Name(s)

Bryce Wong

Project Number

J0327

Project Title

Give Your Back a Break: Improving Backpacks through Biomechanics

Abstract

Objectives

The objective of my project was to develop a backpack that improves proper body alignment while reducing the compression on the shoulders. Backpacks induce distortion of the natural curvature of the spine and impair the musculoskeletal health of the body. Numerous scientific studies, reports, and interviews of medical professionals in the USA and other parts of the world have indicated that thousands of children experience discomfort and pain when carrying heavy backpacks.

Methods

I designed my backpack considering the biomechanics of the body in the key components such as well-padded, molded shoulder straps for broader distribution of load, a hip belt to support the lumbar, a rigid framework to provide structure, and shelves to place the backpack's center of mass closer to the person s body for balance. I compared my prototype against five commercial backpacks. To measure compression forces on the shoulders, I used load cells made of flour dough on a dummy s shoulders and measured and compared the deformation. I determined load distribution in different configurations by using a luggage scale on each shoulder. I measured the center of mass location relative to the back and to evaluate comfort level and areas of strain I wore the backpacks with a blindfold.

Results

The tests indicated that my prototype was better than the commercial backpacks. Some of the results were: 74% of the thickness of the load cells on my prototype was preserved compared to 40% average for the others. Circumference of the compressed load cells increased by just 1.5cm - 2.5cm wider on my prototype compared to an average of 4.74cm - 5.5cm for all others. For the load distribution on the shoulders, my prototype showed less weight on the shoulders with results comparable to the commercial backpack that has a hip belt. For the center of mass location, my prototype measures was 8cm to the back with the sports backpack as second closest. For the blindfold test, my prototype overall showed less strain felt on the key areas of the body.

Conclusions

I can conclude that with all the components integrated into my backpack design, it reduces the strain and pain caused by carrying heavy loads. Also, with the hip belt attached to the shoulder strap, the wearer is required to use the hip belt. The promising results of my design could be the new driving force for backpack manufacturers to incorporate the importance of biomechanical engineering in their products. Furthermore, I hope that more people will understand that using ill-fitted and poorly designed backpacks can affect their

Summary Statement

I designed a better backpack that reduces compression on the shoulders and minimizes back strain associated with carrying heavy loads.

Help Received

I personally interviewed Dr. Nakano, DC who helped me understand some medical terms and my dad who helped me during the blindfold test.