

## SURVEY AMONG SCHOOL-AGED CHILDREN WITH ULTRASOUND-BASED MOTION ANALYZING SYSTEM AT TWO PRIMARY SCHOOLS IN SZOLNOK

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### Abstract

**Aim:** The use of ultrasound based motion analyzing systems is harmless and has no side effects. They are applicable among healthy people and children as well. Since 2007 we have been surveying children who suffer from spine and foot deformities and participate in adapted physical education. With three-year experience we decided to broaden the scope of the survey. In September last year we started a survey among primary school pupils aged 6-10 with the goal to follow up their state. At first we examined the children's initial state when their usual annual medical examination was made at school. The survey is planned to take at least three years. During the survey we pay special attention to reveal spine and foot vault deformities at an early stage, because these deformities are most common in the age group and after discovery conservative therapy-based correction can be started without procrastination.

**Material and Method:** After the orthopaedic examination, we performed a static posture examination and sole pressure distribution examination among 210 pupils from the two primary schools. By analysis with the Zebris CMS-HS ultrasound-based system and using Win Spine program we defined the degree of dorsal kyphosis and lumbar lordosis, the total trunk inclination in the sagittal and frontal planes and the degree of scoliosis.

**Results:** Two children with innate locomotor disorders and a boy with neurological problems were excluded from the survey. Out of the remaining 207 children the orthopaedic examination found 75 healthy ones, 55 with bad back posture and 9 with flat back. 16 times the diagnosis was scoliosis, mostly functional but could be corrected properly. 53 children had no spine deformity but were positively flat-footed. Following the recommendation of the GKE 2008 annual congress, we divided each group into subgroups according to the degree of curvatures in the sagittal plane. Dorsal kyphosis between 30 and 60 degrees and lumbar lordosis between 30 and 40 degrees were considered normal. Because of this consideration the healthy group was not homogeneous, either. 37.3% of them had flat lumbar lordosis, 4% of them had flat lumbar lordosis and thoracic kyphosis, too. Among children with bad back posture these ratios were 50.9% and 3%, respectively.

**Conclusion:** Continuous control over different age groups makes it possible for us to search diagnosis-specific signs in the results of ultrasound-based motion analysis. The sign can be, for example, unbending of the curvature. The results of adapted physical education can be measured numerically. We can call the attention of teachers and parents for the need of posture correction built into physical education and everyday life.

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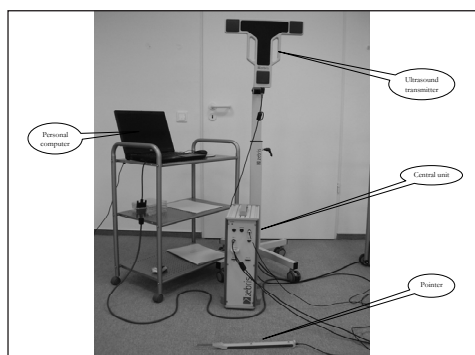
## Introduction

Medical literature describes children's low back and back pains as multi-factorial problems. The body mass index, the mobility and flexibility of muscles and joints, muscular strength, sports, the furniture in schools, heavy school backpacks, psychological factors and smoking – although in different ways – play an important role in children's spine development<sup>3</sup>. In most cases, children's back pain experiences are mild and do not affect their daily life<sup>2,5,6</sup>. The number of complaints is always higher than the actual structural changes. Psychological factors play an important role in children's back pain<sup>2</sup>. Low endurance of trunk flexors and extensors can lead to abnormal posture, which condition later becomes permanent and leads to health problems<sup>7</sup>. Data in the medical literature prove that back pain reports in childhood and early adolescence are significantly related to back pain in adulthood<sup>2,8</sup>. It is important to discover the reasons at an early stage, so the health problems can be cured in time and further complications can be prevented. Despite this demand, spine deformities in childhood are mostly without symptoms and for the lack of expansive orthopaedical examinations they are discovered late or are not recognized at all. Due to late discoveries, the efficiency of cures is behind expectations, and many times spine anomalies in adulthood are the results of health problems not revealed in childhood. Even a simple bad posture can play a great role in the evolution of a secondary degenerative process. At pupils between the ages of 6 to 10 the required muscular development often lags behind the quick height increase. Diagnosis at an early stage followed by appropriate correction is the first step towards prevention. The use of screening makes it possible to establish an exact diagnosis and to start conservative therapy at the earliest possible moment. With the survey our goal was to reveal and record the spine conditions and the back postures of

children between the ages of 6 to 10 and to demonstrate the existence of foot deformities. Using the Zebris CMS-HS system's Win Spine program we received static pictures of the children's spines, and pedographic examinations indicated us the deformities of the foot.

## Material and method

The subjects of our research were children from two primary schools in Szolnok from the first to the fourth grades, and it concerned one class from each grade. 210 children were examined; out of them, 4% were six years old, 25% were seven, 29% were eight, 25% were nine and 18% of them were ten years old. Three children's data were removed. Two of them had a genetic defect and congenital neurological anomaly, which influenced the organs of locomotion. At the third one, we found a complex hip, knee and ankle disorder which had a role in spine deformity. After the orthopaedic examination every patient was measured by the CMS-HS system to investigate the shape of their spine and a foot pressure distribution measurement was also performed by the pedograph. When it was required we used X-ray as well. The system consists of a central unit, an ultrasound transmitter, a personal computer and a pointer (*Figure 1*). The emitters are built



*Figure 1.* Ultrasound transmitter, Pointer, Central unit and PC

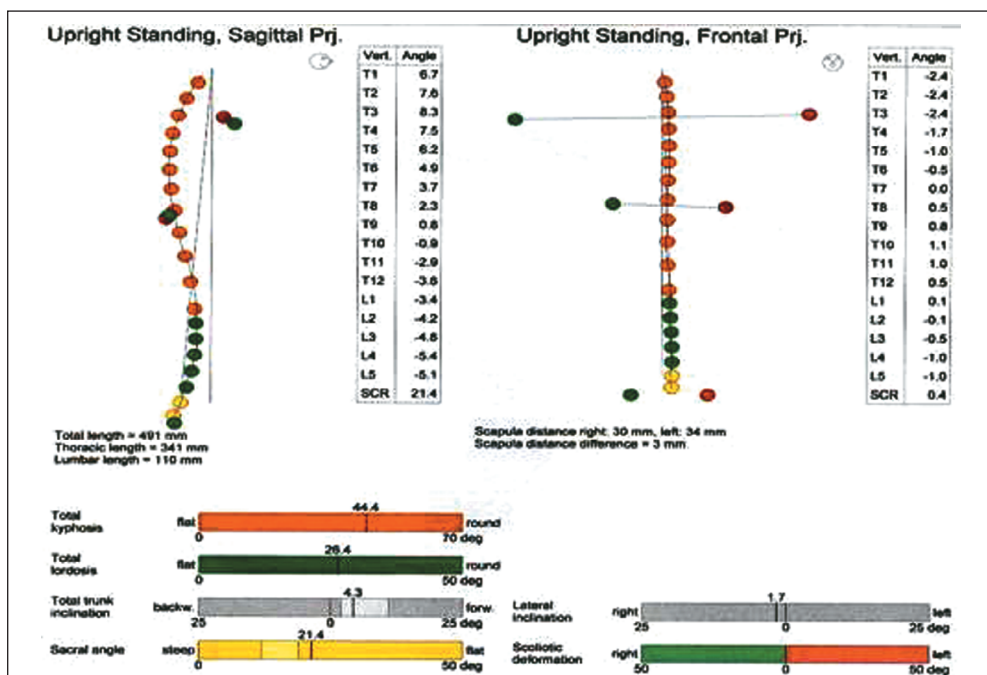


Figure 2. Graphic and numerical data in the sagittal and frontal planes

in the three ends of the T-shaped head of the transmitter in one plane. The pointer contains 2 microphones. By the pointer the anatomical points and the spine can be determined.

The distance between the head and the sensors is calculated in the knowledge of the speed of ultrasound and by measuring time. With the help of the space coordinates of emitters and of the microphones the space coordinates of the determined anatomical points can be calculated. The printed medical report shows numerically and graphically the degree of the dorsal kyphosis, the lumbar lordosis and the scoliosis and the total trunk inclination in the sagittal and frontal planes (Figure 2).

The pedograph has five sensors in each square centimeter. During a 10-second foot examination we received information about the distribution of weight at the left and right legs, back and fore foot (Figure 3).

## Results

Without considering the age groups, 36.2% of the patients were healthy (Figure 4). 26.6% of the children had bad posture and 7.7% of them had scoliosis. The flat back was the rarest with 3.9%. 25.6% of them had no spine deformity but a flat foot. In conclusion, it was established that 61.8% of the children had no spine problems at all.

Diagnosis of flat foot with other problems were common in 40.1% out of the total amount of subjects. Flat foot occurrence was 50% among 6-year-olds, which is not surprising (Table 1). The medical arch does not develop until the sixth to tenth year of life. This decreasing tendency is clearly visible till the age of nine, but from that point the tendency veers round.

When diagnoses are analyzed according to age groups it is evident that bad posture can be

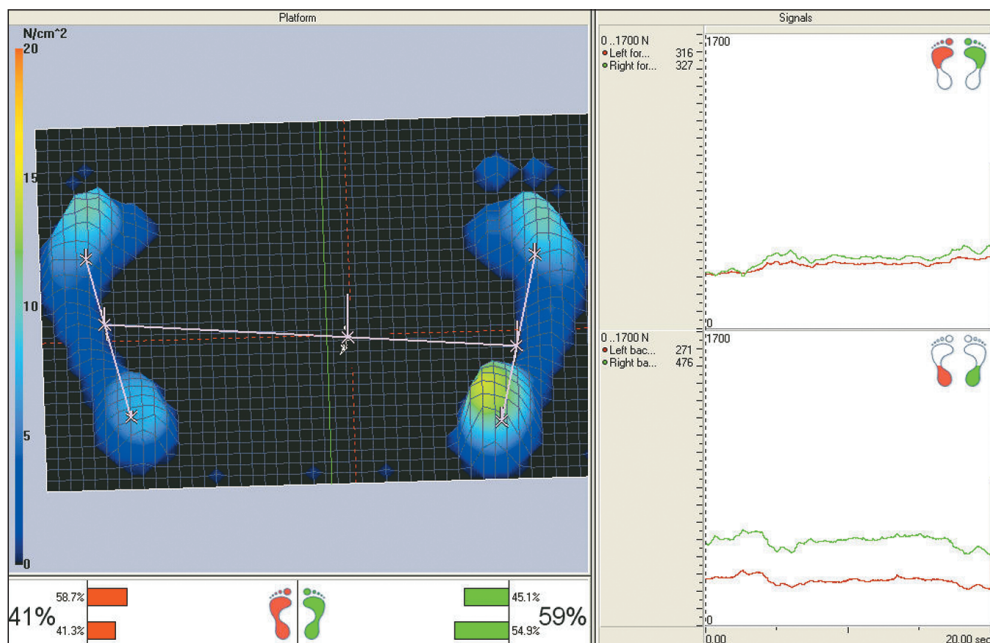


Figure 3. Medical report of the pedograph

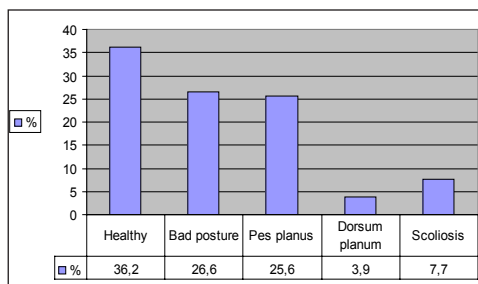


Figure 4. Diagnosis distribution without considering age groups

	6 years	7 years	8 years	9 years	10 years
Healthy (%)	12.5	33.3	54.2	25	32.4
Scoliosis (%)	0	2	6.7	7.7	16.2
Bad posture (%)	62.5	33.3	22	25	21.6
Flat back (%)	0	5.9	1.7	5.8	2.7
Flat foot (as individual clinical picture) (%)	25	25.4	15.3	36.5	27

Table 2. Diagnosis distribution according to age groups

	6 year	7 year	8 year	9 year	10 year
Flat foot (person)	4	22	12	28	17
%	50%	43%	20%	54%	46%

Table 1. Flat foot according to age groups

found in every age group, but it is more frequent among 6-year-old children (Table 2). The age group of eight-year-old children included the healthiest subjects. Scoliosis was always functional.

Following the recommendation of the 2008 GKE congress, we considered dorsal kyphosis between 30 and 60 degrees and lumbar lordosis between 30 and 40 degrees to be normal (Figure 5). Subgroups were created accordingly for every diagnosis. From the eight possible subgroups only three were found as real categories. The occurrence of flat lumbar lordosis was the highest in the groups of flat-footed, bad postured and healthy children.

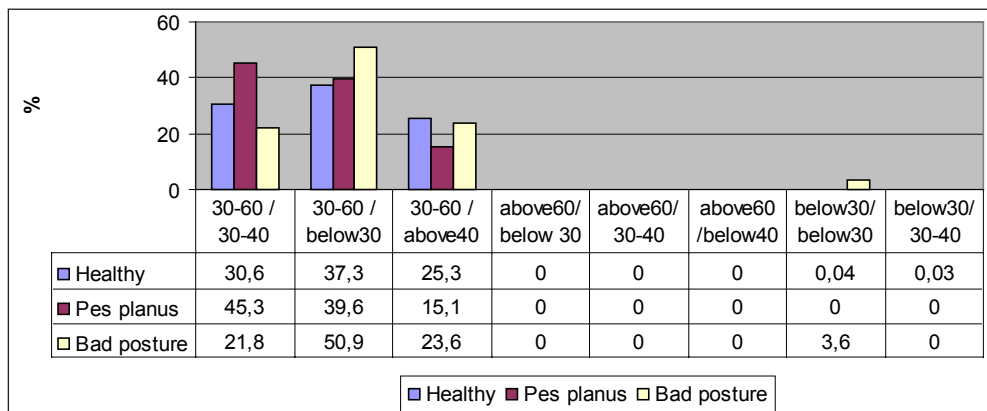


Figure 5. Subgroups according to thoracic kyphosis and lumbar lordosis

## Discussion

With the survey among schoolchildren we wanted to turn attention to the importance of screening of the organs of locomotion. The main characteristic of posture problems is that in the ages examined they do not generate complaints, but later on they can lead to several rheumatological and orthopaedic problems.

The other main characteristic is easy remedy. With more care, children are able to correct a part of sagittal problems, but cannot hold them back permanently. That is why special atten-

tion and strengthening of the trunk's musculature are so important. Beside physical education, regular trainings for good back posture are essential. Children with scoliosis require individual exercise programs. Adapted physical education at school is also important to develop the appropriate muscular strength, which doubles the effect of exercise programs. The cure of children with spine deformities is more efficient when it is backed from several sides. The search for foot deformities is just as important as the examination of the spine. In these age groups, foot problems can be corrected by special physical exercises.

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