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# Perceived risks for slipping and falling at work during wintertime and criteria for a slip-resistant winter shoe among Swedish outdoor workers

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ABSTRACT

The leading cause of work related accidents in Sweden is falls. Many slips and falls occur on icy and snowy surfaces, but there is limited knowledge about how to prevent accidents during outdoor work in winter conditions.

The purpose of this study was to describe risk factors of slips and falls and criteria for slip-resistant winter shoes from a user perspective. The result is based on focus group interviews with 20 men and women working in mail delivery, construction and home care in Sweden. The data was analyzed with qualitative content analysis.

Risk factors described were related to physical work environment, risky work situations, individual and organizational factors. User criteria for winter work shoes focused on safety, adaptation to the environment, usability and own priorities.

The mechanisms of slips and falls during outdoor work are complex. There is a need for more functional and user friendly work shoes than those available and user preferences should be considered by shoe designers. Future challenges include finding ways to make individually adapted shoes suitable for changing work environments, situations and tasks.



## 1. Introduction

The leading cause of work related accidents in Sweden is falls (AFA, 2011). Almost one third of all serious work accidents are falls, both indoors and outdoors caused by workers tripping, slipping or for some other reason losing their balance. Between 2009 and 2010 AFA Insurance registered 2281 outdoor falls, 1756 indoor falls, 1091 falls from heights, 789 falls in stairs, 178 unspecified falls and 156 were related to stepping in and out of a vehicle. Bentley and Haslam (2001) suggest that one explanation may be that many high-risk occupations involve work which takes place in unpredictable, uncontrolled and variable outdoor environments. During 2009-2011 accidents caused by falls on the level have increased. This could be related to the snow rich winters in Sweden 2009/2010 and 2010/2011 (AFA, 2012). Studies have shown that slip and fall accidents are more common during winter months and cold conditions (Bentley and Haslam, 1998; Bell et al., 2000; Leamon and Murphy, 1995). In a survey among outdoor workers in northern Sweden fall events were reported to happen most frequently on icy surfaces also covered with snow (Gao et al., 2008). Also in the UK slip and trip accidents are the leading cause of occupational injury (HSE, 2013a).

Within the construction industry, slip, trip and fall incidents are common, and inappropriate or worn-down footwear has been identified as one of the key risk factors (Bentley et al., 2006). Another profession exposed to high risks for falls is mail delivery workers. Slippery underfoot conditions and poor slip resistance from footwear were considered as the key risk-factors for slips among mail delivery workers in UK (Bentley and Haslam, 2001). In a Swedish study 74% of the surveyed newspaper delivery workers reported a fall, of which 52% resulted in injuries (Gao et al., 2008). Within healthcare falls are also a leading cause of occupational injury but the risk factors of falls in this sector have only recently been studied. A high risk for falls has been reported for community health workers and these falls predominantly occurred outdoors, in patients' rooms and kitchens. Slippery surfaces due to icy conditions or liquid contaminants were a leading contributing factor and the falls were more frequent during the colder months (January–March) (Drebit et al., 2010).

Injuries associated with occupational falls cause both individual suffering as well as increased costs for employers and society. Common injuries registered by AFA (2011) are lower leg and forearm fractures and half of the injuries lead to medical disability. These injuries are associated with a greater risk of long term sick

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leave, especially when they occur in higher ages. Effective preventive measures are thus warranted.

In relation to the scope of the problem, to the best of the author's knowledge, little research has been done regarding risk factors and prevention of slips and falls for outdoor workers. Main contributors are Bentley and Haslam (1998, 2001) and Haslam and Bentley (1999) whose research concerned mail delivery workers in UK. They identified probable risk factors using a range of accident-centered and accident-independent methods. Key factors included slippery underfoot conditions, non-weather related environmental hazards, poor slip resistance from footwear, unsafe working practices, management safety practices, and underlying organizational influences. They recommended interventions that target accident risks at three levels: slip resistance, exposure to hazardous conditions, and employee behavior in the face of hazardous conditions. They also emphasized the use of a participative approach to intervention selection and design.

### 1.1. The need for a slip-resistant shoe

The use of slip-resistant shoes has been associated with a 54% reduction in the reported rate of slipping and falling in a study of US restaurant workers (Verma et al., 2011). The Health and Safety Executive in the UK stresses that appropriate footwear can play an important part in preventing slips and trips at the workplace (HSE, 2013b). To wear slip-resistant footwear is considered important for employees working or travelling outdoors as a part of their jobs and has been recommended by the US National Institute for Occupational Safety and Health (NIOSH, 2010). The use of attachable anti-slip devices on ordinary shoes has been shown to reduce slips and falls outdoors, particularly for elderly people (McKiernan, 2005). Limitations with these devices can however be an altered gait pattern, discomfort, and problems of attaching and detaching to shoes. (Gard and Berggård, 2006).

The Swedish Work Environment Act (SFS, 1977:1160) states that the employer is obliged to provide personal safety equipment needed to prevent accidents and injuries, including safety shoes, which should be adequate in relation to the risks and suited to workplace conditions (AFS, 2001:3). Regulations and guidelines for the basic requirements for safety, protective and occupational footwear provided by an employer have been published in a number of countries such as USA, Canada, Australia and for the European Union. These also include anti-slip protection on contaminated surfaces, however anti-slip protection on snow and ice is not specifically referred to. Furthermore to the best of our knowledge no standards have been set for footwear procured by the employee e.g. home help workers.

A primary risk factor for slipping is low friction between shoes and underfoot surface (Grönqvist et al., 2001; Hanson et al., 1999). Most previous research on slips and falls identified by the author mainly focuses on floors and/or contaminated floors. However icy and snowy surfaces near thawing temperature can be more slippery (Gao and Abeysekera, 2004). The most slip resistant soling material on floors and lubricated floors may not provide sufficient slip resistance on ice (Gao et al., 2004).

### 1.2. Usability aspects

Usability is *"the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction, in a specified context of use"* (International Organization for Standardization [ISO], 9241-11).

Significant correlations between high perceived usability and a higher use of the shoes have previously been shown regarding custom-made orthopaedic shoes (van Netten et al., 2010). This indicates a need to consider a range of factors contributing to perceived usability when designing work-shoes.

### 1.3. Reasons for the study

Existing research focuses mainly on slip resistance and falls on wet and slippery surfaces indoors. We know less about factors contributing to slips and falls in outdoor environment during cold conditions. Varying outdoor conditions pose different requirements on the shoes. In addition the tasks and demands of the work most likely affect the desired properties of the shoe. The required functions of the shoes are hence closely related to the actual working conditions. Perceived usability and other factors contributing to a user-friendly shoe may affect to what extent a shoe will be worn. However little information can be found regarding workers experiences of slips and falls outdoors during wintertime, nor regarding their subjective opinion on important factors for slip resistant winter shoes. A better knowledge of perceived usability may improve our understanding of fall risk factors and assist in the design of preventive measures for work related falls outdoors.

The present study is part of a larger research project conducted by Lund University and Lund Institute of Technology, whose overarching purpose is to develop design recommendations for shoes regarding friction requirements and slip resistance based on friction measurements, biomechanical tests of walking and balance and perceived risk of slipping.

## 2. Aim

The purpose of this study was to describe perceived risks for slipping and falling at work during wintertime and user criteria for slip-resistant winter shoes among construction, mail delivery and home care workers in Sweden.

## 3. Material and methods

### 3.1. Participants and procedure

This study used a qualitative approach with focus group interviews (Barbour, 2007) as a method for data collection. Three focus group interviews were conducted with persons in high risk occupations who frequently work outdoors during winter. These were construction workers, home care workers and mail delivery workers. Each focus group consisted of five to eight participants from the same profession. The participants were recruited through their trade unions, with the aim to get a varied sample of participants within each profession. Three larger unions in the southern part of Sweden were identified and contacted by the author by phone or e-mail to assist in the recruitment of eight participants each for a group interview. The union contact persons were instructed to aim for variation in the sample regarding factors such as age, gender, current workplace, work experience and if possible experience of falling.

The participants in the first group were state employed postal workers, all working full time sorting and delivering mail in residential areas. In addition they were all local union or safety representatives at their respective workplace. The second group was construction workers consisting of two bricklayers, one concrete worker, one scaffolder and four carpenters. They were all local safety representatives and they all had predominantly outdoor work during all seasons, except for one man who worked in a workshop. The third group was home care workers working in a town community care. One person mainly attended patients in a rural area while the others spent most of their time in an inner