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Comparison of cervical angle with and without backpack in government and private school going children

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Abstract
Background and Objectives: Students and backpack are common sight today. Nowadays, a large number of students experience spinal pain quite early in life due to heavy school bag loads. The recommended bag weight is less than 10%-15% of their body weight, heavy weight of school bags may result in musculoskeletal and psychological problems in government and private school going children. This study was conducted to compare the cervical angle with and without backpack among government and private school going children.
Aim: The aim of the study is to compare the cervical angle with and without backpack in government and private school going children.
Method: A sample of 200 subjects were selected to take part in the study based on fulfilment of inclusion and exclusion criteria. They were made to sign an informed consent by their parents. Convenient sampling was used in this study. The subjects were divided into two types. Type 1- Government school going children, Type 2- Private school going children. By using ON protractor app craniovertebral angle and cranio horizontal angle with bag and without bag were assessed in 100 government and 100 private school children.
Results: The demographic data of all subjects who participated in the study, the mean of age, gender, height and bag weight of government school children were 10 years, male, 151 cm and 2 kg while the mean of age, gender, height and bag weight of private school children were 12 years, male, 151 cm and 5 kg, respectively. There is significant difference between cranio vertebral and cranio horizontal angle with backpack and without backpack between government and private school going children.
Conclusion: Cervical angle of government school children with bag and without bag was better than private school children.

Keywords: Backpack, government and private school children, cervical angle

Introduction
Backpacks are one of the basic things carried by students in day to day life. [1] It is an appropriate way to load the spine closely and symmetrically, whilst maintaining stability (Knapik *et al* 1996, Voll and Klimt 1977) [2]. Backpacks having a proper lumbar strap are much better as they put less pressure on the spine [3]. The maximum loads recommended from early studies varied from 25% to 40% of body weight (Haisman 1998) but the information gained from these researches might not apply to primary school students [2]. In 2009, the American Occupational Therapy Association (AOTA) and the American Physical Therapy Association (APTA) recommended not carrying a backpack heavier than 15% (or between 10% and 20%) of the student's body weight; In 2012, this was changed to 10% of their body weight. The American Chiropractic Association (ACA) recommended that backpack weight should not exceed 5–10% of the child's body weight [4]. Common but not supported 'rules-of-thumb' for adults, that are commonly applied to adolescents, are that backpacks should be positioned high on the trunk and loads should be limited to 10% of body weight [5].
The inappropriate use of school bags can lead to muscle imbalance which could turn into chronic neck and back problems later in life. In the UK, the regular backpack weight is 15-20% of their body weight, and some children carry backpacks as heavy as 30% to 40% of their body weight. Many children carry their bags on one shoulder or very low on their backs [6] and to carry their heavy bags children bend their trunk forward to maintain body posture and balance while walking.

Therefore, carrying a heavy backpack can be a source of musculoskeletal disorders like shoulder, neck and back pain in children [7].

School bags have long been thought to be associated with back and neck pain in adolescents (Malhoutra and Sen Gupta 1965), and clinicians are frequently asked for advice on school bag carriage and its contribution to back and neck pain (Wigram 2002). There are several studies done by other researchers, proved that carrying backpacks lead to a forward head position [8]. Epidemiological studies have shown a high prevalence of spinal postural deviations in children and adolescents, with forward head posture (FHP) is being one of the most common postural deviation [9]. When the head is held anterior to its neutral, balanced position and stresses the cervical vertebrae and posterior neck muscles this is known as forward head posture (FHP) [10]. It is associated with shortening of the upper trapezius, the posterior cervical extensor muscles, the sternocleidomastoid muscle and the levator scapulae muscle [9].

The highest rate of growth and changes takes place during puberty and the growth of skeletal system ceases at the age of 16 years for females and 18 years for males but the secondary ossification of skeletal system is not complete until the mid twenties [11]. Beside this external forces such as load carrying may also influence the growth, development and maintenance of the alignment of the human body and the excessive backpack load causes back pain and spinal deformities in children. [2] The pain associated with carrying a backpack is referred to as "backpack syndrome." This syndrome includes the following factors: abnormal body posture causing headaches, fatigue, and cervical and lumbar pain [4] due to which the spine becomes more prone to injury for a greater length of time, so advisable school bags should be used by children during these crucial years of growth and development [6]. Research in young military recruits suggesting that once someone is injured by carrying a load they are more prone to be injured again any injuries raised by carrying a school backpack should be concerning for all involved and should be taken into account by parents, educators and health care professionals regarding the role of heavy backpacks [12]. Bad posture such as forward head posture could be improved with the help of education and appropriate reminders to decrease the expansion of neck pain and to increase the energy and quality of life among school children [13].

Features of suitable school bags based on the scientific criteria:

1. Bags should be chosen from the lightest material [3].
2. Top of the backpacks should not be higher than the shoulders and the bottom of that should not be lower than top of the hip bone [3].
3. To avoid damaging the spine backpacks should be used with two chords [3].
4. Students should put heavier things close to the central axis of the body so that they get so close to the central axis of the body [3].
5. Students should avoid convoluting the backpack on their back [3].

We conducted this study to compare the changes in cervical angle i.e., cranio horizontal and craniovertebral angle with various backpack weight in private and government school children with the help of ON Protractor App due to which the result of this study can be a good guide for teachers and parents so that they can teach proper use of bags to their children and it can be also helpful in the prevention of skeletal deficiency in the next generation.

Methodology

Study type: Comparative study

Sample size: 200 Individuals

Study centre

1. Government Inter College Badowala Jolly grant, Dehradun
2. Doon public school, Bhaniyawala

Selection Criteria

Inclusion Criteria

Normal healthy individuals
Age: 10-13 years
Ability to wear a school bag while standing
Individuals willing to participate in the study

Exclusion criteria

Musculoskeletal problems
Neurological problems
Congenital anomalies
Ill health

Instrumentation

Weighing machine
Measuring Tape
Traditional double shoulder strap school bag
Smartphone
Tripod stand
Stool
Marker

Outcome Measures

Cranio Vertebral Angle
Cranio Horizontal Angle

Procedure

Purpose and procedure of the study was explained to the school authority and permission was taken from the authority regarding the study. The subjects were screened according to inclusion and exclusion criteria. And a written consent form was given to the subjects which was filled by their parents. Purpose and procedure of the study was explained to all the subjects. Subjects were divided into two types–

Type 1: Government school children
Type 2: Private school children

Measurement of height, weight and backpack weight

The height in centimetres and weight in kilograms was measured using a measuring tape and weighing machine respectively.

Height Measurement: The subjects were asked to remove their shoes and to stand near the wall where the measuring tape was stick while maintaining an erect posture.

Weight Measurement: The subjects were instructed to remove the shoes and stand on a weighing machine and the

weight was recorded for each student. The subjects were then asked to wear their backpack and the weight was measured again.
The difference in weight of children with the backpack and without the backpack was calculated and considered as their backpack weight, the study was conducted in the free hour of each class under the supervision of class teacher and physical education teacher.

Fig 5.3: Height Measurement

Measurement of Cervical Angle using Protractor App
By the ON Protractor app CVA and CHA were measured. For testing procedure participants were made to sit straight on a stool and instructed to focus at a particular point on their eye level with chin tuck to maintain a neutral head position. The smart phone was positioned away from the participant on tripod stand and then angles were measured using the smart phone app-On Protractor.
The angles in sagittal view are as follows:-

Cranio vertebral angle: The angle formed at the intersection of a horizontal line through a spinous process of C7 and a line joining to the tragus of ear.

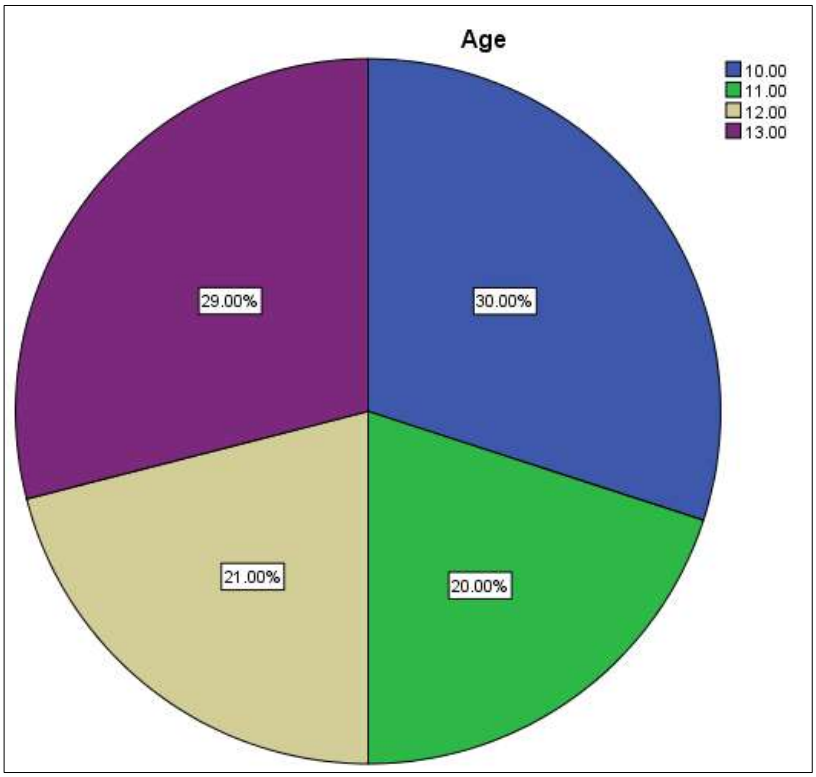
Cranio horizontal angle: The angle formed at the intersection of a horizontal line through the tragus of ear and line joining the tragus of ear and lateral canthus of eye.
Both the angles were measured first without backpack and then with backpack and the observed readings were recorded.

Fig 5.4: Cervical Angle Measurement

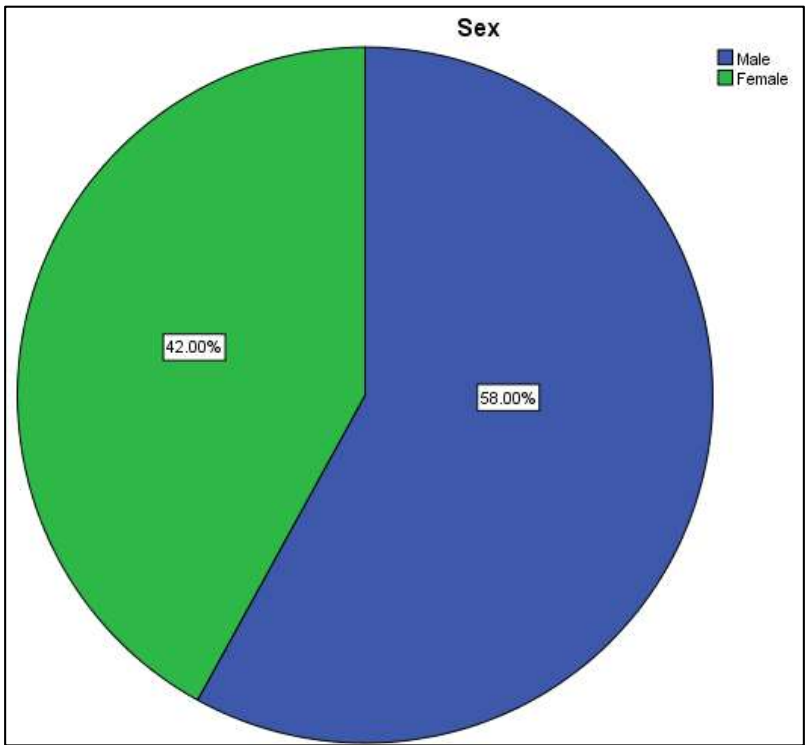
Result

On comparing both Government & Private School data results we find that Private School data results show more mean in weight with bag 42.5900 (Government School- 41.5500), weight without bag 37.3600 (Government School- 37.3300), CVA with bag 49.7969 (Government School- 48.5999), CVA without bag 47.2933 (Government School- 45.5057), CHA with bag 28.4863 (Government School- 24.7663) and CHA without bag 26.6894 (Government School- 22.7822).

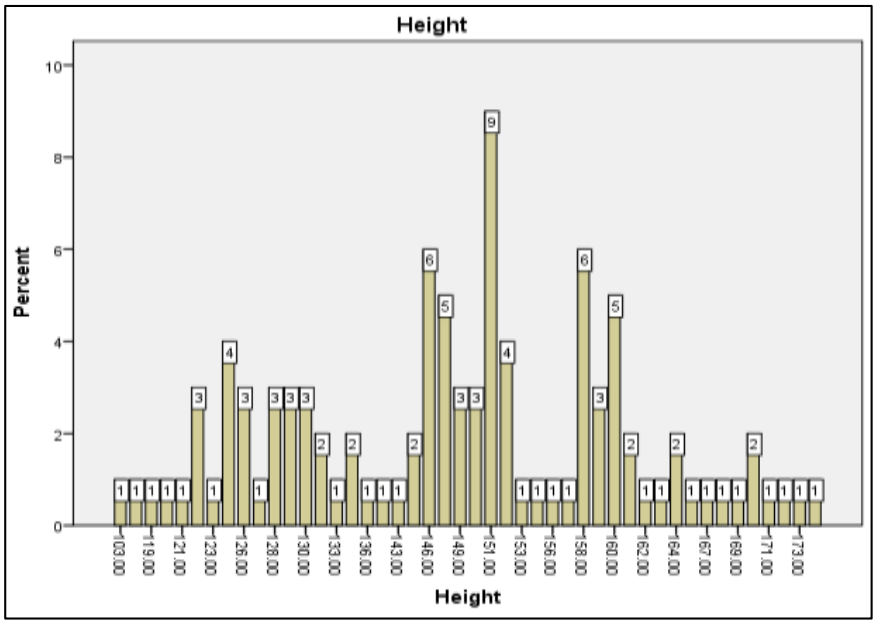
Government School



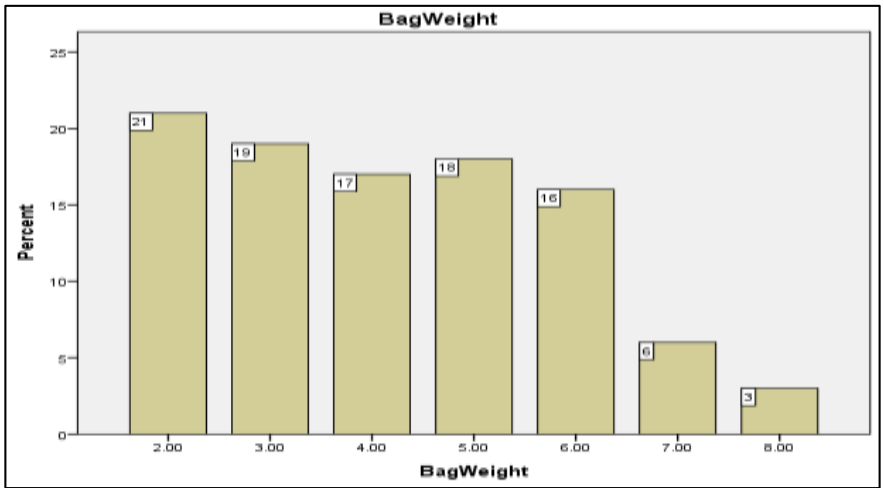
Graph 6.1: Showing mean of age of government school children



Graph 6.2: Showing mean of gender of government school children

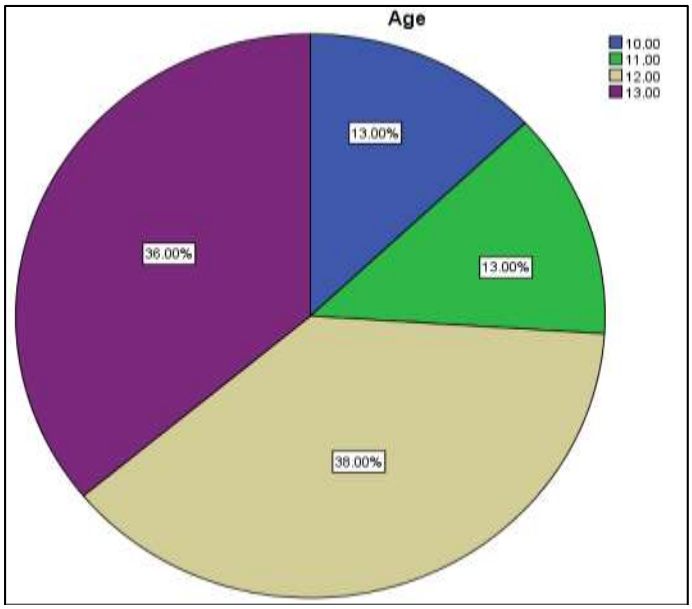


Graph 6.3: Showing mean of height of government school children

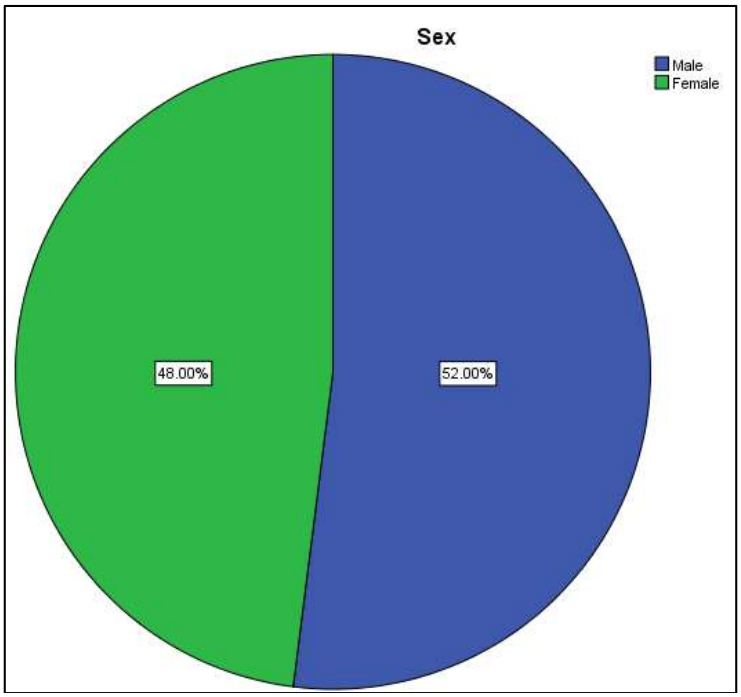


Graph 6.4: Showing mean of bag weight of government school children

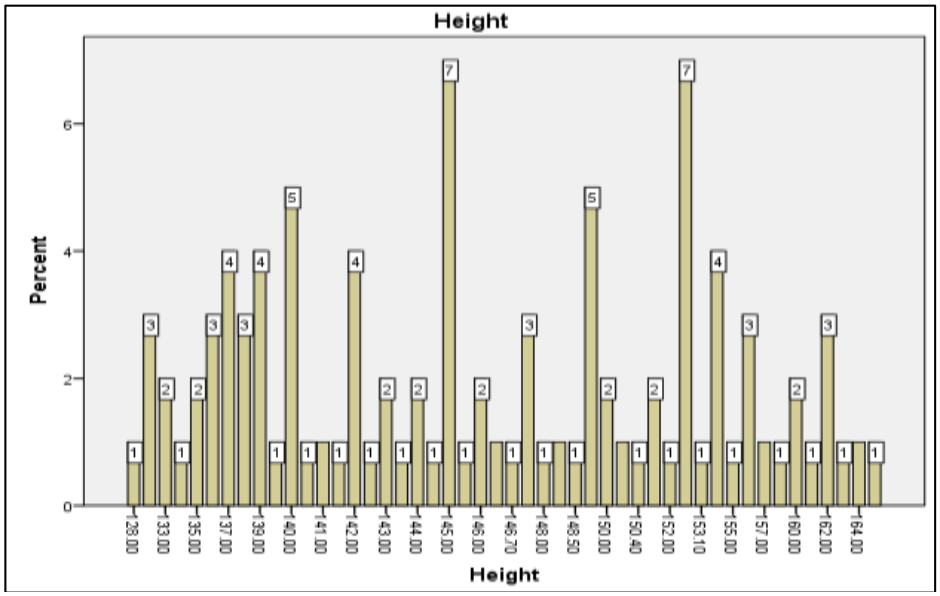
Private School



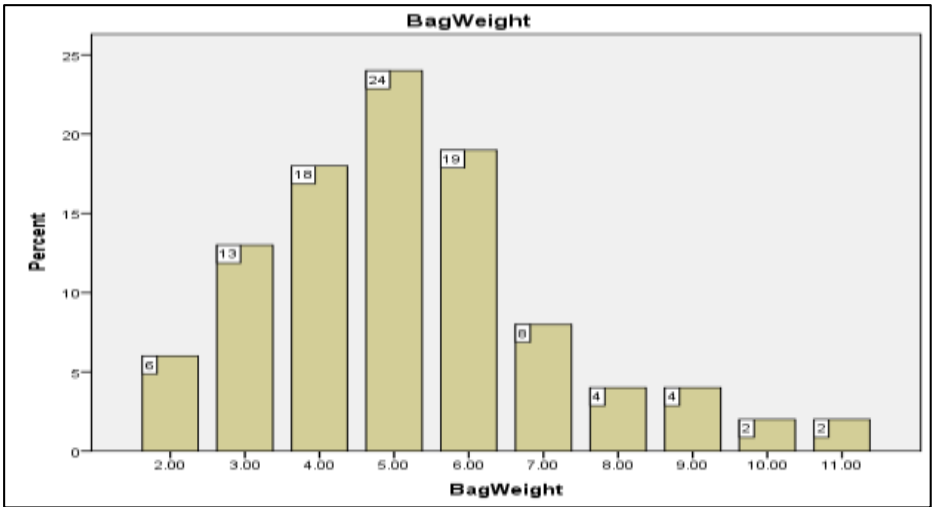
Graph 6.5: showing mean of age of private school children



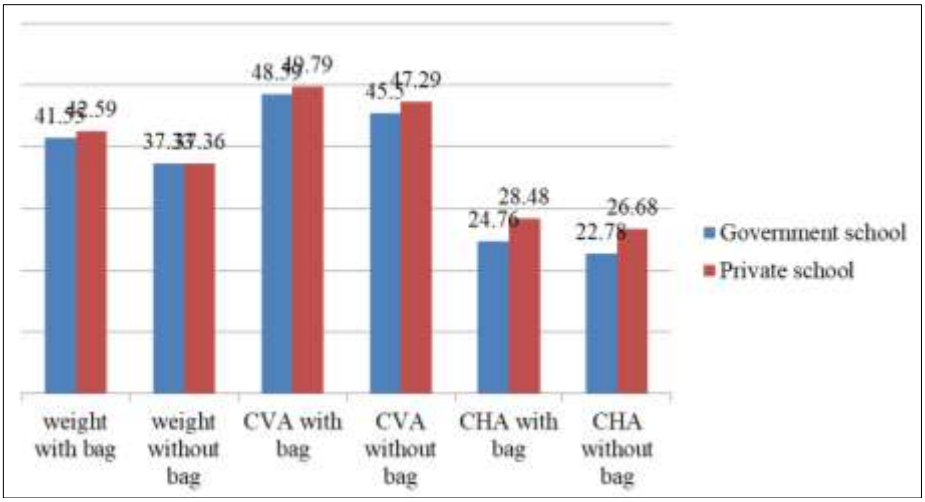
Graph 6.6: showing mean of gender of private school children



Graph 6.7: showing mean of height of private school children



Graph 6.8: showing mean of bag weight of private school children



Graph 7.0: showing comparison of weight with bag v/s weight without bag, CVA with bag v/s CVA without bag and CHA with bag v/s CHA without bag in type 1 and type 2 school children

Discussion

The present study was intended to explore the difference of craniovertebral angle with bag/without bag and cranial horizontal angle with bag/without bag between government and private school going children. We have also find the weight of student with bag and without bag. The comparison was done between private and government school going children age group of 10-13 years on 200 overall sample size. It was found that there was a significant change on the cervical angle when measured with and without a bag between government and private school going children. There was also significant difference between weight with bag and weight without bag between government and private school going children. Thus, the results of this study showed that there is a statistically significant effect of backpack weight on cervical angle of private school going children as compare with government school going children ($p<0.05$).

The reason behind why government school going children have better cervical angles with backpack and without backpack as compare to private school children – The former are more involved in physical activities and outdoor games instead of sitting in a same posture for longer duration of period as well as they carry bags of less weight while private school children carry more bag weight and they usually do less physical activities and live sedentary lifestyle.

Limitation of study

Sample size was small.

Unequal distribution of male and female participants

Recommendations for future study-

Study can be done on large sample size.

In future studies, latest technique for measuring postural angles can be used.

Equal number of male and female subjects can be studied to remove the gender bias.

Other factors like nutrition, psychosocial behaviour etc can be taken to get much better results.

Solutions

Students

They should arrange their educational accessories in a way that the heaviest things get closer to their back.

They should empty their water bottles before coming back to home from school.

They shouldn't carry unnecessary things to their school.

They should do some sort of physical exercises or participate in physical activities also.

Family

Parents should proceed to buy traditional-double strap bags with lumbar strap or wheels which distribute equal weights on body.

They should supervise students in order not to carry unnecessary books and things to school.

Educational facilities

Personal cup-boards or lockers to keep heavy books and materials at school

More outdoor activities

Educational brochures and classes related to posture and backpacks.

Conclusion

On the basis of above results, it can be concluded that with bag and without bag cervical angle was better more in government school going children as compare to private school going children.

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