A study to compare the sagittal posture analysis for single sided and double-sided backpack users

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ABSTRACT

Introduction and Aim: Backpack is a frameless form used to carry manual load/ any sort of equipment that distributes weight across the body and transferring more weight to hips and legs. The student wears the shoulder straps of the backpack on either single or double sides of the shoulder. Wearing backpacks on a single side differs from wearing the backpack on a double side. Methods of usage of backpack bring significant changes in postural alignment and muscle imbalance. Wearing backpack slung or strap over the single shoulder transverse all pressure to the shoulder where the backpack is placed. This results in strain on bones and muscles of the shoulder complex, so in this study is aimed to find the difference in sagittal posture analysis when single and double side backpack is been used.

Materials and Methods: Sagittal posture analysis is a measurement taken from tragus of ear to greater tubercle of the humerus in sagittal posture in students wearing the backpack on a single side and double side. Measurement was taken with load and without load. The study was taken to compare whether there is a difference between wearing bags on a single side and double side by measuring sagittal posture. Measurement shows a considerable change in single-sided and double-sided backpack students and with load and without load.

Results: Study revealed there is a significant change in single-sided backpack students. When the measurement was taken with bags, double-sided backpack students showed a simultaneous decreased measurement on both the right and left side. However, in single-sided backpack students, it showed a decrease in measurement on the side they used to wear the bags and an increased measurement on the opposite side of wearing the bags. Thus, wearing the backpack on a single side may lead to asymmetrical shoulder or postural changes.

Conclusion: Prolonged wearing of bags in a single shoulder will lead to postural changes. When the postural alignment changes, it leads to over straining of shoulder muscles like deltoid, trapezius and back muscles. finally, this leads to back pain and neck pain. However, wearing backpacks on the double side evenly distributes weight to both the shoulder. Hence, it is advisable to wear bags on the double side rather than a single side.

Keywords: Tragus of the ear; greater tubercle; postural alignment; muscle strain; deltoid; trapezius back muscles.

INTRODUCTION

Carrying a backpack is the most common daily activity among students. The way of wearing influences the student's body alignment. A backpack is a frameless material used by students to carry manual load/ any sort of equipment (1). The modern world changes a student's way of wearing the backpacks. Students started to wear backpacks so with a single sling. Fashion makes students wear bags on the single shoulder, which slowly alters their body alignment (2). The study was taken to compare the sagittal posture analysis in both single-sided and double-sided backpack students. Sagittal posture analysis is done by measuring the distance from the tragus of ear to greater tuberosity. The difference in this measurement will show changes in their shoulder, neck and back alignment (3). This changes the posture of the student. Posture is the attitude assumed by our body when it is stationary or moving. This will be the position to hold the body during sitting or standing. Posture will be the position of all body segments relative to each other and spine. An ideal posture is the one where the body segments are arranged vertically. LOG passes through every joint axis. However, a body segment cannot maintain ideal posture, as LOG falls very close to the joint axis and not through joint axis producing a little stress at joint (4-6).

Good posture will be the position where minimum stress is applied to each joint. It is the position to hold the body straight against gravity. Less strain must be applied to supporting muscles and ligaments. In optimal posture, the spine is stacked on top of pelvis and shoulder must hold the spine in place. Bad posture is the static posture that increases the stress to the joints is a faulty/ bad posture. The improper alignment of shoulder, spine and pelvic will alters ROM.kyphosis is the extreme forward curvature of the upper spine accompanied by forwarding curvature of lower spine

(7-9). When observed in the lateral view, it looks Scoliosis is the sideways curvature of the spine when looking from the anterior view, the curvature is easily identified. Lordosis is the increase in posterior concavity which will be common in obesity or pregnancy. Swayback will be related to lordosis. Increase in backward curvature of the spine in the lower region (lumbar) and increase in forwarding curvature of the chest region. In flat-back, the back will be straight with the absence of normal curves of the spine.

Kypholordosis is the combination of kyphosis and posterior lordosis. The posture of the person depends on the arrangement of vertebrae which depends upon intervertebral disc and curves of vertebral column (10). Vertebral column Consist of 33 vertebral bone and 23 IV disk. The spine broadly has 5 regions –cervical, thoracic, lumbar, sacrum and coccyx. The cervical, thoracic and lumbar are movable but sacrum and coccyx are immovable (11). In lateral view, the spine is observed with curves. At birth, it presents a single curve which is posteriorly convex. At later age 4 curves are present in which two are primary and two are secondary. The curve that is posteriorly convex for entire life is the primary or kyphotic curves. The curve that goes for posterior concavity is the secondary/ lordotic curve. Thoracic and sacral are kyphotic and lumbar and cervical are lordotic. The curves are dependent on each other and a part of a closed kinematic chain. Vertebral bodies are connected and separated by IV disc (12-14). The disc comprises of nucleus pulposus and annulus fibrosis and endplates. The endplate contains hyaline cartilage. They undergo calcification with age, annulus fibrosis consists of collagenous fibers and fibrocartilage that surrounds nucleus pulposus contains water, collagen fibers, proteoglycans, and elastin fibers. Type 1 collagen predominates in annulus fibrosis to resist greater tensile forces. Nucleus pulposus is a muco-polysaccharide structure containing 70-90%. Type 2 collagen is greater to resist compressive forces.

The motion segment comprises two adjacent vertebrae along with IV disc, the ligament that connects them. The spine mobility is the sum of movement of each motion segment. The coupling will be the association of one motion about an axis with another motion of different axis. IV disc adds tremendous ROM y allowing tilting of vertebrae on each side. Flexion and extension occur as the result of tilting and gliding of superior vertebra over the inferior vertebra. The spinal column undergoes for axial compression, bending, torsion, and shear force, which depends on the type, duration, and rate of loading. The force acts through the long axis of the spine perpendicular to the disc. This compressive load will be transmitted from the superior endplate to inferior endplate through trabecular bone and another cortical shell. The nucleus pulposus gets deformed by the compressive force. When this force act, the nucleus will exhibit a swelling pressure. Stress is created in annulus fibrosis when swelling pressure is distributed in all directions. The force of the nucleus pulposus is an interaction pair (15-17). The pressure is transmitted to vertebral bodies. Thus, disc and trabecular bone undergo deformation. The endplate will fail first when there is a high load. The IV disc also exhibit creep that produces changes in disc compression and function. Both compression and tension are created during bending. During forward flexion, the anterior disc, ligament, and muscle will go compression and the posterior structure go for tension. In the lateral bending ipsilateral side of the disc is compressed and the contralateral side is stretched. Torsional forces are created during rotation. The outer layer of vertebral bodies, disc, and orientation of facet provide torsional stiffness. Translation occurs when a shear force acts on the midplane of the disc. Zygapophyseal joint resists shear forces. When there is sustained load; disc exhibits creep and the zygapophyseal joint resists the entire shear force. Hence, adaptation of wearing bags on the single shoulder will lead to such kinds of postural deformities. Change in wearing the backpack on the single side also affects the shoulder complex. Overloading on the single side may affect the dynamic stability of the shoulder joint. Shoulder complex composed of scapula, humerus, and clavicle and is a combination of three joints that links upper extremity to the thorax. It includes sternoclavicular joint, acromioclavicular joint, Acapulco thoracic joint and glenohumeral joint. Static position, humeral headrest on fossa, the gravity acts parallel to shaft in the downward direction. It needs vertical force to restore/maintain equilibrium; this force is supplied by the deltoid, supraspinatus, long head of biceps and triceps (18). The mechanism of joint stability is passive. The translator component of rotator cuff muscles prevents shear between the humeral head and glenoid fossa. Deltoid along with infraspinatus, teres minor and subscapular create a pure rotation.

Dynamic stability is described as muscles and soft tissues used to control the movement and other structures like rotator cuff muscles. The deltoid is an anterior stabilizer of the GH joint in abduction and external rotation. Rotator cuff muscle provides dynamic stability during GH mobility. It is the main source of dynamic stability (19). The instability of the glenohumeral joint is a common disorder. Trauma, repetitive motion or frequent dislocation of the shoulder joint lead to this condition. Symptoms occur as pain during activities such as overhead activity, carrying heavy items, swimming. Wearing backpack for a prolonged time will lead to degenerative changes at shoulder complex specifically at AC joint and GH joint. A heavy load will compress the spine leading to scoliosis or can lead to any incorrect postural adaptation.

MATERIALS AND METHODS

The trial was conducted in 100 students from Saveetha College of Physiotherapy. Subjects included in the study were under the age group of 19-21yrs. Both male and female subjects were included. Each subject was asked about their usage of bag either single side or double side. Based on their usage 100 subjects were divided into two groups. One group with students wearing their bags on a single side and another group wearing bags on a double side. Every subject was provided with information about the study and asked for their participation. After their full agreement; subjects were included in the study. Subjects with previous shoulder pain or recently undergone any surgery in the shoulder are contraindicated to the study.

Group A included 50 subjects who wear their bags on double sides of the shoulder with both males and females. Group B included 50 subjects who wear their bags on a single side of shoulder with both males and females. Each subject's postural alignment was observed in the lateral view. Subjects were made to lean against a straight wall with the head, scapula and gluteal region touching the wall. Greater tubercle was palpated. The midpoint of greater tuberosity was marked with a skin marker. Measurement was taken from the tragus of the ear to greater tuberosity using inch tape. The inch tape must behold straight for accurate measurement. Subjects were measured without wearing bags and wearing bags on both sides of the shoulder. The load of the backpack differs in each subject. The subject was measured with their daily carrying load.

Inclusion criteria: Healthy male and female college students were included in the study. Subjects with the age group of 19 to 21 were included. The students taken for the study didn't have any recent injury or surgery in the neck, shoulder or back.

Exclusion criteria: Subjects with congenital deformity are excluded. Students who already had fracture or dislocation at the shoulder joint is not included. Subjects with any changes in postural alignment due to other pathological causes are excluded.

RESULTS

On average almost 70% of double-sided backpack students showed decreased measurement on both sides on wearing bags when compared to the measurement taken without bags. They showed a decreased measurement of bilaterally. However, in single-sided backpack students, when the measurement was taken with the bag, almost 90% of students showed decreased measurement on the side where they used to wear their bags and increased measurement on the opposite side of wearing bags. This shows the unilateral variations in single-sided backpack students when they wear their bags. Hence there is a possibility for the occurrence of the asymmetrical shoulder or postural changes in single-sided backpack students.

Table 1: Comparison between the values of group A without a bag for right and left

Group	n	Mean	SD
Group A without a bag (Right)	50	21.029	1.950
Group A without a bag (left)	50	21.037	1.965

Table 2: Comparison between the values of group A with a bag for right and left

Group	n	Mean	SD
Group A with the bag(Right)	50	20.709	1.950
Group A with a bag (Left)	50	20.771	1.967

Table 3: Comparison between the values of group B without a bag for right and left

Group	N	Mean	SD
Group B without a bag (Right)	50	21.258	2.200
Group B without a bag (left)	50	21.244	2.207

Table 4: Comparison between the values of group B with a bag for right and left

Group	N	Mean	SD
Group B with a bag (Right)	50	21.258	2.193
Group B with a bag (left)	50	21.282	2.257

DISCUSSION

The study revealed that there is a difference in measurement in single-sided and double-sided backpack students. In students wearing their backpacks on a single side, it was found that values decreased on the side in which the students wear the strap of the bag. Several authors revealed about the effects of using backpacks with heavy loads. Merati *et al.,* states the effects of a backpack with 10% of body weight of subjects on cervical and shoulder posture in school children. They found a reduced craniovertebral angle, increased sagittal shoulder posture in loaded conditions and concluded, a load of a backpack with 10% body weight will be too heavy for school going children's (20).

Few types of research found the effects of backpack weight on schoolgirls with vertebral communities. Taimela *et al.,* showed the effects of backpack weight on high school girl students with a spinal deformity like scapula asymmetry, vertebral column deviation, and unsymmetrical shoulder. Their study included students with variable backpack loads like 10%, 12.5%, 15% and 75% of body weight. The result proved only 10% of body weight as backpack load did not show any effect on dropped shoulder and suggested students should not carry a backpack heavier than 10% of body weight (21). Gent *et al.,* study revealed the effects of load placement in posture and spinal curvature. The results proved changes in trunk forward flexing and craniovertebral angle and proved there is decreased effect when the load was placed at the lower spine and to minimize postural adaptations (22). Vicas-Kunse found that effects of backpack shoulder straps length and found changes in upper trapezius pain threshold and craniovertebral angle (23). Viry *et al*., concluded backpack with shorter straps is more beneficial than a backpack with longer straps stated the effects of single side and double side strap backpack on lung function, which included forced vital capacity, forced expiratory volume in 1 second and peak expiratory flow (24). Wedderkopp *et al.,* concluded that decrease in forced vital capacity more in single side backpack students than double side backpack students and no significant changes in forced expiratory volume and peak expiratory flow in both types of wearing backpacks (25).

Those previous studies resulted in the effects of using backpacks with heavy loads and incorrect usage of bags. This study will be a comparative one independent of a load of the backpack. The backpack load will be a variable one according to the subject's usage. The study compares the measurement from the tragus of the ear to the midpoint of greater tubercle in the sagittal plane in both single-sided and double-sided backpack. The measurement was taken both sides with bags and without bags. Of 100 students almost 15 double-sided backpack wearing students and 5 single side backpack wearing students did not show any considerable changes in measurements, hence neglected. In single side backpack wearing students, the measurement was reduced on the side on which students wear their bags. The study results there might be postural changes and shoulder alignment in single-sided backpack students.

CONCLUSION

In single-sided backpack students, the measurement showed a difference between both sides of the shoulder. This shows the chance for the occurrence of the asymmetrical shoulder. Prolonged loading on a single side of the shoulder; may compress the IV disc, changes the orientation of the body of vertebra leading to alteration of spinal curves. Changes in the spinal curve results in postural deformities like scoliosis or kyphosis. Overloading on a single side of the shoulder also results in muscle weakness due to over contraction. This finally results in neck pain, shoulder pain and back pain. Hence, it is advisable to wear backpacks on both sides. This distributes the weight evenly on both sides. Students must be aware of the disadvantage of wearing bags on a single side and even the load of the bag affects the body position. Hence loading the bag over for about 10% of your body weight is considerable.

CONFLICT OF INTEREST: There is no conflict of interest from other authors.

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