Original research

The prevalence of posture pathology in school-aged children (results of a population-based study with the use of the computerized photo-geometric program "Posture")

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

Pathology of posture in children remains currently unresolved problem. According to foreign studies in the general population, the occurrence of idiopathic scoliosis in adolescents with an angle above 10º according to Cobb accounts for 0.93 % to 12.00 %. In Ukraine, the prevalence of posture pathology is not known.

The aim – to study the prevalence of posture pathology among school-aged children.

Material and methods. 1922 schoolchildren of 6–17 years, residents of Kyiv (Ukraine), were examined with the computerized photo-geometric program "Posture" between 2017 and early 2019.

Results. Deviation of the spinal column from the midline in the frontal, sagittal plane (functional and organic disorders of posture) was observed in 75.3 % of children. Among them, signs of scoliotic spinal deformity were found in 72.5 % of children, in girls – 1.5 times more often. The angle of maximum deflection of the scoliotic arch from the median line was ≥5º in 13.7 % of children with scoliosis and in 9.9 % of all the examined children.

Conclusions. Sensitivity (95 %) and specificity (85 %) of the computerized photo-geometric program "Posture" were determined, which points to the necessity to be applied in health care maintaining practice. The pathology of posture in schoolchildren of the city of Kyiv was determined in 75.3 %, among them the signs of scoliotic spinal deformity were noted in 72.5 %. The scoliosis incidence with a deflection angle of spinal deformity ≥5º was 9.9 %. It attests to the fact that it is necessary to develop medical and social programs for the prevention and treatment of posture pathology in children.

Поширеність патології постави в учнів (результати популяційного дослідження з використанням комп'ютеризованої фото-геометричної програми «Постава»)

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Патологія постави в дітей залишається невирішеною проблемою. За даними закордонних дослідників, у загальній популяції частота діагностики в підлітків ідіопатичного сколіозу з кутом понад 10 % за Cobb становить від 0,93 % до 12,00 %. В Україні поширеність патології постави невідома.

Мета роботи – вивчити поширеність патології постави в дітей шкільного віку.

Матеріали та методи. За період із 2017 до початку 2019 року, використовуючи комп'ютеризовану фото-геометричну програму «Постава», обстежили 1922 школярі віком 6–17 років, які постійно проживають у м. Києві (Україна).

Результати. Відхилення хребта від серединної лінії у фронтальній, сагітальній площині (функціональні й органічні порушення постави) спостерігали у 75,3 % дітей. Ознаки сколіотичної деформації хребта виявили у 72,5 % дітей, у дівчат у 1,5 раза частіше. Кут максимального відхилення сколіотичної дуги від серединної лінії становив ≥5º у 13,7 % дітей зі сколіозом і 9,9 % усіх обстежених.

Висновки. Визначили чутливість (95 %) і специфічність (85 %) комп'ютеризованої фото-геометричної програми «Постава», що вказує на необхідність її широкого впровадження у практику охорони здоров'я. Патологія постави у школярів Києва визначена у 75,3 %, ознаки сколіотичної деформації хребта виявили в 72,5 %. Частота діагностики сколіозу з кутом відхилення деформації хребта ≥5º становила 9,9 %. Результати свідчать про необхідність розроблення медико-соціальних програм профілактики та лікування патології постави в дітей.

Распространенность патологии осанки у школьников (результаты популяционного исследования с использованием компьютеризированной фото-геометрической программы «Осанка»)

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Патология осанки у детей остается нерешенной проблемой. По данным зарубежных исследований, в общей популяции частота встречаемости у подростков идиопатического сколиоза с углом более 10º по Cobb составляет от 0,93 % до 12,00 %. В Украине распространенность патологии осанки неизвестна.

Цель работы – изучить распространенность патологии осанки среди детей школьного возраста.

Материалы и методы. За период с 2017 до начала 2019 года с использованием компьютеризированной фото-геометрической программы «Осанка» обследовали 1922 школьников в возрасте 6–17 лет, постоянно проживающих в г. Киеве (Украина).

Результаты. Отклонение позвоночника от срединной линии во фронтальной, сагиттальной плоскости (функциональные и органические нарушения осанки) отмечено у 75,3 % детей. Признаки сколиотической деформации позвоночника диагностированы у 72,5 % детей, у девочек в 1,5 раза чаще. Угол максимального отклонения сколиотической дуги от срединной линии составлял ≥5⁰ у 13,7 % детей со сколиозом и 9,9 % всех обследованных детей.

Выводы. Определена чувствительность (95 %) и специфичность (85 %) компьютеризированной фото-геометрической программы «Осанка», что указывает на необходимость ее широкого внедрения в практику охраны здоровья. Патология осанки у школьников города Киева установлена у 75,3 %, признаки сколиотической деформации позвоночника отмечены у 72,5 %. Частота встречаемости сколиоза с углом отклонения деформации позвоночника ≥5⁰ составила 9,9 %. Результаты свидетельствуют о необходимости разработки медико-социальных программ профилактики и лечения патологии осанки у детей.

Pathology of posture in children includes persistent (organic) and functional curvatures of the spinal column and remains, until recently, an unresolved problem. Children usually visit to a doctor with scoliosis II or higher, when obvious signs of scoliosis are already visualized at the simple examination of a child. Television, video games, a sedentary lifestyle, smartphones and tablets as well as a lack of regular physical activity are the most common risk factors for posture curvatures in children [1,2].

Approximately 10 % of these diagnosed cases require conservative treatment, and approximately 0.1–0.3 % require urgent correction of the deformity [3].

Therefore, it is so important to diagnose posture pathology in children timely [2,4,5]. The data on the epidemiology of this pathology are very contradictory.

Aim

The aim of our work was to study the prevalence of posture pathology in children of school-age applying the screening method of the computerized photo-geometric program "Posture" in Kyiv (Ukraine).

Material and methods

The study included 1922 schoolchildren residents of Kyiv (Ukraine) from various schools, at the ages from 6 to 17 years, between 2017 and early 2019.

All children were examined with computerized photo-geometric program "Posture". Three age groups were defined: Group I – 676 (35.2 %) children of 6–9 years; Group II – 546 (28.4 %) children of 10–12 years; Group III – 700 (36.4 %) adolescents of 13–17 years.

Examination rules:

– The undress child wearing the underwear and socks. Longer hair of the girls examined should be pinned up so as not to cover the earlobes or neck contour.

– The initial position of the child: upright position, legs closed, the child is relaxed.

– Placement of control points in the frontal plane (acromions (determines shoulder misalignment), shoulder blades' angles, waist triangles, iliac bones' ridges, gluteal folds, popliteal fossae) and in the sagittal plane (tragus, mid-shoulder, hip joint projection, mid-knee joint, ankle).

– The place of photographing should be provided with a plumb line.

– The child should be photographed in its original position in 2 projections.

– Computerized photo processing after "Posture" program (using control points on the child's body set by a specialist, skew angles are calculated (shoulders, shoulder blades, pelvis, etc.), the presence, value in degrees, location of the spinal curvature) are determined.

– Questionnaire filling: age, height, weight, grade, type and style of school bag carrying.

– Parents are given a card with processed photos and examination results as well as recommendations.

Examination and interpretation of the results obtained by the photo-geometric method "Posture" took 5 minutes. The photos were included in assessment forms for postural analysis and identification of changes in the frontal plane, sagittal plane, such as kyphosis, lordosis, hypokyphosis, hypolordosis, and anterior head tilt.

The sensitivity was define as Se = A / (A + C), where A is the proportion of true positive test results; A + C is the total number of true scoliosis patients. The specificity was define as Sp = D / (B + D), where D is the proportion of true negative test results among patients without spinal deformity; B + D – diagnostic information value [6].

Results

The sex-specific characteristics of schoolchildren included in our study are presented in *Fig. 1* and *2*.

Among 1922 examined persons, it was found that the deviation of the spine in sagittal and frontal plane (along the spinous processes) was observed in 1447 (75.3 %) children; accordingly, the rest 475 had physiological posture, the incidence of which decreased with the child's age (*Table 1*).

Table 1. The prevalence of posture pathology in children of school-age

Posture	Age							
	6–9 years, n = 676		10–12 years, n = 546		13–17 years, n = 700		Total, n = 1922	
	abs	%	abs	%	abs	%	abs	%
N	277	41	93	17	105	15	475	24.7
PD	399	59	453	83	595	85	1447	75.3

N: physiological posture; **PD:** postural disorder.
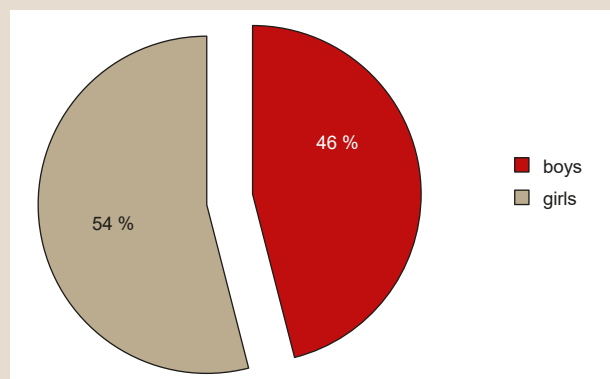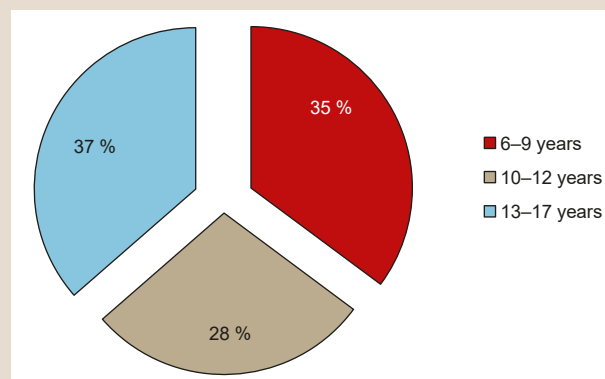
Fig. 1. Sex ratio of 1922 children.

Fig. 2. Age distribution of 1922 children.

Table 2. The prevalence of scoliosis in children at different ages

Scoliosis	Age, n = 1922					
	6–9 years, n = 676		10–12 years, n = 546		13–17 years, n = 700	
	abs	%	abs	%	abs	%
Cobb angle ≥20º, n = 80	13	1.9	16	2.9	51	7.3
SC angle ≥5º, n = 191	27	4.0	59	10.8	105	15

SC: spinal curvature in the frontal plane.

According to the study results, scoliotic disease was 1.5 times more often in girls.

Signs of scoliotic spinal deformity were detected in 1393 (72.5 %) children, kyphotic curvature – in 54, combined disorders were detected in 88 schoolchildren.

During data analysis, which were obtained with computerized photo-geometric "Posture" method, the angle of scoliotic arc maximum deflection from the median line was more than ≥5º in 191 (13.7 %) children with scoliosis and in 190 (9.9 %) of all the examined children (*Fig. 3*).

Children with scoliosis were proposed X-ray investigation in an upright position. According to X-ray images, scoliosis of varying severity was detected in 80 children, in 5 of them – S-shaped scoliosis of III–IV stage of thoracolumbar area. The study results demonstrated that the prevalence of scoliosis Cobb angle of ≥20º increased with the children age (*Table 2*).

Discussion

Deviation of the spinal column from the median line along the spinous processes in the frontal and sagittal planes (functional and organic disorders of posture) was observed in 75.3 % of children. Among them, signs of scoliotic spinal deformity were detected in 72.5 % of children, in girls 1.5 times more often. In 13.7 % of children with scoliosis and in 9.9 % of all the examined children, the angle of maximum deviation of the scoliotic arc from the midline was ≥5º.

According to epidemiological investigations in other countries, in the general population, the frequency of idiopathic scoliosis occurrence in adolescents with an angle above 10º according to Cobb ranges from 0.93 % to 12.00 %. In about 20 % of cases, scoliosis is secondary to another pathological process. The remaining 80 % are cases of idiopathic scoliosis [7–11].
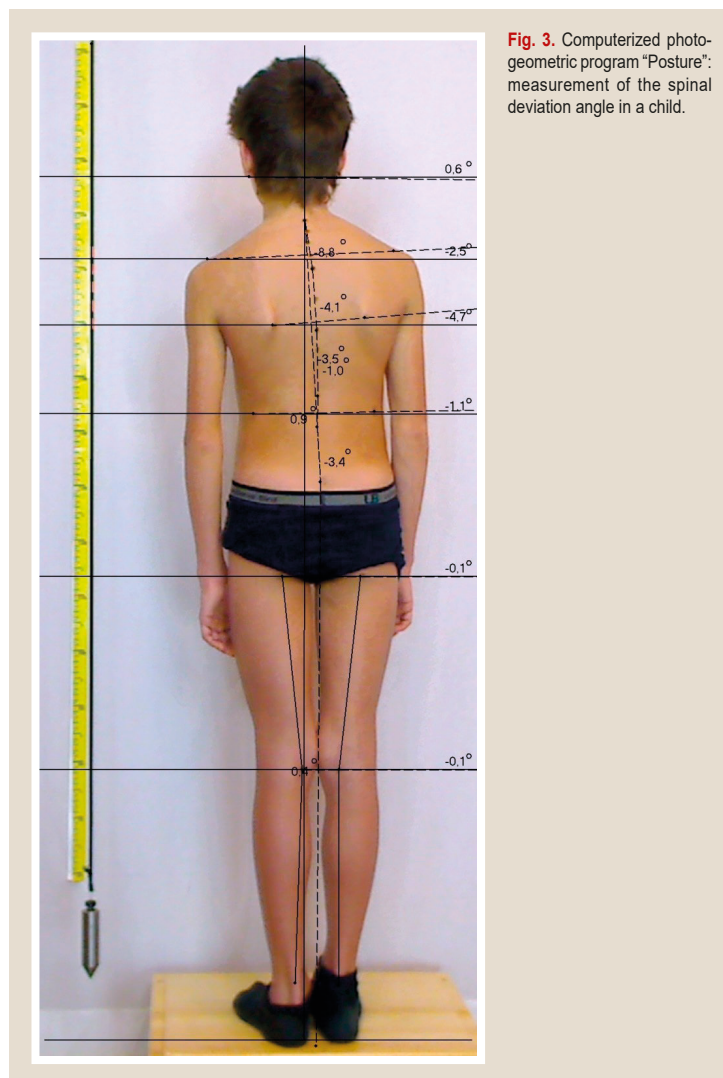

Fig. 3. Computerized photo-geometric program "Posture": measurement of the spinal deviation angle in a child.

Among 79 122 schoolchildren in the city of Wuxi, eastern China, adolescent idiopathic scoliosis was found in 2.4 %, and in the Shanghai area, among 5327 investigated secondary school students (grades 6–8), scoliosis was diagnosed by screening method in 520 children (9.76 %) and spinal X-ray was performed in 102 of them (33.9 %) [12,13].

Ueno M., et al. performed school screenings for more than 250 000 children aged 11–14 years from 2003 to 2007 in the city of Tokyo. Scoliosis was confirmed in 3424 children by radiographic examination, and false-positive results were found (Cobb 0) in 39 cases [14].

2822 schoolchildren were examined in Spain (mean age 8.5 ± 1.8 years), where the number of patients with scoliosis was 1023 (36.3 %). Rib hump was twice common in girls. The risk of hump developing increased with age by 1.12 times. Children wearing school backpacks had a lower risk of scoliosis progression [15].

966 schoolchildren aged 10–16 years were examined in Southern Portugal. The results of the study demonstrated that scoliosis had been present in 41 (4.2 %) children. The highest prevalence was observed among girls (4.5 %), especially at delayed menarche (8.6 %) [16].

In some Polish cities, there are preventive programs aimed at detection of spinal dysfunctions and disorders in children and adolescents. Our study participants were children aged between 6 and 18 years with permanent residence in Poznan. The study enrolled 1.325 boys and 1.355 girls. In the whole study population, the incidence of scoliotic posture, assessed according to the chart of postural dysfunctions by Dega, amounted to 14.6 % in boys and 17.0 % in girls. There were no significant differences between the boys and the girls in particular age groups. It was found that scoliotic posture both in boys and girls (P < 0.05) was associated with age (the correlation was significantly different from zero and positive), and the proportions of students with scoliotic posture rose with age. Scoliometer examination revealed that the incidence of scoliotic posture was more frequent among girls (25.7 %) than among boys (22.2 %). The differences were statistically significant. The boys subjected to the study showed a correlation (r = 0.12) significantly different from zero and positive, in the group of tested girls, the correlation (r = 0.14) was significantly different from zero and positive [17].

The screening program in Hong Kong included 2242 children aged 8–16 years. Sensitivity and specificity (93.8 % and 99.2 %) and predictive value (81.0 %) were the highest and false-positive indexes were the lowest (0.8 %; 6.2 % false-negative) [18].

Chaves P. J. et al. examined 117 schoolchildren in Brazil and stated that high incidence of postural changes was observed in the studied population. About 56 % (n = 14) presented some type of head alteration and the other 44 % (n = 11) presented no head position changes. Among the postural alteration in the alignment of the head, 12 % represented head protrusion and 44 % represented head tilt to the right or left. 64 % represented a shoulder elevation and 24 % had a shoulder protrusion. Other postural alterations also were observed in the studied population, and 67.27 % (n = 74) had pelvic alterations, such as anteversion and pelvic retroversion [19].

The scoliosis incidence among adolescents in Malaysia was 2.55 % [20].

In the United States of America, according to J. Dunn, 2017, the cumulative scoliosis incidence was 1.8 % (reliability 95 %): the interval [CI] of 1.2–2.3 for curvature of more than 10º; 1.0 % (95 % CI, 0.6–1.5) for deformation of at least 20º and 0.4 % (95 % CI; 0.1–0.6) for curvature of 40º [17,21].

Referring to the literature data [6], we have established sensitivity and specificity of the computerized photo-geometric program "Posture", which has indicators 95 % and 85 %, respectively. Diagnostic information content of this method is 0.9.

The spine deviation angle, equal to 5º and determined by a scoliometer, is a criterion for determining the Cobb angle equal to 20º in computer analyzes [22–24]. In our studies, scoliosis of the II degree and higher was observed in 9.9 % of 1922 schoolchildren in Kyiv, respectively, 13.7 % of children had all types of scoliosis, which exceeded the data of modern researchers of the world [2,7,20].

When comparing the data of modern foreign literature [12,13,20,23], the incidence indicators of scoliosis (72.5 %) and postural disorder (75.0 %) in school-aged children coincided.

Such a high prevalence of posture pathology in children is probably because of the lack of medical examination, a change in the lifestyle of modern children (long "monitor" time, using of gadgets, low physical activity, etc.) [25].

Quite possible that the personalized approach to the treatment may contribute to regression and/or compensation, reducing the risk of scoliotic disease further progression [26–30]. Treatment result was provided with an integrated approach using exercises, physiotherapy, corset wearing and, possibly, patient compliance [30–32].

According to the Australian Association of Physiotherapists, the correct balance between screen time and physical activity should be achieved for the prevention and treatment of posture pathology [33]. Therefore, it is so important to diagnose pathology at the early stages.

Conclusions

Sensitivity (95 %) and specificity (85 %) of the computerized photo-geometric program "Posture" were determined, which point to the necessity to be applied in health care maintaining practice.

Posture disorders in schoolchildren of Kyiv were diagnosed in more than 75 % among them signs of scoliotic spinal deformity were found in 72.5 %. The scoliosis incidence with a deflection angle of spinal deformity ≥5º was 9.9 %.

It attests to the fact that it is necessary to develop medical and social programs for the prevention and treatment of posture pathology in children.

Practical recommendations

1. It is recommended to provide photo-geometric screening to school-aged children in order to detect posture disorders.

2. Detection of posture disorders in children will prevent the development of scoliosis of the II degree and higher.

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