

# The impact of user gait patterns and perceptions in the development of quality criteria's for anti-slip devices and winter shoes

Larsson Agneta<sup>1</sup>, Gard Gunvor<sup>1</sup>, Rosander Peter<sup>2</sup>, Berggård Glenn<sup>2</sup>

<sup>1</sup>Department of Health Sciences, Luleå University of Technology, Sweden.

<sup>2</sup>Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Sweden.

## Introduction

Single accidents with pedestrians on ice and snow are high. In Sweden, circa 10,000 men and 15,000 women annually need medical care due to fall injuries. It is therefore important to identify preventive measures and assistive devices to avoid fall related injuries during winter.

Various factors contribute to slips and falls; e.g. footwear, underfoot surface, coefficient of friction (footwear/surface), human gait, physiological and psychological aspects and environmental factors.

There are also various winter shoes and anti-slip devices in the market. The Swedish Transport Administration acknowledge the need to research user need, establish quality criteria and test methods and set standards for anti-slip devices and winter shoes. For professionals within medical care knowledge of interrelations between factors can be essential for patient recommendation about assistive devices, that promote ambulation in the community and reduce falls.

## Study design and method

Research was performed in an experimental setting at an indoor ice rink with tracks (surfaces) of ice, snow on ice, compact snow and concrete (methodology developed by Berggård, 2010). Nine study participants (five women and four men, mean age of 47 years) representing residents participated in trials of 19 anti-slip devices and 20 shoes. Each type was tested on the different surfaces. Study participants were recruited from staff at the University and from one division of the Municipality.

Anti-slip devices selected for analysis were classified in four groups; the first three were attached on the subjects own shoes: 1) heel - covers only the rear of the sole, 2) foot blade - covers only the front of the sole, 3) whole foot - covers the whole sole. 4) The fourth group were shoes with built-in spikes. In this analysis, shoes were of the whole foot type.

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## Measurements

Subjective ratings and objective measures were used to evaluate changes in the participants gait pattern and perceptions while walking on different tracks with different anti-slip devices and shoes.

Study participants were asked to rate different qualities of the gait cycle (e.g. heel strike, toe off) and give their opinion of advantages, disadvantages and other functionalities with the anti-slip devices/shoes while walking on different surfaces. Subjective perceptions are valuable for the identification of prioritised criteria's.

Technological data (friction etc.) are reported elsewhere (Berggård et al, 2015).

## Results

Results of technological testing of friction (fixed position) differed from subjective ratings during the experiment, that is, anti-slip devices or shoe with high friction was not always perceived as safe by users. This implies subjective ratings and the demands placed on the shoes/devices by the participants' normal gait (walking) patterns are important to consider when evaluating the quality criteria.

Of the six identified criteria walking safely was considered as the most important. 'Safely' includes good grip, which is critical when walking on ice, ice/snow, and during initiation and stop of the gait cycle. The variables risk of falling, balance, heel-strike and toe off all relates to the anti-slip efficiency and functionality of devices and shoes. Of these, perceived risk of falling were the most prominent variable and can be considered as an indicator in further analysis.

Lower degrees of perceived postural control and higher risk of falling while walking was significant and interrelated with the ratings of anti-slip devices/shoes with deficient functionality.

Further research with a higher number of study participants are needed to verify the results that are indicated in this study.

## Clinical implications

The efficiency of the anti-slip devices affects, and are affected, by the users' normal gait pattern. This implies that these interrelations need to be considered in the clinic, especially when giving advice to patients with decreased balance ability or other functional limitations, as pros and cons of the various devices may be more prominent for this group of patients than others.

Contact details: [Agneta.Larsson@ltu.se](mailto:Agneta.Larsson@ltu.se)