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Original Research Article

The Effect of Backpack on Cervical and Shoulder Posture in Male Students of Loni

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ABSTRACT

Background: The majority of children use a backpack to transport their belongings to and from school on a daily basis. Today in this competitive world students from very young age have to learn numerous subjects and carry heavy schoolbags. Schoolbags alter the student's unloaded posture and reposition it into a more strained and stressed improper, potentially unbalanced posture, with the addition of external force. Young children are suffering from back pain much earlier than previous generations, and the use of overweight backpacks is a contributing factor. This study was conducted to gather evidence about the actual deleterious change in posture that our children are facing due to carriage of backpacks and hence educate about health issue concerning heavy schoolbags.
Methods: 100 boys aged 11 to 14 years were randomly selected from 2 schools .Cervical and shoulder posture were assessed in terms of Craniohorizontal angle (CHA), Craniovertebral angle (CVA), and Sagittal shoulder posture (SSP) with backpack and without backpacks. Posture was assessed by saggital plane photographs with help of AutoCAD software 2004
Study design: Cross sectional study.
Results: Results showed significant difference in CHA, CVA, SSP with backpack and without backpack. Students showed forward head posture and kyphosis while carrying their own backpack. Most of the students were carrying more than 15% of their body weight in the form of backpack.
Conclusion: Cervical and shoulder posture were significantly alter while carrying backpack when compare the same without backpack.
Keywords: Backpacks, Craniohorizontal angle, Craniovertebral angle, and Sagittal shoulder posture.

INTRODUCTION

As the child starts going to school he uses schoolbags. Schoolbag allows children to carry more items than would be possible by the arms and hand alone. The backpack is an appropriate way to load the spine closely and symmetrically, whilst maintaining stability. [1] The carriage of schoolbag significantly alters the posture and gait of students. However, musculoskeletal problems associated with backpack use have become an increasing concern with school children. [2] The combined effects of heavy loads, position of the load on the body, size and shape of the load, load distribution, time spent carrying, physical characteristics and physical condition of the individual were hypothesized as factors which were associated with these problems. [1, 3] Although musculoskeletal symptoms such as muscle soreness, numbness, shoulder pain and back pain are believed to be multifactorial in origin [3] the carriage of heavy schoolbags is clearly a suspected factor. [4] It appears that time spent carrying the backpack as well as its weight is an important factor favoring back pain. [5] High school students are adolescents who experience a period of accelerated growth and development of skeletal and soft tissue. [6] As growth of the spinal structures extends over a longer period of time than the other skeletal tissues, incongruities in rate of tissue development can pose a threat to postural integrity. [7] Moreover, external forces such as load carrying may also influence the growth, development and maintenance of the alignment of the human body. [8] The carriage of posterior loads by students has been linked with spinal pain, and the amount of postural change produced by load carriage has been used as a measure of the potential to cause tissue damage. An MRI study to document reduced disc height and greater lumbar asymmetry in children with low back pain. [9] Few Indian researchers have focused on the impact of load carriage on high school students. But there is scarcity of studies in rural India. Thus the present was undertaken with the objectives of to determine change in cervical and shoulder posture while carrying backpack and also to compare the same without backpack and to find out percentage of body weight that student's were carrying to school in the form of backpacks.

MATERIALS AND METHOD

Ethical approval was obtained from Pravara Institute of Medical Sciences .Two secondary schools from Loni, Maharashtra, participated in this study. The study was performed in Loni, Rahata, Maharashtra, India. The 2 schools were selected from 3 Secondary school in this area, as the 1 among 3 schools was girl's school was excluded from study. Girl students and their parents were not ready for the photographs. Both the selected schools followed the same curriculum. Procedure of the study was explained to the teachers and parents of the students and written parental permission was obtained. A total 145 male students volunteered to participate and of these, 100 male students fulfilled the inclusion criteria.

Selection Criteria

Inclusion Criteria:

- Normal Male students between age of 11 to 14 years
- Students who carries school bags on both shoulder
- Students with no history of neck pain.

Exclusion Criteria:

- Female students

- Students with history of back and neck pain
- Students with any congenital deformity, Students with scoliosis
- Students with any respiratory disorder
- Students enabled to bring parental consent.

Materials used:

- Electronic Weight pan
- Adhesive marker
- Camera (canon A 530,5 MP,4X ZOOM) with stand
- Measuring tape
- Electronic weighing machine
- AutoCAD software 2004

Prior to data collection measurement of height (cm), weight (kg) and weight of school bag (kg) were recorded. (Table 1) Clothing was removed or rearranged so that neck and shoulders were exposed. The subject were standing and adhesive marker were placed on four anatomical points comprising (Fig.3)

1) External canthus of right eye
2) Right tragus
3) A mid-point between greater tuberosity of humerus
4) Posterior aspect of acromion process of right shoulder Spinous process of C7

Table 1: Distribution of mean, standard deviation, maximum and minimum values of age, weight and height, weight of bag, and % of bag weight to body weight of the 100 students under study.

Sr.No	Variables	Mean± (SD)	Maximum	Minimum
1	Age (years)	13.22± 0.56	14	11
2	Height(cm)	141.27±11.21	170.18	121.92
3	Weight of student (kg)	30.41±5.58	45	21
4	Bag Weight(kg)	4.97±0.65	6	3.5
5	% of bag weight to body weight(kg)	16.65±3.64	24.76	9.09

Subjects were asked to stand comfortable with arms by their side in normal standing posture. They were asked to place their weight evenly on both feet. The lateral malleoli were placed between parallel lines, which are perpendicular to the frontal plane, 2 cm apart. These two lines were drawn to ensure that the subject's position was kept at the same place while taking the photographs. The subject looked directly ahead, camera was placed 2.8 m from subject's right side. Camera was positioned perpendicular to the ground by using a spirit level.

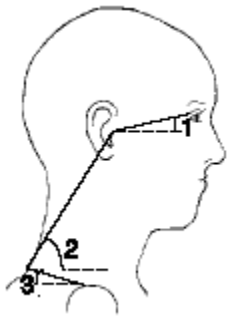
Two photographs were taken from lateral view at same time.

1. Without backpack (Fig.1)
2. Carrying student's own backpack over both shoulders (Fig.2)

Fig.1

Fig.2

In order to evaluate posture of the cervical and shoulder region, 3 angles of measurement reported by previous researches were used as measures for cervical and shoulder posture in this study. The angle were obtained as follows: (Fig.3)



1. Craniohorizontal angle (CHA)
2. Craniovertebral angle (CVA)
3. Sagittal shoulder posture (SSP)

Fig.3

Craniohorizontal angle: The angle formed at the intersection of a horizontal line through the tragus of ear and a line joining the tragus of ear and the external canthus of the eye, was measured. It is believed to provide an estimation of head on neck angle or position of upper cervical spine (Raine and Twomey 1994)

Craniovertebral angle: This angle was defined by Wickens and Kipath (1937). It is the angle termed at the intersection of a horizontal line through the spinous process of C7 and a line to the tragus of the ear. This is believed to provide an estimation of neck on upper trunk positioning .a small angle indicates more forward head posture.

Saggital shoulder posture: The angle formed by the intersection of a horizontal line through C7 and a line between the mid-point of the greater tuberosity of humerus and posterior aspect of the acromion, was measured. This angle provides a measurement of forward shoulder position .a smaller angle indicates that the

shoulder is further forward in relation to C7 – in other words a more rounded shoulder (Raine and Twomey 1994)

Measures of sagittal standing posture are commonly used estimates of the response of the human body to its environment and are accurately measured by photograph. [10]

The angles were measured by AutoCAD 2004: AutoCAD is a computer Aided Drafting program. AutoCAD is 2 dimensional software. It is widely used in Architecture, Civil engineering, Mechanical engineering, Structural engineering, Technical illustration, Land management, Graphics, Electrical Engineering, interior decoration, or even clothing design and Arts. AutoCAD as a drafting tool provides us an electronic drawing sheet. Inside the drawing area one vertical and horizontal line present called Graphic cursor or Crosshairs. On command these Graphic cursor will join the anatomical markers. It will give us the degree of that angle.

DATA ANALYSIS AND RESULTS

Statistical analysis was done by GraphPadInStat software (Trial version 3.03) using various statistical measures such a mean, standard deviation (SD) and tests of significance such as unpaired 't' test. The results were concluded to be statistically highly significant with $p < 0.01$. Unpaired 't' test was used to compare differences between the angles without backpack and with backpack . There is highly significant difference found in Craniohorizontal angle ($t = 1.982$, $p<0.01$) after carrying backpack when compared with no backpack. This angle provides position of upper cervical spine (Raine and Twomey 1994). (Table 2) This angle increased after carrying backpack indicating more upper cervical spine extension.

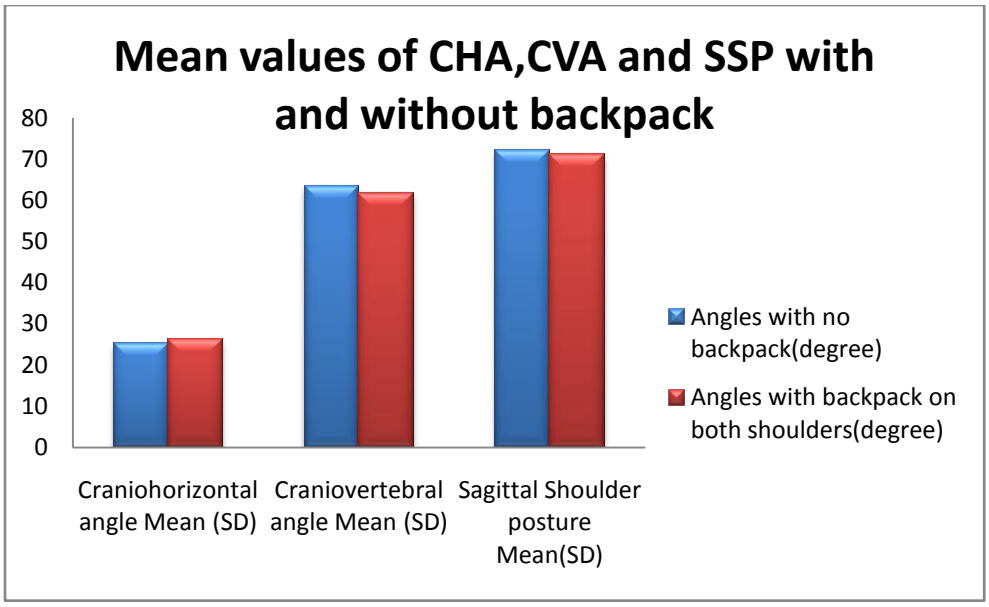
There is highly significant difference found in Craniovertebral angle ($t = 2.02$, $p<0.01$) after carrying backpack when compared with no backpack. (Table 2) This angle provides an estimation of neck on upper trunk positioning and small angle indicates more forward head posture. (Wickens and Kiputh 1937) This angle decreased after carrying a backpack indicates more forward head posture.

There is highly significant difference found in shoulder sagittal posture ($t = 1.857$,$p<0.01$) after carrying backpack when compared with no backpack . (Table 2)This angle provides a measurement of the forward shoulder position. A smaller angle indicating more rounded shoulder (Raine and Twomey 1994). This rounded shoulder reflects thoracic kyphosis.

On average students were carrying 16.65% of their body weights in the form of backpack.

Table 2: Distribution of Mean, Standard deviation and p-value of difference of Craniohorizontal angle, Craniovertebral angle and Sagittal shoulder posture angle without backpack and with backpack on both shoulders.

	Without backpack Mean ± SD	With backpack Mean ± SD	"P" value	Result
Cranio-horizontal angle	25.1 ± 1.370	26.3 ± 1.337	p<0.01	Highly significant
Cranio-vertebral angle	63.4 ± 1.350	61.8 ± 2.098	p<0.01	Highly significant
Shoulder sagittal posture	72.3 ± 1.337	71 ± 1.764	p<0.01	Highly significant



DISCUSSION

This work entitled "effect of backpack on cervical and shoulder posture in male students of Loni" was carried out in 2 school of Loni village. Girls students were not included as they were hesitated for body exposure.

Collectively there is flexion of lower cervical spine, extension of upper cervical spine and increased thoracic kyphosis after carrying backpack compared without backpack. Hence students showed forward head with thoracic kyphosis and protracted shoulder with backpack.

When the child carries backpack due to the posterior load the center of gravity moves posterior. Child's body tries to keep center of mass between the feet, so with a backpack, the trunk is in more forward position. This requires more forward head position and protraction of the shoulders but this would mean looking down. As the head and neck are brought forward, the student is forced to extend the occiput to keep the eyes horizontal. [11, 12] This will lead to forward head posture. Students of this age are in adolescent stage exhibits much greater mobility and flexibility than adult. Hence time expanded in faulty posture leads to deleterious effect on the body. Children do many activities while carrying a backpack e.g. walking playing, cycling and traveling to school. Most postural deviation in the growing child fall in the category of developmental deviation but when this pattern become habitual they may result in postural faults. [13] Plus the students were carrying around 16.64% of the body in the form of their backpack to school. Epidemiologic, physiologic, and biomechanical data support the suggested weight limit of 10% to 15% body weight. [14] Many experts recommend limiting the schoolbag load to 10% to 15% of body weight. [14] The proper maximum weight for loaded backpacks should not exceed 15% of the child's body weight. For example, an 80-pound child should not carry more than 12 pounds in a backpack. [15] They should not carry more than 15% of body weight. Children aged 11-14 years have an increased forward lean posture carrying 17% of the body weight, implying that such a weight

represents overload for this age group of children. [16] One study suggests that carrying a backpack weighing 15% of body weight would be too heavy for high school students to be able to maintain their normal postural alignment - in other words, carrying a load of less than 15% of body weight could be recommended. [17] One researcher recommended that a student's backpack should not exceed 10% of body weight. [18] The carrying weight of a school bag for children could be recommended as 10% of body weight because it was not significantly different from 0% load in the metabolic cost. [19] In our study 66 students were carrying backpack more than 15% of body weight concern. Most of the time students don't carry the books according to the time table. Even the students have more affinity towards some study material that they carry every day to the school. [20] One student in the study was carrying 24.76% of body weight which is hazardous and rectification is the need of the hour.

CONCLUSIONS

This study concludes that Forward head posture increased when carrying a backpack and the students are carrying heavy backpacks to the school. This shows that the backpack has an effect on changes in cervical and shoulder posture. Parents and teachers are cognizant of good postural habits and able to recognize the influence and habits tend toward development of good or faulty posture, they will able to contribute of this aspect of well-being in the daily life of growing individual. Nevertheless, postural instruction and training should not be neglected in the good programme of health education; attention should be paid to observable faults. When instructions are given, it should be simple and accurate. It should be given in such manner as to capture the interest and cooperation of the child. Of course eliminating backpack is not practical but limiting their weight will reduce forward head posture.

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