UCSD Researchers Report Results of Children's Backpack Study

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As long as children have carried their books and belongings in backpacks they have complained of shoulder and back pain. A University of California, San Diego (UCSD) School of Medicine-led team found that how loads are distributed under backpack straps may help identify the source of shoulder and back pain in children.

The study, published in the December 5, 2005 issue of the Archives of Pediatric and Adolescent Medicine, concludes that the average backpack load that children are now carrying should be reduced. Excessive pressure on the shoulder from too much backpack weight may be causing shoulder pain, and an uneven backpack load may contribute to low back pain. The researchers hope their study will influence and improve future backpack design.

The research team, led by Principal Investigators Brandon Macias, B.A. of UCSD's Department of Orthopaedic Surgery, and Gita Murthy, Ph.D. who was a fellow in UCSD's Department of Anesthesiology during the time of the research, studied five boys and five girls, aged 13 years old. Each child's backpack was fitted with pressure sensors on the shoulder straps. The pressure sensors are the same type as those that measure standard blood pressure. The children wore standard identical backpacks first carrying 10% of their body weight, then 20% and finally 30%. Macias says the group decided to study the backpack loads because there have been no studies connecting physiological pain and backpack loading.

Prior to loading each backpack the children's backpack shoulder straps were positioned with sensors to obtain contact pressure measurements over a 30-second recording period. The researchers noted that contact pressures measured significantly higher on the right side than the left side at all bodyweight levels and determined that it may have been due to posture, a factor they suggest warrants further study. The authors said that other studies have indicated that posture changed when shoulders were asymmetrically loaded, adding that long-term asymmetrical loading on the shoulders may alter the spine curvature and produce back pain.

With each weight level the children reported increased perceived pain levels. Surface pressures measured by the investigators were higher than the pressure threshold to obstruct normal skin

and muscle blood flow, measured at 30mmHg. According to previous studies children commonly carry backpack loads of 22% of their body weight. The study found that pressures at 20% of body weight measured 70 mmHg on the left shoulder and 110 mmHg on the right shoulder -- skin surface pressures that are more than double and triple the threshold for reduced blood flow.

Murthy states, "The concern of heavy backpacks and back and shoulder pain to parents is not new. However, the objective data that we have published is new and important. The more objective data that the public has, the more educated they become, and perhaps more inclined to change the way children carry backpacks."

"Furthermore, manufacturers and designers of backpacks often try to optimize design based upon the data available in the literature," Murthy states. "Our shoulder loading data may help designers and engineers design a wider shoulder strap, for example, that will help spread the load of the backpack."

Murthy adds that the Consumer Product Safety Commission (CPSC) estimates that annually there are nearly 7,500 emergency room visits due to injuries related to backpacks or book bags (National Electronic Injury Surveillance System, Consumer Product Safety Commission, 2004).

The research team hopes that parents will help their children avoid using heavy backpacks for prolonged periods and prevent backpack pain and related injuries.

The researchers recommend that concentrated backpack loads be minimized and the way children carry backpacks be optimized to promote safety and comfort, adding that the reported backpack averages of 22% of body weight is too high. They state it is difficult to give an overall recommendation because of different body types and life styles, but emphasize that the average load that children are carrying now needs to be reduced because the high pressure on the shoulder may be causing the shoulder pain, and asymmetric loads may contribute to low back pain.

"Previous studies have measured general pain and heavy backpacks," Macias says. "But, they have not correlated backpack load distribution and pain. This correlation is important to establish how much load in a backpack is too much."

The researchers state they are the first group to look at backpack shoulder loading in children quantitatively. Previous research has focused on questionnaires, reported pain, and measuring the loads inside children's backpacks. Measuring the amount of pressure and its distribution on the shoulders helps identify the difference between shoulder pain versus back pain.

The research team consisted of Brandon Macias, B.A., Staff Research Associate, UCSD Department of Orthopaedic Surgery; Gita Murthy, Ph.D., Postdoctoral Fellow in the UCSD Department of Anesthesiology at the time the study was conducted, and currently an environmental consultant; Henry Chambers, M.D., Pediatric Orthopedic Surgeon and Chief of

Staff, San Diego Children's Hospital and Health Center and Associate Clinical Professor, UCSD Department of Orthopedic Surgery, Children's Hospital and Health Center - San Diego, Department of Orthopaedic Surgery, and Alan Hargens, Ph.D., Professor, UCSD Department of Orthopaedic Surgery.

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