D6 The Influence of Experience on Utilized Coefficient of Friction While Walking in High-Heeled Shoes

Mark G. Blanchette, MS, 352 Myrtle Street, #6, Glendale, CA 91203*

After attending this presentation, attendees will have been introduced to the preliminary findings of a research study investigating how an individual's experience wearing high heel shoes influences the utilized coefficient of friction (uCOF) during walking. After attending, attendees will understand the basic theory of why slips occur, how heel height affects uCOF, and whether one's experience wearing high-heeled shoes plays a role in contributing to increased slip risk.

This presentation will impact the forensic science community by sharing the beneficial knowledge obtained from this presentation to forensic scientists/engineers who study the scientific and/or practical aspects of slip and fall events.

Slips occur when the utilized friction (uCOF) of an individual exceeds the available friction provided by the shoe/floor interface.[1] uCOF can be influenced by a number of factors including walking speed, age, the presence of a disability, shoe hardness, and shoe design.[2,3] With respect to shoe design, we recently have reported that the friction demand during walking increases as a function of heel height.[4] More specifically, we reported that the uCOF while wearing high heels (9.5 cm) was significantly higher than when wearing shoes with low (1.3 cm) and medium heel heights (6.4 cm). Although uCOF increases with heel height, it is not known how experience affects uCOF during walking. It is conceivable that women who do not have extensive experience walking in high heels may ambulate in a way that increases uCOF and therefore slip risk. The purpose of this study was to determine whether the level of experience wearing high heeled shoes affects uCOF during walking.

To date, six healthy women have been recruited for this study. Based on a survey describing their experience wearing high heeled shoes, three subjects were classified as "experienced" (experience rating of 8 or higher on a 10 point scale) and three were classified as novice (experience rating of 3 or lower on a 10 point scale). The two groups were similar in terms of age (28.0 ± 4.4 vs. 26.0 ± 5.3 yrs), height (159.3 ± 7.5 vs. 166.0 ± 6.6 cm), and weight (53.7 ± 12.6 vs. 64.4 ± 16.1 kg). Subjects walked at self-selected velocity under 2 different shoe conditions that varied in heel height (low: 1.27 cm and high: 9.53 cm). Each subject was provided with footwear in their respective size. Both shoes had the same manufacturer and were chosen for their similarities in design, construction materials, and quality. Ground reaction forces were recorded using a force platform at 1560 Hz. Utilized friction was calculated as the ratio of resultant shear force to vertical force. For each trial, subjects' peak uCOF was determined during the first 50% of the stance phase.

Subjects in both groups walked at similar velocities for both shoe conditions. For all subjects, utilized friction increased for both groups as heel height increased. However, the change in uCOF across shoe conditions in the novice group (0.23 to 0.35) was more pronounced than the experienced group (0.22 to 0.29). The higher uCOF in the novice group during the high heel trials was the combined result of a 14% decrease in the vertical ground reaction force and a 30% increase in the resultant shear force when compared to the experienced group.

Consistent with the previous study,[4] results indicate the friction demand during walking increases as a function of heel height. When wearing high heels, novice subject demonstrated a 51% increase in uCOF compared to the low heel condition. This was in contrast to the 31% increase in uCOF observed in the experienced group. These results signify the need for individuals to be properly acquainted with high- heeled shoes in order to minimize the risk of slips and falls.

References:

1 Hanson JP, Redfern MS, Mazumdar M. Predicting slips and falls considering required and available friction. Ergonomics. 1999;42(12):1619-33.

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3 Burnfield JM, Tsai YJ, Powers CM. Comparison of utilized coefficient of friction during different walking tasks in persons with and without a disability. Gait & Posture. 2005;22:82-8.

4 Blanchette MG, Powers CM. The Influence of Heel Height on Utilized Coefficient of Friction During Walking. Gait & Clinical Movement Analysis Society. Denver, CO, 2009.

Slips, High Heels, Utilized Friction

 ** Presenting Author*