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Original Article

Prevalence of spinal abnormalities among the male junior high school students of Kermanshah city

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Abstract

Introduction: Skeletal abnormalities affect physical efficiency and fitness during daily life and sports activities. This research was carried out to evaluate different spinal abnormalities of male junior high school students.

Methods: The study population comprised of male junior high school students in Kermanshah, Iran, among whom 390 students were selected by cluster sampling. The required data were collected by spinal examination using New York test, Thomas test, Adam's test, and flexible ruler, and the data of somatotypes were collected by Sheldon method. The obtained data were analyzed by descriptive statistics.

Results: The results showed that 18.93% of students were in normal physical condition, and 81.03% of them suffered from at least one kind of abnormality. Among spinal abnormalities, the sway back and flat back abnormalities (2.56%) were found to have the lowest prevalence and right shoulder dropping (65.64%) and hyperlordosis (38.46%) were found to have the highest prevalence. Regarding their body type, 61.8% of the samples were ectomorphic, 21.79% were endomorphic, and 16.41% were mesomorphic.

Conclusion: The findings showed a high incidence of abnormalities among students. Although this level of prevalence is less than those of some other societies, it is obviously indicative of a lack of sufficient attention to the physical health of students.

Introduction

Humans are a completely mobile being and their survival is dependent upon physical activities. Hence, improper physical mobility and physical mobility less than the normal range will reduce efficiency and will disturb daily activities. Many experts consider the contemporary mechanical life, which is the outcome of industrial and technological advances, as the major cause of immobility and believe that poor physical movement and adopting inappropriate habits can bring about physical ailments (1). However, it should be noted that automation of the current age is different from economic improvement, and cannot account for the incidence of abnormalities in all societies.

The spine, an S-shape structure, is an important part of the human skeleton. It is responsible for supporting the body in different activities and plays a major role in maintaining the orientation of the body (2). Since the function of this bone structure depends on the performance of muscles and nerves, people with appropriate power, strength, and flexibility are less vulnerable to spinal abnormalities. Therefore, poor physical movement and extreme and improper physical movements lead to the imbalance of power and muscular strength in the long run. Hence, muscles will consequently not be able to maintain a normal posture, and the person will be at risk of physical abnormalities due to bone deformities and incidence of postural abnormalities (3).

Abnormalities may occur due to various reasons (4). Unhygienic practices during pregnancy, abnormal deliveries, unhealthy nutrition during childhood, dominance of mechanical life, inadequate physical activities of children (poor movement), and improper habits especially during the growth period, mental problems, wearing unhealthy clothing, and shoes, or even professional sports may cause abnormalities in humans. These physical deficiencies and weaknesses are not observed easily during childhood, but they bring about problems that disturb the normal functioning of the body and reduce longevity (5,6).

Studies have shown that physical abnormalities cause functional disabilities (7). Inappropriate desk and bench setup, false habits, environmental factors, improper handling of schoolbags, and poor sanitation of schools are the factors influencing the incidence of physical abnormalities among students. One of the most common types of these abnormalities is shoulder

dropping (6, 8). In a similar study on physical abnormalities among junior high school students, abnormalities were reported to be associated with incorrect habits in schoolbag handling, sleeping, and sitting while doing homework (9).

Of the most substantial health problems of students are problems caused by carrying heavy bags and backpacks that have a significant effect on the incidence of movement disorders at a young age (10). Many studies have suggested that the maximum weight of students' school bags or backpacks must be 10% of their body weight (11-13). In a study by Mohammadi et al. (2012) on elementary school students in Tehran, Iran, only 28.3% of the backpacks weighed less than 10 percent of students' body weight (14). They also found a significance relationship between low back pain and weight of the backpacks and the duration of carrying them in children of all age groups. Increased backpack weight leads to increased pressure on the spine in the sagittal plane. Bending the body forward to keep balance while carrying heavy bags has negative impacts on the natural curvature of the lumbar region. Heavy backpacks can cause uneven shoulders and increased chest curvature causing kyphosis, thus making students feel pain in their shoulder, lower back and neck (15, 16).

Ramprasad et al. (2010) concluded that carrying heavy and non-standard backpacks leads to significant changes in the curves of the spine and can cause strain on the neck, bend the chest and torso forward, increase the curvature of the back and cause permanent changes (17). Zakeri (2015) and Shamsoddini et al. (2012) reported a close relationship between the weight of the backpack and musculoskeletal disorders in the shoulder, neck and back among the students (18, 19).

Zakir et al. (2016) found a significant relationship between the non-standard weight of backpacks and the prevalence of uneven shoulder ($p = 0.01$), Kyphosis ($p = 0.009$) and lordosis ($p = 0.02$) among students (8).

Ramprasad (2010) concluded that backpacks with non-standard weighs significantly ($p = 0.002$) increased the size and angle of the spine curvature and eventually caused musculoskeletal disorders and deformities (20).

Various studies have highlighted the clinical importance of lumbar lordosis diagnosis (21-25). Lumbar lordosis is a key feature for sagittal plane balance maintenance. Several studies believe that lordosis angle increases from childhood to adulthood (26, 27), and even up to the age of 20 (28). For example, Cil et al. (2005) showed that the angle of lordosis increases from 44.3 at the age of 3-6 years to 54.6 at the of age of 13-15 years. According to studies, it can be concluded that lumbar lordosis develops during embryonic period. The major increase in lordosis angle occurs in the first three years of life and this increase will continue at least until adolescence (26). The researchers also believe that the smallest scoliosis abnormalities in the spine will lead to change and deformity of the back, lumbar and cervical spine, which ultimately lead to injury (29, 30).

In fact, several studies have mentioned many factors for creating permanent defects or temporary disorders in the spine (31) and they all confirmed that the students have physical abnormalities in most societies where both factors related to facilities in educational spaces and personal moving habits of students such as carry school bags and supplies are effective in creating these anomalies.

The researchers believe that Kermanshah city, owing to economical conditions, geographical location, consequences of the imposed war as well as inadequate nutrition and sanitation, and low physical and mental health as a result of unfavorable economic conditions and unemployment of the parents of the study population (although not all the families of the study population suffer from these problems), is more distinct than other communities in terms of the incidence of physical abnormalities. Hence, the current study was aimed to assess the spinal deformities among the male junior high school children in Kermanshah city.

Materials and methods

This cross-sectional survey was conducted to identify and classify students with spinal deformities using standard tools and tests. The study population comprised of the male junior high school students of Kermanshah city (N= 34,305). The mean age of the students was 13.7 ± 0.5 years, their mean weight was 40.78 ± 3.05 kg, and their mean height was 150.01 ± 6.6 cm. Descriptive statistics were used to calculate the mean, percentage, and standard deviation of the data. The study sample included 390 students selected from the triple education regions of Kermanshah by cluster sampling, with 95% confidence level and $\alpha \leq 0.5$ (32). The researchers decided to randomly select four schools from region 1, four schools from region 2, and five schools from region 3 (30 students from each school from the three levels equally) from the total of 34,305 students (10,285 students in region 1, 9,634 students in region 2, and 14,386 students in region 3).

To collect the required data, the students were first randomly and equally chosen from the first, second, and third grades. Then, a questionnaire containing general information and some personal characteristics was distributed among them. Each item was completely explained while students were responding. Having completed the questionnaires, the researchers explained the objectives of the research.

Then, each respondent reported to the location of physical examinations. The height and weight of the respondent were recorded in special sheets. Flexible ruler and New York, Thomas, and Adams tests were used to evaluate the spinal status of the students, and Sheldon test was applied to identify the body type, as follows. Descriptive statistics were run to analyze the data.

New York test: A qualitative test to evaluate the postural and skeletal structure (skeletal-muscular deformities) of a person. The subject is stationed behind a checkerboard and evaluated from anterior, posterior, and lateral views.

Thomas test: In this test, the subject is asked to lay on his/her back and raise his/her leg from the ground up to 90º. If the other leg is also raised at the same time, the muscles of that region are shortened, which is related to the rectus femoris muscle. This test is used to diagnose lumbar lordosis.

Adam's test: In this test, the subject is standing and bends forward until his/her hands reach the knees or a little lower. In the case of the loss of spinal deviation, scoliosis is of mobile type. If this deviation is not lost, the chest is visible on one side of convexity and the shoulder is raised, scoliosis is of the fixed type .

Flexible ruler: In this non-invasive method, the dorsal vertebrae 4 and 12 are marked. Then, a flexible ruler is placed on the dorsal vertebrae, the formed arch is drawn on a proper (7) paper, and T4 and T12 points are connected and named L. A vertical line is drawn from L to the opposite arch, which represents kyphosis arch, where it has the maximum distance. This line is called H. Using the formula 4 Arc tan$= \frac{2h}{L}$, a result less than 40 shows the subject has no kyphosis and more than 40 indicates the subject has kyphosis. T4 is marked is because of the comparison of its results with radiography where the shoulder covers the vertebrae 1–3. Based on reports, this method has 89% correlation with radiology, which is an invasive method.

Sheldon method: It is the first method proposed by William H. Sheldon in 1939 in United States to determine the body type through anthropometric measurement of 4000 men objectively. The somatotypes ectomorph, mesomorph, and endomorph were named by Sheldon et al. after fetal layers of human body, i.e., ectoderm representing bone tissue, skin, and hair, mesoderm representing muscular tissue, and endoderm representing fatty tissue and digestive system. Sheldon described the physical characteristics of these three body types as follows:

Ectomorphic: A linear, usually tall person with a body build dominating other tissues.

Mesomorphic: Athletic body type more superior in connective tissue and muscles than other tissues.

Endomorphic: A fat person with heavy fat accumulation.

Results

The findings of the present study are presented in two sections. In the first section, the percentages of postural deformities in the study samples are described (Figure 1), and in the second section, the percentages of body type are reported (Figure 2).

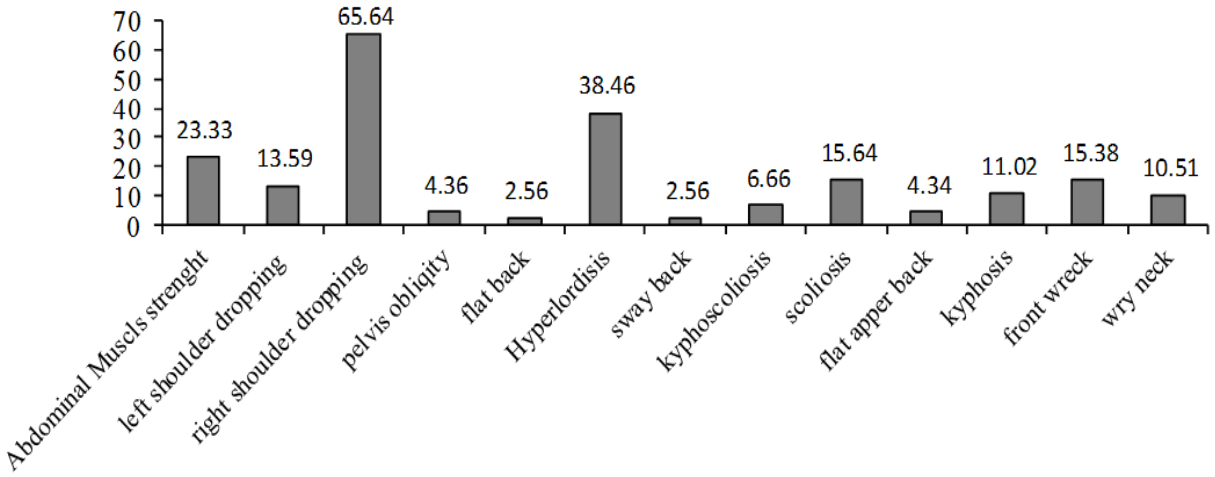

Figure 1. Percentage of spinal abnormalities in the male junior high school students of Kermanshah city (N=390).

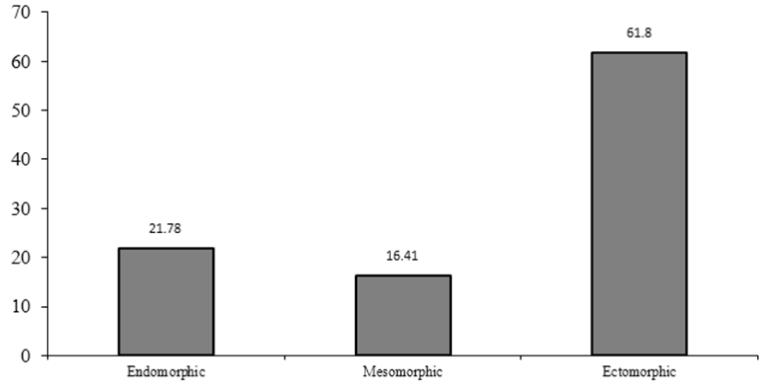

Figure 2. Percentage of the body types of the male junior high school students of Kermanshah city (N = 390).

According to the results, 18.97% of the study samples had a normal body type, and 81.03% of them had physical abnormalities. Moreover, the findings indicated that the most common postural deformities were right shoulder dropping (65.64%); lumbar lordosis (38.46%), abdominal muscle weakness (23.33%), and sway back (15.64%). Abnormalities like hollow and round back (6.66%), pelvic tilt (4.36%), sway back(2.56%) and flat back (2.56%) were found to have lower incidence rates.

Discussion

This study investigated the spinal deformities in the male junior high school students of Kermanshah city. Abnormality is defined as bodily deformities that mainly occur due to poor mobility, lack of knowledge about correct physique, false habits, muscular weakness, malnutrition, etc. they can be improved, however, by corrective exercises, depending on the type of deformity (7). The upper body anomalies are closely correlated with the spine, providing an appropriate space for the spinal cord that is vulnerable and plays a pivotal role in maintaining proper body structure. The arcs of the spine increase the resistance against vertical forces, like body weight and objects, as well as the forces exerted on the body during sports or daily work (7), which is indicative of the important role of the spine. False habits of sitting, resting, handling objects, doing daily activities, careers, special sports, and poor motor activities are the functional factors that cause physical abnormalities (1).

An overview of the incidence of deformities shows that the characteristics of the involved organ are one of the factors affecting the high incidence of deformities in different body organs. The organs with larger joints have more mobility and are more vulnerable than other organs. On the other hand, organs with more muscles, stronger ligaments, and wider motor range have more strength. Right shoulder dropping was found to be 65.64% and left shoulder dropping was reported to be 13.58%. Based on the face-to-face interviews with students, all right-handed students had right shoulder dropping and the left-handed ones had left shoulder dropping, except for the ones with scoliosis, in whom shoulder dropping was dependent on this abnormality. This is indicative of doing sports and daily activities by the superior hand. That is why the tendency to use the superior hand and right shoulder dropping appears to be a normal phenomenon.

Lumbar lordosis was recognized as the second common spinal lesion among students in this study (38.46%). Lumbar curvature is of great significance because it carries the upper body weight and transfers it directly to the pelvis. Any increase or decrease in lumbar curvature can affect the body balance and cause various anomalies in the lumbar and pelvic regions. It is believed that the muscles in this area are one of the factors affecting the lumbar-pelvic balance, as well as the performance of lumbar lordosis and pelvic tilt (33). Also, weakness of abdominal, dorsal, and lumbar muscles has been recognized as the most common factors increasing the lumbar curvature (34).

Since in this study the samples showed a high incidence rate of abdominal muscle weakness as well as different spinal abnormalities, such as sway back, which is the result of pelvic tilt and increased kyphosis and lordosis, tilted back, rounded back, and rounded and hollow back, and due to the high mobility of lumbar vertebrae, especially intervertebral disc 4 and 5, the presence of lumbar lordosis was not out of the our expectation.

Abdominal muscle weakness was the third prevalent abnormality of the studied samples (23.33%). Power imbalance and absence of muscular flexibility, especially abdominal muscles, normally occur due to lack of regular physical activities and physical training programs at schools and adopting incorrect body postures.

Scoliosis was reported to be the fourth common lesion among the studied samples (15.64%). Since factors such as neuromuscular and connective tissue disorders, growth-dependent problems, asymmetry of the brain stem, genetic factors, and factors associated with balance and sensory systems responsible for body balance like visual, proprioceptive, and vestibular systems, are involved in postural deviations, including scoliosis (35), analysis of the incidence of scoliosis in healthy societies is high in healthy people as well. Because the students in the study were healthy regarding the abovementioned factors, factors other than sensory disabilities associated with the incidence and prevalence of scoliosis should be taken into account. These factors include false motor activities like incorrect sitting, standing, and sleeping, improper handling of objects, lateral superiority, and unilateral activities, poor movement and muscular weakness, and socioeconomic activities (36).

Compensatory or complex deformities need time to occur because an abnormality should occur in order for another disorder to happen. Therefore, anomalies like sway back, which are the result of increased kyphosis, lordosis, and pelvic tilt, have less prevalence than other abnormalities (2.56%).

Flat back and flat waist also belonged to the endomorphic samples (14.34% and 2.56%). The researchers believe these two deformities are false in endomorphic body type because the spinal arc space at dorsal, lumbar, or both was overfilled with fat and gave a false flat appearance to the spine in these two regions, much different than the real flat back and flat waist.

Shortening of the body muscles and stretching of muscles opposed to them cause's abnormalities. Thus, if muscles have sufficient flexibility, the efficiency of organs will be increased, and the incidence of complications and deformities will be minimized. However, in the age range 12–15, due to longitudinal growth of long bones, muscular flexibility and stretching are reduced. Therefore, the researchers of this study considered the shortening of muscles a natural phenomenon. However, if it is considered an abnormal phenomenon, other age ranges are required to be investigated.

Another point to consider is that only 18.97% of the samples were physically normal. The ambiguous point is that some students with only one spinal abnormality were categorized as abnormal the same as those with more than one abnormality. So, a healthy person was someone with no abnormality.

All normal samples (n = 74) in this study were mesomorphic. However, there were mesomorphic samples that were abnormal. The researchers believed it was because of extreme use of specific muscles, sport activities using the superior side, etc. What is important here is that the thin and fat participants (ectomorph and endomorph) were not included as normal people.

Irrespective of the cause and severity of deformities, it should be noted that the incidence of abnormalities in the male junior high school students of Kermanshah is

worrying. However, these figures in turn are lower than those of some other societies, and this difference can be due to the differences between the societies studied with

regard to job, gender, age range, etc., so a high incidence of abnormalities should not be expected in this age range. It is quite evident that the education authorities should identify and eliminate these problems.

Conclusion

The results of the present study comfirmed other studies regarding the high incidence of abnormalities. However, there may be little differences due to diverse statistical societies, but all of them regarded lack of mobility of the participants as the main cause of physical abnormalities.

Since the participants of the current study are adolescents, the incidence of this disorder is alarming because factors such as age, career, etc. will intensify the abnormalities. Given the more rapid and effective treatment of deformities in younger ages owing to more flexibility of muscles and joints, it is necessary to design evaluation, modification, and training programs in order to provide a suitable ground for the prevention and treatment of these abnormalities.

Studying the incidence of physical abnormalities at universities may be a repetitive act, but lack of knowledge about a person's physical condition, physical deformity, its following complications, etc. in different societies, especially among students, is indicative of unawareness of normal physical conditions. The high incidence of spinal deformities shows the necessity of providing information and allocating specialized treatment centers for corrective movements under the supervision of specialists.

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