

Slips and Falls in Limited-service Restaurant Workers

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Liberty Mutual Research Institute for Safety

generating knowledge to help people live safer and more secure lives



Mission:

To advance scientific, business-relevant knowledge in workplace and highway safety, and work disability

- Center for Injury Epidemiology
- Center for Physical Ergonomics
- Center for Behavioral Sciences
- Center for Disability Research



5 Leading Causes of Nonfatal Injury, United States -2011

Rank	Age Groups										All Ages
	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	
1	Fall 147,819	Fall 980,092	Fall 659,063	Fall 624,123	Struck by/ Against 1,039,781	Fall 830,843	Fall 795,173	Fall 984,995	Fall 909,229	Fall 2,403,146	Fall 9,256,761
2	Struck by/ Against 35,388	Struck by/ Against 381,370	Struck by/ Against 429,506	Struck by/ Against 615,721	Fall 921,958	Overexerti on 675,342	Overexerti on 589,259	Overexerti on 498,178	Struck by/ Against 260,734	Struck by/ Against 269,421	Struck by/ Against 4,619,897
3	Other Bite/ Sting 15,525	Other Bite/ Sting 173,697	Other Bite/ Sting 116,853	Overexerti on 306,379	Overexerti on 724,410	Struck by/ Against 656,043	Struck by/ Against 493,018	Struck by/ Against 438,778	Overexerti on 256,738	Overexerti on 203,047	Overexerti on 3,440,314
4	Foreign Body 11,120	Foreign Body 143,838	Cut/Pierce 116,813	Cut/Pierce 137,359	MV- Occupant 703,817	MV- Occupant 572,542	MV- Occupant 412,035	MV- Occupant 383,832	MV- Occupant 236,368	MV- Occupant 194,678	MV- Occupant 2,686,589
5	Fire/Burn 10,634	Overexerti on 94,656	Overexerti on 86,337	Pedal Cyclist 110,225	Other Assault ^A Struck by/ Again 484,128	Cut/Pierce 402,941	Cut/Pierce 310,614	Other Specified 337,326	Cut/Pierce 193,449	Cut/Pierce 148,065	Cut/Pierce 2,165,207

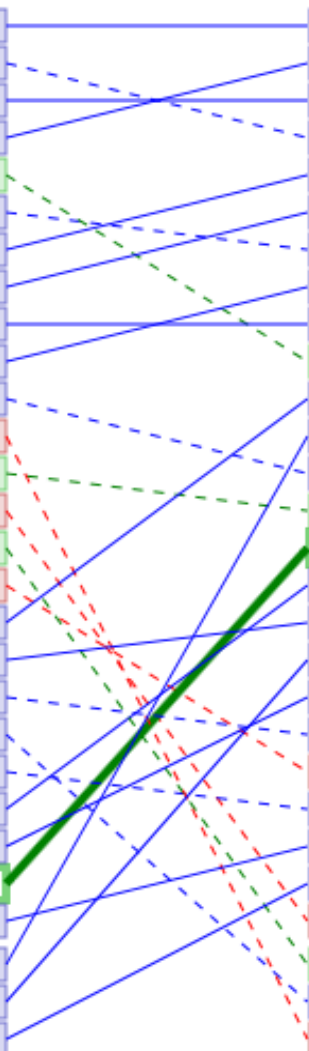
Causes of DALYs 1990 and 2010 – High income North America (*Lancet*, 2012)

1990 Mean rank (95% UI)

1.0 (1-1)	1 Ischemic heart disease
2.9 (2-6)	2 Lung cancer
3.8 (2-8)	3 Low back pain
4.4 (2-7)	4 COPD
4.4 (2-7)	5 Road injury
5.1 (3-7)	6 Stroke
7.5 (3-11)	7 Major depressive disorder
7.6 (6-9)	8 Other musculoskeletal
9.6 (5-16)	9 Neck pain
10.2 (8-13)	10 Diabetes
12.1 (8-18)	11 Anxiety disorders
12.3 (10-15)	12 HIV/AIDS
12.3 (9-17)	13 Self-harm
14.4 (11-19)	14 Preterm birth complications
14.9 (10-22)	15 Interpersonal violence
16.2 (13-20)	16 Lower respiratory infections
17.1 (11-22)	17 Drug use disorders
18.3 (15-22)	18 Colorectal cancer
18.7 (16-21)	19 Breast cancer
20.2 (16-24)	20 Congenital anomalies
22.4 (14-31)	21 Asthma
22.6 (19-27)	22 Cirrhosis
23.0 (16-30)	23 Alcohol use disorders
25.0 (20-30)	24 Falls
25.6 (17-35)	25 Schizophrenia
25.6 (21-30)	26 Alzheimer's disease
28.6 (25-32)	29 Chronic kidney disease
31.0 (22-41)	30 Osteoarthritis

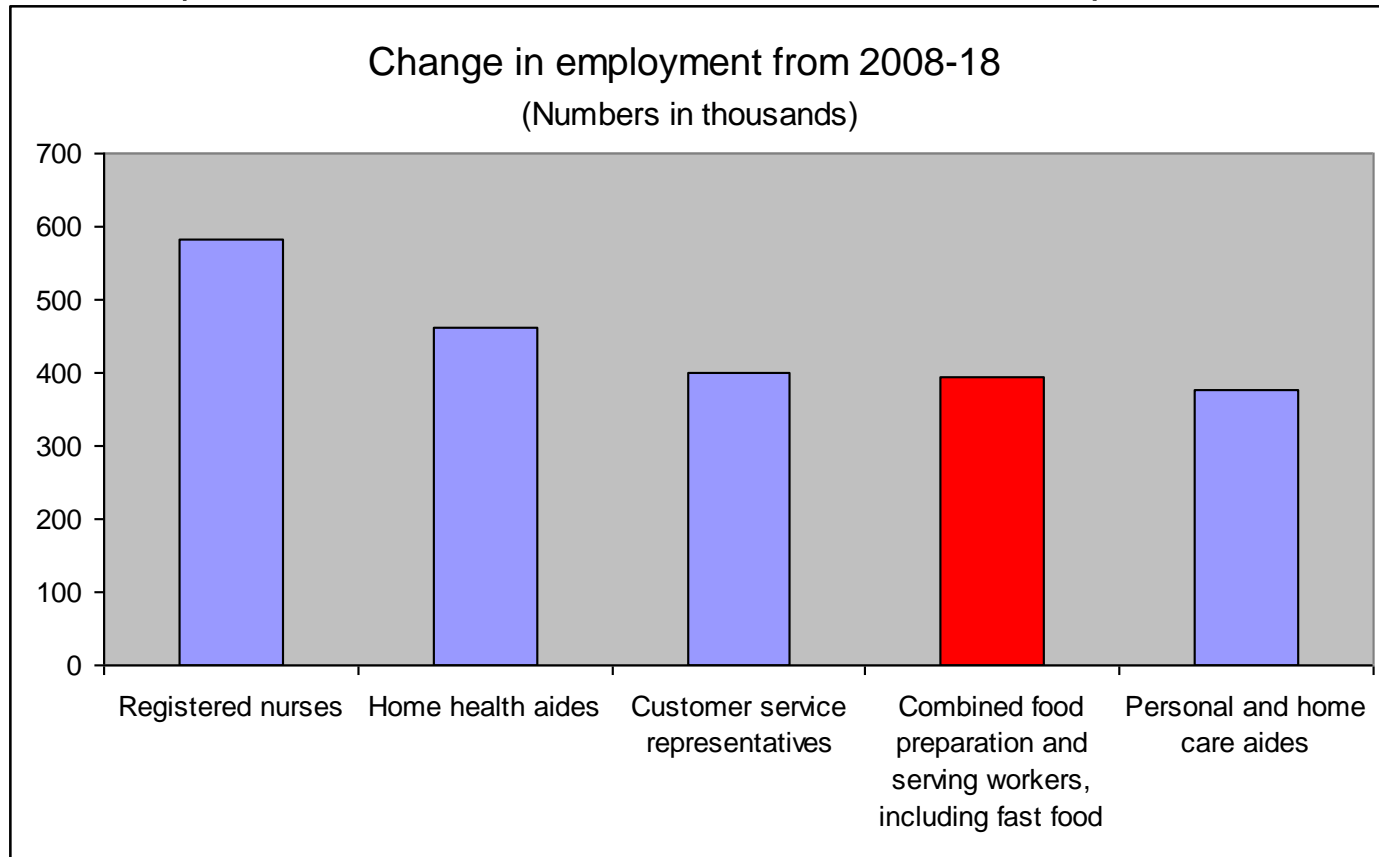
2010 Mean rank (95% UI)

1 Ischemic heart disease	1.0 (1-1)	-17% (-22 to -7)
2 COPD	2.9 (2-5)	34% (19 to 50)
3 Low back pain	3.3 (2-8)	26% (2 to 56)
4 Lung cancer	4.5 (2-8)	6% (-5 to 18)
5 Major depressive disorder	5.0 (2-10)	46% (14 to 82)
6 Other musculoskeletal	5.6 (3-8)	35% (24 to 47)
7 Stroke	7.4 (5-10)	1% (-7 to 8)
8 Diabetes	7.5 (4-10)	59% (42 to 74)
9 Neck pain	9.7 (5-14)	25% (1 to 53)
10 Road injury	10.2 (7-13)	-17% (-24 to -2)
11 Drug use disorders	10.8 (7-13)	80% (35 to 120)
12 Alzheimer's disease	11.1 (8-14)	159% (86 to 226)
13 Anxiety disorders	12.5 (9-15)	20% (4 to 38)
14 Self-harm	14.4 (12-21)	3% (-13 to 16)
15 Falls	16.9 (14-24)	57% (30 to 81)
16 Cirrhosis	17.9 (15-25)	33% (10 to 48)
17 Colorectal cancer	18.6 (14-23)	9% (-3 to 41)
18 Chronic kidney disease	18.7 (15-24)	67% (45 to 83)
19 Alcohol use disorders	20.8 (14-29)	27% (1 to 57)
20 Breast cancer	21.5 (18-26)	0% (-8 to 8)
21 Lower respiratory infections	21.6 (16-26)	-11% (-24 to 9)
22 Asthma	22.4 (14-31)	14% (5 to 23)
23 Schizophrenia	23.3 (15-33)	26% (9 to 47)
24 Osteoarthritis	23.8 (15-34)	58% (31 to 89)
25 Preterm birth complications	24.1 (17-29)	-24% (-40 to -3)
26 Interpersonal violence	24.1 (15-30)	-22% (-34 to 3)
30 Congenital anomalies	29.8 (26-33)	-25% (-34 to -4)
35 HIV/AIDS	36.8 (33-41)	-60% (-65 to -55)



Employment in Restaurants

~7.5% of total U.S. workforce is employed in restaurants
(~9.5 million workers, BLS, 2011)



Specific Aims

- Aim I

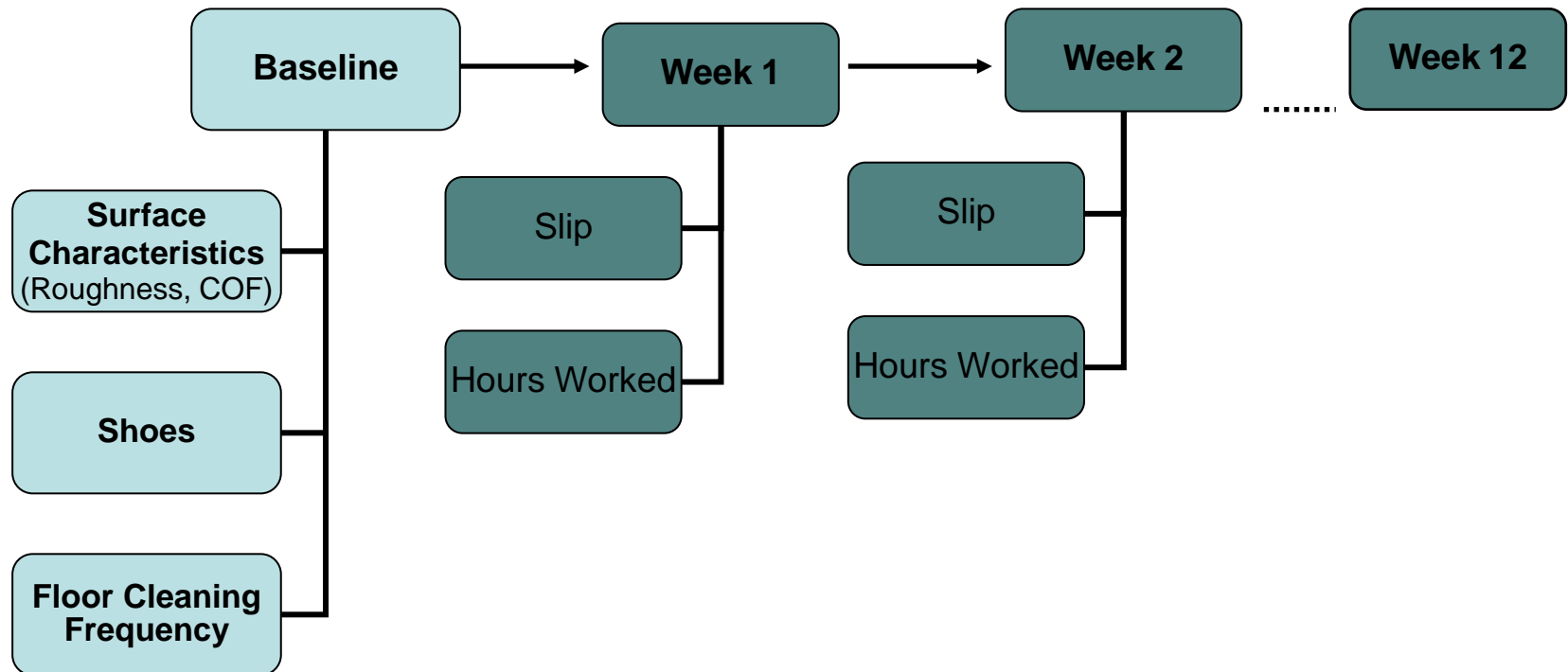
To describe slipping and floor cleaning experience in limited service restaurant workers

- Aim II

To examine the effects of floor-surface characteristics, slip-resistant shoe and floor cleaning frequency on risk of slipping.

Study Design: Prospective cohort, nested case-crossover arm

Timeline for exposure and outcome information collection (selected variables)



Study Population

- 36 restaurants from 6 states
 - 10 chain A
 - 13 chain B
 - 13 chain C

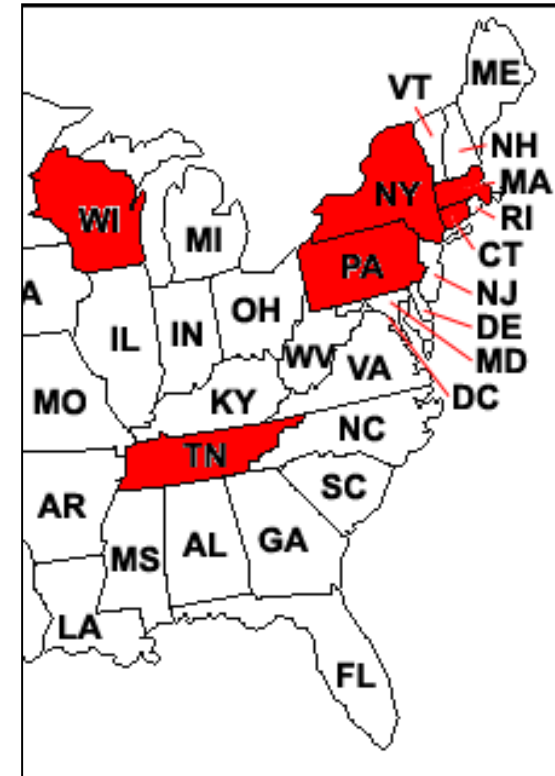


- Main menu:

- Study data collection from 2007 to 2009

- 475 participants

- Approximately 13 participants per restaurant (range 5-18)



Rate of slipping

- Total number of slips = 1168 and falls = 60
- Total number of hours worked = 105,240
 - 34.5 slips per full-time employee (2000 hrs) per year

1.14 falls/2000 hrs.



1.07 falls/2000 hrs*



- Variation of mean individual slipping rate between restaurants
 - Range: 0.02 – 2.49, Interquartile Range: 0.26 -1.04

* Assuming Poisson distribution and 2.5 hours time at risk each day

Qualitative Assessment of Slipping Hazards

- Loading fries in fryer across the walkway
- Overflowing sink
- Recessed drains in the floor
- Slope between freezer and cooler
- Ineffective ventilation

Floor cleaning protocol compliance

	Enzyme Based (25 Restaurants)		Non-Enzyme Based (11 Restaurants)	
Water Temp	n	%	n	%
Hot/Warm	89	61.8	57	98.3
Cold	52	36.1	1	1.7
Varies	1	0.7	0	0.0
Don't Know	2	1.4	0	0.0
Total	144	100.0	58	100.0



Begin in the Dining Room

- Sweep floor debris with broom into dust pan.

NOTE: Place "Wet Floor" cones in area to be mopped.

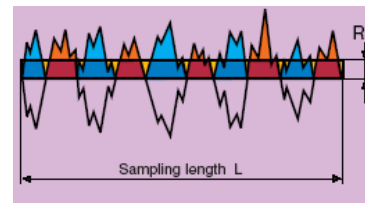
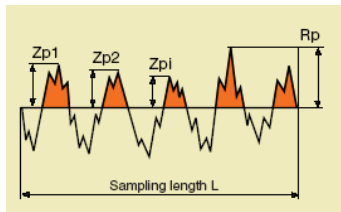
- Fill mop bucket with cold Floor Cleaner Solution.

NOTE: Do not use Hot water.

Step 2

Exposure Assessment

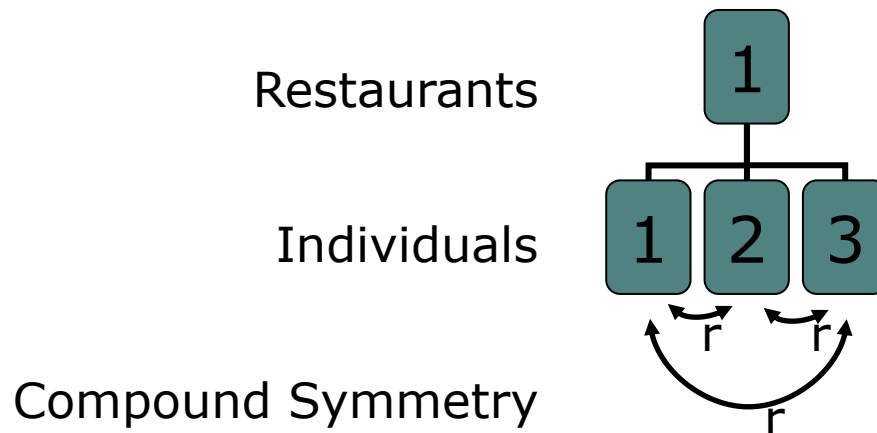
- Surface roughness (R_{pm} and R_a) and Coefficient of friction (COF)
 - ◆ 3 tiles in 8 zones in each restaurant
 - ◆ Mean roughness and COF for each



- Slip-resistant status of the shoe was determined by the 'slip resistant' marking on the sole
- Managers - the frequency of cleaning the entire kitchen floor every day

Statistical analysis

- A generalized estimating equation model with a compound symmetry covariance structure
- Negative Binomial regression was used to calculate rate ratios and their 95% CIs



Results – Fixed Factors

	Unadjusted			Adjusted*		
	<u>RR</u>	<u>95% CI</u>		<u>RR</u>	<u>95% CI</u>	
Slip-resistant shoes	0.37	0.26	0.53	0.46	0.34	0.63
COF (0.1)	0.66	0.54	0.82	0.79	0.66	0.95
R _a (1 μm)	1.04	0.87	1.25			
R _{pm} (5 μm)	0.99	0.81	1.21			
Daily floor cleaning frequency	0.88	0.79	0.99			

Notes:

- Adjusted for age, gender, BMI, education, job tenure, primary language and chain
- Interaction effect between COF and slip-resistant shoes was not statistically significant

Friction

- One of the few analytic studies to examine COF in active work environments
- Average COF values (0.67, range 0.45 – 0.86) and association with slipping were similar to those found in the previous study
(Courtney, Verma et al., 2010)
- OSHA, in a non-mandatory guideline, suggests a COF of 0.5 as safe for walking
 - Restaurant workers reported high rate of slipping at average COF values generally considered “safe”
 - No absolute cutoff

Cost-benefit Analysis - Shoes

- A study published in 1995 estimated workers' compensation loss from injuries due to STF to be about \$116 per worker in the restaurant industry (Leamon and Murphy, 1995)
- If slip-resistant shoes are provided and the rate of slipping and thus injuries from STF is reduced by 50%, \$58 will be saved per worker.
- The cost of \$30/pair slip-resistant shoes would represent a saving of approximately \$2 for each dollar invested.

Overall Summary

- Rate of slips and falls are high in limited service restaurants
- Three potential prevention approaches:
 - 1) Reduce floor contamination by improving work processes
 - 2) High slip resistance floor – selection and maintenance
 - 3) Use of slip-resistant shoes

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