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*Review Article*

# Postural Effect of Back Packs on School Children: Its Consequences on Their Body Posture

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## ABSTRACT

Students stand and move with backpacks that may be heavy, posture and balance may be altered. The purpose of this study was to determine if posture or postural stability change with back pack weight, the type of backpack worn or the location of the backpack on the spine. To measure posture and postural balance during three types of tests: static, dynamic and fall forward. Static tests were performed without a backpack, and with three backpacks, each tested in two different locations (high on the back; low on the back) with three different loads (no weight; 10% of the bodyweight; 20% of the bodyweight). Results indicate that postural stability and body position while wearing a backpack weighing 20% of the body weight are significantly different from conditions is which no backpack or a backpack with 0 or 10% of the bodyweight is worn. Standing with a back pack weighing 20% of the bodyweight results in an anterior movement of the shoulder and head, an increase in the movement of the center of pressure and an anterior, superior movement of the center of gravity. The location of the backpack also significantly altered postural stability and posture. When the backpack was worn in the high position, postural stability, as indicated by decreased movement of the center of gravity within the base of support, was greater than the low position but the head was in a more anterior position. In addition to the changes resulting from increase backpack weight and backpack location, the study found evidence that gender, body mass index and age may also alter stability and posture when wearing backpacks. These potentially at risk populations should be studied further to identify risks of injury and falls.

***Keyword:*** Weight, location, type of backpack, postural stability.

## INTRODUCTION

The word '**posture**' in most common usage almost exclusively refers to the way a person sits or stands, and is generally termed 'good posture' or 'bad posture'.

Posture can be defined as the position of all the body segments observed at a specific moment. Adequate posture occurs when the body is kept in balance with the least expenditure of energy possible. Inadequate posture consists of poor interrelations between parts of the body. These imperfect interrelations cause muscle tension and shortening, which makes

appropriate joint movements more difficult to achieve. Incorrect movements cause injuries to the musculoskeletal system and limit the ability to perform daily activities. The prevalence of postural problems is associated with pain.

Good posture is generally understood as standing with the head balanced effortlessly above the spine which is straight and vertical except for the slight natural curves in the lower back and neck i.e. it has a slight S-shape. Such a posture is widely recognized as being associated with good appearance, good health, strength, athleticism, and stamina.

By contrast the term bad posture is most commonly used to describe the human position in which the head and shoulders are placed forward of the spine with the spine curved into an excessive S-shape, or a C-shape, and it is widely referred to as a slouched, or hunchback posture. Bad posture is commonly regarded as a poor appearance, and is associated with backaches of all types, poor health, poor breathing, tiredness, and ready fatigability.

***The Posture Theory***

Forward curvature of the upper spine places the head and shoulders forwards, where the individual would fall in that direction if it was not for the strain being taken by the spine and back muscles to prevent that, which, in the longer term, disposes to various backaches.

Such a posture in infancy can also put downward pressure on the chest disposing to chest wall deformities, such as flat or backward chest shape. The forward posture places the weight of the head and shoulders over and above the chest, and puts downward pressure on the chest and ribs to cause a variety of musculoskeletal and other chest pains.

The forward posture also places downward pressure on the lungs and respiratory muscles which disposes to breathlessness, and can affect their structure and breathing pattern to add to the aspect of breathlessness.

That posture also places pressure on the air in the chest to impair the flow of blood from the feet to the brain, and dispose to faintness. Over a period of years it can also affect the strength of the blood vessels below the chest, and possibly the pattern and regulation of blood flow, causing weak circulation to the brain which disposes to faintness and abnormal tiredness, and more generally, to an impaired capacity for physical exertion, where faintness, and other symptoms occur at higher levels of exercise.

Incorrect postural habits developed since elementary school can generate irreversible changes in children as ligaments and intervertebral discs suffer a degenerative process throughout life and do not have regeneration mechanisms. These findings justify the creation of prevention programs to reduce the risk of postural changes and back pain in schoolchildren due to inadequate use and transport of school backpacks. The life goal of schoolchildren is to play, therefore any pain that deprives them of that is a source of worry.

Such a posture also places pressure on the stomach to cause stomach pains, indigestion, and poor digestion, which can impede growth.

The changes in the backpack model and mode of transport are related to the instructions received in the educational session, which emphasized comfort and body symmetry during load bearing2-6 and recommended the bilateral shoulder use of double-strap backpacks. This recommendation was a result of the findings of the first evaluation, including wheeled backpacks with a total mass of more than 10kg when the school material required for the day did not exceed 1.5kg (textbook, school diary and pencil case). The wheeled backpacks alone (between 5 and 7kg)

already exceeded the safe load-bearing limit of 3.68kg. This limit was based on the mean values for the children's body mass found in the first evaluation. The video footage also revealed that the children had to climb a flight of stairs to reach the classrooms, and the wheeled backpack generated overload and asymmetry because the children stopped pulling the wheeled backpacks and had to carry them to overcome the obstacle.

The forward position of the head and shoulders also, in some chest shapes, puts downward pressure on the dagger shaped sternum, or breastbone, where the lower tip is pressed into the upper abdomen, to cause soreness or pain in that local area, and dispose to injury which would add the problem .The forward and downward pressure can also displace internal anatomy and dispose to aches and pains as a result of that secondary effect.

Such body physique also pushes the kidneys and adrenal glands forwards, resulting in congestion and symptoms related to those factors, and cause strain on the back in that area. The forward position of the weight of the head and shoulders also puts strain on the neck and throat, and disposes to neck ache, sore throat, and laryngitis, coughs, colds, and voice problems - hoarseness, and or, temporary voice loss.

That posture also alters the angle between the head and neck which impedes the flow of air and fluids along the mouth, nasal passages, and Eustachian tubes, causing congestion in those structures, and it strains the jaw joint, disposing to jaw and facial pains, and it pushes the lower teeth forward against the upper teeth, or vice versa, disposing to dental and gum problems.

A study has reported that not only the magnitude of load but also the position of the backpack might influence efficient posterior load carriage. Efficient load carriage has been associated with minimal energy expenditure and minimal spinal tissue stress. Spinal tissue stress is related to altered posture (i.e. posture that deviates from gravitational alignment; Grimmer et al. 2002).

The symptoms are not likely to occur each and every time a person leans forward, but are the result of the repetitive, constant, or long term affects of that physique. Regardless of any questions about the individual aspects of the theory, such a physique disposes to a large range and number of ailments in the manner which I have described.

Those problems can be prevented in the early development of children where the spine is pliable; in much the same way as such a curvature can be prevented in a young tree.

***Types of posture***

**i. Good posture**

It involves an upright spine with slight natural forward curves in the neck and lower spine, and broad and straight shoulders. Significant increases in the curves or other changes in shape are listed below.

**ii. Poor posture**

**It's** the term used to describe an abnormal forward curve in the upper spine due to slouching while standing, and a ***C-shaped*** curve along the entire spine which can be seen from the side when a person slouches forward in the sitting position. Hence it is often referred to as the **slouched** posture.

**iii. Kyphosis**

It's a more extreme forward curvature of the upper spine and is due to an abnormality in the structure of the spine and is generally referred to as the ***hunchback*** posture. It is usually accompanied by a corresponding forward curve in the lower spine so that it looks like a reverse S-shape when seen from the side.

**iv. Scoliosis**

It's the medical term for ***sideways curvature*** of the spine which usually results from a person using one hand to do most of their tasks because most people are either left or right handed. It can also result from one leg being longer than the other.

**v. Lordosis**

It's an excessive forward curve in the lower spine and is usually associated with a hunchback posture. Common causes are obesity or pregnancy where the weight of the abdomen drags the lower spine forward.

**vi. Swayback**

It's the backward curvature of the lower spine

**vii. Flatback**

It's where the normal slight curves of the spine are not present and the back is abnormally straight.

**viii. Kypholordosis**

It's the combined abnormality of a forward stoop in the upper spine (kyphosis), and a forward curvature of the spine (lordosis), and usually occurs because the stoop puts the weight of the persons head in front of the centre of gravity with a tendency to fall forwards, so the instinctively push their lower spine forward to restore the centre of gravity and maintain a counterbalance upright position. A side view of the body shows a spinal Colum with an ***S-shape*.**

ix. **Kyphoscoliosis**

It's the combination of a forward curvature of the upper spine (kyphosis), and a sideways curvature (scoliosis), where multiple abnormalities commonly occur because they may be due to poor nutrition which weakens the bones or muscles, and affects every part of the human skeleton in a variety of ways.

x. **Kyphocostosis**

It's the combination of forward curvature of the upper spine (kyphosis), and deformities of the rib cage (costosis) which involves abnormalities of the chest, such as one that is abnormally flat and shallow, or deep and barrel shaped.

**xi. Neck stoop**

It can be seen from the side view in a person with a deep chest where the rib cage forms a triangular structure which prevents the spine from collapsing into a C-shape, so it remains straight, but the neck bends sharply forwards.

Many backpacks have been designed specifically to improve load distribution, balance, stability, and organization. One such design is the compartmentalized backpack, created specifically to carry and organize textbooks. The compartmentalized backpack has three major compartments made of elastic materials. The structure and elasticity of the compartments are designed to help to keep the textbooks close to the body's center of mass and to keep the mass from settling at the bottom of the backpack. The purpose of this study was to compare a compartmentalized backpack and a standard backpack in relation to metabolic and biomechanical factors.

A backpack should not weigh more than 15% of a child's total body weight. In other words, a child weighing 85 pounds should not be toting a backpack that weighs more than 12.75 pounds. A child weighing 140 pounds should not carry a pack weighing more than 21 pounds. The weight of a backpack and its contents can cause a person's posture to deteriorate. Heavy school backpacks may also deform natural curves in the back. If the curves are interrupted in the lower and middle back, the result is muscle strain and irritation to the rib cage or spine joints. Much of this suffering is brought by bad habits initiated during our younger years may be because of carrying overweight backpacks to school. (Rai, A. et al2013)

The schoolbag is a common cause of backache in school going children. A heavy bag may cause a child to compensate by

leaning his body forward and this can strain muscles in his neck, shoulders and back. The child may also find it difficult to put the bag on and take it off, or he falls frequently in school while carrying his schoolbag.

Carrying this weight 5 days a week throughout the school year affects children's backs. Add distance and time to and from school, extra gear and equipment, poor daypack/schoolbag design, contents (for example, number and size of work books, homework copies/materials), carrying and loading of a schoolbag - the schoolbag very much becomes a health threat.

*According to an international study, daily backpack carrying is a frequent cause of discomfort for school children. School backpacks were felt to be heavy by 79.1% of children, to cause fatigue by 65.7%, and to cause back pain by 46.1%*[*].

Most students wear backpacks when attending school or college and they use two strap backpacks. The backpacks were filled with books so that the weight of the bag approximated different percentages (10%, 15%, and 20%) of each individual subject's body weight. In some cases, prolonged wearing of overly heavy backpacks can lead to posture and muscle problems, which can cause injury and pain—indeed, the American Occupational Therapy Association considers that over 50 percent of students aged 9 to 20 have chronic back pain from over packed or poorly packed backpacks. Knowing how to lighten your load and keep it that way is important for your health and comfort. The backpack was carried on both shoulders, placed on the trunk, and fixed to a position (at waist level) so that the subject felt most comfortable and stable.

Once the child enters school, the school bag becomes the indispensable companion. A school bag full of hopes is always the first gift given to a child as an entrance present. However, a heavy school bag not only weight psychologically on a child, but also physically on the posture. In the lower class has the heavier the school bag. Overloading schoolbag cause muscle fatigue, back pain and poor posture. To protect the child from skeletal-muscular disorders, Taiwan recently suggested that schoolbag should be less weight than it is now ***panels and water tight welded seams.***

Each school year millions of children walk to, from and around school carrying a significantly greater amount of weight in their backpacks and for a longer period of time. Children have to carry a full day's class schedule of school books, in addition to other items and supplies, throughout the day1. The average student carries a backpack weighing almost one fourth of his or her body weight. Three out of 10 students typically carry backpacks weighing up to one third of their body weight at least once a week.

Carrying heavy backpacks can lead to pain and injury that prevent students from participating in everyday activities. It was estimated that in 2001, there were seven thousand injuries related to the use of backpacks (NEISS, 2001).

***Method of Carrying Backpack***

Methods of carrying backpacks may also influence pain, although this remains controversial.( Korovessis 2004) found that asymmetric carrying—having strap(s) on only one shoulder—resulted in greater pain in student participants. This was also discovered in a study conducted by Rice (2008). 26% of children who carried two-strap bags reported soreness, pain, and discomfort, whereas 50% of children who carried one-strap bags reported pain. The number of participants who experienced pain from asymmetric carrying was almost twice the number of those who carried their backpacks symmetrically (Rice et al., 2008)

Backpacks are a convenient way to transport items around, making them

popular for military, hiking, and school purposes. Most of the research about backpack loads and their effects on the body have focused on adults, specifically on hiking and military utilization. However, it is critical to understand the effects of increased backpack weight on children due to their developing bodies. Too much load on the body changes static and dynamic posture as the body tries to overcome the posterior shift in the center of mass (Singh and Koh 2009).

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. 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 backpack.

In a study found that carrying a10-kg backpack on one shoulder brought about an imbalance and, after the swing children needed a greater propulsive force to regain balance. Carrying a 10-kg one strap backpack also induced an asymmetric gait for braking and propulsive foreaft forces. This asymmetric gait was not apparent with a two-strap backpack .It concluded that carrying a 10-kg schoolbag affects gait kinetics and that children should carry their backpacks on both shoulders rather than use a one-strap backpack.( Cottalorda et al2003)

***Current backpack harness design has more to do with the hips than the back and shoulders. "Weight is transferred to the hips using a padded belt connected to the lower part of the backpack and secured around the user's waist. Shoulder straps, far from being a way to 'hang' the pack on you, simply keep the pack from twisting or rotating."***

A study investigated that the impact of backpacks on 10 children aged 11-13years using measurement of static posture and gait kinematics. The children participated in tests under four conditions: no backpack, one-strap backpack, two-strap backpack, and one-strap athletic bag. (Pascoe et al) also noted that carrying one-strap bags caused a shoulder elevation and a curvature of the spine away from the weight of the backpack. In their study, shoulder elevation from a horizontal position and lateral spinal deviation was not significantly different between two-strap back packs and no backpack. However, one-strap athletic bags promoted lateral spinal bending and shoulder elevation, while the two-strap backpack significantly reduced the stresses of carrying backpacks. It was concluded that the daily physical stresses associated with carrying athletic bags on one shoulder significantly alter the posture and gait of young people. These alterations of the spine may be responsible for the perceived back pain (51%) reported in their study. (Pascoe et al1997)

***Factors Which Affect Weight of School Bags***

There are two factors which affect weight of school bags on children posture and stability.

***i. Direct Factor***

A number of underlying factors emerged which contribute to the increased bulk and weight which children must transport to school on a daily basis. The number of textbook, workbook and copies in use, the size and weight of individual

textbooks was identified by researcher that this issue is increasing concern as children progress to second level schooling. Multi level text books containing curriculum, additional content of school bags likes bottles lunches flasks sports equipments musical instruments etc. weight of school bags that means it's constructed from heavy material such as leather which adds weight to the overload.

***ii. Indirect Factor***

A number of factors which have an indirect influence on the weight of schoolbags were also identified such as storage facility ,curriculum, school organization and time table requirements, lack of awareness, children's organizational skills, homework requirements and co-ordination of homework, lifting and carrying techniques health education programmes and so many other factors which affect on posture stability.

## CONCLUSION

Carrying a heavy backpack can be a source of chronic strain; and can cause shoulder, neck and back pain in children. Some students wear their bag on only one shoulder, and they might walk tilted to one side and suffer neck pain. If the bag straps are too thin, they can dig into the shoulder muscles and strain the neck. The problems of schoolbags are incremental and should be implemented in a cohesive manner in order to reduce the weight of schoolbags to an increasing degree. Therefore it concluded that postural effect of back packs on school children and its consequences on their body posture due to many factors which affect children's stability in their posture way of carrying backpacks, types of backpacks and so on. Children's Health and Healthy Children advise a proper fit and lightening the load. Leave out any items your child does not absolutely need for that day, such as laptops or other electronic devices, extra books or notepads. Also ensure that children bring only important items that they needs for that night's homework. While at school, urge your child to use his locker, desk or other storage areas so he doesn't have to cart around so much stuff. Awareness should be created among health care professionals, teachers, parents to restrict backpack load less than 5% of bodyweight by using school locker shelves. Improper use of backpacks is not healthy for anyone, especially for children who are more susceptible to injury because their bodies are growing and developing. Students, staff, and families need to be educated about backpacks' contribution to back pain and taught appropriate interventions to reduce injury.

## REFERENCES


- Negrini, S., & Carabalona, R (2002). Backpacks on! Schoolchildren's Perceptions of Load, Associations with Back Pain and Factors Determing the Load. Spine, 27(2), 187-195.
- Cottalorda J, Rahmani A, Diop M,Gautheron V, Ebermeyer E, Belli B.( 2003) A.Influence of school bag carrying on gait kinetics. J Pediatr Orthop; 12:357-364.
- Pascoe DD, Pascoe DE, Wang YT, Shim M, Kim CK. (1997). Influence of carrying book bags on gait cycle and posture of youths. Ergonomics; 40:631-641.
- Rice, Valerie, Carita Devilbiss, and ConneMara Bazley. (2008).. "An educational exercise on backpacks for schoolchildren." International Applied Human Factors and Ergonomics Conference
- Avantika Rai1, Shalini Agarawal2 (2013) Back Problems Due To Heavy Backpacks in School Children IOSR Journal Of Humanities And Social

Science (IOSR-JHSS) Volume X, Issue X, PP 01-00 e-ISSN: 2279-0837, p-ISSN: 2279-0845. www.iosrjournals.org
- Korovessis, Panagiotis, Georgios Koureas, and Zisis Papzisis.(2004)."Correlation between backpack weight and way of carrying, sagittal, and frontal spinal curvatures, athletic activity, and dorsaland low back pain in schoolchildren and adolescents. " Journal of Spinal Disorders andTechniques;17:33-40.
- Erkintalo MO, Salminen JJ, Alanen AM, Paajanen HE, Kormano MJ.(1995 ) Development of degenerative changes in the lumbar intervertebral disk: results of a prospective MR imaging study in adolescents with and without low-back pain. Radiology.196 (2):529-33.
- Singh, T. & Koh, M. (2009) Effects of backpack load position on spatiotemporal parameters and trunk forward lean. Gait & Posture, 29, pp. 49–53.
- Zapater AR, Silveira DM, Vitta A, Padovani CR, Silva JCP (2004). Seat posture: the efficiency of an educational program for scholars. Ciênc Saúde Coletiva; 9(1):191-9.
- Mason DE. Back pain in children. Pediatr Ann. (1999); 28(12):727-38.
- Mackie HW, Legg SJ, Beadle J, Hedderley D. (2003) Comparison of four different backpacks intended for school use. Appl Ergon; 34(3):257-64.
- Rodrigues S, Montebelo MIL, Teodori RM (2008). Plantar force distribution and pressure center oscillation in relation to the weight and positioning of school supplies and books in student's backpack. Rev Bras Fisioter.; 12(1):43-8.
- Shumway-Cook A, Woollacott MH. ; (2001) Motor control: theory and practical applications. Maryland (USA): Lippincott Williams and Wilkins
- Westcott SL, Lowes LP, Richardson PK. (1997) Evaluation of postural stability in children: current theories and assessment tools. Phys Ther.; 77(6):629-45.
- Griegel-Morris P, Larson K, Mueller-Klaus K, Oatis CA. (1992) Incidence of common postural abnormalities in the cervical, shoulder, and thoracic regions and their association with pain in two age groups of healthy subjects. Phys Ther.; 72(6):425-31.
- Szeto GP, Straker L, Raine S. A field (2002).comparison of neck and shoulder postures in symptomatic and asymptomatic offi ce workers. Appl Ergon.; 33(1):75-84.
- Grimmer, K., Dansie, B., Milanese S., Pirunsan, U. and Trott, P., (2002), Adolescent standing postural response to backpack loads: a randomised controlled experimental study. BMC Musculoskeletal Disorders, 3,10. Available online at: http://www.biomedcentral.com/1471–2474/3/10.

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