

Prevalence of anatomical/orthopedic disorders and effective factors in children aged 6–14 years

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ABSTRACT

Background: Musculoskeletal disorders are common among children. Community- and school-based studies have revealed that the complaint of pain in childhood associated with musculoskeletal deformities is common. **Objective:** The present study aims to examine the prevalence of extremity, spinal and chest wall deformities and other disorders in children aged 6–14 years, and to determine the relationship between these disorders and nutrition, benefiting from sunlight, and familial factors. **Method:** The present cross-sectional study was conducted among 625 children aged 6–14 years attending elementary and secondary schools in rural, urban, and suburban areas. Children were evaluated for kyphosis, scoliosis, lordosis, chest wall disorders, and other disorders. Families were also asked about the factors that may be associated with these disorders. Chi-square test and binary logistic regression test were used for data analysis and $p < 0.05$ was considered statistically significant. **Results:** Anatomical/orthopedic disorders were detected in 30% of the children. The most common anatomical disorders are genu varum and chest wall deformities. The most important risk factor for the development of anatomical/orthopedic disorders was family history. In addition, being male and living in the city center are important risk factors. After 2 years of age, yogurt and cheese consumption decrease the risk of genu varum. **Conclusions:** The important risk factor in the development of anatomical/orthopedic disorders is familial-genetic features. Gender and nutrition are effective factors as well.

Keywords: *Anatomic disorder, Child, Musculoskeletal abnormalities*

Musculoskeletal disorders are common, and it is estimated that approximately 24% of the population seek primary care for musculoskeletal disorders each year.¹ While musculoskeletal disorder treatment has typically focused more on adult patients, it is also estimated that the ratio of seeking primary care is 7% among children [1]. Community- and school-based studies have revealed that the complaint of pain in childhood associated with musculoskeletal deformities is common [2,3]. While pain is the most common musculoskeletal disorder symptom in children, other symptoms such as claudication, stiffness, muscle weakness, and tiredness are common as well [4]. Walking impairments caused by rotational problems are the most common orthopedic disorders in the children age group [5]. Parents take care of problems when there is an abnormality which can cause health problems, or the children fail to participate in sporting activities enough. Most rotational problems spontaneously disappear during the course of typical development, whereas some may require surgery [6]. The most common chest wall deformities observed in children are pectus excavatum. Another important disorder category is the spinal and postural disorders, namely kyphosis, scoliosis, and lordosis. These may be congenital or develop later due to wrong habits [7].

MATERIALS AND METHODS

This study was a cross-sectional study conducted in 2017; it consisted of children aged 6–14 years attending elementary and secondary schools in rural, urban, and suburban areas. The results of the present pilot study, which was carried out by taking 95% confidence interval and 80% power as a reference point, revealed that the minimum sample size to be achieved was 199. The sampling method was quota sampling, and 625 elementary and secondary school children were reached. Three quotas were set for the study, that is, rural, urban, and suburban quotas. The ethics committee has taken permission for this study. Schools to be studied in each quota were determined by drawing lots, and one school was chosen from each area. All the children aged 6–14 years were reached in the specified schools. The study was conducted with the permission of the Turkish Ministry of National Education, and the families of the children were asked for their permission for study-related measurements.

All examinations of children were made at school; children's height and weight were measured. Each child was inspected to determine asymmetry at shoulder levels. These reviews were made by leaning on a flat floor. Children with asymmetric posture were evaluated for kyphosis, scoliosis, and lordosis. Chest wall

anomalies were also evaluated by removing the clothes of children. All extremities of children, chest cages were evaluated, and those with abnormalities were recorded while paying attention to privacy during all examinations. After the evaluation of anatomic/orthopedic anomalies, questionnaires were sent to families. In the questionnaire sent to the families, the duration of breastfeeding for the children, the frequency of milk and dairy products consumed after 2 years of age, the duration of living in the solar home, whether there is any anatomic or orthopedic disorder in any of the family, and kinship between the mother and father were asked. This survey was completed by parents, and the questionnaires were sent to us. Informative consent form was obtained from the children's families.

Statistical analysis was performed; frequency distributions were expressed in percentages (%) in the presentation of qualitative data, and Chi-square test was used for the analysis of these data. Parametric tests were used for qualitative data with normal distribution while non-parametric tests were used for qualitative data that do not follow a normal distribution. Chi-square test and binary logistic regression test were used data analyzes and $p < 0.05$ was considered statistically significant.

RESULTS

A total of 625 students were included in the study in three different school settings in rural, urban, and suburb areas. Table 1 shows the sociodemographic characteristics of the students; children were aged from 6 to 14 years, and the mean age was 9.12 ± 1.62 years. Mean height of the children was 131.57 ± 9.92 cm (range: 108–162 cm), and mean weight was 29.21 ± 7.69 kg (range: 16–62 kg).

While 2.7% of the children were never breastfed, 32.4% were breastfed from 1 to 6 months and the rest breastfed for over 7 months. Table 2 shows the prevalence of morphometric disorders of the children detected on examination.

With respect to distribution by area, genu varum had the highest prevalence in urban areas with 24.5% Fig. 1. There was a significant difference compared to other areas ($p < 0.001$). All the students with kyphosis had a positive family history of the disease, meaning it was revealed on investigation that either one of the parents or a close relative had kyphosis. All the students with chest wall deformities had a positive family history of the disease as well. One student had left convex scoliosis. Of the chest wall deformities, the most common one was pectus excavatum Fig. 2 with a prevalence of 86.4%, followed by 11.4% barrel chest and 2.3% pectus carinatum (Table 3). Regarding the ratios of chest wall deformities by area, there was no significant

difference between the relevant areas ($p = 0.545$). Out of the study population, 2.1% of the students had walking impairment while 0.5% had asymmetrical extremities and 3.4% had anatomical disorders such as syndactyly, hearing loss, gynecomastia, hallux valgus, polydactyly, and convergent strabismus.

In our study, no correlation was found between anatomical/orthopedic disorders and the frequency of dairy product consumption other than genu varum. After the age of 2, as yogurt and cheese consumption decreased, the prevalence of genu varum increased ($p < 0.05$). Table 4 shows the results of logistic regression analysis performed depending on the presence of any anatomical/orthopedic or morphometric disorders in the children. Model-data fit was found to be good (Hosmer and Lemeshow Test $p = 0.848$). Independent variables in the model explained 43.8% of the change in the dependent variable, and overall predictive accuracy ratio of the model was 87%.

It was found that the coefficients of independent variables added to the model for the prediction of the presence of any morphometric disorders in the children were significant, except for that of breastfeeding. Considering odd ratios of the variables, the most important risk variable for the morphometric disorder was the positivity of family history. The probability of detecting any morphometric disorders in children with positive family histories, increased by 227 times. The risk of developing anatomical/orthopedic disorders was 20 times as much in those living in urban areas, 1.8 times as much in boys, and 2.1 times as much in those with related parents. Although the risk of anatomical/orthopedic disorder development in children who were never breastfed, increased by 2.5 times, the model coefficient was not found to be significant ($p = 0.125$).

Considering the amount of sunlight received by the house in which the family lived for the longest time, there was a low but significant correlation with kyphosis ($p = 0.011$, Cramer's V coefficient = 0.156). Similarly, a relationship was found between the duration of living in a house receiving sunlight and asymmetrical extremities ($p = 0.001$, Cramer's V coefficient = 0.267). As the duration of living in a house, without receiving sunlight, increased, the prevalence of kyphosis and asymmetry of extremities increased as well. Furthermore, as the age increased the prevalence of disorders rose too ($p < 0.001$, Cramer's V coefficient = 0.271).

DISCUSSION

The most common orthopedic disorder in children aged 6–14 is genu varum. The most common chest wall deformity is pectus excavatum. Moreover, the most important factor affecting the development of deformities and disorders in children is the positive family history of the relevant condition(s). Living in urban areas, being male, parental consanguinity are also factors affecting the prevalence. It was found that consuming more dairy products after the age of 2 reduced the risk of genu varum development, and living for a long time in a house receiving sunlight, reduced the prevalence of kyphosis and asymmetry of the extremities.

Table 1: Sociodemographic characteristics of the students

Residence	n (%)
Urban	407 (65.1)
Rural	66 (10.6)
Suburb	152 (24.3)
Sex	
Male	326 (52.2)
Female	299 (47.8)

Table 2: Distribution of anatomical disorders in students

Type of anatomical/orthopedic disorder	n (%)
Scoliosis	
Present	1 (0.2)
Absent	621 (99.8)
Lordosis	
Present	3 (0.5)
Absent	619 (99.5)
Kyphosis	
Present	5 (0.8)
Absent	617 (99.2)
Genu varum	
Present	95 (15.3)
Absent	527 (84.7)
Genu valgus	
Present	1 (0.2)
Absent	621 (99.8)
Chest wall deformity	
Present	44 (7.1)
Absent	577 (92.9)

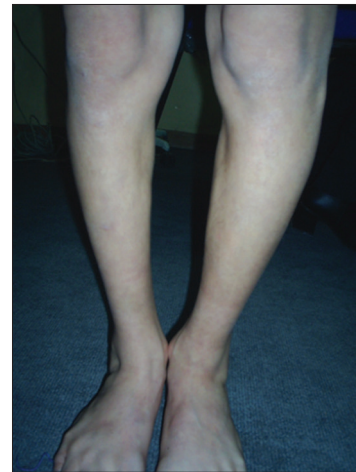
Table 3: Distribution of the types of chest wall deformities

Deformity type	n (%)
Pectus excavatum	38 (86.4)
Barrel chest	5 (11.4)
Pectus carinatum	1 (2.3)
Total	44 (100.0)

Table 4: Logistic regression analysis results for the morphometric disorder model

Deformity type	Anatomical/orthopedic disorder			95% CI	
	B	p	Exp (B)	Lower	Upper
Family history	5.427	<0.001	227.419	51.746	999.485
School area	3.001	<0.001	20.109	6.127	65.994
Sex	0.607	0.021	1.836	1.098	3.070
Parental relationship	0.753	0.023	2.122	1.112	4.051
Breastfeeding	0.924	0.125	2.518	0.775	8.185

In a study by Asadi *et al.*, significant differences were found between two groups of children aged 10–18, that is, the group playing football versus the group not playing football. Genu varum was more common among children aged 16–18 years playing football. They associated the high prevalence in this group with previous knee traumas [8]. McDermott *et al.* showed a positive correlation between the duration of exercise and the degenerative changes in runners [9]. Age, weight, metabolic diseases, Vitamin D deficiency, and environmental factors may be associated with this disorder of the knee joint. Intense exercise and sharp maneuvers may also be effective in the development of genu varum in children [10]. While this angulation of the knee is considered normal until the age of 2 years, varus angulation after the age of 2 years was considered to be abnormal. This is typically

**Figure 1: Genu varum****Figure 2: Pectus excavatum**

seen in overweight children beginning to walk at an early age [6]. A study carried out among children aged 6–15 years in Japan, reported the prevalence of musculoskeletal disorders to be 8.6%. As age goes up in childhood, the prevalence of disorders increases too [11]. Another study found the prevalence of musculoskeletal disorders in children to be 8.6%. The same study also reported a higher prevalence among males and the prevalence increased in positive correlation with age and the most problematic parts of the body were feet, knees, and the lower back [12]. Studies have shown that several factors such as age, gender, and trauma are effective in the development of genu varum. Our study found a correlation between age and prevalence of disorder as well. Our results support that reduced consumption of dairy products after the age of 2 years was also an effective factor. As suggested in the literature, we to believe that the age increases the prevalence of disorder because it increases the trauma prevalence. We also believe that a diet poor in calcium contributes to abnormal angulation. A European study also showed that the prevalence of genu valgum and genu varum was associated with a calcium-poor diet [13].

A study conducted among children aged 6–15 years in Turkey to investigate the prevalence of congenital anomalies found it to be 6.8%. The same study found the prevalence of pectus carinatum

and excavatum to be 0.768% [14]. Our study found the prevalence of chest wall deformities to be 7.1%. Another study, however, found the prevalence of pectus carinatum and excavatum to be 0.5% and 0.89%, respectively. In this study, 5.8% of the children had a positive family history of the condition [15]. On the other hand, all the children in our study, with chest wall deformities had a positive family history of the relevant condition(s). We believe that this high prevalence of chest wall deformities was associated with the area and the sample. Furthermore, our study found that the prevalence of any deformities in children with a family history of congenital anomalies increased by 227 times. It can be seen that the most important factor, affecting the prevalence of congenital anatomical/orthopedic disorders, was genetics. Horth *et al.* studied 48 family trees and 2000 individual, and they found evidence indicating autosomal recessive transition associated with these disorders and 3.8 times as many anomalies in males as in females [16]. We too found twice as many anomalies in males as in females.

CONCLUSIONS

The result of our study reveals that the most common orthopedic disorders were genu varum and chest wall deformities. It was found that the most important risk factor for morphometric disorders was family history.

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We ensure that we transfer the rights of the work to the journal.

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