

# Slips & Falls

*Employee experience and perception of floor slipperiness:*

*A field survey in fast-food restaurants*

**By Kai Way Li, Theodore K. Courtney, Yueng-Hsiang Huang, Wen-Ruey Chang and Alfred J. Filiaggi**

**S**LIP AND FALL INCIDENTS are a significant safety problem in workplace environments. Courtney, et al (1118) reported that same-level falls accounted for 20 to 40% of occupational injuries in the developed countries studied. Slips also contributed to 40 to 50% of these fall-related injuries. The 2005 Liberty Mutual Workplace Safety Index estimates that in the U.S. the direct cost of disabling workplace injuries from same-level falls is \$6.9 billion annually, ranking second to overexertion (Liberty Mutual 1). The Washington State Department of Labor and Industries (L&I) reported an average workers' compensation cost per claim for same-level falls of \$6,745 from 1997 to 2001 (L&I 1).

Falls are also a leading cause of occupational injuries in Taiwan. In 2002, a total of 13.9% of occupational injuries were related to falls (CLA 1). Among these reported falling cases, 76.6% were the falls on the same level, which accounted for 10.6% of all occupational injuries.

Restaurant workers are one of the largest groups of injured workers each year (BLS 22). Same-level falls make up the largest proportion (26%) of cases with days away from work in restaurants, while slips and trips without a subsequent fall contributed another 5% of such cases (Filiaggi and Courtney 18). The top 10 risk industrial classes for same-level falls in Washington State included restaurants, which recorded 6 times the number of claims of the next highest industry (nursing homes). Other high-risk industries for same-level falls included logging, wood frame building construction, roofing, state healthcare facilities, motels and hotels, wholesale meat dealers, building construction and trucking (L&I 2).

Floor slipperiness is a critical issue in studying slip-and-fall problems in restaurants. This article describes a field study conducted at 10 fast-food restaurants in Taiwan to quantify the experience of slips and falls at work and employee perception of floor slipperiness in the major working areas of restaurant kitchens.

**Kai Way Li, Ph.D.**, is a research scientist at Liberty Mutual Research Institute for Safety (LMRIS), Hopkinton, MA. Before joining LMRIS, he was a professor with the Department of Industrial Management at Chung-Hua University in Taiwan. Li holds a B.S. in Civil Engineering from the National Chiao Tung University, Taiwan, an M.S. in Industrial Engineering from the University of Texas and a Ph.D. in Industrial Engineering from Texas Tech University. Li is a member of the Ergonomics Society, Taiwan, and the Chinese Institute for Industrial Engineers.

**Theodore K. Courtney, M.S., CSP**, is director of the Quantitative Analysis Unit at LMRIS, and an instructor on injury, safety and ergonomics at the Harvard School of Public Health. A recipient of the U.K. Ergonomics Society's William Floyd Award for his work in slips and falls research, he holds a B.S. in Human Factors from Georgia Tech and an M.S. in Industrial and Operations Engineering from the University of Michigan. Courtney is a former member of the ASSE Foundation Research Committee, a member of the editorial board of the Journal of Environmental and Occupational Hygiene and a member of ASSE's Greater Boston Chapter.

**Yueng-Hsiang Huang, Ph.D.**, is a research scientist at LMRIS. Her primary research interests are in occupational injury and accident prevention, return-to-work issues, work/life balance, employee selection, training and performance evaluation. She holds a Ph.D. in Industrial/Organizational Psychology from Portland State University. Huang is a member of the ASSE Foundation Research Committee.

**Wen-Ruey Chang, Ph.D.**, is a researcher at LMRIS. His research areas include slips, trips and falls, and whole body vibration. In 2003, he received the William Floyd Award from the U.K. Ergonomics Society for his work in the measurement of slipperiness. Chang holds a Ph.D. in Mechanical Engineering from the University of California at Berkeley. He is a member and Fellow of the Ergonomics Society and American Society of Mechanical Engineers, and a member of American Society for Testing and Materials.

**Alfred J. Filiaggi, CSP, ARM**, is managing consultant with Liberty Mutual's national market loss prevention department. For 3 years before returning to the field operation in 2004, he worked as a research scientist at LMRIS. He previously served as a safety manager for three East Coast divisions of a large restaurant chain, providing safety program administration for more than 250 restaurant operations. Filiaggi holds a B.S. in Commerce and Engineering Sciences from Drexel University. He is a member of ASSE's Greater Boston Chapter.

### Participating Restaurants

The operations of fast-food restaurants in Taiwan are similar to those in the U.S. except that the former, in general, have smaller kitchen spaces and fewer workers on duty than the latter. In addition, the fast-food restaurants in Taiwan rely less on previously cooked or prepared foods, which makes raw meat processing more common.

The mean ( $\pm$ SD) age of the 10 participating restaurants was 32.4 ( $\pm$ 26.7) months. Quarry tile was the typical flooring material in the restaurant kitchens. The tiles in 7 of the 10 restaurants originally had grit embedded on the surface; however, in most cases, the grit had been severely reduced due to the wear and



tear of daily operations. The age of the tiles were unknown, but they were believed to be older than the restaurants because the participating sites rented the properties and the tiles were generally not replaced upon commencement of restaurant operations at these locations. Tile sizes and patterns could, and often did, vary within the same chain restaurant.

For all participating restaurants, scheduled floor cleanings were performed twice per day. Floors in customer dining areas were mopped before both the location's opening and closing. Kitchen floors were mopped both after the lunch hour and before the restaurant closed. In each cleaning, employees mopped first with commonly used floor detergent solutions, then used a dry mop to absorb residual liquid. Additional cleanings were performed in customer dining areas when spills were noted or reported. Only the dry mop was used to remove spilled liquids on the floors.

The coefficient of friction (COF) of the floors in the kitchens of these restaurants was measured using a Brungraber Mark II slipmeter immediately after the lunch hour but before the scheduled cleaning. In areas near the front counter, the ranges of the mean COF were 0.69 to 1.1 (maximum reading in the slipmeter). In cooking areas, the mean COF ranged from 0.26 to 0.98. In the sink areas, the mean COF ranged from 0.08 to 0.37. Details of the friction measurement results are discussed in Chang, et al (401).

Typical of fast-food restaurants, the lunch period was a peak activity time. During this time, the work pace was faster and the potential for contaminant build-up was greater. By measuring employee percep-

tion and friction during and immediately after the lunch period, the study attempted to standardize the time period for both perception and friction measures. In addition, staffing was typically at peak levels during the lunch period, permitting a larger sample size.

As noted, participating restaurants were surveyed during and immediately after the lunch hour on weekdays. All employees on duty at the time of the survey were invited to join the study. A total of 56 of 58 employees (participation rate = 96%)—40 females (71.4%) and 16 males (28.6%)—from all 10 restaurants agreed to participate. The numbers of participants per restaurant ranged from 4 to 10, with an average of 5.6. Participants in each restaurant included the shop manager or supervisor in charge at the time of the researchers' visit.

While small enterprises in Taiwan are required to report fatalities and multiple casualty accidents, they are not required to maintain detailed injury and illness records; therefore, no historical injury data were available. (Using a leading indicator approach to understanding the falling exposure, employees were asked about their history of slipping and/or falling in the prior work month.)

The mean ( $\pm SD$ ) age, length of tenure and working hours per week of the participants were 22.6 ( $\pm 5.9$ ) years, 13.1 ( $\pm 13.3$ ) months and 37.9 ( $\pm 9.6$ ) hours, respectively. Participants were interviewed individually, and each participant answered the questions on the survey anonymously.

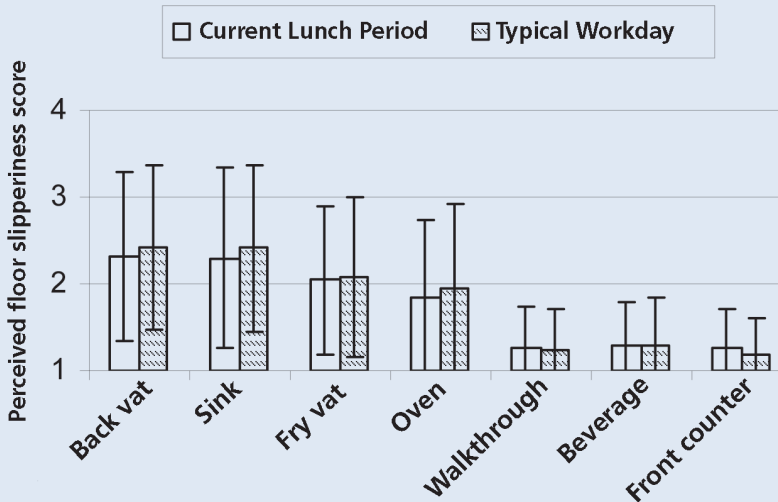
### Perceptions of Floor Slipperiness

To assess floor slipperiness in the kitchens as per-

**Abstract:** Restaurant workers are commonly exposed to occupational slipping and falling risks. Researchers conducted a field study of slipping and falling experience and perception of floor slipperiness among employees in 10 U.S.-style fast-food restaurants in Taiwan. Perception of floor slipperiness results show that the back vat, sink, fry vat and oven areas are rated as significantly more slippery than other working areas in the kitchens. Employees also identified the back vat, sink, oven and fry vat areas as the areas in which slips most frequently occurred. In addition, degree of wear was determined for each participant's shoe sole.

Figure 1

## Perceived Slipperiness for Major Areas in Restaurant Kitchens



Note. Rating scale: 1 = not slippery to 4 = extremely slippery.

ceived by employees, the researchers identified seven major areas in each restaurant kitchen and reproduced these areas on a plan view map for each respective restaurant. The researchers determined these key areas based on their prior research and safety experience as well as on observations from earlier site visits as employees appeared most frequently in these areas during the restaurant's lunch period.

The seven areas identified were fry vat, back vat, oven, sink, beverage, front counter and walkthrough. The fry vat and back vat are the areas in which french fries and fried chicken, respectively, are cooked. The research team observed that grease and oil contamination were typical in these areas. The walkthrough is the area where employees enter and exit the kitchen. The front counter is the area for taking customer orders, exchanging cash and delivering food. The beverage stand is typically located next to the front counter inside the kitchen. Floor surfaces in the front counter, walkthrough and beverage areas were normally dry. The sink is used to defrost meat and to wash the cookware. Wet floors are common in this area.

Participants were asked to rate each area from 1 to 4, with 1 being not slippery and 4 being extremely slippery based on floor conditions they experienced during the lunch period on that day. In a subsequent section of the survey, participants were asked to provide the same ratings of the same areas based on a typical workday. The mean ( $\pm$ SD) floor slipperiness scores are shown in Figure 1.

The subjective ratings of floor slipperiness for different areas based on employee perceptions during the lunch period on the day of the visit and during a typical workday were both tested using the Kruskal-Wallis test. Both results were strongly significant

( $p < .001$ ). Multiple comparisons between the areas for both the lunch period on the day of the visit and the typical workday were performed. Both showed that the back vat, sink, fry vat and oven areas were rated as significantly more slippery (both at  $p < .05$ ) than the beverage, walkthrough and front counter areas. These four slippery areas not only had higher mean perceived slipperiness values but also higher standard deviations compared to the other three areas. The differences among the back vat, sink, fry vat and oven areas were not statistically significant, nor were the differences among the beverage, walkthrough and front counter areas.

### Employee-Identified Slippery Areas

Participants were asked to identify any area in addition to those listed on the survey that they felt was slippery and the reason they felt it was slippery. Seven participants (12.5%) reported the walk-in freezer was slippery due to ice and frost accumulations on metal floor surfaces. Five participants (8.9%) reported the storage room was slippery because of wet and/or oily floors. Although customer dining areas were not regarded as a working area by the investigators, four participants (7.1%) identified them as slippery because beverage spills are common (and employees must clean these spills immediately to protect customer safety).

Two participants (3.6%) each reported that the lavatories, ice machines and built-in ramps were slippery because of wet and/or oily floors. In addition, floor "bumps" (surface irregularities such as pipes that had been tiled over) and stairs were each identified by 1 participant (1.8%) as slippery because of uneven floor surfaces. The wet and/or oily floors in the storage rooms, lavatories, ramps, bumper and stairs might be attributed to cross-contamination or unintentional transport of surface contaminants across areas by employee activities.

### Recent Slip/Fall Experience

Participants were asked about their experience with slips and/or falls at work in the past 4 weeks. Among the interviewees, the number (percentage) of those who did not slip and fall, who slipped without falling, and who slipped and fell were 15 (26.8%), 34 (60.7%) and 7 (12.5%), respectively (Figure 2). The percentage of slipping with/without falling (73.2%) was surprisingly high even though no participant reported an injury from a falling event. In two restaurants, every participant had slipped either with or without a fall in the prior 4 weeks.

### Location of Employees Slips and/or Falls

The 73% of workers who slipped and/or fell in the past 4 weeks were asked to indicate the location(s) where the event occurred. Figure 3 presents the results. Similar to perception reports, employees identified the back vat, sink, oven and fry vat areas most often. For the 7 falls, 2 occurred in the customer dining areas when the employees stepped on a freshly mopped area while mopping before the end of the business day. Two falls occurred on the wet

floor in front of an ice machine. One fall each occurred at the sink, back vat and an employee-only stair area.

**Will I Fall Again?**

Interviewees were asked whether they agreed with the statement, "In the future, I don't think I will slip and fall in my current job." Eight employees (14.3%) agreed; 8 (14.3%) somewhat agreed; 22 (39.3%) disagreed and 17 (30.4%) somewhat disagreed. One participant neither agreed nor disagreed.

The Spearman's correlation coefficient ( $\rho$ ) between the agreement of this statement and the experience of slipping and falling in the previous 4 weeks was only 0.13 and was not statistically significant at the  $\alpha = .05$  level. Nearly 70% of interviewees felt that slips and falls were likely to happen in their current jobs regardless of whether they had slipped and/or fallen in the past 4 weeks.

**Footwear Type**

Participants also reported the type of shoes they wore at work. Seventeen participants (30.4%) responded that they wore shoes which their employer had designated as "slip-resistant"; 15 (26.8%) wore sneakers; 3 (5.3%) wore sport shoes; and 21 (37.5%) wore "work shoes." The latter were not slip-resistant shoes that were supposed to meet employer guidelines for uniform appearance. All shoes worn by participants had tread grooves or geometrical designs on the original soles. No smooth-soled shoes were reported.

**Degree of Shoe Tread Wear**

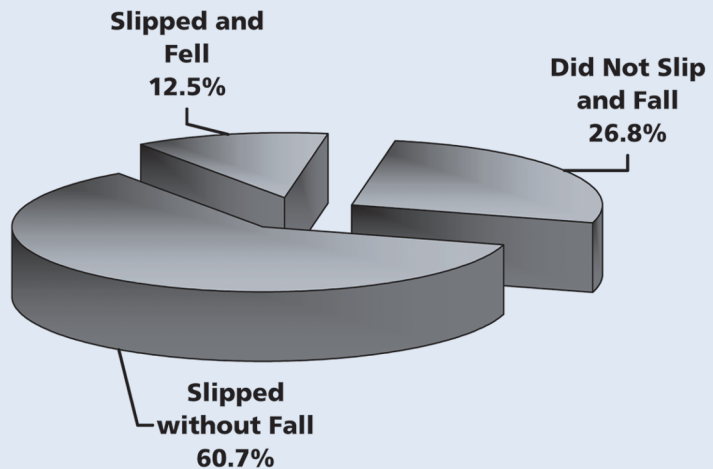
The shoe sole of each participant was photographed at the conclusion of the interview. A panel of investigators trained in tribology, industrial engineering and safety engineering (members of the research team) later rated the degree of wear of each shoe at critical surface contact points (e.g., trailing edge of heel) in the laboratory.

The shoe soles were rated as either not worn, partially worn and fully worn. Shoes rated as not worn were normally new or appeared to be in near-new condition. The fully worn shoes were those with fully worn tread grooves. In fact, some participants commented that their shoes were so badly worn that they believed the shoes should be replaced immediately. Shoes that could not be classified as either not worn or fully worn were rated as partially worn. Photos 1, 2 and 3 (pg. 38) show examples of shoes classified in the three categories.

The percentages for not worn, partially worn and fully worn shoes were 19.6%, 46.4% and 33.9%, respectively. Tests for association between the degree of wear and employee-reported experience of slipping and falling were conducted; the results were not statistically significant. Among the 7 fall cases, however, 4 of 7 sets of shoes were rated as fully worn. In addition, one employee wearing a pair of slip-resistant shoes rated not worn by the panel slipped and fell while mopping the floor.

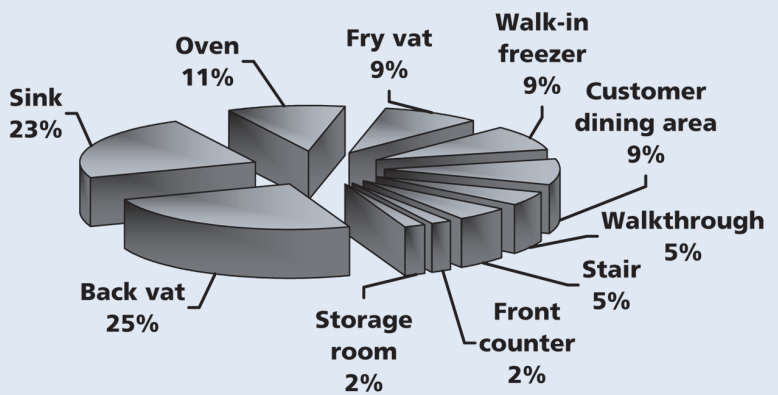
**Figure 2**

**Worker Slip & Fall Experience within Prior 4 Weeks**



**Figure 3**

**Locations of Employee Slips**



Note. Locations of employee slips with (n = 7) and without (n = 41) fall.

**Implications of Findings**

The results of the field survey showed that slips and falls are common in the restaurant kitchens visited in Taiwan. Employees clearly indicated that the active cooking and cleaning areas of the kitchen (back vat, sink, fry vat and oven)—often called the "back of the house"—were more slippery than the order fulfillment or "front of the house" areas. Chang, et al (401) previously reported that the friction variations were high in these kitchens and the distributions were consistent with subjective ratings.

Most employees had slipped or fallen within the prior 4 weeks at work and expected to do so again. The areas most frequently cited as the location of the slip or fall (Figure 3) event were consistent with areas employees rated as most slippery (Figure 1). Interestingly, as noted, the perception-rated areas

(From top) Photo 1: Shoes with soles that are not worn.

Photo 2: Shoes with soles that are partially worn.

Photo 3: Shoes with soles that are fully worn.



agreed in general with the findings for friction measurement (Chang, et al 401). Collecting employee ratings of floor slipperiness and history and location of slipping and falling not only in the kitchen but also in the entrance, dining areas and even the parking lot could provide additional information to direct future efforts to prevent slips and falls.

With respect to footwear, most employees did not wear slip-resistant shoes in this frequent slip environment. The shoes they wore were generally worn, with more than one-third of employees wearing shoes with soles judged to be fully worn. Furthermore, the fact that several falls occurred during floor cleaning when employees stepped on wet floors suggests that managers may not have had effective safe work practices and training in place.

A general principle is to mop so that crossing a recently mopped area is avoided or minimized. In addition, Filiaggi and Courtney (18) indicate that typical work practices in floor cleaning should include using the proper amount of cleaner; temporarily blocking drains (to allow the cleaner sufficient time to penetrate); applying cleaning product evenly on floor surface with a clean mop; allowing sufficient time for the cleaning product to loosen contaminants; deck scrubbing the floor; and reopening floor drains, squeegeeing and rinsing the floor with hot water.

Several limitations must be noted. The sample sizes for statistical testing of differences in employee responses and expert observations were small due to

the relatively small numbers of employees that make up a full shift of staff at the participating restaurants. Information about employee perception of slipperiness and moreso on employee history of slipping and/or falling relied on employee recall of past experience, which can be biased. In addition, employees' self-classification of shoe type could be influenced by their interpretation of the response options. Finally, degree of wear was evaluated by an expert panel based on photographic evidence rather than on a physical evaluation of the shoes themselves, which could affect the accuracy of the classification.

## Conclusion

The results indicate that exposure to both slippery floors and to actual slipping and/or falling are relatively high in the studied facilities. Employees appeared to be a good source of information on slipperiness and work practice issues, which suggests that employee interviews and/or ratings could help management improve restaurant floor safety. For example, employee-reported information on both slip history and slipperiness perception concurred on the particular areas of the restaurant kitchen that could be problematic. This was consistent with the findings in the literature (Chang, et al 401) as well.

However, based on researcher observation and employee reports of slipping and falling incidents, employees appeared not to be adequately prepared by their employers in terms of training in appropriate work practices, nor were they provided with appropriate equipment to effectively address these concerns. Workplaces such as restaurants need strategies to further reduce the risk of slips and falls. Filiaggi and Courtney (18) suggest site management buy-in, safety modeling, integrated safety training, accountability and worker involvement—particularly in hazard identification and remediation—as key aspects of a restaurant safety program. ■

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