Analysis of Fall Injuries by Body Mass Index

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Objective: To examine the association of body mass index (BMI) and fall injuries.

Methods: Data were derived from the 2010 Behavioral Risk Factor Surveillance System and included subjects aged 45 years and older from Texas. The outcome was self-reported falls that resulted in injury to the respondents. Analysis of fall injuries by BMI was conducted and standard errors, 95% confidence intervals (CIs), and coefficients of variation were reported. Complex sample multivariate Poisson regression was used to examine the association of BMI and fall injuries.

Results: A total of 18,077 subjects were surveyed in 2010, and 13,235 subjects were aged 45 years old and older. The mean BMI was higher (29.94 vs 28.32 kg/m^2) among those who reported fall injuries compared with those who did not. The fall injuries reported by obese respondents (relative risk [RR] 1.67) were found to be significantly ($P = 0.031$) higher compared with normal-weight respondents in the multivariate regression. Other risk factors that had significant association with fall injuries (when adjusted for BMI) were activity limitations (RR 5.00, 95% CI 3.36–7.46) compared with no limitations, and not having formal employment (homemaker: RR 2.68, 95% CI 1.33–5.37; unable to work: RR 5.01, 95% CI 1.87–13.29; out of work and students: RR 3.21, 95% CI 1.41–7.29) compared with the employed population.

Conclusions: There is a significant association between obesity and fall injuries in adults aged 45 years old and older in Texas. Interventions in fall prevention, although generally targeted at present to older adults, also should take into account the weight status of the subjects.

Key Words: body mass index, fall injuries, falls, obesity, overweight

More than one-third of adults (33.8%) in the United States are obese.[1] Rates have been rising dramatically during the last 20 years,[2] and every state had an obesity prevalence rate of at least 20% in 2010.[2] Ratings of at least 25% were found in 36 states with Texas being one of 12 states reaching 30% prevalence.[2] The prevalence of obesity is higher in certain population groups such as those living in rural areas, African Americans, and those without a high school diploma.[3] Obesity has been identified as a risk factor for a host of chronic disease conditions and injuries, including falls.[3a, 14]

Risk factors for falls have been categorized as intrinsic and extrinsic factors. Numerous reports have studied risk factors in each of these categories, but it is accepted that falls often result from dynamic interactions of risks in both categories. Intrinsic factors include a history of falls, age, sex, living alone, ethnicity, medicines, medical conditions, impaired mobility and gait, sedentary behavior, psychological status, nutritional deficiencies, impaired cognition, visual impairments, and foot problems. Extrinsic factors include environmental hazards such as poor lighting, slippery floors and uneven surfaces, footwear and clothing, and inappropriate walking aids, or assistive devices.[4,5]

Some studies have explored the association between obesity and falls[6–10]; however, the mechanism of this elevated risk for people who are obese is unknown. Further research that studies the association between obesity and injury at the population level and explores how this association varies by demographic characteristics, socioeconomic conditions, and health status could provide updated and critical information to create greater awareness about the overweight/obesity burden for the community, employers, healthcare providers, health-promotion advocates, and other stakeholders. This study was undertaken to provide updated evidence on the association of obesity and falls.

Key Points

- This study details the association of obesity and fall-related injuries at the population level.
- This study explores how the association between obesity and fall injury varies as to demographic characteristics.
- This study provides critical information and creates greater awareness about the overweight/obesity burden for individuals, the community, employers, healthcare providers, health-promotion advocates, and other stakeholders.

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A unique opportunity exists to examine the association between excess weight and injury in the United States using the Behavioral Risk Factor Surveillance System (BRFSS).[11] BRFSS is the world's largest ongoing telephone health survey system, tracking health conditions and risk behaviors in the United States yearly since 1984.[11] These data provide detailed demographic, socioeconomic, behavioral risk, and health status information on nationally representative populations.[11] Data from Texas were used because they were accessible to this team and the population surveyed was large enough to test the hypothesis. Texas is the second-largest US state in terms of population and has a high rate of obesity, a diverse population with respect to race/ethnicity and socioeconomic status, and a large segment of its population lives in the border region (along the United States-Mexico border).

The objective of this research was to provide an update on the evidence of association between body mass index (BMI) and the risk of fall injuries and how this association varies by age, sex, ethnicity, risk factor for heavy alcohol consumption, activity limitations, income, marital status, employment, health status, and presence of diabetes mellitus and cardiovascular disease. We expect that the findings from this study will support the incorporation of BMI as a new and important demographic variable in epidemiological investigations that study the risk factors of falls and other injuries; existing studies on falls rarely go beyond the traditional demographic factors such as age, sex, and race/ethnicity. By establishing this association, a different dimension of the burden of the obesity epidemic is brought to light, because studies associated with obesity often ignore acute injury as outcomes and the associated economic burden of these obesity-associated injuries.

Methods

Data from the 2010 Texas BRFSS were used for this analysis. The Texas BRFSS is a part of the national BRFSS and conducts an independent annual telephone survey in coordination with the Centers for Disease Control and Prevention (CDC). The outcome for this study was defined as falls within 3 months and falls that caused an injury in the previous 3 months. The exact questions asked were the following: In the past 3 months, how many times have you fallen? and Did this fall cause an injury? An injury implied that the reported fall restricted regular activities for at least 1 day or required medical attention. Both injury outcome (falls and fall injuries) were used in this analysis; however, the primary focus was on falls that resulted in injury.

The primary independent variable of interest was BMI as a categorical variable (normal, overweight, or obese), and the covariates were age (categorical or continuous variable), sex (male vs female), marital status (married vs unmarried), employment status (employed, homemakers, retired, unable to work, others [out of work or students]), risk of heavy alcohol consumption (at risk vs not at risk), limited in activities (yes vs no), income (<$25,000, $25,000 to <$75,000, or >$75,000), general health (fair to poor vs excellent, very good, or good), doctor-diagnosed diabetes (yes vs no), and cardiovascular disease (yes vs no).We used CDC definitions of overweight and obesity: a BMI between 25 and 29.9 is considered overweight and a BMI of 30 or higher is considered obese.[12]

The CDC weighted survey data to correct for the probabilities of selection in terms of telephone number selection, number of adults in the household, and number of residential telephone lines, as well as a poststratification weighting factor that adjusted estimates by age and sex to the geographic stratification of population. As such, to adjust for this complex sample data, statistical methods taking the complex sampling into account were applied.

Descriptive statistics such as mean and percentage of falls and fall injuries by BMI categories were reported. Their standard errors (SEs), 95% confidence intervals (CIs), coefficients of variation, design effects, and unweighted counts also were presented. Complex sample Poisson regression was used to examine the association of BMI with the risk of fall injuries. This was performed in two ways: first, BMI was considered as a categorical variable (normal, overweight, or obese); second, BMI was treated as a continuous variable, which was viewed as a trend test to examine whether the risk of fall injuries increases when BMI increases. Both models were adjusted for confounding variables. The crude rate ratios (RRs), adjusted RRs, 95% CIs, and *P* values were reported.

All of the analyses were conducted using SAS version 9.02 (SAS Institute, Cary, NC) and STATA version 12 (StataCorp, College Station, TX). The significance level was 0.05 with two-sided tests. Typically, respondents who did not know the answer or refused to answer were not included in the calculation of parameter estimates. This study was approved by the institutional review board at the University of Texas Health Science Center, Houston.

Results

Of the 18,077 subjects surveyed in 2010, 13,235 subjects were 45 years old or older; 2307 falls and 837 fall injuries were reported. Because 313 and 336 subjects had missing data for the outcome of falls and fall injuries, 12,922 and 12,899 subjects remained for analyses for falls and fall injuries, respectively.

Female subjects accounted for 63.9% of the population studied. Approximately 37% were overweight and 30.8% were obese. Their average age was 64.0 years. Approximately 27.8% ranked their general health as fair to poor; 19.2% were reported to have doctor-diagnosed diabetes mellitus and 17.2% had cardiovascular disease. In the study population, 56.5% were married, 15.9% did not graduate from high school, approximately 39.2% were currently employed, 35.4% had a household income <$25,000, 24.1% were Hispanic, 22.2% were living in the border regions, approximately 3.8% were at risk for heavy alcohol consumption, and 30.2% had limitations to normal activities. The characteristics of subjects who sustained falls and fall injuries are compared in Table 1.

Table 1. Characteristics of subjects who sustained falls and fall injuries: 2010 Texas BRFSS data

Variables/levels	Respondents with falls (%)	Respondents with no falls (%)	Respondents with fall injuries (%)	Respondents with no fall injuries (%)	Total respondents (%)
BMI categories					
Normal	640 (29.1)	3317 (32.8)	233 (29.2)	3719 (32.4)	4050 (32.2)
Overweight	745 (33.9)	3808 (37.7)	252 (31.6)	4296 (37.4)	4651 (37.0)
Obese	815 (37.0)	2982 (29.5)	312 (39.1)	3476 (30.2)	3870 (30.8)
Age, y (SD)	64.5 (11.7)	63.9 (11.4)	63.7 (11.7)	64.0 (11.5)	64.0 (11.5)
Age group, y					
45–54	552 (23.9)	2638 (24.9)	217 (25.9)	2970 (24.6)	3271 (24.7)
55–64	670 (29.0)	3066 (28.9)	252 (30.1)	3475 (28.8)	3828 (28.9)
>65	1085 (47.0)	4911 (46.3)	368 (44.0)	5617 (46.6)	6136 (46.4)
General health					
Fair to poor	1043 (45.6)	2518 (23.9)	472 (56.8)	3073 (25.6)	3658 (27.8)
Good, very good, or excellent	1246 (54.4)	8037 (76.1)	359 (43.2)	8917 (74.4)	9496 (72.2)
Sex					
Male	740 (32.1)	3918 (36.9)	243 (29.0)	4407 (36.5)	4784 (36.1)
Female	1567 (67.9)	6697 (63.1)	594 (71.0)	7655 (63.5)	8451 (63.9)
Doctor-diagnosed diabetes					
Yes	586 (25.5)	1884 (17.8)	236 (28.3)	2228 (18.5)	2537 (19.2)
No	1716 (74.5)	8720 (82.2)	599 (71.7)	9820 (81.5)	10,681 (80.8)
Cardiovascular diseases					
Yes	613 (27.1)	1575 (15.0)	267 (32.7)	1916 (16.1)	2241 (17.2)
No	1650 (72.9)	8900 (85.0)	550 (67.3)	9982 (83.9)	10,802 (82.8)
Marital status					
Married	1125 (48.9)	6142 (58.1)	371 (44.4)	6886 (57.3)	7445 (56.5)
Unmarried	1175 (51.1)	4431 (41.9)	465 (55.6)	5129 (42.7)	5739 (43.5)
Education					
<High school	461 (20.0)	1556 (14.7)	177 (22.1)	1826 (15.2)	2099 (15.9)
High school graduate and some college	1185 (51.4)	5431 (51.3)	448 (53.7)	6162 (51.2)	6761 (51.2)
College graduate	658 (28.6)	3600 (34.0)	210 (25.1)	4045 (33.6)	4342 (32.9)
Employment					
Yes	635 (27.7)	4387 (41.6)	177 (21.3)	4844 (40.4)	5155 (39.2)
No	1661 (72.3)	6152 (58.4)	655 (78.7)	7136 (59.6)	7989 (60.4)
Household income					
<$25000	914 (46.6)	2930 (32.8)	385 (54.0)	3449 (33.9)	3944 (35.4)
$25000 to <$75000	699 (35.6)	3608 (40.3)	233 (32.7)	4071 (40.0)	4388 (39.4)
>$75,000	350 (17.8)	2406 (26.9)	95 (13.3)	2660 (26.1)	2805 (25.2)
Race/ethnicity					
White	1534 (67.4)	7093 (67.8)	516 (62.4)	8100 (68.2)	8783 (67.4)
Black	147 (6.5)	646 (6.2)	65 (7.9)	726 (6.1)	819 (6.3)
Hispanic	541 (23.8)	2485 (23.8)	219 (26.5)	2798 (23.5)	3138 (24.1)
Other	53 (2.3)	234 (2.2)	27 (3.3)	260 (2.2)	296 (2.3)
Border/nonborder					
Border	1758 (77.7)	8093 (77.9)	635 (77.3)	9201 (77.9)	10,056 (77.8)
Nonborder	505 (22.3)	2294 (22.1)	187 (22.7)	2607 (22.1)	2877 (22.2)
Employment status					
Employed (for wages or self-employed)	635 (27.7)	4387 (41.6)	4844 (40.4)	177 (21.3)	5155 (39.2)
Homemakers	244 (10.6)	1156 (11.0)	1307 (10.9)	92 (11.1)	1432 (10.9)

TABLE 1. *(Continued)*

Variables/levels	Respondents with falls (%)	Respondents with no falls (%)	Respondents with fall injuries (%)	Respondents with no fall injuries (%)	Total respondents (%)
Retired	775 (33.8)	3851 (36.5)	4368 (36.5)	251 (30.2)	4711 (35.8)
Unable to work	509 (22.2)	703 (6.7)	938 (7.8)	261 (31.4)	1262 (9.6)
Other (out of work, students)	133 (5.8)	442 (4.2)	523 (4.4)	51 (6.1)	584 (4.4)
Risk factor for heavy alcohol consumption					
Not at risk	2201 (97.0)	9992 (96.0)	803 (97.6)	11,367 (96.1)	12,394 (96.2)
At risk	69 (3.0)	414 (4.0)	20 (2.4)	463 (3.9)	494 (3.8)
Limited in activities					
Yes	1184 (51.9)	2701 (25.6)	534 (64.6)	3339 (27.9)	3964 (30.2)
No	1096 (48.1)	7852 (74.4)	293 (35.4)	8645 (72.1)	9180 (69.8)

Because of rounding, percentages shown may not add up to 100%. BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; SD, standard deviation.

The mean BMI for those sustaining fall injuries was higher than for those who did not fall (29.94 kg/m^2 vs 28.32 kg/m^2; Table 2). Mean BMI also was higher for those experiencing falls compared with those who reported no falls (29.39 kg/m^2 vs 28.23 kg/m^2). The SEs and confidence values (CVs) were higher in subjects with fall injuries (SE 0.457 vs 0.104, CV 0.015 vs 0.004) and with falls (SE 0.254 vs 0.111, CV 0.009 vs 0.004), reflecting a larger variation of BMI in the group with falls or fall injury than in those without falls or fall injury.

The normal-weight and overweight groups reported 5.2% and 5.3% fall injuries, respectively (Table 3), compared with the obese group, which reported 7.0% fall injuries. In total, 5.8% (5.2%–6.5%) of subjects were injured from falls in the survey population.

Complex sample multivariate Poisson regression was applied to examine the risk of fall injuries in relation to BMI and other risk factors (Table 4). There was a statistically significant association (P = 0.031) between the risk of fall injuries and obese respondents (RR 1.67, 95% CI 1.05–2.66) compared with normal-weight respondents. Significant association was reported between falls and those who were not formally employed (homemakers: RR 2.68, 95% CI 1.33–5.37, P = 0.006; unable to work: RR 5.01, 95% CI 1.88–13.38, P = 0.001; others [people who were out of work or students]: RR 3.21, 95% CI 1.41–7.32, P = 0.006) relative to those who reported being employed. No significant relation was found between falls and retired workers (RR 1.38, 95% CI 0.76–2.49, P = 0.288) compared with employed workers; however, a significant association was reported between falls and activity limitations (RR 5.00, 95% CI 3.36–7.46, P < 0.001).

BMI was treated as a continuous variable in another model (data not shown). This model was viewed as a test of the linear trend for BMI increase with the risk of fall injuries. After adjustment of the confounding factors, BMI was statistically and positively associated with the risk of fall injuries (RR 1.03, 95% CI 1.01–1.05, P = 0.007). From these results, it appeared that a 1-U increase in BMI was associated with a 3% increase in reporting fall injuries. There was no significant association of risk of fall injuries found with general health status, sex, diabetes mellitus diagnosis, cardiovascular diseases, marital

Table 2. Means of body mass index by falls and fall injuries: complex sample descriptive

Outcome	Mean	Standard error	95% CI	Coefficient of variation	Design effect	Population size	Unweighted count
Fall injuries							
Yes	29.94	0.457	29.04–30.83	0.015	2.892	456,039	797
No	28.32	0.104	28.12–28.53	0.004	3.306	7,359,185	11,491
Total	28.42	0.102	28.22–28.62	0.004	3.269	7,815,224	12,288
Falls							
Yes	29.39	0.254	28.89–29.89	0.009	2.889	1,303,373	2200
No	28.23	0.111	28.01–28.44	0.004	3.364	6,524,214	10,107
Total	28.42	0.102	28.22–28.62	0.004	3.266	7,827,587	12,307

CI, confidence interval.

Table 3. Percentage of fall injuries by BMI categories: complex sample descriptive

BMI category/ estimates	Respondents with fall injuries	Respondents without fall injuries
Normal weight		
Percentage	5.2	94.8
SE, %	0.6	0.6
95% CI	4.2–6.5	93.5–95.8
Confidence values	0.108	0.006
Design effect	2.364	2.364
Unweighted count	233	3719
Overweight		
Percentage	5.3	94.7
SE, %	0.6	0.6
95% CI	4.2–6.5	93.5–95.8
Confidence values	0.112	0.006
Design effect	3.184	3.184
Unweighted count	252	4296
Obese		
Percentage	7.0	93.0
SE, %	0.7	0.7
95% CI	5.8–8.5	91.5–94.2
Confidence values	0.099	0.007
Design effect	3.006	3.006
Unweighted count	312	3476
Total		
Percentage	5.8	94.2
SE, %	0.4	0.4
95% CI	5.2–6.5	93.4–94.8
Confidence values	0.061	0.004
Design effect	2.876	2.876
Unweighted count	797	11,491

BMI, body mass index; CI, confidence interval; SE, standard error.

status, income, race/ethnicity, and risk factor for heavy alcohol consumption.

Discussion

A higher BMI is shown to have a positive association with higher rates of fall injuries in this study. This association between fall injuries and obesity is significant after accounting for multiple confounding factors. Other studies have shown a higher risk of fall-related injuries among obese individuals. In a study of University of Oklahoma employees, approximately 27% of obese respondents reported falls in the previous year and 32% admitted to stumbling while walking.[13] A study of the Medical Expenditure Panel Survey found a higher rate of injuries, especially falls, requiring medical attention among people with a higher BMI and obesity classification.[14] The BRFSS data for Texas allowed this research group to reconfirm this association and find a significant difference in rates of fall injuries between obese and normal-weight people; however, another study did not find a statistically significant relation.[15]

Wu et al reported that obese people fall more often as compared with normal-weight people.[6] The mechanism that causes this risk for obese people is unknown, but researchers hypothesize that gait patterns, chronic conditions, and health problems are some of the risk factors.[7,8] Common outcomes of falls reported by other studies include fear of falling, additional falls, fall injury, fractures, hospitalization, impaired mobility, loss of independence, impaired quality of life, decreased self-efficacy, and activity avoidance.[16,17]

Our study revealed that people who were limited in their activities were significantly more likely than people whose activities were not limited to sustain fall injuries. Certain comorbid conditions, which could be the risk factors of falls, also may be the underlying reasons for activity limitations. Falls, however, may have created the activity limitations. In addition, not being employed has been demonstrated as a risk factor for falling in other studies.[18] Our study confirmed that not being employed (excluding retirement) may be a risk factor for falling. Conversely, a serious fall injury may be a risk factor for losing employment. Also, as a cross-sectional survey, our instrument did not reveal as to the risk factor of poor health whether people who had fallen may have reported poor health or whether people who have poor health have more falls incidents.

There was no significant association between age and fall injuries when age was input as a continuous or categorical variable in the models. As evidenced by previous studies,[19–21] it is likely that the association between age and falls may have been partially mediated by myriad other reasons such as the risk factors of heavy alcohol consumption, activity limitations, income, marital status, employment, health status, and presence of diabetes and cardiovascular disease. Falls have intrinsic and extrinsic factors, and falls often result from dynamic interactions of risks in multiple categories. It is possible that age may not always present itself as an independent risk factor of falls when other age-related variables such as living alone, medical conditions, impaired mobility and gait, psychological status, nutritional deficiencies, impaired cognition, visual impairments, environmental hazards, constrictive footwear and clothing, and inappropriate walking aids or assistive devices are taken into account in the model. Other reasons that may explain this lack of association include a relatively healthy and young population surveyed, some of whom may be at higher work-, leisure-, or exercise-related risk, compared with the older adult populations that typically are subjects in fall epidemiology studies. We cannot examine this assumption further because of the lack of an indicator

Table 4. Association of BMI and other variables of interest with the risk of fall injuries: complex sample Poisson regression model

Variables	Crude RR (95% CI)	*P*	Adjusted RR (95% CI)	*P*
BMI categories				
Underweight vs normal	0.47 (0.20–1.10)	0.082	0.32 (0.11–0.89)	0.029
Overweight vs normal	1.05 (0.66–1.68)	0.824	1.23 (0.77–1.98)	0.384
Obese vs normal	1.72 (1.11–2.66)	0.015	1.62 (1.02–2.59)	0.043
Age group, y				
55–64 vs 45–54	0.94 (0.59–1.49)	0.783	0.83 (0.53–1.29)	0.397
>65 vs 45–54	0.62 (0.43–0.91)	0.013	0.70 (0.46–1.07)	0.099
General health fair to poor, yes vs no	5.46 (3.61–8.26)	<0.001	1.44 (0.75–2.79)	0.277
Male vs female	0.99 (0.67–1.46)	0.958	1.56 (0.97–2.47)	0.063
Diabetes mellitus, yes vs no	1.51 (1.04–2.19)	0.029	0.74 (0.49–1.14)	0.171
Cardiovascular diseases, yes vs no	2.47 (1.67–3.67)	<0.001	1.07 (0.69–1.66)	0.765
Marital status, unmarried vs married	2.33 (1.61–3.38)	<0.001	1.36 (0.97–1.90)	0.072
Income				
$25,000 to <$75,000 vs >$75,000	1.80 (0.89–3.62)	0.102	0.93 (0.41–2.14)	0.869
<$25,000 vs >$75,000	4.74 (2.33–9.65)	<0.001	1.02 (0.40–2.60)	0.964
Race/ethnicity				
Black vs white	2.20 (1.11–4.39)	0.024	1.46 (0.76–2.80)	0.257
Hispanic vs white	0.93 (0.64–1.36)	0.718	0.75 (0.50–1.11)	0.151
Other vs white	0.87 (0.47–1.61)	0.659	0.66 (0.28–1.55)	0.337
Employment status				
Homemakers vs employed	2.24 (1.30–3.88)	0.004	2.67 (1.33–5.35)	0.006
Retired vs employed	1.63 (1.12–2.38)	0.011	1.38 (0.77–2.49)	0.288
Unable to work vs employed	14.53 (9.37–22.53)	<0.001	4.99 (1.87–13.29)	0.001
Other (out of work, students) vs employed	5.45 (2.43–12.23)	<0.001	3.21 (1.41–7.29)	0.006
Risk factor for heavy alcohol consumption, at risk vs not at risk	1.14 (0.44–2.97)	0.793	1.84 (0.84–4.04)	0.135
Limited in activities, yes vs no	7.85 (5.55–11.09)	<0.001	5.01 (3.36–7.48)	<0.001

Adjusted variables in the multivariate models were age group (45–54, 55–64, ≥65); sex; general health (fair to poor vs excellent, very good, and good); doctor-diagnosed diabetes mellitus (yes vs no) and/or cardiovascular disease (yes vs no); marital status (unmarried vs married); household income (<$25,000, $25,000 to <$75,000, >$75,000); race/ethnicity (white, black, Hispanic, other); employment status (employed, homemaker, retired, unable to work, other [out of work or student]); risk factor for heavy alcohol consumption (at risk vs not at risk); and limited in any way in any activities because of physical, mental, or emotional problems (yes vs no). If BMI was treated as a continuous variable in the complex sample Poisson regression model and the adjusted variables were the same as the above, BMI was positively associated with the risk of fall injuries (RR 1.03, 95% CI 1.01–1.05, P = 0.007); this showed a linear trend of the risk of fall injuries with the increase of BMI. If the polynomial regression model (quadratic) was run, the BMI was statistically significant (RR 1.16, 95% CI 1.01–1.33, P = 0.035), but the quadratic item was not statistically significant, P = 0.076. BMI, body mass index; CI, confidence interval; RR, rate ratio.

variable in the dataset. In addition, our study did not find an association between age group and the risk of injurious falls, which could be by chance.

The limitations of this research are mainly data related, because BRFSS data do not include information on other injuries except falls; do not contain information related to the cause, nature, or severity of falls; and data are self-reported and respondents may overestimate height and underestimate weight, creating biased BMI estimates. Height and weight (ie, BMI) were recorded at the time of the survey call, whereas a fall injury could have occurred any time during the previous 3 months. The assumption is that BMI has not changed between the survey call and the date of fall injury; this is fairly reasonable because of the short period between the survey and the date of fall injury. Some obese/overweight workers who experienced an injury or disability may no longer be participating in the survey because of health issues; therefore, they would not be included in the study population, resulting in a selection bias issue. The use of BMI as an indicator for overweight/obesity has been questioned by some studies and waist measures have been proposed. The BRFSS survey, however, does not capture this variable.[22,23] The dataset did not contain information indicating where the falls occurred (eg, at home, at work, in nursing facility, in hospital). Such information would assist in the development of preventive programs in the appropriate direction. In the present study, underweight respondents were combined with the normal-weight group because there were only 176 underweight individuals with 12 injurious falls reported.

Despite these limitations, BFRSS data have been used widely in epidemiological studies including injury and other

health issues.[24–26] The results of our study may not be applicable to other populations because the Texas climate or other region-specific variable may have an impact on the type or severity of falls. Future studies should examine these issues in other states and regions to establish whether the results from Texas are generalizable.

Numerous environmental, occupational, and other determinants are proven risk factors for falls, and this survey data did not contain information on these. Doctor-diagnosed diabetes mellitus and cardiovascular disease could serve as proxy variables for the medications taken because medications previously have been implicated as a risk factor.

The need to curb the upward trend of the incidence and prevalence of obesity and its comorbid conditions has received much attention among public health and public policy advocates. Although other health conditions such as diabetes mellitus, heart disease, and stroke have been proven more prevalent in the obese population, injury, especially related to falls, also is an important concern. Education about fall prevention, although generally targeted at present to older adults at risk also could be applied to overweight and obese subjects of all age groups.

Conclusions

Innovative strategies are required during the next few decades to help ensure that overweight/obese people are free from injury and illness. With inadequate evidence in the scientific literature and a general lack of understanding about the association between BMI and the risk of fall injuries, few attempts will be made to reduce falls among overweight/obese people. We expect that this research will aid in the development of interventions and will tailor health-promotion programs designed to reduce the risk of fall injuries among people with weight issues.

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