STUDY OF THERMAL COMFORT OF TREKKING BOOTS FOR WINTER MID MOUNTAIN CONDITIONS

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INTRODUCTION

The goals of the present study were to determine the relative influence of diverse design elements on the thermal comfort of trekking boots for winter mid mountain conditions and the selection of materials that provide the best comfort rate. To achieve these objectives the microclimatic characteristics inside the footwear and the subjective perception of thermal comfort has been evaluated outdoor in a winter mid mountain environment. Twelve boots were manufactured according to an experimental design in which diverse materials were used. The influence of different design elements and materials in the thermal comfort has been assessed.

REVIEW AND THEORY

Mechanical and thermal comfort and functionality are features increasingly demanded by consumers for outdoor activities due to the demanding characteristics of the environment and the activities performed. Compared to other parts of the body, feet are more affected by the exposition to cold climates. This happens because feet cannot produce enough heat by themselves making it necessary for other parts of the body to provide heat. However, the transmission of heat to the extremities is limited under cold climate conditions, due to the reduction of the blood flow (Bergquist, 1994).
A huge amount of new materials has appeared in the market in the last years to improve the thermal comfort in footwear for cold conditions. However, there is not information available concerning the performance of these materials in real conditions of use (González, 2001). And although thermal factors have been studied during experiments with subjects (Kurz, 1992 and Kawabata, 1993) and several laboratory tests have been developed, the relative importance of footwear design elements in the thermal comfort has not been assessed.

PROCEDURES

Twelve boots were manufactured for tests in winter mid mountain conditions according to an experimental design in which diverse materials were used for the upper, insole, lining, sole and insole lining. Two boots from the market were included in the experiment for comparison.
Six healthy males participate in the tests. Temperature and humidity were measured continuously during the experiment between the first and second toes and on the longitudinal arch. Skin temperature on the foot plant, instep and tip of the second toe were also recorded. Subjects were asked during the test about humidity and temperature perception on the foot as a whole or by zone, footwear thermal comfort and footwear general comfort.
Tests were carried out outdoor in a winter mid mountain environment and climatic conditions (temperature, humidity and wind speed) were recorded during the experiment. The test was divided into three phases: After a 10 minutes rest on a chair, participants performed a 30 minutes exercise walking over snow. Finally, participants rested on a chair during 10 minutes (Kurz, 1992). Parameters were obtained from the curves of temperature and humidity measured over time according to the experiment phases (Figure 1).

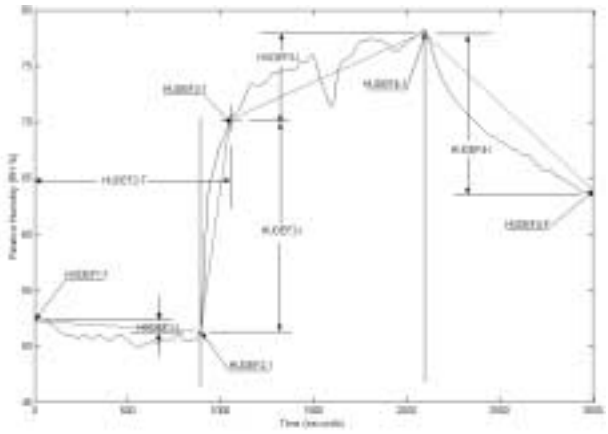

Figure 1: Parameterization of the measurement over time of the relative humidity in toes.

Statistical analysis of variance was used to determine if there were differences between boot materials for subjective and physiological parameters during the test. Further analysis have been made in order to determine the relationship between microclimate characteristics and comfort level, the influence of humidity and temperature perceptions with the thermal comfort

and the relationship between thermal aspects with the global footwear comfort.

RESULTS AND DISCUSSION

Significant differences in the footwear-foot microclimate parameters and subjective perception were found between the different boots tested. The influence of different materials in the thermal comfort has been assessed, finding out the combination of materials that provide the best comfort rate and the relative importance of footwear design elements in the thermal comfort has been determined for cold environments.
The relationship between physiological and subjective measures and the influence of overall and by foot-part microclimate perception on thermal comfort and global comfort has been assessed.

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