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Original Study Article



The structure of lesions of the musculoskeletal system in adolescent children, considering the somatic pathology and living environment

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BACKGROUND: Pathology of the musculoskeletal system ranks first among health disorders of the younger generation. The frequency of posture disorders, scoliosis, and flat feet increases as the child grows older and requires careful monitoring, preventive measures, and long-term rehabilitation measures.

AIM: This investigation studies the formation frequency of lesions of the musculoskeletal system lesions, considering the somatic pathology in adolescent children brought up under various conditions, and addresses the issue of preventive and corrective measures.

MATERIALS AND METHODS: The main group consisted of schoolchildren aged 11–15 from social institutions ($n = 60$). The comparison group included children from complete families ($n = 60$). The health assessment was conducted in accordance with the methodological recommendations developed at the Research Institute of Hygiene of Children and Adolescents. The material was copied from forms 112/y, 003/y, 026/y, and the clinical examination results and the conclusions of other specialists were collected. Statistics were evaluated by the Pearson's χ^2 -criterion with the Yates correction, with values of $p < 0.05$.

RESULTS: The health of children from social institutions was significantly worse than that of complete families ($p = 0.04$). They were 4.8 times more likely to form chronic diseases ($p = 0.04$), especially those of the central nervous and musculoskeletal systems, digestive organs, blood circulation, and the ear, nose, and throat (ENT) organs were leading ($p = 0.001$). Lesions of the musculoskeletal system were more often combined ($p = 0.02$). In the comparison group, functional disorders occurred more often ($p = 0.04$), and digestive and circulatory organ diseases prevailed. Pathology of the musculoskeletal system occupied the third position and was significantly less common ($p = 0.0001$).

CONCLUSIONS: The health of children from social institutions is worse than that of schoolchildren from complete families. In them, lesions of the musculoskeletal system occupy second place, the frequency of combined lesions is higher, the increase in orthopedic pathology occurs mainly because of scoliosis, flat feet, and posture disorders. Neurodysplastic and idiopathic forms prevail in the structure of scoliosis. In children with scoliosis, diseases of the central nervous system, digestive organs, and blood circulation are more often registered. In children with flat feet, lesions of the digestive and circulatory organs are more often diagnosed. In children with impaired posture, diseases of ENT organs, circulatory organs, and vision are more often detected. Therefore, the musculoskeletal system pathology must be considered as an interdisciplinary problem, requiring a comprehensive rehabilitation program that involves other specialists.

Keywords: children brought up in social institutions; a complete family; children's health; the structure of somatic pathology; orthopedic pathology.

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Оригинальное исследование

Структура поражений опорно-двигательного аппарата у детей подросткового возраста с учетом соматической патологии и среды проживания

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Обоснование. Патология костно-мышечной системы занимает одно из лидирующих мест среди нарушений состояния здоровья подрастающего поколения. Частота ее возрастает по мере взросления ребенка, в связи с этим необходимы тщательное наблюдение, профилактические и длительные реабилитационные мероприятия.

Цель — изучить частоту формирования поражений опорно-двигательного аппарата с учетом соматической патологии у детей подросткового возраста, воспитывающихся в различных условиях, для решения вопроса о профилактических и коррекционных мероприятиях.

Материалы и методы. Основную группу составили школьники 11–15-летнего возраста из учреждений социальной сферы ($n = 60$). В группу сравнения вошли дети из полных семей ($n = 60$). Здоровье оценивали в соответствии с методическими рекомендациями, разработанными в НИИ гигиены детей и подростков. Материал собирали путем выкопировки из форм 112/у, 003/у, 026/у результатов клинического осмотра и заключений других специалистов. Статистику оценивали по χ^2 -критерию Пирсона с поправкой Йейтса при значениях $p < 0,05$.

Результаты. Здоровье детей из социальных учреждений достоверно хуже, чем из полных семей ($p = 0,04$). У них в 4,8 раза чаще выявляли хронические заболевания ($p = 0,04$), среди которых лидировали нарушения центральной нервной и костно-мышечной систем, органов пищеварения, кровообращения и ЛОР-органов ($p = 0,001$). Поражения опорно-двигательного аппарата чаще носили сочетанный характер ($p = 0,02$). В группе сравнения чаще регистрировали функциональные нарушения ($p = 0,04$), преобладали заболевания органов пищеварения, кровообращения. Патология костно-мышечной системы занимала третью позицию и встречалась достоверно реже ($p = 0,0001$).

Заключение. Здоровье детей из учреждений социальной сферы хуже, чем у школьников из полных семей. У них поражения опорно-двигательного аппарата занимают второе место, частота сочетанных поражений выше, прирост ортопедической патологии происходит преимущественно за счет сколиоза, плоскостопия и нарушения осанки, в структуре сколиозов преобладают нейродиспластическая и идиопатическая формы. У детей со сколиозом чаще диагностируют заболевания центральной нервной системы, органов пищеварения, кровообращения, у детей с плоскостопием — поражения органов пищеварения и кровообращения, у детей с нарушением осанки — заболевания ЛОР-органов, органов кровообращения, зрения. Патологию костно-мышечной системы следует рассматривать как междисциплинарную проблему, в связи с чем необходима комплексная программа реабилитации с привлечением других специалистов.

Ключевые слова: дети, воспитывающиеся в учреждениях социальной сферы; полная семья; здоровье детей; структура соматической патологии; ортопедическая патология.

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BACKGROUND

In recent years, the health of the younger generation has become a matter of concern to the society, since the consequences of negative trends in its condition influence directly fundamental values such as labor, defense, reproductive, and intellectual potential of the country [1]. According to the Ministry of Health of the Russian Federation, >50.0% of school graduates have restrictions in choosing a profession on medical grounds [2]. Every third teenager, upon initial military registration, was found to require additional examination and treatment, >40.0% of persons of pre-conscription age were diagnosed with diseases that in half of the cases prevented military service, and lesions of the musculoskeletal system are significant [3]. In the process of educational activity, children experience deviations in several functional systems, especially in the musculoskeletal system, with postural disorders, scoliosis, and platypodia ranking first [4, 5]. As a result of foot flattening, not only the supporting and damping functions of the lower extremities decreased sharply but also the position of the pelvis and spine changes, which leads to postural defects, spinal deformities, as well as musculoskeletal dysfunction [6]. Moreover, the frequency of progressive forms of scoliosis varies from 12.0% to 80.0% [7]. In the case of a general deterioration in health, pronounced changes more often occur among students with poor health status [8]. They have reduced mental and physical performance and general motor activity; moreover, diseases and morphofunctional deviations of several systems develop more often [9]. However, most of them are unaware of the current situation and, without complying with a healthy lifestyle, further worsen their condition. In recent years, a completely unfounded confidence has been formed among modern youth that health is guaranteed at a young age and that any excessive loads, gross violations of nutrition and day regimen, insufficient physical activity, stress, and other risk factors are within the scope of the abilities of a young body; thus, it can cope with all challenges [7, 8]. The idea that health is not wasted remains inviolable, gives rise to absolutely unjustified self-complacency, and harms the younger generation. In the literature, measures to prevent this phenomenon are not sufficiently discussed, the role of the district pediatrician when working with such children is not disclosed, and there are no data on the organization of comprehensive care by various specialists. Moreover, no specific retrospective study has focused on musculoskeletal pathologies and its relationship with other diseases. Risk factors contributing to the formation of such a pathology have not been identified, and clinical and functional diagnostics of scoliotic disease has not been developed.

The study of these issues will allow the development of preventive measures that will help prevent the progression

of the pathological process in pupils of the social sphere. By creating a health-saving environment and favorable conditions for the effective implementation of preventive and health-improving measures, taking into account the characteristics of this cohort, it is possible to preserve the health of the younger generation.

The study aimed to analyze the frequency of the development of the musculoskeletal system lesions, taking into account the somatic pathology in adolescents brought up in various conditions, to address issues of preventive and corrective measures.

MATERIALS AND METHODS

Initially, 1,800 adolescents participated in the study. Of these, 120 individuals who lived in the same environmental conditions and studied in the same type of educational institutions according to the traditional program were selected. The main group included children aged 11–15 years, who were brought up in social institutions for minors from the age of 6 years ($n = 60$). The comparison group consisted of schoolchildren of the same age and sex brought up in two-parent families ($n = 60$). Data obtained were processed using Microsoft Office Excel and Word 2016 software packages. To test the differences between the groups, Pearson's nonparametric chi-squared test (χ^2) with Yates' correction was used. Differences were considered significant at $p < 0.05$.

RESULTS

The incidence of somatic pathology in studied adolescents was analyzed, and the structure of disorders of the musculoskeletal system was clarified. In this study, the health status of children in the main group was significantly worse than that of the comparison group ($p = 0.05$). In the main group, 28.3% of the children more often registered in health groups III and IV because of chronic pathology (55.0%, $p = 0.04$). In the comparison group, 25.0% of the children registered more often in the health group II (70.0%) because of functional disorders ($p = 0.04$). Chronic diseases occurred at the stage of compensation and sub-compensation in 33.0% and 21.7% of the adolescents in the main group, respectively. In the comparison group, only 8.3% of the adolescents had a phase of exacerbation of chronic pathology. In the structure of somatic pathology in adolescents of the main group, lesions of the central nervous system (75.0%), musculoskeletal system (73.3%), and digestive organs (66.7%) were the most common. Diseases of the circulatory system (55.0%), ear and mastoid process (38.3%), eye and adnexa (33.3%), and respiratory system (31.7%) ranked fourth to seventh. Diseases of the hemato-poietic system (28.3%), genitourinary system (18.3%), and

endocrine systems and eating disorders (10.0%) ranked eighth to tenth. The proportion of adolescents with somatic pathologies in the comparison group was less than that in the main group, but significant differences were registered only in adolescents with disorders of the central nervous system (16.7%, $p = 0.0001$), musculoskeletal system (31.7%, $p = 0.0001$), digestive system (38.3%, $p = 0.005$), and ear and mastoid process (13.3%, $p = 0.04$).

Foot flattening (10.8%), platypodia (16.7%), and scoliosis of varying severities (13.3%) prevailed in the range of orthopedic pathology. Postural disorders were detected in 26.7% of the adolescents; other lesions did not exceed 5.0%. In the children of the comparison group, posture disorders and foot flattening (20.0% and 15.0%, respectively) were more common than scoliosis (5.0%, $p = 0.02$) and platypodia (15.0% $p = 0.89$). The main group was more often diagnosed with platypodia (40.0%, $p = 0.0001$), postural disorders (33.3%, $p = 0.66$), and scoliosis (21.7%, $p = 0.0001$). Various combinations of the musculoskeletal system disorders were detected in 28.3% of the main group, which were detected 18.0% more often than that in the comparison group; however, no significant differences were found ($p = 0.16$).

Combinations of postural disorders and foot flattening (15.0%) were more often found in the comparison group. In the main group, 13.3% of the patients had a combination of postural disorders and platypodia, 11.7% patients had platypodia and scoliosis, and 6.7% patients had scoliosis and chest deformity. This confirms the opinion that children of this category can have various combined lesions of the musculoskeletal system. Its more severe manifestations were more often recorded in the main group.

Thus, lesions of the musculoskeletal system in adolescents have clear differences, indicating the significance of the influence of the living environment on its incidence and structure, which must be taken into account in preventive and rehabilitation measures.

In addition, various combinations of major somatic diseases and lesions of the musculoskeletal system have been established. With the lesions of the central nervous system, foot pathology (10.8%), scoliosis (7.9%), and chest deformity (5.0%) were more often detected. Such combinations were more often diagnosed in the main follow-up group (16.7%, 10.0%, and 10.0%, respectively), less often in their peers of the comparison group (5.0%, 5.0%, and 0.0%); however, no significant differences were found ($p = 0.38$, $p = 0.99$), except for chest deformity ($p = 0.02$).

Regarding digestive pathologies, platypodia (7.5%) and postural disorders (6.7%) were more often recorded in the main group (15.0% and 11.7%, $p = 0.04$, $p = 0.05$). As regards circulatory diseases, postural disorders (7.5%) and platypodia (6.7%) were more common; in the comparison group, postural disorders (8.3%) were more common than

platypodia (3.3%); however, no significant differences were found.

Posture disorders (26.7%) ranked first among orthopedic pathologies in patients aged 11 years, postural disorders (21.7%) and foot flattening (14.2%) by age 12, platypodia (15.8%) and degree 1 scoliosis (10.8%) by age 13, and degree 2 scoliosis (13.3%) and platypodia (11.7%) by age 15. Thus, as the child grows older, the orthopedic pathology progresses; thus, not only district pediatricians and orthopedic traumatologists but also doctors of educational organizations and social institutions for minors should consider the course of preventive and rehabilitation measures.

During the follow-up period, the lesions of the musculoskeletal system increased by 19.2% ($p = 0.04$). The increase did not exceed 8.3% in the comparison group and 31.7% in the main group ($p = 0.02$), which clearly reflected the deterioration. At school age, the skeletal system is not fully matured yet, and the elasticity of the child's skeleton and incorrect body positioning easily lead to the formation of deformities and developmental disorders [5, 9, 10–12], which was confirmed in the present study. If they were not detected timely and no measures were taken to eliminate them, they become the cause of more persistent and serious disorders and diseases [10–12]. Thus, when implementing timely preventive measures, it is required to take into account not only the age characteristics of the child and the place of residence but also combined lesions of somatic pathology, which can reduce the risk of developing chronic diseases of the musculoskeletal system.

An analysis of the distribution of adolescents by forms of scoliosis showed that neurodysplastic (31.7%) and idiopathic (21.7%) forms of scoliosis were 16.7% more common in the main group; however, no significant differences were detected ($p = 0.32$ and $p = 0.13$). Most of them (83.3% and 91.7%) had degree I–II deformities, which is consistent with literature data [6, 10]. The dystrophic form of congenital or post-traumatic scoliosis in both groups, which is discussed by many authors and presented in many sources, was not registered. Ten adolescents (16.7%) were diagnosed with scoliosis associated with connective tissue dysplasia (11.7% and 5.7%, respectively, $p = 0.57$).

Regarding the distribution by the type of posture disorder, lateral curvatures were recorded in 28.1% of the adolescents in the main group (30.0%) and in 25.0% in the comparison group ($p = 0.91$). Stooped posture and round back were noted in 18.8% and 18.8% of the patients, which is 9.3% and 5.0% more common in the main group (30.0% and 25.0%); however, no significant differences were found ($p = 0.97$, $p = 0.99$). Circular-concave, flat, and plano-concave back types were registered only in the main group (10.0%, 10.0%, and 5.0%, respectively), which are the main cause of "school diseases."

Considering the combination of various health disorders in adolescents with orthopedic pathology, it is necessary to implement preventive and rehabilitation programs and an integrated approach to medical and recreational activities, and studying the dynamics of morbidity in different age periods are required.

DISCUSSION

Numerous studies have reported an increase in the prevalence of morphological and functional abnormalities [1, 2, 5, 6, 10] and chronic diseases, whereas the pathologies of the gastrointestinal tract, musculoskeletal system, and vision rank first [5, 10]. If timely measures are not taken, then comprehensive negative consequences arise, which is clearly seen in the present study. Adolescents are highly sensitive to negative factors, as reduction in resistance, body reactivity, and adaptive capabilities contribute to the impairment of all components of health, various combinations of somatic diseases developed, whereas the musculoskeletal system pathology ranks first [7], as detected in the present study. Scientific studies have shown that musculoskeletal disorders during childhood affect the formation of vertebrogenic pathology during adulthood with the appearance of secondary dysfunctions of the central nervous system, heart, lungs, and other organs and systems [9]. Skeleton ossification ends by age 20; therefore, during the school period, the skeletal system is not yet formed, and skeletal elasticity and improper body posture easily lead to developmental deformities and disorders [9–12]. The study of this phenomenon contributes to the identification of priority fields in the implementation of recreational and preventive measures among children with poor health background [13–15]. In the questionnaire survey and clinical examination, we provided not only the age-related aspects of the formation of lesions of a particular system, taking into account the place of residence, living conditions, and education, but also the occurrence of diseases over time from birth to age 15.

CONCLUSION

The state of health of adolescents living in social institutions is significantly worse than that of schoolchildren born and brought up in two-parent families. In them, musculoskeletal lesions rank second among somatic pathologies; the incidence of combined lesions is higher, the increase in orthopedic pathology was mainly caused by scoliosis,

platypodia, and posture disorders, and neurodysplastic and idiopathic forms and scoliosis associated with connective tissue dysplasia prevail in the structure of scoliosis. Such disorders are more often recorded in pediatric patients with central nervous system and circulatory diseases, and postural disorders are more common in patients with circulatory and digestive disorders. In pediatric patients with platypodia, digestive and circulatory lesions are more often detected. As the disease, including orthopedic pathologies, progresses with age, musculoskeletal lesions should be considered an interdisciplinary and multicomponent problem; therefore, it is necessary to develop a comprehensive rehabilitation program involving an orthopedic traumatologist, neurologist, cardiologist, and gastroenterologist, and the obligatory use of additional radiation and instrumental methods of examination in outpatient-polyclinic conditions.

ADDITIONAL INFORMATION

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Conflict of interest. The authors declare no conflict of interest.

Ethical considerations. The study was approved by the local ethics committee of the Smolensk State Medical University of the Ministry of Health of the Russian Federation (Protocol No. 57-03/n-10 dated 01/14/22). The materials submitted do not contain information constituting state secrets or confidential information and may be recommended for publication in the public media. There are no restrictions in sending this material to other countries.

Author contributions. V.A. Bogormistrova performed the survey, collected and processed the material, analyzed the survey data, and wrote the article. V.N. Shestakova compiled the survey questionnaires, conducted a clinical examination, analyzed the literature, and edited the manuscript. P.N. Svoboda performed statistical processing of the material, studied the literature, and wrote the article. A.A. Udovenko performed a survey and statistical processing and wrote the article. D.V. Sosin analyzed the survey data, performed clinical examination, and wrote the article. All authors made a significant contribution to the study and preparation of the article and have read and approved the final version before its publication.

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