

Using Physiological and Psychophysical Measurements to Assess Backpack Loads for Middle School Students

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Introduction

- Over 40 million US students use backpacks (Jacobs, 2002)
- Average weight carried is comparable to NIOSH lifting limit for adults (Negrini, Carabalona, & Sibilla, 1999; Waters, Putz-Anderson, & Garg, 1994)
- Increasing number of children reporting back pain (Siambanes, Martinez, Butler, & Haider, 2004)
- Debate over the cause of heavy backpacks
- Debate over appropriate load limit
- Study age group in an important physical growth period (*Growth and development, ages 11 to 14 years, 2006*)

Significance

- Wide range in the recommended load limit can be confusing to parents and students
 - American Occupational Therapy Association (AOTA): 15% body mass (BM)
 - American Academy of Pediatrics (AAP): 10 to 20% BM
- Finding an appropriate load limit is important to reduce injuries to the back, neck, and shoulders as well as posture problems (Dale, 2004)
- Universal load limit would help students, parents, and teachers understand the importance of restricting the load of a backpack to ensure the present and future safety of students

Research Questions

- Is there a significant change in the electromyography (EMG), heart rate, ratings of perceived exertion (RPE), ratings of perception of pain (CR10), and trunk forward lean?
- If there is a significant change in the measurements, at what load does the change occur?

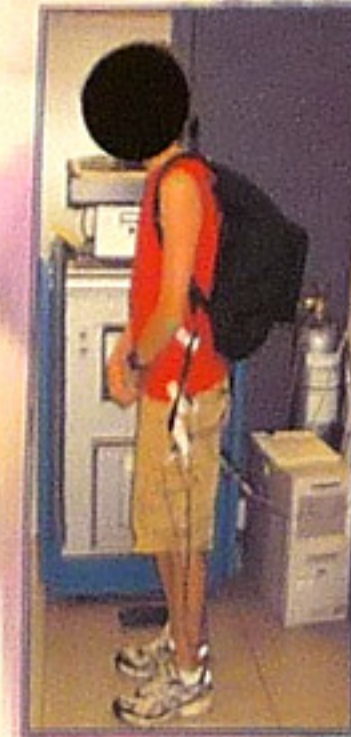


Figure 1. Standing trial

Methodology

- 20 subjects (11 to 14 years old): 10 males, 10 females
- Two backpacks
- Two trials: standing and walking on a treadmill
- Carried loads of 0, 10, 15, and 20% BM
 - Each load carried twice for both trials
- Measured EMG, heart rate, ratings of perceived exertion, ratings of perceived pain, and trunk forward lean



Figure 2. Walking trial

Results

- No significant findings from EMG, heart rate, or RPE measurements
- Significant difference between 10 and 15% BM for perception of pain (CR10) for all areas in both trials except middle back, standing (Figures 3 and 4)
- Significant difference between 10 and 15% BM for trunk forward lean in the walking trial (Figures 5 and 6)
- Trunk forward lean at 15 and 20% BM for both trials is higher than that found during normal gait (Stokes, Andersson, & Forsberg, 1989)

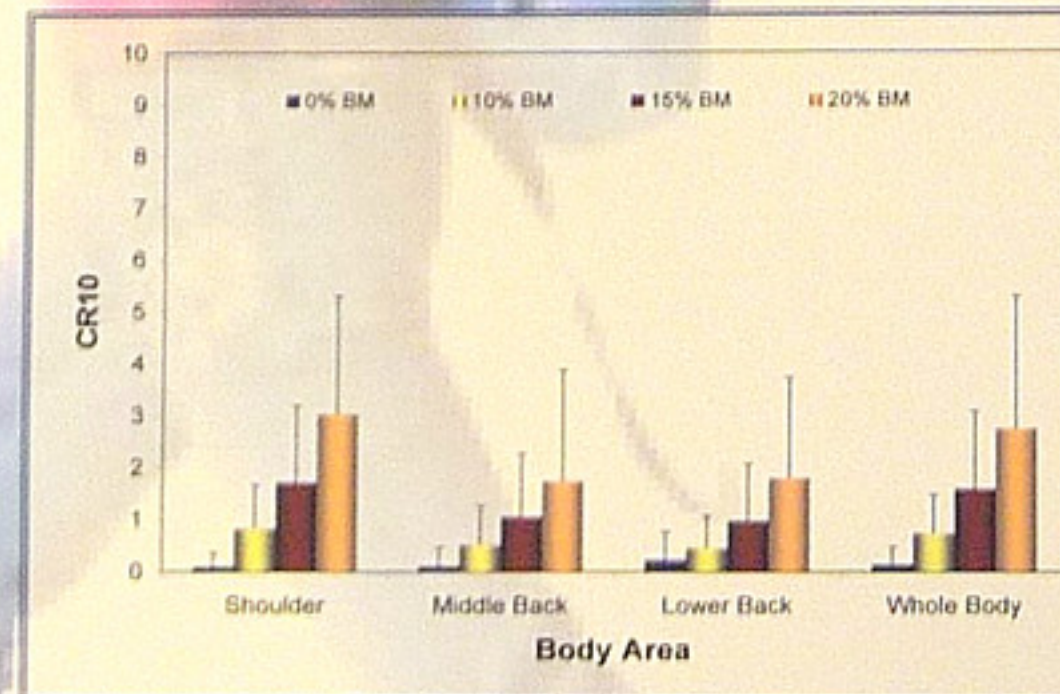


Figure 3. Average perception of pain ratings for each body area and load - standing trial

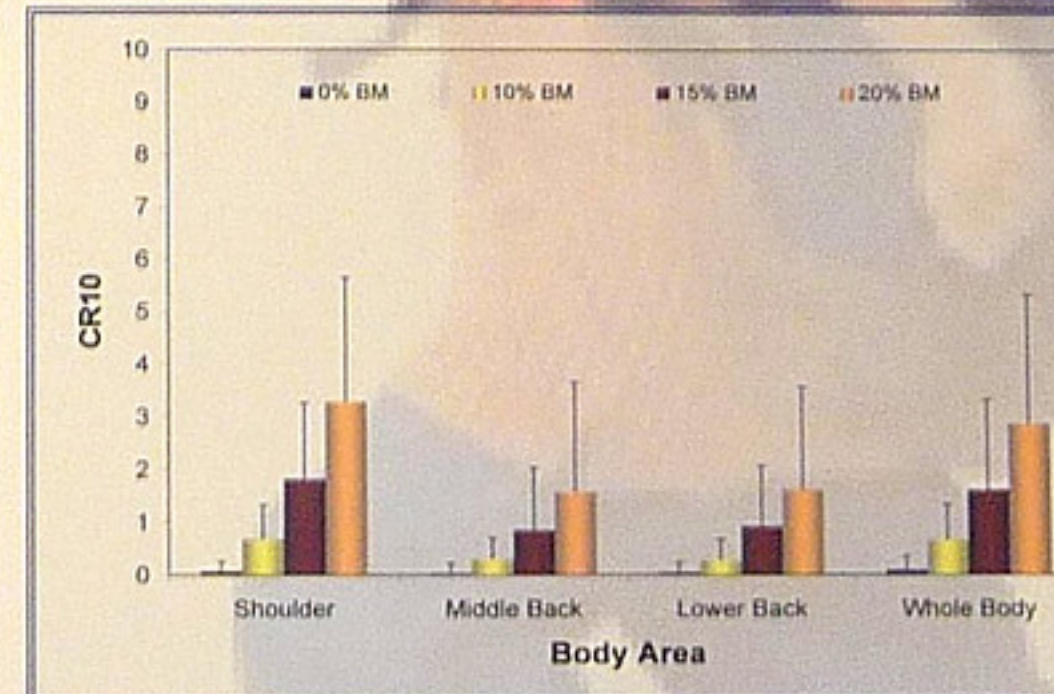
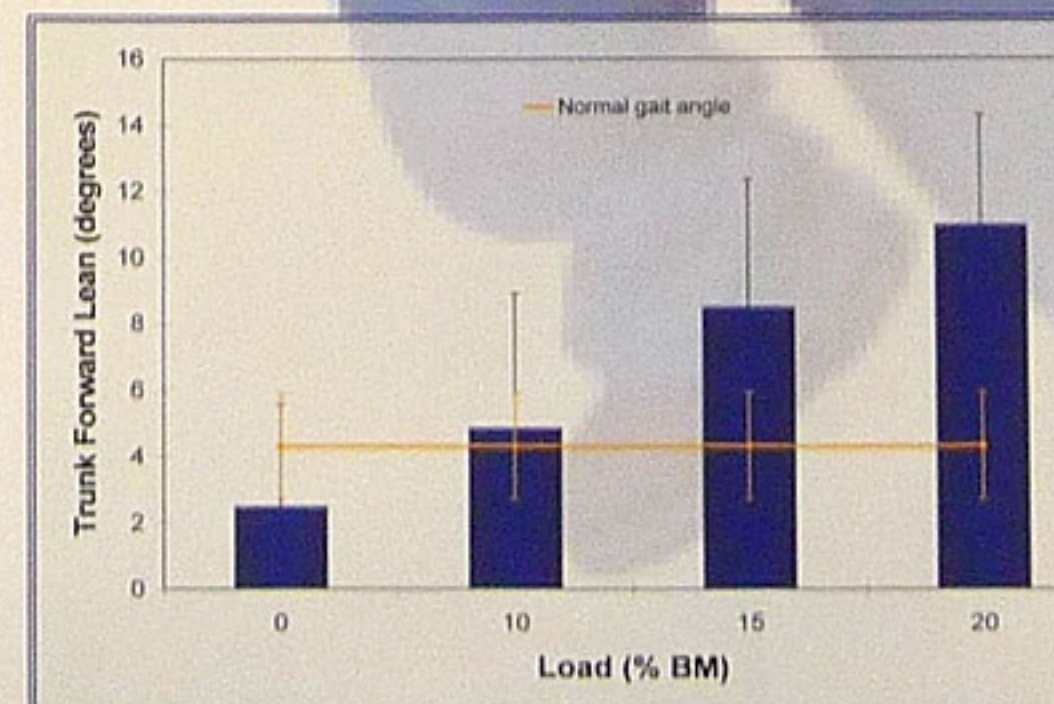
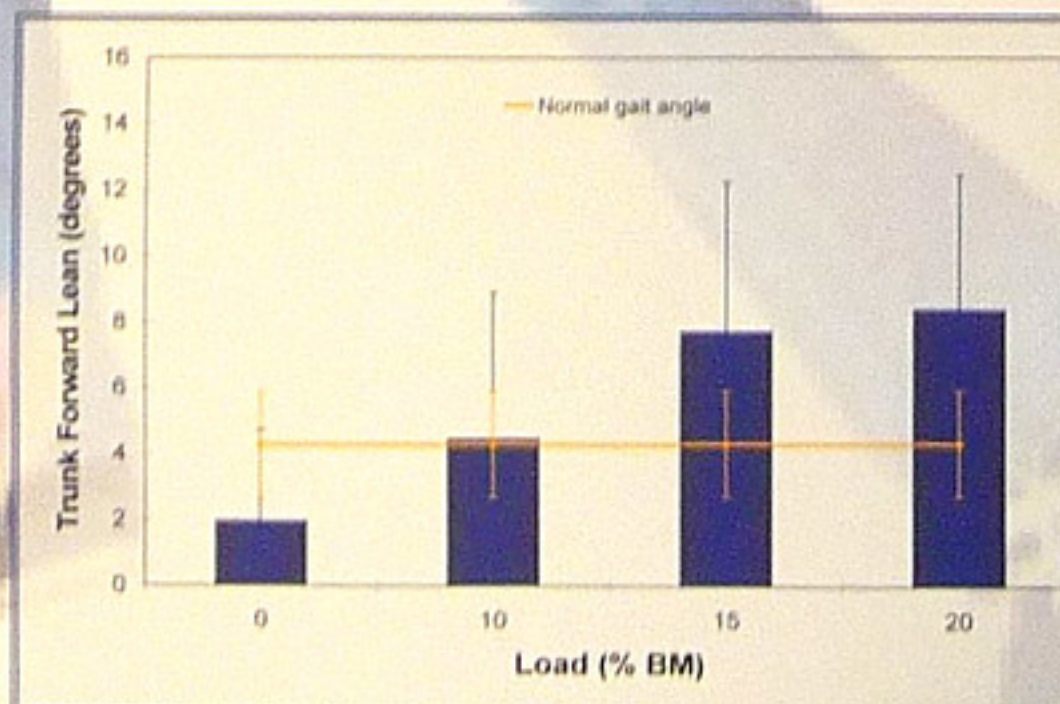


Figure 4. Average perception of pain ratings for each body area and load - walking trial



Conclusions and Recommendations

- Results indicate that the load limit for middle school students is 10% BM
- Students should follow AOTA guidelines for loading their backpack
- Schools should have backpack awareness programs or participate in Backpack Awareness Day and Month
- Students should try a loaded backpack on before buying
- Parents and students should weigh the backpack regularly
- Extra items that are not needed for that day should be removed

Future Research

- Use the same backpack loads for each student
- Use body mass index (BMI) to group subjects
- Include more dynamic activities to simulate normal carrying situations
- Increase the individual trial times