Original Article

ANALYSIS OF CERVICAL AND SHOULDER POSTURE IN SCHOOL CHILDREN USING BACK PACK EXPERIMENTAL STUDY

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ABSTRACT

Background: The backpack is one of several forms of manual load carriage that provides versatility and is often used by school students. Musculoskeletal problems associated with backpack use have become an increasing concern with school children. **Materials and Methods:** A total of 200 subjects were taken for the study (100 Males and 100 Females) and they were recorded photographically under several load-carrying conditions. Cervical and Shoulder posture angles were calculated and compared. **Results:** After measuring all the angles by using UTHASCA Image tool 3.0 version. It was noted that Cranio-horizontal angle, Shoulder sagittal posture angles significantly increased and Cranio-vertebral angle significantly decreased. Also the weight and time of backpack carried influenced Cervical and Shoulder posture. **Conclusion:** Forward head posture increased when carrying backpacks especially one with a heavy load. Carrying backpacks weighing 15% of body weight appeared to be too heavy to maintain standing posture for school students.

KEY WORDS: Backpacks; 15% Body weight; Cervical posture; Shoulder posture; Angles.

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INTRODUCTION

The backpack is one of several forms of manual load carriage that provides versatility and is often used by school students [1]. The backpack is an appropriate way to load the spine closely and symmetrically, whilst maintaining stability. 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 conditions of the individuals were hypothesized as factors, which are associated with these problems.

Past research shows numerous attempts to study the effects of these factors on the health and safety of adult carriers. The maximal loads recommended from these early studies varied from 25% to 40% of body weight[3]. High school students are adolescents who experienced a period of accelerated growth and development of skeletal and soft tissue[4]. Their spinal structures are thus markedly different from those of adults. As growth of spinal structures extends over a longer period of time than the other skeletal tissue. Incongruities in rate of tissue development can pose a threat to postural integrity[5]. Moreover external forces such as load carrying may also influence the growth, development and maintenance of the alignment of the human body[6]. Consequently posture in adolescent can be affected by both internal and external influences, which may make adolescents more susceptible to injury.

Changes in alignment of neck can produce strain of cervical joints and soft tissues as well as imbalanced muscle performance. It has been shown that the school bag, approximately 15% of the body weight can cause excessive loading on the spine, the upper part of the body consisting of head, cervical spine and upper extremity that load their weight into the thoracic spine [7]. This study is intended to ascertain the effect of carrying backpack in Indian school children.

MATERIAL AND METHODS

A total number of 200 school going students are participated in this study with sample size 200 (100 Males, 100 Females) with Simple random sampling (Lottery method). Materials used in this study are measuring tape, Weighingmachine,DigitalCamera, UTHSCAImage tool, 3.0software version, School bag, Adhesive markers. Inclusion criteria are Age group between 13 to 16 both sexes are included in this study. Backpack with 15%of bodyweight and body mass index is18 to 20.Exclusion criteria are any Neurological deficiencies, Cardio respiratory problems, recent orthopedic trauma, Subjects with obvious musculoskeletal deformities are excluded from the study.

Interventions:

Interventions			Subjects	Age group
Without backpack	With backpack 15%bodyweight	With 5minwalk	200	13 – 16 yrs
Measurement of cranihorizontal, craniovertibral angle and Sagittal shoulder posture			(100 males and 100 females)	

PROCEDURE: The subjects were informed about the nature of study and consent was taken. Clothing was rearranged so that shoulders were exposed with the subject standing; adhesive markers were placed on six anatomical point's first point from external canthus of the right eye, second from right tragus third point from the inferior margins of both ears.

1. A midpoint between greater tuberosity of humerus and posterior aspect of acromion process of shoulder.
2. Spinous process of C7.

Cranio horizontal angle- the line is drawn through the tragus of ear to the external canthus of the eye and another horizontal line is drawn through the tragus of ear, the angle formed at the intersection is cranio horizontal angle, was measured.**Cranio vertebral angle**- the angle formed at the intersection of horizontal line through the spinous process of C7 and line of tragus of ear was measured.**Sagittal shoulder posture**- the angle formed at the intersection of horizontal line through C7 and line between the midpoint of greater tuberosity of humerus and posterior aspect of acromion was measured. All these points was digitized with a specific sequences using UTHSCA-Image tool 3.0 software version.

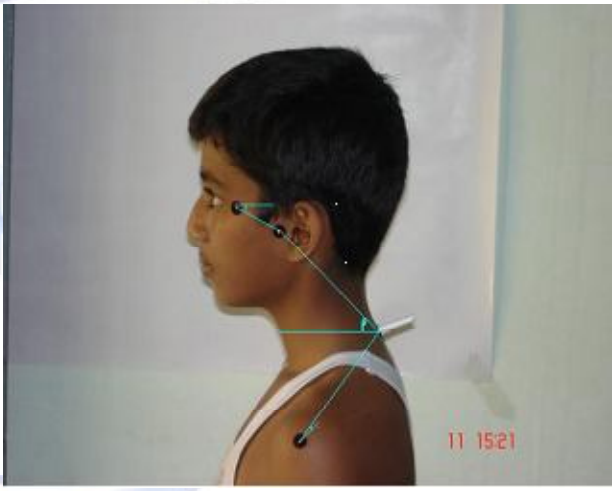

Figure-1: Measurement of Craniohorizontal, Craniovertibral and Saggital shoulder angle without backpacks

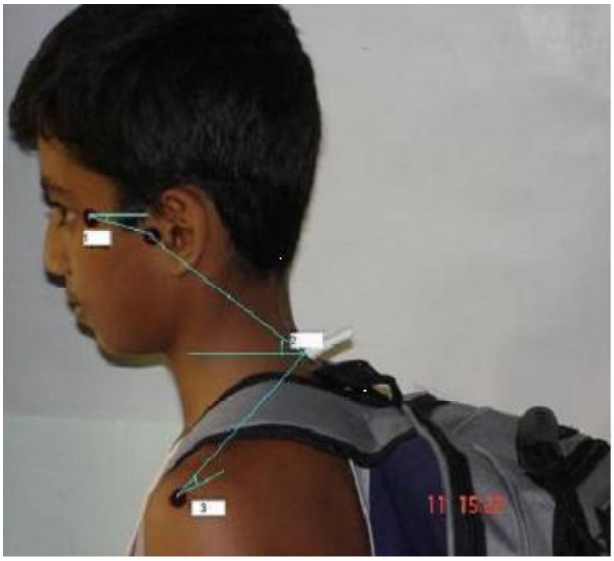

Figure-2: Measurement of Craniohorizontal, Craniovertibral and Saggital shoulder angle by using backpacks

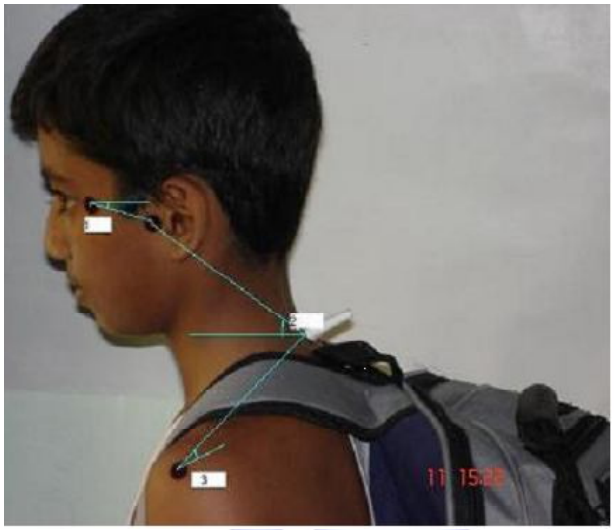

Figure-3: Measurement of Craniohorizontal, Craniovertibral and Saggital shoulder angle by using backpacks after five minutes walk

Statistical analysis A total of 200 students were selected based on simple random sampling .The data is collected for measuring Craniohorizontal angle, craniovertebral angle, and sagittal shoulder angle by using UTHSCA Image tool 3.0 software version first without backpack, then with backpack weighing about 15% of body weight and after 5 min walk with the same. The data obtained was analyzed by using SPSS software package. The mean improvements and standard deviations for these angles where calculated by descriptive analysis. This analysis showed that the mean values of craniovertebral angle reduced in the loaded posture in comparision with that produced by the unloaded conditions. The other two angles increased with loading & further increased when the subjects walked with the load for 5 minutes. Further the significance for the variance between postures was analysed by ANOVA, which showed p value significant at <0.05, for all the measured angles.

RESULTS

The Mean and standard deviation values of the three angles without backpack, with backpack & after 5 minutes of walk with the backpack are presented in the following tables respectively:

INTERPRETATIONS: From the below tables showing the mean, standard deviation & variance of all three angles, it can be understood that the mean values of the craniovertebral angle reduced in the loaded postures in comparison with that produced by the unloaded conditions. The other two angles increased with loading & further increased when the subject walked with the load for 5 minutes.

Table- 1: Descriptive Analysis for Craniohorizontal Angle:

Postural Assessment	Mean	Variance	SD
Without Back pack	23.1	32.6	5.71
With Back pack weighing about 15% of Body weight	25.91	38.16	6.17
After 5min of walk with Back pack weighing about 15% of Body weight	28.33	35.03	5.91

Table- 2: Descriptive Analysis for Craniovertebral Angle:

Postural Assessment	Mean	Variance	SD
Without Back pack	51.04	16.34	4.04
With Back pack weighing about 15% of Body weight	46.68	27.88	5.28
After 5min of walk with Back pack weighing about 15% of Body weight	45.66	30.81	5.55

Table- 3: Descriptive Analysis for Sagittal Shoulder Posture:

Postural Assessment	Mean	Variance	SD
Without Back pack	20.56	28.14	5.3
With Back pack weighing about 15% of Body weight	24.29	29.22	5.4
After 5min of walk with Back pack weighing about 15% of Body weight	26.86	29.74	5.45

The mean of all the measured angles is represented by the following graph:

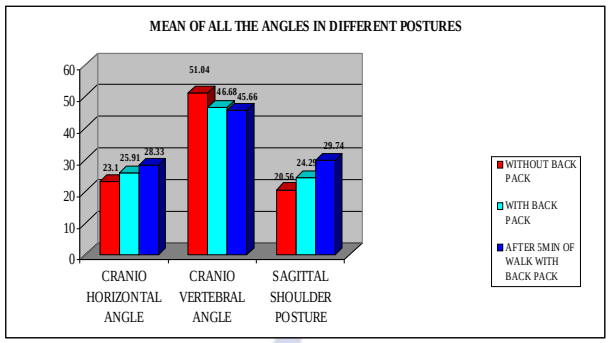

Figure 4: Mean of all the measured Angles

From the above graph showing the mean of all three angles, it can be understood that the mean values of the craniovertebral angle reduced in the loaded postures in comparison with that produced by the unloaded conditions. The other two angles increased with loading & further increased when the subject walked with the load for 5 minutes.

ANOVA – ANALYSIS OF VARIANCE

ANOVA was done to know the variation in each angle in all the three postures and it is presented in the following tables:

Table 4: Analysis of variance between postures with craniohorizontal angle

Source of variation	Sum of Squares (SS)	Degrees of freedom (d.f.)	Mean Square (MS) MS = SS/d.f	F RATIO	5% F -limit (from the table)
Between samples	2736.62	(3 – 1)=2	1368.31	**38.77**	F(2,597) is **3.00**
Within samples	21065.83	(600 – 3)=597	35.28		
Total	23802.45	(600 – 1)=599			

INTERPRETATION:

The results were significant at $p < 0.05$ for the cranio horizontal angle between the three postures as the calculated F value was greater than the table value depicting that there were significant variation between the unloaded posture and the loaded postures and also there is significant difference between carrying the backpack equivalent to 15% of body weight for a duration of 5 minutes and the unloaded posture.

Table-5: Analysis of variance between postures with craniovertebral angle.

Source of variation	Sum of Squares (SS)	Degrees of freedom (d.f.)	Mean Square (MS) MS = SS/d.f	F RATIO	5% F -limit (from the table)
Between samples	3264.33	(3 – 1)=2	1632.16	**65.25**	F(2,597) is **3.00**
Within samples	14933.03	(600 – 3)=597	25.01		
Total	18197.37	(600 – 1)=599			

The results were significant at $p < 0.05$ for the cranio vertebral angle between the three postures as the calculated F value was greater than the table value depicting that there were significant variation between the unloaded posture and the loaded postures and also there is significant difference between carrying the backpack equivalent to 15% of body weight for a duration of 5 minutes and the unloaded posture.

Table-6: Analysis of variance between postures with sagittal shoulder angle.

Source of variation	Sum of Squares (SS)	Degrees of freedom (d.f.)	Mean Square (MS) MS = SS/d.f	F RATIO	5% F -limit (from the table)
Between samples	4023.07	(3 – 1)=2	2011.53	**65.27**	F(2,597) is **3.00**
Within samples	17334.87	(600 – 3)=597	29.03		
Total	21357.94	(600 – 1)=599			

The results were significant at $p < 0.05$ for the angle of Sagittal Shoulder posture between the three postures as the calculated F value was greater than the table value depicting that there were significant variation between the unloaded posture and the loaded postures and also there is significant difference between carrying the backpack equivalent to 15% of body weight for a duration of 5 minutes and the unloaded posture.

DISCUSSION

From the interpretation of results, we can infer that carrying a backpack over both the shoulders had an effect on the postural angles measured. There was a decrease of the craniovertebral angle (Fig-4) when carrying the load indicating a more forward posture whilst carrying a backpack whereas the Sagittal Plane shoulder posture increased under load (Fig-4)

A more rounded shoulder is represented by a smaller sagittal shoulder angle, provided the position of C7 remains fixed. However, a smaller sagittal shoulder angle does not necessarily indicate a more rounded shoulder posture, as it is difficult to know if C7 remained in the same place under different postural conditions. For instance a larger sagittal shoulder angle may also represent a more rounded shoulder if the forward posture is increased. Therefore, the more anterior head position observed in most subjects in this study when carrying a backpack may contribute to an enlarged sagittal shoulder angle.

The Craniohorizontal angle showed significant difference when comparing the posture without a backpack and whilst carrying the backpack

To date, as per available information, this study seems to be the first objective investigations of the postural alignment among school children due to the backpacks. Also the study involved the analysis of time over the loading. There was a significant difference at $p<0.05$ between the subject carrying a backpack and walking for 5minutes and when the subject were in unloaded condition. The craniovertebral angle reduced after carrying the subject's backpack weight for 5minutes, indicating that time carrying a load influences neck on upper trunk position. However, the difference in the effect on posture between walking with a load for 5 minutes, and standing still with a load for 5minutes was not tested.

Overall, 200 school children were analyzed for these angles in different postures to detect the change in their postural alignment and the results were obtained using a separate analysis of variance for each angle.

The results were also significant at $p<0.05$ stating that there is a change in the postural alignment of the children due to the carrying of the backpacks about 15% of their bodyweight and also the time it is carried has a deteriorating effect.

CONCLUSION

The study can be concluded stating that a small but significant differences were found when comparing posture whilst carrying a backpack under different conditions, for the Craniohorizontal angle, Craniovertebral angle and Sagittal shoulder posture.

A significant reduction in the craniovertebral angle was found while carrying a backpack weighing about 15% of body weight over both the shoulders indicating an increase in the forward head posture. Also there was significant increase in the Craniohorizontal angle and the Sagittal shoulder posture with the loading.

Thus it implies that the weight of the backpack has an effect on changes in the cervical and shoulder posture, suggesting that carrying a backpack weighing 15% of body weight would be too heavy for high school students aged 13 to 17 years to maintain their normal postural alignment, in other words, carrying a backpack of less than 15% of body weight could be recommended.

LIMITATIONS

1) The study was done to investigate the effect of time while carrying a backpack and walking; the effect on stating loading was not considered.

2) The study was also limited to sagittal plane analysis of postural changes and the frontal plane analysis was not considered.

RECOMMENDATIONS FOR FUTHER STUDIES

1) Further research is needed to investigate the effect of backpack carriage in static and dynamic conditions on cervical and shoulder posture changes.

2) Similar studies can be done with the unilateral carrying of backpacks on the shoulders.

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