Final Performance Report

Work Related Risk Factors Associated with Falls during Pregnancy

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ABSTRACT

Background: Though falls are a major source of trauma during pregnancy and 70% of pregnant women are employed, information on falls among pregnant workers is lacking. Study objectives were to estimate fall prevalence and risk factors among pregnant workers.
Methods: Birth certificate data identified women at least 20 years old who recently delivered a child. Data were collected via phone, internet, and mail surveys. The primary outcome investigated was a fall at work during pregnancy. Adjusted odds ratios and confidence intervals were calculated.
Results: Of the 3997 total subjects, 26.8% reported falling during pregnancy. Of the 1070 women who fell, 35.4% had two or more falls. Of the 2847 employed women, 26.6% (757) fell during their pregnancy and 6.3% (179) fell at work. Occupations with the highest rate of work falls were service and teaching/childcare. Walking on slippery floors, hurrying, or carrying an object occurred in 66.3% of work falls. The yearly cost for workplace falls during pregnancy is almost 100,000 lost work days and over $11 million in lost wages.
Conclusion: The service and teaching/child care industries should be evaluated for risk reduction. Pregnant workers should be counseled on reducing factors which contribute to falls.

SIGNIFICANT FINDINGS

Of the 3997 total subjects, 26.8% reported falling during pregnancy. Of the 1070 women who fell, 35.4% had two or more falls. Of the 2847 employed women, 26.6% (757) fell during their pregnancy and 6.3% (179) fell at work. The most common contributing factors of work falls were slippery floors (40.0%), moving at a hurried pace (39.3%), and carrying an object or child (30.3%). While the most common factors for non-work falls were stairs (43.4%), slippery floors (33.9%), and carrying and object or child (27.1%). Of the 130 women wearing shoes at the time of the work fall, 33 (25.4%) reported their shoes were slick, loose, or backless and 21 (16.2%) reported a heel height of one inch or greater. The majority of work falls (52.1%) occurred in the afternoon between noon and before 6 PM. The occupations with the highest rates of fall at work were food service, other service (such as beauticians and housecleaners), and teaching and childcare with rates of 13.2%, 12.8%, and 10.2% respectively. Contributing factors of work falls differed by occupation. Not surprisingly, slippery floors were especially important among food service employees (involved in 58.3% of their work falls), whereas clutter was the leading factor for nurses (involved in 40% of their work falls) and problems with shoes (including loose, backless, and slick/worn soles) were a leading factor of work falls among healthcare professionals, sales, and management/professionals. As discussed in detail below, the yearly cost for workplace falls during pregnancy is almost 100,000 lost work days and over $11 million in lost wages.

USEFULNESS OF FINDINGS

This study showed that 2.5% of pregnant workers missed work due to a fall. Clearly prevention of work and non-work falls would greatly benefit both workers and employers. Pregnant workers should be counseled on slowing their pace, using caution when carrying objects especially if visual range is blocked, and being especially mindful of slippery floors. Interventions targeted for specific occupations should include a reduction of slippery floors for food service employees, removing clutter for nurses, and proper shoe wear for women in sales, management, and professional occupations.

To estimate the cost in lost wages from missed work due to falls during pregnancy, occupations from our data were applied to 2000 Bureau of Labor Statistics tables [27] to calculate a mean daily wage of $115/day for our employed participants. There are 3.9 million pregnant women annually in the United States [28], and our data suggests that 71.2% of them will be employed during pregnancy. This study found that 2.5% of pregnant workers missed work due to a fall, 0.7% due to work falls and 1.8% due to non-work falls. Using the minimum number of days of missed work of 0.5 (at least 1/2 day), 2 (2-5 days), 6 (6-10 days), and 11 (more than 10 days) based on the categories in our questionnaire (Table II), work falls during pregnancy result in at least 99,525 missed work days and $11,445,375 in lost wages and non work falls during pregnancy result in at least 79,003 missed work days and $9,085,345 in lost wages. Considering the minimum number of work days missed were used in this calculation, this is likely to be an underestimate and does not include medical cost or cost to employer such as lost productivity.

Hence, not only should industry examine this issue but health care providers need to alert their pregnant patients. It is highly recommended that an intervention study directed at high risk industries and/or health care providers be implemented.

SCIENTIFIC REPORT

A. Background

It is estimated accidental injury occurs in 6-7% of all pregnancies and that falls are the most common cause of minor injury during pregnancy [1-3]. In addition, falls cause 17-39% of all trauma during pregnancy associated with emergency department visits and hospital admissions[1-9] Falls during pregnancy may result in injury to the mother including fractures, sprains/strains, head injury, rupture of internal organs, placental separation, rupture of the uterus and membranes, and occasionally maternal or fetal death [3-12].

Overall, 70.3% percent of mothers 20 years of age and older report employment during their pregnancy; 88.1%, 67.2%, and 51.4% report employment with their first child, second, and third or later child, respectively [13]. Falls are a leading cause of occupational injury [14] and, in 2000, caused 19.7% of missed work days [15]. Of a total of 330,913 yearly non-fatal falls, 39% (n=131,751) occur to women [13]. For Swedish female employees less than 45 years of age, falls accounted for 18% of occupational accidents, and data suggests that falls for men and women differ with respect to contributing factors [16]. During pregnancy, women undergo continuous physiological, anatomical, hormonal, and biomechanical changes that may increase risk of fall and injury. Specific changes that may increase risk of falls and injury include weight gain, lengthened abdominal muscles, limited hip joint range of motion, increased lordosis, inferior and anterior shift in center of gravity, increased joint laxity, increased estrogen, decreased kinesthetic sense and diminished coordination, increased interstitial fluid, decreased reaction time, and changes in foot biomechanics and gait pattern [17-19].

There are no statistics related to falls occurring to pregnant workers even though women represent approximately 43.2% of the civilian labor force or 56.6 million workers [13]. Therefore, this retrospective cohort study was conducted involving recently pregnant women who delivered live births within eight weeks of initial contact. It was conducted in partnership with Hamilton County General Health District and the City of Cincinnati Department of Health who provided databases of public record birth certificates in order to identify participants.

B. Purpose, Objective, Hypotheses and Specific Aims

The overall ***purpose*** of this study was to determine the prevalence rates of falls for the pregnant worker, to identify risk factors related to falls, to evaluate the risk factors leading to medical injuries to the mother and fetus as a result of falls occurring at the workplace compared to elsewhere. The *objective* of the study was to identify rates and risk factors of falls among pregnant workers.

Three study *hypotheses* were proposed: 1. The risk factors related to falls occurring during pregnancy while at the workplace will be significantly ($p < .05$) different than for those occurring outside the workplace. 2. The rate of falls among those in health service and wholesale and retail trade compared to all other occupational sectors will be significantly higher ($p < .05$). 3. The rate and severity of medical injuries will be significantly higher ($p \leq .05$) greater for those pregnant women falling while on the job compared to those falling elsewhere.

In order to test these hypotheses, the following four specific aims were accomplished:

Specific Aim 1: Identify from birth certificates a cohort of women who have delivered within four to six weeks in Hamilton County.

Specific Aim 2: Collect information related to falls and injuries occurring during pregnancy using telephone interviews and mailed questionnaires, regarding employment risk factors (such as shoe wear, job tasks involving reaching, lifting and carrying, workload, lighting conditions, condition of floors or walking surfaces, height of workstation), and non-employment risk factors (such as sleep disturbances, health status, gestational length, availability of vision correction).

Specific Aim 3: Identify the occupations with the highest rate of falls and associated medical injuries and characterize the risk factors associated with falls and injuries.

Specific Aim 4: Determine the occupational and non-occupational factors related to maternal or fetal injuries resulting in falls.

C. Research Design and Methods

C.1. Subject identification and data collection (Specific Aims 1, 2)

Women were considered eligible if they had delivered within eight weeks at a hospital located in Hamilton County, were at least 20 years old, and lived in Ohio, Kentucky, or Indiana. A total of 6217 eligible women were identified from public record birth certificate data from December 1999 through July 2000. They were sent letters explaining the study and giving them the opportunity to complete an internet or telephone survey. Telephone interviewing began five days after initial letters were sent, and at least eight attempts on different days and times were made to contact subjects. A mail survey was sent to those women not completing the phone or internet survey, followed in two week intervals by a reminder postcard and another mail survey. Eligible women who had not completed the phone, internet, or mail survey were sent a two question postcard, and phone calls were made to those with numbers. The purpose of this brief questionnaire was to determine if non-participants had fallen at work or elsewhere and if they were employed during pregnancy. Ten percent of participants completed a test retest survey to analyze the reliability of fall and injury data.

This study was approved by the University of Cincinnati Institutional Review Board. Informed consent was obtained differently each survey method as approved by the University of Cincinnati IRB. For the phone, verbal consent was given and the interviewee signed a statement indicating that consent was given for each phone participant. For internet surveys, participants who visited the web page were given a description of the study and asked for consent. After providing informed consent by clicking on the "consent" button, the participant was allowed into the questionnaire screens. For the mail survey, participants signed a hard copy informed consent and returned it with the completed survey. When each questionnaire was received, the signed consent was separated from the questionnaire (which included only ID numbers) and stored in a locked cabinet. Participants completing the phone and internet were given $5. For those participants not completing the phone or internet survey, a mail questionnaire was sent including a $2 bill incentive.

C.2 Outcome definitions

To determine if a fall had occurred during pregnancy, all subjects were asked "During this last pregnancy, did you experience any loss of balance, resulting in a fall where some part of your body -- other than your feet -- touched the ground?" For participants with multiple falls, the most severe fall was chosen for analysis based on injury, medical attention, and restricted activity. Injuries included bruise, cut, sprain or strain, broken bone, turned ankle, or other. Medical attention included a phone call or visit to a physician, an emergency room visit, or hospital admission. All falls analyzed occurred in women who were employed during

pregnancy, the falls were distinguished by the location of the fall. Work falls were defined as those falls that occurred while working, and non-work falls were defined as those that occurred elsewhere including the home and community.

C.3 Questionnaire (Specific Aim 2)

A fall and injury survey was developed based on previously identified risk factors among non-pregnant populations and with questions selected from other instruments including the Job Content Questionnaire [20], the NIOSH questionnaire for Mature Workers [21], and the Fall from Elevation Questionnaire developed by the Bureau of Labor Statistics [22]. Survey instruments received outside expert review from members of a Scientific Advisory Board and other recognized injury experts [23]. Three methods of surveys were used for data collection including phone, internet, and mail questionnaires. The 15 minute phone and internet questionnaires were identical, but the mail questionnaire was a subset of the former limiting the length to four pages.

Predisposing risk factors were collected in all three surveys including maternal age, race, education, presence of a permanent partner, previous problem with balance or vision prior to pregnancy, and diabetes (gestational and mellitus). Additional risk factor information was collected from phone and internet participants including maternal weight gain during pregnancy, height, number of toddlers age three and under cared for during pregnancy, number of previous live birth deliveries, desire for pregnancy, and exercise patterns prior to pregnancy.

Work conditions were ascertained from phone and internet participants including duration of employment, noise, shift rotations, number of breaks, lifting, and full or part time status. Stress at work was assessed through five questions regarding adequate time to complete job task, fast working pace, job satisfaction, and control over work load and schedule. A work environment was defined as loud if the participant had to speak overly loud to be heard. Lifting questions included weight, frequency, and any accommodations made by the employer during pregnancy.

Situational factors of falls were collected in phone, internet and mail surveys including month of gestation at the time of the fall, location, and whether the fall was associated with a slippery floor, uneven or sloped ground, stairs, ladder, curb, van, car, elevator, escalator, machinery, or a cluttered or poorly lit area. Shoewear at the time of the fall was ascertained including heel height and if the shoes were slick, worn, loose, or backless. For phone and internet participants, time of day and events occurring at the time of the fall were recorded including body actions (turning, reaching, or bending), obstruction of view, and being more tired than usual. In addition, for the phone and internet participants, acute illness (including hypoglycemia, dizziness, and extreme vomiting or diarrhea) on the day of the fall and consumption of medications, caffeine, and nicotine within eight hours prior to the fall were recorded for phone and internet participants. If the fall had occurred at work, phone and internet participants were asked questions to determine if they were performing a new task or unfamiliar task, if the fall was reported to the employer, and if a workers' compensation claim was filed as a result of the fall.

C.4 Occupation/Industry identification (Specific Aim 3)

Employment was defined as working outside the home for pay. Full time work was defined as working at least 30 hours per week. All women who were employed during pregnancy were asked five questions from which staff at the National Institute for Occupational Safety and Health coded industry and occupation based on 1990 census classification system: company name, type of business or industry, job title, job activities, and the primary product or service produced. Occupational codes were grouped into categories prior to analysis based on four concepts: 1) possible high risk groups as indicated by Bureau of Labor Statistics injury data

(i.e., service, food service, nursing); 2) possible intervention groups that would be easy to target (i.e., teaching/childcare, nursing); 3) a pilot study done with the occupational field on Hamilton County birth certificate data performed to determine where the majority of pregnant women work; and 4) common categories used in census coding.

C.5 Data management and analysis (Specific Aim 4)

Telephone and internet data were entered directly into computer files. Mail survey data were computer entered using 100% keystroke double entry with a 10% comparison against hardcopy. Responses were standardized and coded and a system of checks and compare programs were applied as quality control measures.

Descriptive statistics were used to examine the distribution of each variable. One outcome was whether a woman fell at work (yes, no). In addition, contributing factors of work and non-work falls were compared using chi square. Unadjusted odds ratios and 95% confidence intervals were calculated to determine variables marginally associated with fall at work. Mantel-Haenszel chi square was used to evaluate significant trends for ordinal categorical variables. Correlations among covariates were determined, and cluster analysis was carried out to assess associations among subsets of variables to aid in data reduction. Logistic regressions were performed to investigate the association between risk factors and the dichotomous outcome of fall at work (yes, no) during pregnancy. Because the phone and internet surveys provided more information, two separate logistic regression models were obtained, one for the phone and internet participants, and one for the mail participants. Logistic model building proceeded by first entering all variables at least marginally associated ($p<.25$) with fall at work. Interactions and confounders were investigated by stratified analyses, observing changes of greater than 15% in coefficients, and by backward regression. Factors significant at $p<.05$ and factors that changed coefficients more than 15% were retained for the final model. For the phone and internet dataset a variable identifying whether the survey was completed by phone or internet was tested for confounder or interaction status but was not significant for the final model and did not change coefficients more than 15%.

The amount of missing data was small (<5%) and evenly distributed across methods, except for race and occupation. Race had missing frequencies of 4%, 2% and 6.7% in the telephone, internet, and mail questionnaires respectively. Occupation was missing in 0.4%, 7.7%, and 4.2% in the telephone, internet, and mail questionnaires respectively. Variables that were missing in less than 5% of participants were replaced with the mode and mean for categorical and continuous data, respectively. Imputation for variables missing in more than 5% of the participants (i.e., race and occupation) was done by using the SPlus function *transcan* - a nonlinear additive transformation and imputation function.[24] Therefore, the missing values of race and occupation were replaced by a predicted value that was most probable. All other statistical analyses were performed using SAS (Cary, North Carolina), version 8.1. Test retest was analyzed using kappa and percent agreement for two dichotomous outcomes: fall during pregnancy (yes, no) and any injury due to a fall during pregnancy (yes, no). All statistical analyses were performed using SAS (Cary, North Carolina), version 8.1.

D. Results

D.1 Participation and description of population

Overall, of the 6217 eligible women, 3997 (64.3%) participated (1639 phone, 506 internet and 1852 mail completions), 144 (2.3%) refused, 154 (2.5%) had no viable address and 1925 (30.9%) did not respond. The 2220 non participants (including those who did not respond to our contact attempts, refused or had no viable address) were characterized by birth certificate

data analysis as being younger compared to participants with a mean age of 27.4 compared to 29.7 years, respectively. Of the 3997 participants, 2847 (71.2%) were employed during pregnancy. Demographics of those women employed and not employed were similar (Table I); 83.4% of those employed were Caucasian, compared to 83.6% for those not employed. Also, both groups were of similar age and similar method for responding (e.g. 46.7% of the employed versus 45.4% of the unemployed responded by mail). However, college attendance was somewhat dissimilar between the employed and non-employed at 76.6% versus 70.0%, respectively. Over 90% of both groups reported having a permanent partner. Of the 6217 letters sent to eligible women, 1639 participated in the phone survey, 506 in the internet survey and 144 refused. After ten days of phone and internet interviewing, the mail survey was sent to the remaining 3928 women. From 3928 mailings, 1556 women completed the first mailing, 296 completed the second mailing and 154 had no viable addresses.

D.2 Comparing work and non-work falls in employed pregnant women

The overall fall rate among all 3997 women was 26.8% (1070). Among the 2847 employed, it was 26.6% (757) for falls versus 27.2% (313) among the 1150 not employed. Of these 757 employed women who fell during their pregnancy, 99(13.1%) fell at work, 578 (76.4%) fell elsewhere, and 80 (10.6%) fell both at work and elsewhere. Of the 80 who fell at both, 41 described their most serious fall as a work fall and 39 as a non-work fall. Therefore, in order to achieve mutually exclusive events when comparing work and non-work falls, 140 works falls (99 + 41) and 617 non-work falls (578 + 39) were used. When analyzing risk factors for a fall at work, however, 179 women who fell at work (99 + 80) were used.

The majority (61.4%) of work falls occurred from the fifth through seventh months of gestation (Fig I). Of the women who described their most serious fall at work compared to those occurring elsewhere, 51.4% versus 57.2% experienced an injury, 17.9% versus 19.3% obtained medical attention, and 30.0% versus 32.7% experienced restricted activity (Table II). Falls occurring at work were more likely to result in missed work compared to falls occurring elsewhere, 14.3% and 8.1%, respectively ($p=.02$). Though a slightly lower percentage of work versus non-work falls sought some type of medical attention (17.9% versus 19.3%), among those obtaining medical attention a considerable larger proportion of work falls required a more costly emergency room visit or hospital admission (68.0% versus 38.7%, respectively with $p<.01$). Similarly, among the women who missed work, the number who missed two or more working days for a work fall versus non-work fall was higher 70.0% versus 52.0% ($p=.17$), respectively. Those restricted six days or longer was greater for those falling at work (33.3%) than elsewhere (20.3%) ($p=.07$).

As shown in Table III, the most common contributing factors of work falls were slippery floors (40.0%), moving at a hurried pace (39.3%), and carrying an object or child (30.3%). While the most common factors for non-work falls were stairs (43.4%), slippery floors (33.9%), and carrying and object or child (27.1%). Of the 130 women wearing shoes at the time of the work fall, 33 (25.4%) reported their shoes were slick, loose, or backless and 21 (16.2%) reported a heel height of one inch or greater (not shown).

Time of fall was obtained from 71 phone and internet participants who fell and was divided into four six hour intervals beginning at six AM. The majority of work falls (52.1%) occurred in the afternoon between noon and before 6 PM. The remaining work falls were evenly divided between morning (23.9%) and evening (22.5%) with only 1.4% of the falls occurring in the early morning hours.

D.3 Work risk factors for fall at work

The occupations with the highest rates of fall at work were food service, other service (such as beauticians and housecleaners), and teaching and childcare with rates of 13.2%, 12.8%, and 10.2% respectively (Table IV). Of the 2847 women who worked during pregnancy, 89 had missing occupation (76 refusals and 13 missing or insufficient data). The fall rate at work among these 89 women was 7.9% (7). Contributing factors of falls differed by occupation for those women who described their most serious fall at work (Table V). Slippery floors were especially important among food service employees, contributing to 58.3% of their work falls. Clutter was the leading factor for nurses, involved in 40% of their work falls. Problems with shoes (including loose, backless, and slick/worn soles) were a leading factor of work falls among healthcare professionals, sales, and management/professionals. In addition, hurrying was a leading factor in work falls among food service, administration, management and professional and healthcare professional occupations. Location (indoors versus outdoors) varied with occupation. All food service work falls occurred indoors, whereas, for occupations such as service other and management/professional, almost half of work falls occurred outdoors.

Among the 89 phones and internet participants who described their most serious fall at work, 39 (43.8%) reported the fall to their employer and 12 (13.5%) filed a workers compensation claim as a result of the fall. In addition, 6.7% (6) were performing a new task at the time of the fall.

The unadjusted analysis of work conditions showed that women working in a loud environment were significantly more likely to fall at work with an odds ratio of 1.9 (95% confidence interval 1.2, 2.9) (Table VI). Other elevated but non-statistically significant factors ($OR \geq 1.2$) included working for less than three months when first pregnant (OR=1.4), rotating shifts (OR=1.2) or not knowing how much weight was lifted in a typical day (OR=1.2). Questions from the Job Content Questionnaire and job satisfaction were not statistically significant ($p<.05$); however, women having more influence over their schedule demonstrated an exposure response relationship (p=.10) of decreased falls at work.

D.4 Multivariable analysis for fall at work

Logistic regression modeling showed that, among the phone and internet participants, younger women aged 20-29 or women who worked in a loud environment had odds ratios of 1.5 (95% confidence interval 1.0, 2.3) and 1.9 (95% confidence interval 1.2, 3.0), respectively (Table VII). Phone and internet participants with less education demonstrated a protective odds ratio of 0.4 (95% confidence interval 0.2, 0.9). Significant factors for a fall at work among the mail participants were lack of a permanent partner and less than college education with odds ratios of 1.8 (95% confidence interval 1.0, 3.2) and 2.1 (95% confidence interval 1.2, 3.8).

D.5 Study reliability and validity

Based on non-response surveys, employment rates between participants and non-participants were similar at 71.2% and 72.6%, respectively. Of the 2847 employed participants, 179 (6.3%) fell at work and of the 276 employed non-participants, 23 (8.3%) fell at work. Among the participants, employment rates did not differ significantly between early responders (phone and internet) through later responders (first mailing and second mailing) although there was a gradual proportional increase in participants employed in high risk occupations from 11.7% in the phone/internet to 15.2% in the second mailing. Test retest reliability for fall and injury was completed by 415 (10.4%) of the 3997 participants. Kappa values for fall was k=.85 and for any injury was k=.58, with percent agreement of 92.8% and 84.6%, respectively.

E. Discussion

To our knowledge this is the first study investigating falls among pregnant workers. It was found that one in four pregnant workers fall and that 23.6% of those falls occur at work. In agreement with other studies, we found that younger workers are at higher risk for fall [25]. In addition, women working in a loud environment were more likely to fall at work.

Of the 1517 phone and internet participants, 12 filed a workers compensation claim as a result of the fall during their pregnancy, resulting in a 9 month incidence rate of 7.9 per 1000. A Swedish study reported a yearly incidence rate of reported accidents due to work falls of 1.3 per 1000 for female workers under the age of 45 years [26]. The Bureau of Labor Statistics reports a rate for missed work due to fall at work of 32 cases per 10,000 workers (0.32%) for all occupations and gender [15]. Our study found a rate of 20 cases per 2847 pregnant workers (0.7%) of missed work days due to a fall at work.

The occupations found to be high risk for falls during pregnancy in our study were similar to a Swedish study that reported three female occupations with high rates of fall at work: social work, child nursing and home help; lodging and catering service work; care taking and cleaning work [16]. Nurses in our study, however, did not experience a high fall rate at work. One explanation is that during pregnancy, nurses may receive more help from peers, thus decreasing their workload and their risk of falls.

Similar to our results, Kemmlert found that slippery floors and snow/ice were involved in 28% and 25%, respectively of female fall accident reports and, among waitresses, 63% of all reported falls were due to slippery floors [16]. Noting these similarities, intervention targeting female occupations may also prevent falls among pregnant workers.

The yearly cost due to work falls in the United States is estimated at $8.3 billion in direct cost and $16.6 billion in indirect cost [14]. To estimate the cost in lost wages from missed work due to falls during pregnancy, occupations from our data were applied to 2000 Bureau of Labor Statistics tables [27] to calculate a mean daily wage of $115/day for our employed participants. There are 3.9 million pregnant women annually in the United States [28], and our data suggests that 71.2% of them will be employed during pregnancy. This study found that 2.5% of pregnant workers missed work due to a fall, 0.7% due to work falls and 1.8% due to non-work falls. Using the minimum number of days of missed work of 0.5 (at least 1/2 day), 2 (2-5 days), 6 (6-10 days), and 11 (more than 10 days) based on the categories in our questionnaire (Table II), work falls during pregnancy result in at least 99,525 missed work days and $11,445,375 in lost wages and non work falls during pregnancy result in at least 79,003 missed work days and $9,085,345 in lost wages. Considering the minimum number of work days missed were used in this calculation, this is likely to be an underestimate and does not include medical cost or cost to employer such as lost productivity.

The strength of this study is the population based design and the detail descriptive information obtained regarding the characteristics of falls during pregnancy. However, some limitations exist. Due to the retrospective nature of the questionnaire, recall bias is possible. We believe recall bias for fall and injury is minimal because women were contacted within eight weeks after delivery and test retest analysis for fall and injury ranged from 0.58 - 0.85. It was possible that falls occurring early in pregnancy were not recalled. The authors believe that non-participation bias was minimal (except in younger women aged 20-24) for many reasons. First, we used the Tailored Design Method in survey creation and administration; this method as described in the Methods and Materials section has been shown to maximize participation and decrease overall survey error[29]. Second, results from the non-participation survey indicated fall rates and employment rates were similar in participants and non-participants. Third, comparing

early to late responders, the proportion of women who reported a fall did not decrease significantly. An additional strength of this study is the use of multiple survey methods to maximize participation. Although multi mode surveys are becoming more popular due to increasing difficulty in reaching population based participants by one mode (due to unlisted numbers, call blocking mechanisms and answering machines), they often exhibit different results by survey mode[29]. As demonstrated in this study, the odds ratio for women with lower education differed by survey mode (less than one among women who used the phone and internet method and greater than one among women who used the mail survey). Thus, any conclusions regarding the association between education and falls in this study may be misleading; results may be due to differential response bias. Attempts were made to decrease any bias due to survey method by using unimode construction when developing the surveys[29].

In summary, this study showed that 2.5% of pregnant workers missed work due to a fall. Prevention of work and non-work falls would likely benefit both workers and employers. Future research might explore if counseling would reduce number of falls (e.g., slowing their pace, using caution when carrying objects especially if visual range is blocked, and being especially mindful of slippery floors). Interventions targeted for specific occupations might include a reduction of slippery floors for food service employees, removing clutter for nurses, and proper shoe wear for women in sales, management, and professional occupations.

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TABLE I: Demographic characteristics of 3997 participants stratified by employment status during pregnancy. *

	Employed (n=2847)	Not employed (n=1150)	Total (n=3997)
Age[a]	29.7 ± 5.1	30.6 ± 5.2	29.9 ± 9
Race			
Caucasian	2374 (83.4)	961 (83.6)	3335 (83.4)
African American	280 (9.8)	72 (6.3)	352 (8.8)
Other	98 (3.4)	82 (7.1)	180 (4.5)
Refuse/missing	95 (3.3)	35 (3.0)	130 (3.3)
Education			
≤ high school education	667 (23.4)	345 (30.1)	1012 (25.4)
some college	631 (22.2)	277 (24.2)	908 (22.8)
college grad	1547 (54.4)	525 (45.8)	2072 (51.9)
refuse/missing	2 (0.1)	3 (0.3)	5 (0.1)
Permanent partner	2592 (91.1)	1075 (93.5)	3667 (91.9)
Method			
Phone	1142 (40.1)	497 (43.2)	1639 (41.0)
Internet	375 (13.2)	131 (11.4)	506 (12.7)
Mail	1330 (46.7)	522 (45.4)	1852 (46.3)
Fall	757 (26.6)	313 (27.2)	1070 (26.8)

*Data are presented as n (%)
[a]Age presented as mean ± standard deviation.

FIGURE I: Fall Frequency by Gestational Age for Work Falls (N=140)

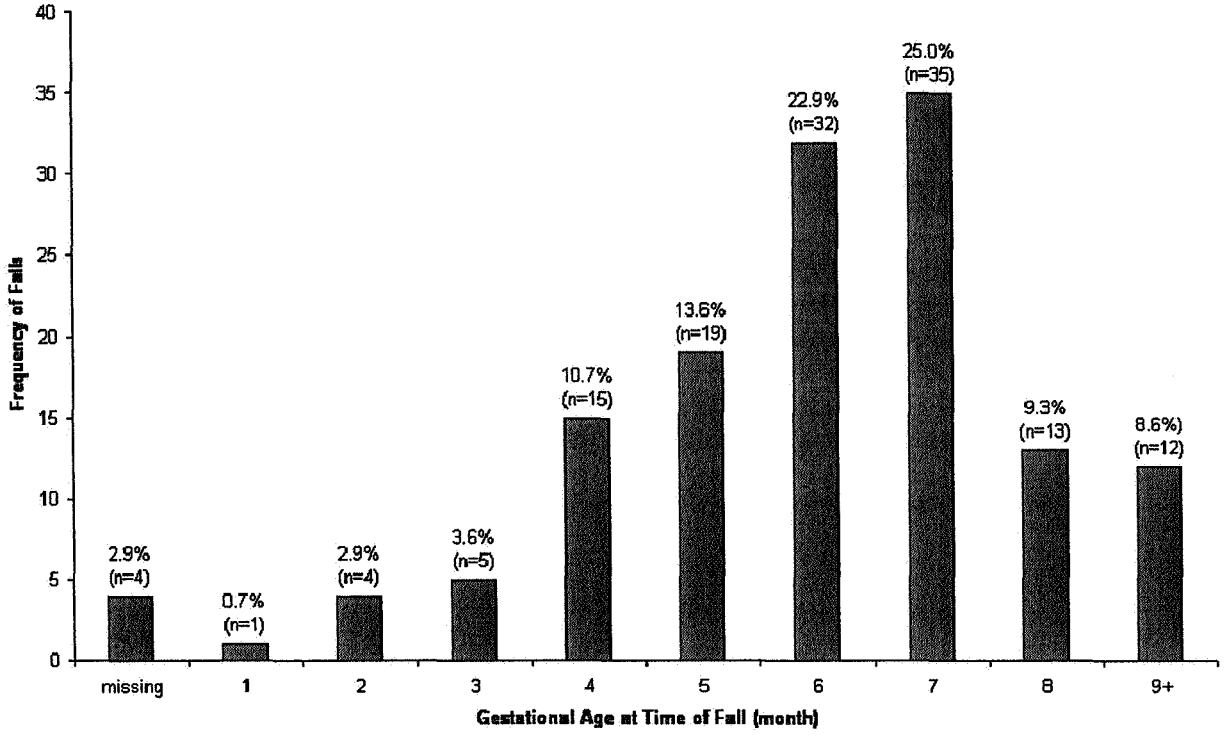

TABLE II: Injury, Medical Attention, Restricted Activity, and Missed Work for Most Serious Falls Occurring at Work (n=140) versus Elsewhere (n=617).

	WORK FALL	NON-WORK FALL
Injury		
	n (% of 72)	n (% of 353)
Bruise	26 (36.1)	157 (44.5)
Cut	16 (22.2)	30 (8.5)
Turned ankle	4 (5.5)	44 (12.5)
Sprain/strain	15 (20.8)	94 (26.6)
Broken bone	5 (6.9)	11 (3.1)
Other	6 (8.3)	17 (4.8)
Medical attention obtained		
	n (% of 25)	n (% of 119)
Visit to physician office	8 (32.0)	73 (61.3)
Emergency room visit	12 (48.0)	36 (30.3)
Hospital admission	5 (20.0)	10 (8.4)
Restricted activity		
	n (% of 42)	n (% of 202)
≤ 1 day	16 (38.1)	79 (39.1)
2-5 days	12 (28.6)	82 (40.6)
6-10 days	6 (14.3)	18 (8.9)
> 10 days	8 (19.0)	23 (11.4)
Missed work*		
	n (% of 20)	n (% of 50)
≤ 1 day	6 (30.0)	24 (48.0)
2-5 days	5 (25.0)	23 (46.0)
6-10 days	2 (10.0)	2 (4.0)
> 10 days	7 (35.0)	1 (2.0)

*work falls resulted in more missed days compared to non-work falls (p=.02)

TABLE III: Comparison of Contributing Factors of Work and Non-Work Falls.

Factor of Fall	Work Falls (n=140) n (%)	Non-work Falls (n=617) n (%)	Total Falls (n=757) n (%)
Indoors[b]	93 (66.4)	327 (53.0)	420 (55.5)
Stairs[b]	30 (21.4)	268 (43.4)	298 (39.4)
Body Movements at Time of Fall:			
Carrying an object or child[a]	27 (30.3)	79 (27.1)	106 (27.8)
Turning, reaching, or bending[a]	23 (25.8)	64 (21.9)	87 (22.8)
Pushing, pulling, or lifting[a]	2 (2.3)	14 (4.8)	16 (4.2)
Hurried pace[a,c]	35 (39.3)	76 (26.0)	111 (29.1)
Running[a]	2 (2.3)	8 (2.7)	10 (2.6)
Struck, pushed, or knocked over by accident	5 (3.6)	26 (4.2)	31 (4.1)
Struck, pushed, or knocked over on Purpose	1 (0.7)	4 (0.7)	5 (0.7)
Fell from elevation[a,b]	20 (23.3)	122 (41.8)	142 (37.6)
Fell more than 3 feet[a]	1 (0.7)	27 (4.4)	28 (3.7)
Vision Problems:			
Obstructed View[a]	6 (6.7)	36 (12.3)	42 (11.0)
Poor Lighting	18 (12.9)	114 (18.5)	132 (17.4)
Slippery floor surface overall	56 (40.0)	209 (33.9)	265 (35.0)
Slip on water[b]	31 (22.1)	78 (12.6)	109 (14.4)
Slip on snow	18 (12.9)	102 (16.5)	120 (15.9)
Slip on other	15 (10.7)	52 (8.4)	67 (8.9)
Uneven/sloped floor[c]	25 (17.9)	175 (28.4)	211 (26.4)
Cluttered area[c]	16 (11.4)	37 (6.0)	53 (7.0)
Time of fall[a]			
6:00 am - 11:59 am	17 (23.9)	67 (27.7)	84 (26.8)
12:00 pm -5:59 pm[c]	37 (52.1)	92 (38.0)	129 (41.2)
6:00 pm - 11:59 pm[c]	16 (22.5)	74 (30.6)	90 (28.8)
12:00 am - 5:59 am	1 (1.4)	9 (3.7)	10 (3.2)
Unknown or missing	18	50	68

[a]Questions included in the internet and phone but not in the mail survey therefore the denominators are 89 work falls and 292 non-work falls (total n=381).
[b]chi square $p<.01$
[c]chi square $p<.05$

TABLE IV: Proportion of Falls at Work by Occupation from Highest to Lowest risk.

Occupation	Total employed	Fell at work (%)
Food service	106	14 (13.2)
Service other (hairdressers, housekeeping, protective, & transport)	102	13 (12.8)
Teachers/childcare	354	36 (10.2)
Healthcare professionals (MDs, vets, dentists, pharm, RDs, PAs, therapists, not nursing)	101	8 (7.9)
Missing, refuse, insufficient work data	89	7 (7.9)
Sales/retail sales (not food)	324	18 (5.6)
Management and professional (not healthcare or teachers)	809	44 (5.4)
Nursing	212	11 (5.2)
Administration	497	23 (4.6)
Healthcare services (dental hygiene, tech, not nursing)	95	3 (1.3)
Others (farmers, laborers, forestry, technologists, technicians not healthcare)	158	2 (1.3)

Table V: Leading Contributing Factors of Work Falls by Occupation*

Occupation	Work Falls (n)	n(%) indoors	slippery flr	clutter	hurry[a]	carry[a]	shoeprob[b]	stairs
Food service	12	12 (100)	7 (58.3)	1 (8.3)	3 (100.0)	2 (66.7)	0	2 (16.7)
Service other	11	5 (45.5)	5 (45.5)	1 (5.6)	1 (14.3)	1 (14.3)	2 (18.2)	2 (18.2)
Teachers/childcare	30	22 (73.3)	12 (40.0)	4 (13.3)	3 (15.0)	4 (20.0)	8 (26.7)	6 (20.0)
Healthcare professionals	6	5 (83.3)	1 (16.7)	1 (16.7)	2 (40.0)	1 (20.0)	5 (83.3)	1 (16.7)
Sales/retail sales	13	8 (61.5)	4 (30.8)	2 (15.4)	3 (50.0)	4 (66.7)	5 (38.5)	3 (23.1)
Management/professional	33	18 (54.5)	15 (45.5)	1 (3.0)	11(45.8)	7 (29.1)	11 (33.3)	7 (21.2)
Nursing	10	8 (80.0)	1 (10.0)	4 (40.0)	1 (16.7)	1 (16.7)	1 (10.0)	1 (10.0)
Administration	16	10 (62.5)	5 (31.3)	1 (6.3)	9 (75.0)	5 (41.7)	4 (25.0)	6 (37.5)

*Factors were not mutually exclusive

[a] Questions included in the internet and phone but not in the mail survey therefore the denominators vary by occupation as follows: Food service (3); Service other (7); Teachers/childcare (20); Healthcare professionals (5); Sales/retail sales (6); Management/professional (24); Nursing (6); Administration (12).

[b] Shoe problem includes shoes that are loose, backless, or have worn/slick soles.

Table VI: Crude Odds Ratios for Fall at Work for Work Risk Factors for 1,517 Phone and Internet Participants Employed during Pregnancy.

Factor	Fall Rate at Work (n)	Crude OR (95% CI)	p
Loud environment			
Yes	10.5% (30/285)	1.87 (1.20, 2.92)	.006
No	5.9% (73/1232)	1.0 (reference)	
Work history at time became pregnant			
< 3 months	8.8% (16/182)	1.38 (.79, 2.42)	.25
At least 3 months	6.5% (86/1321)	1.0 (reference)	
Work rotating shifts			
Yes	7.9% (15/189)	1.21 (.69, 2.14)	.51
No	6.7% (88/1324)	1.0 (reference)	
How much weight did your job commonly require you to lift (pounds)?			
< 10	6.7% (66/987)	1.0 (reference)	
10 pounds or more	7.1% (34/482)	1.06 (.69, 1.63)	.87
Don't know	6.7% (3/45)	1.00 (.30, 3.30)	.96
How many times a day did you lift that weight?			
<5x	6.9% (23/332)	1.0 (reference)	
At least 5x	7.0% (12/171)	1.01 (.49, 2.09)	.80
Don't know	8.3% (2/24)	1.22 (.27, 5.52)	.86

TABLE VII. Adjusted odds ratios for Fall at Work for Phone/Internet and Mail Participants

VARIABLE	PHONE/INTERNET			MAIL		
	ALL (n) n=1517	FALL[a] n (%) n=103 (6.8)	aOR (95%CI)[b]	ALL (n) n=1330	FALL[a] n (%) n=76 (5.7)	aOR (95%CI)[b]
Age (years)[c]						
20-29	659	53 (8.0)	1.5 (1.0[e], 2.3)	741	44 (5.9)	ns[f]
≥ 30	858	50 (5.8)	1.0 (ref)	589	32 (5.4)	
Permanent partner[d]						
Yes	1456	101 (6.9)	ns[f]	1139	55 (4.8)	1.0 (reference)
No	61	2 (3.3)		191	21 (11.0)	1.8 (1.0[e], 3.2)
Education[cd]						
≤ high school degree	277	11 (4.0)	0.4 (0.2, 0.9)	390	37 (9.5)	2.1 (1.2, 3.8)
some college	304	22 (7.2)	0.9 (0.5, 1.4)	329	15 (4.6)	1.1 (0.6, 2.1)
college grad	936	70 (7.5)	1.0 (reference)	611	24 (3.9)	1.0 (reference)
Loud work environment[c]						
Yes	285	30 (10.5)	1.9 (1.2, 3.0)		Not available[g]	
No	1232	73 (5.9)	1.0 (reference)			

[a]Denotes fall at work

[b]aOR denotes adjusted odds ratios and CI, confidence interval

[c]Variables involved in phone and internet final model. Initial model consisted of unadjusted factors with p<.25 among phone and internet participants: survey method, education, maternal age, number of toddlers cared for during pregnancy, diabetes, and fulltime employment status during pregnancy (employed full time, employed part time), influence over work schedule, loud work environment, and duration of employment at time of initial pregnancy.

[d]Variables involved in mail final model. Initial model consisted of unadjusted factors with p<.25 among mail participants: lack of a permanent partner, education, age, and race.

[e]Lower bound confidence interval was rounded down to 1.0, does not include 1.0

[f] Not significant at p<.05 to be in final model

[g] Question was not included in the mail survey

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Dunning K, LeMasters G, Levin L, Bhattacharya A: Falls in workers during pregnancy: job hazards and high risk occupations. Sixteenth EPICOH Congress on Epidemiology in Occupational Health, Barcelona Spain, September 2002

LeMasters G, Dunning K, Levin L: Potential selection biases of 4000 new mothers responding to internet, phone or mailed health surveys. Sixteenth EPICOH Congress on Epidemiology in Occupational Health, Barcelona Spain September, 2002

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LeMasters G, Dunning K, Levin L, Bhattacharya A: Potential participation and response bias using phone, internet and mailed survey methodologies. (In preparation to be submitted to Public Health Reports)