of spinal prevention among 111 children, after the 8-month program, called Porci Berci. 79.33% of the children gave correct answers for theoretical spine prevention questions, 93% could give correct answer for questions about correct posture and 79.01% acquire the „spine friendly” movements (<http://www.zalaszam.hu/pb/publikacio.html>).

Similarly Greet et al. (2007) condcuted a reseach with 190 children who took part in a back school program, containing theoretical back care and physical activity promoting program (complete), 193 children who only took part in theoretical back care program (partial) and 173 children were in acontrol group. In both intervention groups the knowledge of back care and back care behavior were significantly (p<0.001) higher than in the control group. The increase of the total score of back behavior was significantly (p<0.001) higher in the back care group than in the complete group.

In the research of Fabiana et al. 392 students were included from 4th to 8th grade and 114 students were evaluated at follow-up. The 9 week back care program consisted of theoretical and practical parts, and 2 years passed between the end of the program and the follow-up. There was a significant difference (p<0.001) between the pre- and post-intervention scores and between the pre-intervention and follow-up scores (p<0.001) (Fabiana et al., 2012).

*Posture*

As a result of the Porci Berci program, between 1998-2009 1138 children were measured with the Matthias test (posture test). According to the results in 1998, although 249 between the ages 8-10 years 30.52 % of the children could carry the test right, in 2004, 2005 and 2009 the repeated tests showed a constantly deteriorating tendency (Tóthné et al., 2015).

In the research of Somhegyi et al., during the school year of 2001/2002, 200 6-14 years old children took part in the primary prevention program of the Hungarian Spine Society and 213 in the control group. In the intervention group all the 12 muscle tests (responsible for posture) significantly (p<0.01) improved. In the control group in some of the abdominal and back muscle tests significant (p<0.01) improvement came to be, but this result significantly (p<0.01) lower than the improvement in the intervention group, 6 muscle tests have not been changed and 4 showed significant (p<0.05) decadence(Somhegyi et al., 2014).

Kovácsné et al. examined the habitual posture of 30 (mean age: 12.7±2.2 years) ballet dancers and 32 (13.7±2.9 years) hip-hop dancers on the effect of a 3-month core stability training program. The posture measured after the program improved by a high percentage, in both groups of dancers (ballet 52.17%, hip-hop 37.5%) (Kovácsné BV et al., 2016).

Kayapinar tested the effectiveness of a back school program among 80 (40: intervention group, 40: control gorup) 5-7 years old children on the change of parameters on posture. In the intervention group most of the parameters showed significant (p<0.05) change, and most of the parameters measured after the program were significantly (p<0.05) better in the intervention group than in the control group(Fatma et al., 2012).

**Conclusions**

The 10-week child back school program is an effective intervention for the development of spine prevention knowledge, and for improvement in habitual posture and posture deemed correct in 6-7 years old children. Howewer, the 10 weeks long intervention is be able to raise the was not shown to habitual posture and posture deemed correct measurements into the normal range among the subjects. The workbooks have shown useful in the education and reinforcement of the education of the children for the knowledge of spine functions, exercises and correct body postures in children who are not able to read yet. For children who can’t read or write yet, elaborated theoretical curriculum, practical part and home workbook are needed. The program should be taken for a whole school year. It is reccomended to be tested on preschool children.

**Limitations**

The research was conducted on a small size of population, a larger number of the population would allow more reliable conclusions.

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**Conflict of interest statement**

The authors declare no conflicts of interest.

**References**

Anna B, Ryszard P. Exemplification of Movement Patterns and Their Influence on Body Posture in Younger School-Age Children on the Basis of an Authorial Program „I Take Care of My Spine”. *Medicine*. 2016;95(12):e2855.

Babócsay B, Kovács B, Járomi M. Egészségügyi dolgozók gerinciskola programja, *Egészség-Akadémia.* 2014;5(3):153-164.

Elisabeth G, Greet C, Ilse De B, et al. Back posture education in elementary schoolchildren: a 2-year follow-up study. *Eur Spine J.* 2007;16:841-850.

Elisabeth G, Greet C, Ilse De B, Lieven D. Effects of back posture education on elementary schoolchildren’s back function. *Eur Spine J*. 2007;16:829-839.

Fabiana AF, Roberta FCM, Mariana OK et al. Effects of an educational back care program on Brazilian schoolchildren’s knowledge regarding back pain prevention. *Rev Bras Fisioter*. 2012;16(2):128-133.

Fatma CK, Sami M, Selda U. The investigation effects of sample pilot study program on posture of preschool children. *Procedia- Social and Behavioral Sciences*. 2012;46:2806-2810.

Fejérdy G. Csont és ízület évtizede konferenciája. Budapest; 2001

Greet MC, Dirk LR de C, Elisabeth JAG, et al. Back education in elementary schoolchildren: the effects of adding a physical activity promotion program to a back care program. *Eur Spine J*. 2007;16:125-133.

Günter L. *Rückenschule für kinder*. Gräfe & Unzer; 1998:1-96.

Julia JH, Jennifer LK. Daily exercises and education for preventing low back pain in children: cluster randomized controlled trial. *Phys Ther*. 2015;95:507-516.

Kovácsné BV, Szilágyi B, Kiss G, et al. Application and examination of the efficiency of a core stability training program among dancers. *Eur J Integr Med*. 2016;8S:3–7.

Leszek B, Wojciech S, Wojciech K, et al. Low back paininschool-agechildren: riskfactors, clinicalfeatures and diagnostic management. *Semin Ultrasound CT MR*. 2004;25(6):490-505.

Matias N, Priscilla R e SN, João LRN, et al. Back pain and behavioral habits of high school students: a comparative study of two Brazil’s region, *Rev Bras Reumatol*, 2017;57(5):495-499.

M Jordá L, E Pérez B, M García-Mifsud, et al. Back school: a simple way to improve pain and postural behaviour. *An Pediatr (Barc)*. 2014;81(2):92-98.

Motylewski S, Zientala A, Pawlicka-Lisowska A, et al. Assessment of body posture in 12- and 13-year-olds attending primary schools in Pabianice. *Pol Merkur Lekarsi*. 2015; 39(234):368-371.

Ormos G, Kiss R. Neck posture measurement amongst schoolchildren, *Biomechanica Hungarica*, 2010;3(1):183-188.

Peller S. A kisgyermek- és serdülőkori gerincbetegségek megelőzése és kezelése, Iskolaegészségügyi konferencia*.* Gödöllő; 1977

Penha PJ, Baldini M, [João](https://www.ncbi.nlm.nih.gov/pubmed/?term=Jo%C3%A3o%20SM%5BAuthor%5D&cauthor=true&cauthor_uid=19243728) SM. Spinal posture alignment variance according to sex and age in 7- and 8-year old children. *J Manipulative Physiol Ther*. 2009;32(2):154–159.

Sabine K, Siegfried S. *Rückenschule für Kinder ein Kinderspiel*. München, Deutschen Bibliothek; 2001:1-187.

Selma A, Razija S, Nurka P, et al. Epidemiology of musculoskeletal disorders in primary school children in Bosnia and Herzegovina. *Mater Sociomed.* 2016;28(3):164-167.

Seyffarth H. *Gyermekedről van szó*. Budapest, Gondolat Kiadó; 1977: 22-44.

Somhegyi A, Gardi Zs, Feszthammer A-né, et al. (2003). Tartáskorrekció, 1-40.

Somhegyi A, Lazáry Á, Feszthammer A-né, et al. A biomechanikailag helyes testtartás kialakítását, automatizálását és fenntartását szolgáló mozgásanyag beépítése a testnevelésbem. *Népegészségügy*. 2014;92(1):11-19.

Tóth K, Tóthné SV. Porci Berci barátokat keres - Egészségmegőrző oktatóprogram kisiskolásoknak. *Mozgásterápia*. 2000;9(2):10-13.

Tóth K, Tóthné SV. *Porci Berci barátokat keres - Egészségmegőrző oktatóprogram kisiskolásoknak.* POTE- Egészségügyi Főiskolai Kar Zalaegerszegi Tagozat; 1998:1-27.

Tóth K, Tóthné SV. Az iskolakezdés gyógytornász szemmel. *Fizioterápia*. 2007;16(3):15-19.

Tóthné SV, Tóth K. *Tudatos ülés gerinciskolája általános iskolásoknak.* Pécs, PTE-ETK; 2015:1-154.

Weiss A., Weiss W., Stehle J, et al. Beeinflussung der Haltung und Motorik durch Bewegungsförderungsprogramme bei Kindergartenkindern. *Deutsche Zeitschrift für Sportmedizin*. 2004;*55*:101-105.

Yamaguchi N, Chosa E, Yamamoto K, et al. Screening for musculoskeletal problems in Japanese schoolchildren: a corss- sectional study nested in a cohort, *Public Health.* 2016;139:189-197.

<http://www.zalaszam.hu/pb/publikacio.html>, Letöltés ideje: 2018.09.12.