

# from Research to Reality

*Slips and Falls*

Using Perception  
to Gauge Risk

LIBERTY MUTUAL RESEARCH INSTITUTE FOR SAFETY

SCIENTIFIC UPDATE



**Liberty Mutual.**  
RESEARCH INSTITUTE FOR SAFETY

# Letter from the Director



## Dear Readers

*This issue of *Scientific Update* profiles an area of slips-and-falls research aimed at identifying modifiable risks that can be lessened through simple, often low-cost interventions such as proper housekeeping. A principal thesis of this research is that surveying employees about risks is a quick and easy way to identify hazardous environments in the workplace. The featured study is the first to demonstrate that subjective*

*assessments of slipperiness are reliable indicators of actual risk and can be used to prioritize fall intervention opportunities. While the research to date has focused on workplace*

*risk factors, the findings will help everyone exposed to these common, everyday hazards.*

*We invite you to read more about these developments, and, as always, we welcome your feedback.*

A handwritten signature in black ink that reads "Ian Noy".

*Ian Noy, Ph.D.  
Vice President and Director*

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# Slips and Falls

## No Laughing Matter

*If you go to YouTube and type in “slips and falls,” thousands of videos appear, and many are tagged with words like “funny,” “hilarious,” or “hysterical.” However, the serious injuries that occur every day due to slips and falls are no laughing matter. According to the U.S. Centers for Disease Control, nearly a third of non-fatal injuries treated at emergency departments in 2011—more than nine million—were related to falls. Falls were also the second-leading cause of fatal traumatic injuries.*

Falls are the leading cause of injuries in the U.S. overall, the number-one cause of off-the-job injuries, and the second-leading cause of injuries at work. “From the Global Burden of Disease and Injury studies, we know that falls are also one of the fastest growing causes of disability in the U.S. and Canada,” says Theodore K. Courtney, M.S., CSP, director of the Center for Injury Epidemiology (CIE) at the Liberty Mutual Research Institute for Safety. “That’s why slips and falls continue to be a primary focus at the Research Institute.”

For nearly 60 years, the Liberty Mutual Research Institute for Safety has conducted research to examine how and why falls occur and to provide a scientific basis for strategies to help control slip and fall risk. Early Institute research examined the role of friction in slips and falls. It sought ways to make friction measurements feasible, reliable, and repeatable in the workplace. The research efforts resulted in the development of the Horizontal Pull Slipmeter™—an ASTM-standard device developed by Institute researchers. This slipmeter has been used for decades to assess floor friction in thousands of industry settings.

Over the years, the Institute broadened its research in order to look at various contributing factors as well as risk-control strategies for slips and falls. Investigations of the effects of contamination and friction changes, as well as studies of footwear

and various floor-cleaning protocols, have produced useful knowledge for slip-prevention best practices. A recent research collaboration with the U.S. Centers for Disease Control and Prevention’s National Institute for Occupational Safety and Health showed that double-digit risk reduction is possible when using a practical portfolio of interventions.

This body of research helps improve worksite safety in many different sectors including healthcare, retail, hospitality, and other environments where the risk of slipping is high. The findings have important safety implications for workers as well as customers, patients, vendors, and contractors. “By mitigating the risk of slips and falls for employees, you also reduce risk for everyone else who comes onto that site,” asserts Courtney.

Most recently, researchers from the CIE and other Institute Centers, along with collaborators at the Harvard School of Public Health, explored the association between workers’ perceptions of floor slipperiness and the actual rates of slipping in the workplace. Explains Courtney, “We originally set out to better understand how perception interacted with floor friction. Along the way, however, we discovered that perception holds much greater potential for reducing slips and falls than we initially imagined. The knowledge gained through this research provides the basis for a new approach to slip risk assessment that could help prevent serious fall-related injuries.”

# Unlocking the Power of Perception



## Slip Risk Assessment

*Same-level falls are a leading cause of injury — both on and off the job — but are we doing all we can to help reduce these incidents? Recent research developments suggest that surveying employees about their slipping risks at work can provide valuable information for assessing and addressing these hazards.*

As the primary initiating event for same-level falls, slipping contributes to up to 85 percent of fall-related workplace injuries. For that reason, safety researchers have long been interested in finding ways to accurately measure slipperiness. For the most part, researchers and practitioners rely on objective friction (i.e., slipmeter) measurements to evaluate floor surfaces. However, recent research has shown that subjective measures—namely, workers' perceptions of slipperiness—may provide an effective and more practical alternative to objective measurement strategies. "Employees accumulate a wealth of information about potential workplace hazards while simply doing their jobs. We are now beginning to understand how to tap into this information to better assess slip risk," explains Theodore K. Courtney, M.S., CSP, director of the Institute's Center for Injury Epidemiology.

### Testing Perceptions: From Idea to Application

The idea that employees' perceptions could be potential indicators of actual slip and fall risks evolved gradually, originating at the Institute's Hopkinton Conference in 2000. The conference brought together university, industry, and government representatives from seven different countries to address the current state of research on slips and falls. Participants explored several major areas of research including epidemiology, biomechanics, tribology, and human-centered approaches. Courtney notes, "With respect to perception, we discussed existing research on objective and subjective methods. There was considerable evidence that people could discriminate [among] differing degrees of slipperiness in controlled laboratory studies, but this had not been tested beyond the laboratory in the uncontrolled, real-world environment."

In 2002, Institute researchers led by Senior Research Scientist Wen-Ruey Chang, Ph.D., examined objective and subjective

measures in a cross-sectional field study of 10 limited-service restaurants and 126 workers. As part of that project, the investigators collected workers' self-reported perceptions of slipperiness and compared them with objective friction measures taken in eight areas of each restaurant. The findings, published in the *Journal of Occupational and Environmental Hygiene* (Vol. 3, No. 11, 2006), confirmed a correlation between perceived slipperiness and measured friction.

The research team also asked workers if they had slipped and/or fallen at work within the four weeks prior to their interview. "Because the team asked these additional questions, we later discovered a strong association between friction and workers' self-reported slip experiences," notes Senior Research Scientist Santosh K. Verma, M.D., Sc.D., M.P.H., one of the study's co-investigators. Dr. Verma notes, "This finding, published in *Injury Prevention* [Vol. 16, No. 1, 2010], opened the door to future studies where we could evaluate the influence of various factors, including perception, on slipping risk over a longer period of time."

### Study Explores Power of Perception

In 2008, Dr. Verma and a team of Institute researchers joined forces with researchers at the Harvard School of Public Health to examine the influences of individual, environmental, and organizational factors on workplace slips and falls. This project, which involved 36 limited-service restaurants and 475 workers, led to some exciting firsts including the first independent confirmation that slip-resistant footwear reduces slipping risk by 54 percent (*Occupational and Environmental Medicine*, Vol. 68, No. 4, 2011 and *Scientific Update*, Vol. 14, No. 1, 2011). As part of this investigation, researchers also examined the association between workers' perceptions of slipperiness and their slipping outcomes.

“The findings from our research could have broad application for organizations that are looking to reduce slip hazards and to help people stay safer.”

Researchers collected objective and subjective data in each of the participating restaurants. At the baseline, teams measured the coefficient of friction (COF) in eight functional areas in each restaurant. These objective measures were averaged at the restaurant level to calculate each restaurant’s mean COF. To assess employee perceptions, researchers asked participants to rate floor slipperiness in these same eight areas based on a typical workday scenario. Participants used a four-point rating scale in which: 1 = not slippery, 2 = a little slippery, 3 = more slippery, and 4 = very slippery. Researchers aggregated and averaged these ratings at both the restaurant level (finding an overall rating for each restaurant) and at the area level (finding eight ratings per restaurant for each of the eight areas surveyed).

After completing the baseline measurements and surveys, the team asked participants to report their slip experiences each week for the following 12 weeks by phone (via interactive voice-response system), an Internet-based survey, or paper survey forms. Each week, participants reported their number of slips and the number of hours they had worked during the previous week. They also reported the functional area(s) within the restaurant where they had slipped.

The study’s findings, published in *Occupational and Environmental Medicine* (Vol. 70, No. 11, 2013), revealed that each increase of 1 point (on the 4-point scale) in the mean restaurant-level perception of slipperiness was associated with a 2.71-times higher rate of subsequent slipping. Results were similar for area-level perceptions within the restaurant.

“Slipping rates nearly tripled with each one-point increase in aggregated perception. That is very significant,” says Courtney, the study’s first author, who notes that this finding has implications for those industries most affected by slips and falls—such as healthcare, retail, hospitality, and construction. “The strong association between perception and actual slipping means that workers’ perceptions can be used to help identify and control slipping hazards. This is a highly scalable risk assessment approach,” explains Courtney, meaning that smaller enterprises as well as larger organizations could readily leverage the method.

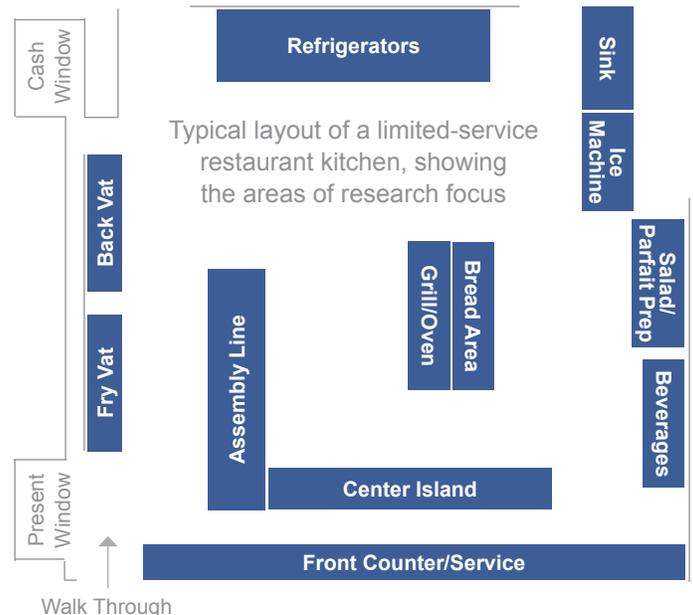
With that in mind, the Research Institute is currently examining slipperiness perception in a new study of full-service restaurants. In addition to back-of-the-house kitchen areas, this study examines front-of-the-house areas, including reception, take-out, bar, dining rooms, and other areas that are open to both employees and to the general public. In this way, employees’ perceptions of floor slipperiness may provide useful information for helping restaurant patrons, as well as workers, avoid falls.

“We now have evidence that workers can identify future slip risk across a given location fairly accurately by using this method. This suggests that workers’ perception ratings should be considered in risk assessment and reduction strategies,” says Courtney. “The findings from our research could have broad application for organizations that are looking to reduce slip hazards and to help people stay safer.”

### Perception of Floor Slipperiness Study

Workers rated slipperiness of eight restaurant areas on a “typical day” using a 4-point Likert scale:

“On a scale of 1 to 4, with 1 being not slippery and 4 being very slippery, circle the number that you think best describes the floor condition for each area on a typical workday.”



# Survey Offers Proactive Approach to Slips and Falls Prevention

## Research to Reality

*One of the particular challenges associated with managing same-level slips and falls is that most work environments are dynamic, which makes it difficult to identify a hazard prior to injury. Rather, an individual falls, suffers an injury, and the unfortunate event brings attention to a hazard that may have otherwise gone unnoticed.*

In some situations, a slip or fall that occurs without an injury goes unreported, leaving a potentially hazardous condition for the next person. “That’s why, in many cases, slips and falls interventions are implemented *reactively*,” says Wayne Maynard, CSP, CPE., Liberty Mutual Risk Control Services product director. “We have to find more ways to be *proactive* in this area and to identify potential risks before the slips and falls happen.”

A more proactive approach is precisely what Maynard and a team of risk-control specialists are working on, using the evidence provided by the Research Institute’s slipperiness perceptions research. “Our research showed a strong association between employee perception of slipperiness and subsequent slipping at work. That means that employees’ perceptions are an accurate indicator of slip risk, and it is not necessary to wait for an injury to occur to take action,” explains Maynard. “Areas of risk can be identified using a perception survey, and then practitioners can look for ways to reduce that risk.”

While not discounting the value of objective measures, such as friction, Maynard notes that these measures can be expensive and difficult to implement in the field. “Slipmeters are great tools for assessing floor surface friction and related risk; however, they are not always practical,” explains Maynard. Industries that have a particularly high risk for same-level slips and falls—retail, restaurant, hospitality—are fast-paced and conditions are ever-changing. “Employers can’t just stop everything to take slipmeter measures during the course of normal business. A perception survey, on the other hand, is entirely scalable and non-disruptive to everyday business operations.”

Maynard and the team are currently working to develop an online slipperiness perception survey that can be accessed via smartphone or other computer device. Beginning in 2014, restaurants will be able to administer the customized online survey at very low cost, without disrupting daily operations. The survey data will provide slip-risk information for the various areas of their business.

Based on the survey findings, practitioners will be able to identify high-risk areas and then select appropriate interventions for mitigating slips and falls in those areas. “One of the real advantages to this process is that, after an intervention is implemented, the survey can be re-administered to determine whether or not it was successful,” notes Maynard.

The straightforward and time-efficient risk assessment survey approach requires little to no technical background to use. “Organizations can easily implement the survey. Even a small organization that doesn’t have access to mechanical slip-assessment devices (and the expertise to use them) can employ the survey as a stand-alone approach to slipperiness assessment,” notes Maynard. “However,” he adds, “if an employer can combine the survey data with objective measures, it will provide a more comprehensive approach to slip-and-fall risk assessment.” While the initial survey is envisioned for restaurants, Maynard says surveys will be developed for other industries over time.

An additional benefit of the employee perception survey is that it encourages employee engagement in the safety process. In early 2013, the National Safety Council listed employee

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engagement as among one of the four fundamentals of successful safety management. Maynard elaborates, “It is important to engage employees in the risk identification process. The slipperiness perception survey gets workers thinking about, believing in, and actively contributing to safety efforts. When that happens, morale improves and employees become advocates of the company’s safety program. That’s always a win.”

“This is going to be a very helpful tool,” says Maynard. “It adds an important arrow to the quiver of slips-and-falls safety management protocols. “It is very difficult to take slipmeter measurements during the normal course of business, and you need the device and a trained operator to take the readings. A perceptions survey, on the other hand, is entirely scalable and non-disruptive to everyday operations.”

*Wayne S. Maynard CSP, CPE is a product director for Liberty Mutual Insurance Risk Control Services. As product director specializing in ergonomics and tribology, Maynard works closely with the Research Institute and business units within Liberty Mutual to develop high-end research-based products and tools that support the company’s book of business and target-industry strategies. Prior to his current position, Maynard served as manager of technical services and product development at the Research Institute.*

*Maynard has authored/co-authored numerous articles and presented many times at industry and safety conferences. He belongs to several technical committees on ergonomics, pedestrian walkway safety, and footwear. Maynard holds a B.A. from the University of Maine and is a Certified Safety Professional and Certified Professional Ergonomist. He also holds the Associate in Loss Control Management designation.*



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