Editorial

Backpacks in children

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All parents want their children to do well in school. They make sure that children bring home their books and do their homework at night. They also ensure that they have their books packed away in their backpacks ready to be taken to classes the next day. However, they may be overlooking a threat to their children's health. Recently scientists have begun to examine the effects of carrying heavy backpacks full of books. What they have discovered is that carrying heavy backpacks may pose a serious threat to the child's spinal development.

Of the factors linked with back pain in schoolchildren, none has stimulated greater parental anxiety than the use of school backpacks. Viry et al[1] studied the effects of school backpack weight on the presence of nonspecific low back pain in 123 eighth-graders in France. The authors concluded that nonspecific adolescent back pain was associated with female gender and carrying a backpack weighing more than 20% of the student's body weight[3].

Grimmer and Williams[2] surveyed 1,269 high-school students in Adelaide, South Australia, and recorded backpack load as a percentage of total body weight and height. The authors found a strong association in all grades between low back pain and both backpack weight and the length of time carried[2]. Again, girls were more likely to report low back pain than boys; girls' description of back pain increased in year 8, while boys reported a similar response 1 to 2 years later. The authors suggested that this finding may represent the relationship between the different peak growth phases between genders and the susceptibility of rapidly growing spines to back pain[2]. More than one fifth of the students were found to carry backpack loads greater than 10% of their body weight[2].

Siambanes et al[3] studied 3,498 students living in two counties in California where each student's weight and backpack load were measured. Controlling for age, socioeconomic status, walking to and from school, and method of wear, results indicated that backpack weight, measured as a percentage of body weight, was effective in predicting back pain ($P < 0.01$). Girls and those who walk to and from school were more likely to report back pain ($P < 0.01$)[3].

Negrini and Carabalona[4] recently performed a cross-sectional study of 237 sixth-graders in Milan, Italy. The children reported that their backpacks were heavy (79%), caused fatigue (65.7%), and caused back pain (46.1%). No significant difference between genders was detected[4].

The weight of schoolbags and the prevalence of musculoskeletal symptoms amongst 140 students (70 third form students comprising 35 females and 35 males, and 70 sixth form students comprising 35 females and 35 males) from five New Zealand secondary schools was investigated[5]. Schoolbag weight for third form students (mean age 13.6 years) was 13.2% of their body weight, while for sixth form students (mean age 17.1 years) it was 10.3% of their body weight. Musculoskeletal symptoms were reported by 77.1% of the students. Symptoms were most prevalent in the neck, shoulders, upper back and lower back[5].

A magnetic resonance imaging study demonstrated that increasing backpack loads significantly compressed lumbar disc heights measured in the midline sagittal plane ($P < 0.05$)[6]. This is the first study to use advanced imaging to demonstrate how backpack loads are responsible for a significant amount of back pain in children, which in part, may be due to changes in lumbar disc height or curvature[6].

A team of researchers at Auburn University, Australia studied 421 students and found that backpacks carried with one-strap promoted lateral spinal bending and shoulder elevation[7]. Additionally, they noted that carrying a backpack promoted significant forward lean of head and trunk[7].

A study carried out on healthy male school-children (n=200), mean (SD) age 12.5 (0.5) years, from high schools in Mangalore, India showed that carrying a backpack weighing 15% of body weight changes all the postural angles (cranio-vertebral, head on neck, head and neck on trunk, trunk and lower limb) in preadolescent children[8]. A study was done in Canada

to evaluate the changes in children's trunk forward lean (TFL), cranio-vertebral angle (CVA) and spinal lordosis angle (LA) that occurred with high, medium and low load locations during standing and walking. Results indicated that significant changes occurred in TFL and CVA when the backpack was loaded to 15% body weight[9].

Carrying a backpack over 2 shoulders is the most efficient means of carriage, but often backpacks are carried over 1 shoulder. Thirty-two children (12-13 years) were assessed under 2 load conditions using the GAITRite system. No significant differences were found in base of support, stride length, or velocity when compared with the unloaded baseline walk during backpack use with loads limited to 15% of body weight[10].

There is debate about a 10% versus 15% of body weight cutoff point for safe weight of school backpacks. A study was done in Pennsylvania, USA using electromyography, posture evaluation, heart rate, and ratings of perceived exertion and perceptions of pain to find an acceptable backpack load limit for middle school students[11]. Twenty middle school students aged 11 to 14 (10 female and 10 male) volunteered for the study. The subjects completed two tests, standing stationary and walking on a treadmill, where they carried 5% incremental loads from 0% body mass (BM) to 20% BM. The study indicated that the Borg-CR10 ratings and trunk flexion angle for the walking trial indicated a possible load limit of 10% BM due to the non-significant difference between 0 and 10% BM and the significant difference between 10 and 15% BM[11].

In a study done in Northern California[12] 531 5th to 12th grade students and their backpacks were weighed. Students were individually interviewed about how often they experienced pain while carrying a backpack, the site of their pain, and if the pain had interfered with school activities or led to medical care. Data support the use of a 10% of body weight cutoff for safe use of backpacks for all grade levels. Greater relative backpack weight was associated with upper- and mid-back pain reports but not neck or lower back pain; it was also associated with lost school time, lost school sports time, and greater chiropractic utilization[12].

There are certain things that parents should look for when buying a backpack for their child[13]:

1. Look for backpacks with wide, padded shoulder straps. Narrow straps dig painfully into shoulders and can hinder circulation, causing numbness or tingling in the arms, which over time may cause weakness in the hands. Padded shoulder straps help absorb the load.

2. Look for backpacks with "S" shaped shoulder straps, which will ergonomically contour to the child's body.

3. Consider the weight of the backpack when empty. For example, a canvas backpack will be lighter than a leather one.

4. Look for backpacks with a waist or chest strap. This will help to keep the load close to the body and help maintain proper balance.

5. Look for backpacks with a built in back support.

6. Look for backpacks with a lumbar pillow.

7. Make sure the backpack is not too heavy. Even when worn properly with both straps, leaning forward to compensate for this extra weight can affect the natural curve in the lumbar, or lower back region. Extra weight may cause a rounding of the shoulders and an increased curve in the thoracic or upper back region. As a result, the student may experience back, shoulder and neck pain. A good rule to follow is to carry no more than 10% of one's body weight.

8. Consider purchasing a backpack with wheels.

Recommendations for backpack use include the following[13]:

1. Wear both shoulder straps. Slinging a backpack over one shoulder causes a person to lean to one side to compensate for the uneven weight, curving the spine. Over time, this can cause lower and upper back pain, strained shoulders and neck, and even functional scoliosis, or curvature of the spine. Teenage girls are especially susceptible to scoliosis.

2. Distribute weight evenly across your back. The more spread out a load is, the less strain it puts on any one part of your body. Load pack so the heaviest items are right next to your back.

3. Snug shoulder straps so the pack fits close to the upper part of your back. The further a backpack's load is from your back, the more it pulls you backward and strains muscles between your shoulders.

4. Use the waist belt, and side/chest straps. Keep the load close to your body. Keeping the pack close to your hips also shifts "work" to your legs.

5. The bottom should rest in the curve of your lower back and the top touch just below the vertebral prominence on your neck.

6. Neatly pack your backpack, and try to keep items in place.

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