A Pilot Design for Student Backpack based on Participatory Ergonomics and Anthropometric Factors

Somayeh Mohammadi¹, Hushang Shahnava² Hamid Reza Mokhtarinia³, Reza Nejatbakhsh⁴*
¹Master of Ergonomics, IRAN
²Emeritus Professor, Luleå Tekniska Universitet, SWEDEN
³Assistant Professor, Department of Ergonomics, University of Social Welfare and Rehabilitation Science, Tehran, IRAN
⁴*Assistant Professor, Zanjan University of Medical Science, Zanjan, IRAN

Introduction: There have been various studies that address the physiological effects and other forces exerted on the body caused by wearing a backpack (Daniel B. Jensen, 2010). Ergonomic designing of various products is meant to make products compatible with users’ bodies. Such a user-friendly product will improve convenience and productivity, while lowering stress (Rateau, 2004). An ergonomically acceptable design will achieve success when it fits the taste of the target audience and what users want from a product. (Lucas, 2011) The present study is an attempt to determine anthropometric dimensions for designing a backpack, determine the fifth to ninety-fifth percentiles in terms of anthropometric dimensions, identify appropriate size and dimensions of backpacks designed as pilot models for different age groups, and to ergonomically and aesthetically assess designing factors using computer software and based on a participatory ergonomics approach.

Material and Methods: Anthropometric measurement of 50 volunteers male and female school children were gathered by Vicon analyzes motion system static test. Figure 1 depicts the arrangement of the markers on the body.

A number of suggestions provided in the literature on designing and/or selecting appropriate backpack for students were used as a guideline for anthropometric measurements. The following measurements, therefore, must be taken into account: Shoulder Breadth, Hip Breadth, Shoulder Width, Acromion prominence to the root of the neck, Torso length (C7-L5) and its curvature, Distance between right and left apex of scapula and its curvature. The distance between the inferior angle of scapula, The distance between apex and inferior angle of scapula, distance between T10-L5 and its curvature, distance between right and left Posterior superior iliac spine, Chest width, Distance between Iliac crest and Umbilicus and Total distance between apex of scapula- acromion- Junction of the arm with the trunk to Iliac crest

Furthermore 200 male and female school children have participated in an aesthetics study, using special software. Figure 2 summarizes the features of the program.
Results:

Anthropometric measurements: The measurements involved in designing the backpack frame were compared for different school grades. Mean shoulder width, chest breadth, waist breadth, C7-L5 distance and its curvature, RSC-LSC curve length, distance between right and left apex of scapula, distance between right and left sacrum and distance between T10-L3 have shown differences among grades. No significant difference was found in other measurements.

Results of aesthetic information extraction: Model 1 was selected by 53% of girls and 54% of boys, followed by Model 3 and Model 4 that were selected by 14% and 22% of participants, respectively (Figure 3).

In terms of color, 66% of girls and 72% of boys preferred multicolor backpacks. In cartoon characters, 37% of girls and 40% of boys used several pictures, and 30% of girls and 16% of boys did not want any picture on their backpacks. Seventy six percent of girls and 98% of boys preferred safety fluorescent strips on their backpacks. In addition, 50% of girls and 67% of boys liked to have ID cards on their backpacks.

From the accessory menu, the participants selected food container, canteen, pencil case, drinking cup, and scissors as the things they liked to carry over the week along with their books and notebooks.

Discussion:

Overall shape: Given the similarities between students from different grades in terms of their measurements, three backpack sizes are proposed.

Straps: Shoulder strap, chest strap and waist strap were designed adjustable from the 5th to the 95th percentile of measurements.

Padding and lumbar support: Given the almost similar measurements students from different grades a single waist padding size was proposed. In addition, two padding sizes were proposed for interscapular area.

Extracting Aesthetic Information:

The present study focused on extracting ergonomic information for designing backpacks. In addition to participants' preferences, several recommendations were proposed to improve the designs based on a user-oriented approach.

Keywords: Backpack, student, Ergonomics

Figures:
Figure 1 A schematic of marker arrangement on the body

Figure 2 A screenshot of the accessory menu and the computer program used in extracting aesthetic information

Figure 3 Proposed backpack models
References:

