

Prevalence of faulty posture in children and youth from a rural region in Iran

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Summary

Study aim: To assess the presence of musculoskeletal deformities in lower extremities and to detect faulty posture in schoolchildren living in a rural region of Iran.

Material and methods: 172 schoolchildren aged 5-20 years, including 66 boys and 106 girls were screened deviations in the musculoskeletal system. Furthermore, the postural muscles including the hamstring and gastroc-soleus were examined for finding any shortness.

Results: The prevalence of cervical lordosis (22.6% vs. 6.1%), forward head posture (24.1% vs. 9.1%) and thoracic kyphosis (27.8 % vs. 7.6%) was significantly higher in girls than in boys. The prevalence of cervical lordosis, FHP, thoracic kyphosis, and genu varum increased with age; in the case of genu valgum, the situation was reversed. Genu varum was almost twice as frequent in girls as in boys (44.4% vs. 25.8%; $p < 0.01$), while the genu valgum was more frequent ($p < 0.001$) in boys than in girls (13.6 and 2.8, respectively). No significant age or gender-dependent differences were found for hamstring shortness (29%), gastroc-soleus shortness (21%), genu recurvatum (22%), and hallux valgus (31%).

Conclusions: Faulty posture and lower limb deformities were highly prevalent in school children in this rural region. More attention should be paid to implementing school-based screening programs aimed at early detection of any musculoskeletal-related abnormalities and taking preventive steps to reduce their negative consequences.

Key words: Faulty Posture – Children – Visual assessment

Introduction

Faulty posture is common in children and teens with a wide spectrum of symptoms and causes [7,8,15,24]. Multiple intrinsic and extrinsic factors may influence posture in children such as age, sex, height, weight, hereditary factors, the physical environment of a child, socioeconomic level, psychosocial and emotional factors, physiological changes during puberty, improper postural habits, the presence of the pain, and the testing environment [3,21,24]. Any deviation from the standard postural alignment causes excessive loads on the articular structures and weakening periarticular soft tissues like muscles, tendons, ligaments, and fascia by stretching and tethering them beyond their normal limits [20], resulting in possible heel pain, back pain and neck pain as well as structural deformities of the spine and intervertebral disk degenerations [10,30]. Therefore, early detection of musculoskeletal alterations has been a challenging task for different medical specialists [7,8,11].

Epidemiologic studies have shown that musculoskeletal problems due to any structural deviations in children are very common. The combination of hyper pronation with genu recurvatum has been considered a risk factor in recurrent knee injuries and anterior cruciate ligament ruptures in athletes due to structural malalignment and altered neuromuscular functions [4,13,19,29]. Foot problems, including hallux valgus and heel pain, are common in children with different rates of incidence (17.4%-80.0%) and gender specific tendency [17].

Although several studies have been undertaken in school children about the prevalence of faulty posture and lower limb deformity, the prevalence of postural abnormalities and lower limb deformities has never been thoroughly examined in the rural region of Turkmanchay, Iran. It is a suburb of Mianeh, one of the oldest cities in eastern Azerbaijan in northwestern Iran. This region was selected by authorities at Tabriz University of Medical Science for screening and detecting any health problems, including musculoskeletal disorders in children, and then presenting

a report as a small part of the larger project. This study was designed to detect any postural abnormalities in the spinal region and lower limb deformities in school-aged children by visual observation and to explore any associations with age and gender.

Material and Methods

Participants: A total of 172 children including 66 boys and 106 girls with no known impairment of the musculoskeletal system affecting the vertebral column or the limbs were screened in this study. Participants were students at primary, intermediate, and secondary schools (ages ranging from 5 to 20 years old) in the Turkmanchay region in Mianeh, Iran. The prevalence of faulty posture and lower limb deformities were assessed in boys and girls as well as in 3 different age groups: A) 5-10 years old ($n = 23$); B) 11-15 years old ($n = 93$); C) 16-20 years old ($n = 49$). The body mass of each child was measured by medical scale with an accuracy of 0.01 kg. Body height was measured by a hanged meter with an accuracy of 0.1 cm. Basic characteristics of studied subjects are presented in Table 1.

Table 1. Characteristics of studied subjects (mean $\pm$ SD)

Variable	Boys ($n = 66$)	Girls ($n = 106$)
Age (years)	12.5 $\pm$ 2.1	13.1 $\pm$ 3.0
Body height (cm)	149.2 $\pm$ 11.0	149.6 $\pm$ 17.7
Body mass (kg)	41.3 $\pm$ 11.6	44.5 $\pm$ 12.4
BMI (kg/cm ²)	18.1 $\pm$ 3.8	19.9 $\pm$ 3.4

Inclusion criteria included: good general health; no report of pain, systemic disease, or neurological disease; no evident musculoskeletal injury or trauma; agreement to participate in this research. The criteria for exclusion were the presence of any joint stiffness and any obvious deformity. All participants had received detail information about the aims of study and had signed a consent form or received parents' permission to take part in this project. Ethical approval for performing research was obtained from the Ethical committee in research deputy of Tabriz University of Medical Sciences.

Procedure: Before performing the survey, the aims of the survey were described to school authorities. With due respect to local customs and national ethics, the screening program was designed to give the least amount of inconvenience and disturbance to students and the school schedule; therefore, each child was examined with suitable clothing. The child was instructed to stand in zero anatomic position and relax posture with face forward,

arms at side, hands face forwards, and forearms in mid-position between supination and pronation.

Visual posture assessment: The participants in this study were qualitatively evaluated by physiotherapy students who had short-term training in the field of musculoskeletal problems. The examiners had a postural assessment sheet and were requested to mark any abnormality according to observation. The girl subjects were evaluated by female therapists and boys by male therapists. The subjects were asked to stand in the sagittal and frontal plane. Musculoskeletal total body screening was carried out without using a plumb line or any other postural graphic devices.

Anterior view: The position of feet, knees, and legs were observed in this view. Bowlegs or knocked knee (genu valgum and genu varum) were noted in this view as well. In addition, hallux varus or valgus and the presence of any callosities were recorded on the postural assessment sheet [20].

Lateral view: In this view, the presence of the forward head posture (FHP), any abnormalities in cervical lordosis, pathologic thoracic kyphosis, and the presences of genu recurvatum were recorded on the postural assessment sheet [20].

Muscle shortness evaluation: For detection of gastrocnemius muscle shortness participants were asked to lie down on the bed; an examiner extended the participant's knee and while holding it in extended position, dorsi flexed the participant's ankle. If the examiner should be able to reach at least 10° to 15° of dorsi flexion by goniometer it was considered normal. Otherwise it was regarded as shortened gastrocnemius and abnormal [20].

For assessment of hamstring shortness in the 90-90 straight leg raise test, subjects were asked to lay down on a bed with both hips in 90° while the knees are bent. The subject grasped behind the knees with both hands to fix hips at 90° of flexion, then actively extended each knee respectively as much as possible. We considered 10° to 20° short of extension as normal flexibility of hamstrings by goniometer, otherwise it was considered abnormal [20].

Statistical analysis: Due to the relatively small sample size, the data was analyzed by age and gender independently. All analyses were performed by using SPSS v.15. Chi-square test was used to assess between-group differences. The level of $\alpha=0.05$ was considered significant.

Results

The prevalence of soft tissue and postural abnormalities observed in the studied boys and girls is presented in Table 2. FHP posture was found to be more frequent ($p<0.01$) in the female group as compared with their male

counterparts (24.1% vs. 9.1%). Moreover, cervical lordosis and thoracic kyphosis were more common in girls than in boys (respectively: 22.6% vs. 6.1%; $p<0.01$, and 27.8 % vs. 7.6%; $p<0.001$), which means the girls showed a greater tendency for spinal abnormalities.

Table 2. Frequency (%) of soft tissue and postural abnormalities observed in studied boys and girls

Variable	Boys (n = 66)	Girls (n = 106)
Cervical lordosis	6.1	22.6**
Forward head posture	9.1	24.1**
Thoracic kyphosis	7.6	27.8***
Hamstring shortness	28.8	31.5
Gastroc-soleus shortness	27.3	16.7
Genu recurvatum	28.8	19.8
Genu valgum	13.6	2.8**
Genu varum	25.8	44.4**
Hallux valgus	39.4	27.4
Dorsal calluses	33.3	23.5

Significantly different from respective value observed in boys:

** $p<0.01$; *** $p<0.001$

Total knee abnormality, including genu varum, genu valgum and genu recurvatum, was reported in a slightly more than half the students. Genu varum was the most common postural abnormality in the children with its preponderance in female students (44.4%), which was almost as twice as much in male students (25.8%; $p<0.01$), while the genu valgum was more frequent ($p<0.001$) in boys than in girls (13.6 and 2.8, respectively). Foot deformities including the presence of hallux valgus and dorsal callosities were reported in about 32% and 27% of the subjects, respectively, and were not gender-dependent.

As shown in Table 3, the prevalence of cervical lordosis, FHP, thoracic kyphosis, and genu varum increased with age; in the case of genu valgum, the situation was reversed. No significant age-dependent differences were found for hamstring shortness (29%), gastroc-soleus shortness (21%), genu recurvatum (22%), and hallux valgus (31%). Dorsal calluses were the most frequent among the subjects aged 11-15 years (34.4%).

Discussion

A child is not an adult in miniature and is not presumed to have an adult's standard alignment, as greater range of mobility and flexibility take place during growth and development. It is possible that this greater flexibility in a child may create transitional observation in the child's alignment that could be considered an abnormality in an adult [24]. In other words, it may be a physiologic entity rather than a pathologic one. Because this survey was a cross-sectional study and not longitudinal one, it was not possible to assess this connection. However, this study aimed at determining the prevalence of faulty posture and lower extremity deformities in school children in a rural district of Iran. The results show that more than 50% of the study subjects had some kind of foot or knee problems and poor posture. In the present study, we did find that the occurrence of the vertebral faulty posture was more common in girls than in boys. In the knee area, the prevalence did not follow any particular pattern but genu valgum was more frequent in boys and genu varum vice versa. This prevalence pattern may mirror the association of other musculoskeletal conditions, like shoulder and low back pain [31], which we unfortunately did not examine in our subjects. However, a shortage of health services in the studied region, parents' inability to pay for private

Table 3. Frequency (%) of soft tissue and postural abnormalities observed in 3 age groups

Variable	5-10 years (n = 23)	11-15 years (n = 93)	16-20 years (n = 49)
Cervical lordosis	4.3	14.0	26.5*
Forward Head Posture	8.7	9.7	32.7*###
Thoracic kyphosis	0.0	16.1*	34.7***#
Hamstring shortness	26.1	26.9	34.7
Gastroc-soleus shortness	13.0	24.7	18.4
Genu recurvatum	17.4	24.7	20.4
Genu valgum	21.7	7.5	0.0**
Genu varum	21.7	34.4	51.0*
Halux valgus	30.4	34.4	26.5
Dorsal calluses	7.0	34.4**	22.4

Significantly different from the group of 5-10-year-olds: * $p<0.05$; ** $p<0.01$; *** $p<0.001$ Significantly different from the group of 11-15-year-olds: # $p<0.05$; ### $p<0.001$

treatment, and a lack of access to general practitioner or physiotherapy services, plus a culture of a lack of healthy body awareness, may partly explain the high prevalence of deformities and poor posture in the examined children and youth.

In our study, cervical lordosis, FHP, and thoracic kyphosis were more common in girls than boys. With categorized age groups, we found that FHP and thoracic kyphosis more common in older age groups. According to Widhe [32], the relationship between thoracic kyphosis and lumbar lordosis was independent of gender and age at 5-6 years old, while at 15-16 years old kyphosis was significantly less pronounced in girls than boys. Nitzschke and Hildenbrand [23] reported an increased kyphosis in 12% of the girls and in 15% of the boys, while in the study Poussa *et al.* [27] the prevalence of thoracic hyper kyphosis (exceeding 45°) was the same in the 14-year-old girls and boys; at the age of 22 years it was more frequent in boys than in girls (9.6% vs. 0.9%). In the growth period from adolescence to adulthood, there was an increasing tendency of kyphosis in the male subjects but in females the opposite trend was found [27]. As a result, in their longitudinal study they found men to be more kyphotic than women. In a study by Mellin and Poussa [22] with 294 boys and girls aged 8-16 years old, it was found that the upper thoracic sagittal alignment was more vertical among girls. However, they could not find any significant age-related differences between boys and girls in this regard.

Ultrasonography research on children indicated that muscular balance in the knee joint is one of the factors affecting patellar position in the knee [16]. Disturbing muscular balance results in the faulty position of the patella. This may lead to patellofemoral joint pathologies in later years. Moreover, shortened hamstrings may cause walking with flexed knees and the hyper function of quadriceps, both of which might result in the stimulation of the patellar tendon to grow and cause a high standing of the patella. Erkula *et al.* [5] reported that in severe hamstring shortness, the knee's extensor mechanism is affected and patella is migrated cephalad, which may cause changes in posture, walking ability, and knee discomfort. They suggested performing a routine knee extension deficits exam in evaluating knee discomfort. In another study, limited hamstring flexibility has been suggested as a possible cause of lumbar pain in children [28]. However, Harreby *et al.* [12] in their study on Danish children found hamstring flexibility defect more than 40° in 12.2% of the subjects, and according to the authors the defect was very common in growing teenagers, but no correlation with low back pain was found. Brodersen [2] diagnosed back pain in 7% of children; knee and heel pain in 3%. However, in children with extension deficit of more than 40°

degrees, the incidence of low back pain rose to 15%. Moreover, in their study 75% of boys and 35% of girls had short hamstrings and 13% had Achilles shortness. Another study indicated that the extensibility of the hamstring muscle affects thoracic and pelvic posture in young athletes, especially in maximal trunk flexion [18]. Fakhari *et al.* [6] in research on 3308 healthy girls reported that the prevalence of hamstring and calf muscle shortness altogether was more than 30% in secondary school children. They indicated that shortness of the calf muscle and the hamstring are present together and concluded that in the case of finding one defect we should look for the other one as well. Hamstring shortness was found in 79.4% of cases in a survey of 7781 children aged 6-12 years old [25]. In our survey, hamstring shortness was reported in nearly one-third of the subjects and gastroc-soleus shortness in 21%. Neither were age or gender dependent.

Babaei and Salehi revealed a significant association between foot disorders including hallux valgus, hallux rigidus, flat feet, and short gastroc-soleus [1]. Hoshina *et al.* [14] in their study reported 2 peak age periods in developmental hallux valgus: one in adolescence and the other one in the period between 40 and 50 years old. In both groups, hallux valgus was associated with the collapse of arch structure, but in the young group the causative factor was joint laxity, whereas in older group it was the degeneration of ligaments. They concluded that hallux valgus deformation continues to progress during adolescence, and its progression stops in the 50's, and therefore, it is instead an age-dependent deformity rather than a gender-specific one. However, in this study the prevalence of hallux valgus was not related to age or gender, and it amounted to about 31%. In contrast, in a musculoskeletal deviations survey performed in children in Utah, hallux valgus was found only in 9% of subjects, pronated foot in 38%, genu valgum in 34%, pes planus in 20%, and the incidence of genu recurvatum in 16% [11]. In turn, Penha *et al.* [24] reported the frequency of genu recurvatum among school children amounting to 54% while in this study it was about two times lower. Nevertheless, our data were to some extent in agreement with the findings of Penha *et al.* [24] and Pinho and Duarte [26], confirming that there was a progressive decrease of knee hyperextension during childhood development. In the present study, the rate of hallux valgus was neither age- nor gender-related.

Faulty posture and lower limb deformities appear to be considerable risk factors for musculoskeletal problems later in life and should receive more prophylactic and therapeutic attention. By detecting large numbers of children with musculoskeletal deviation we could demonstrate the absolute necessity for performing screening programs

among Iranian schoolchildren. Many countries, like the United States, Australia, England, Sweden, Norway, Denmark and Japan, had started some musculoskeletal screening program about 4 decades ago. In countries like Japan and some states in the United States performing a screening program is mandatory [30]. Our findings suggest that there is a need for involving well-qualified health personnel in the school screening and preventive programs aiming at early detection and disease management/treatment, which prevents the progression of musculoskeletal problems in the adulthood period in a very effective and economical way. Furthermore, it is possible by performing an effective referral system to affect corrective intervention in time. Further, it can prevent unnecessary psychological trauma that in the growing period may cause irreversible results. These data appear to be innovative considering the fact that Iran's student population is about 14 million students in primary and secondary schools [33], and there is not a regular screening program for early detection of musculoskeletal abnormalities. Clinically it is important to know whether a subject or patient has any postural abnormality or asymmetry. Based on the results of this study, it is possible to trace the source of various abnormalities in adulthood to childhood. This method can be used for screening children in the early period and manage them with preventive measures. The findings of this study suggests that physiotherapists can play a very active role in detecting these postural abnormalities, especially in schoolchildren prior to their becoming a complex entity. The primary prevention process will also improve their professional skills and effectiveness.

While not diminishing the importance of the research, there are several limitations in the study that should be mentioned: first, it is a cross-sectional study and does not demonstrate any physiological variation during the development process of children, which is quite common in these periods. Second, this study was performed by senior physiotherapy students without much clinical experience. Additionally, involvement of more than one examiner due to religious principles adds the problem of inter-examiner reliability. Finally, because of the poor reliability of this type of assessment and the relatively small sample size, the obtained results should be interpreted and generalized with caution.

Summing up, using the observation method we detected that faulty posture and lower limb abnormalities are common in schoolchildren from rural region in Iran. Moreover, there was a predominance of faulty posture in girls and in older children. Therefore, local authorities, health professionals, and teachers should pay more attention to taking preventive steps to reduce negative, musculoskeletal-related consequences.

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Acknowledgements

The authors thank the Green Umbrella Organization affiliated with the Cultural Deputy of Tabriz University of Medical Sciences for financial support in the screening process and sample collections. We would like to thank Amin Abdali and Fereshteh Jalalimanesh for their work in collecting data. Furthermore, we acknowledge the help of Dr. M. Ghojzadeh in reading the manuscript and helping with the statistical analyses.

Received 06.07.2012

Accepted 14.11.2012

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