BMI and Seatbelt Use

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Abstract

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Objective: Seatbelt use among obese persons may be reduced because seatbelts are uncomfortable. We investigated the association between obesity and seatbelt use with data from the 2002 Behavioral Risk Factor Surveillance System Survey.

Research Methods and Procedures: Multivariable logistic regression was used to calculate odds ratios and 95% confidence intervals (CIs) for seatbelt use among overweight (BMI, 25.0 to 29.9), obese (BMI, 30.0 to 39.9), and extremely obese (BMI $\geq$ 40.0) persons, relative to a non-overweight/non-obese reference group (BMI $\leq$ 24.9), adjusted for age, race, gender, education, and state seatbelt law.

Results: Adjusted odds ratios for seatbelt use were 0.89 (95% CI, 0.85 to 0.93) for overweight, 0.69 (0.66 to 0.73) for obese, and 0.45 (95% CI, 0.40 to 0.50) for extremely obese persons. Interaction effects were evident for all covariates, with stronger associations between increasing BMI and decreasing seatbelt use for women, increasing age, higher education, and residence in states with a secondary seatbelt law. There was a linear decrease in seatbelt use with increasing BMI for all subgroups except persons 18 to 24 years old.

Discussion: Lack of seatbelt can be added to the list of risk factors associated with obesity. Effective preventive interventions are needed to promote seatbelt use among overweight and obese persons.

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Introduction

Motor vehicle crashes are a leading cause of preventable morbidity and mortality in the U.S., accounting for some 40,000 fatalities, 500,000 hospitalizations, and 4 million emergency department visits annually (1). Seatbelts can reduce crash-related deaths and injuries by 50% or more (2), yet 20% of U.S. adults do not routinely buckle up (3). Because discomfort is a widely cited reason for non-use of seatbelts (4), seatbelt use prevalence may be lower among the obese. However, little is known about the association between body weight and seatbelt use.

Several previous studies have examined the association between body weight and seatbelt use (5–7). In a survey of 3410 adults, Lichtenstein et al. (5) found that obesity was an independent risk factor for non-use of seatbelts. Using a sample of internal medicine patients, Hunt et al. (6) reported obesity as one of several risk factors for non-use of seatbelts. Using data from the 1981 to 1983 Behavioral Risk Factor Surveys, Goldbaum et al. (7) reported that obesity was associated with decreased seatbelt use. Several studies have looked at the relationship between relative body weight and risk of injury in a motor vehicle crash, with several examining seatbelt use as a confounding variable (8–12). Boulanger et al. (13), in an examination of injury patterns of obese persons in motor vehicle crashes, reported a lower rate of seatbelt use among the obese, but the finding was not statistically significant. All studies specifically examining obesity as a correlate of seatbelt use have found that seatbelt use decreases as BMI increases (5–7). The other studies that have looked at seatbelt use in the context of obesity and injury have focused on seatbelt use and obesity as independent predictors of injury and death and have not specifically reported the association between BMI and seatbelt use (8–12).

Further epidemiological investigation could help to clarify the need for preventive interventions to promote seatbelt use among the obese and to identify subpopulations of obese persons at greatest risk for non-use of seatbelts. We examined the association between BMI and seatbelt usage

using data from the 2002 Behavioral Risk Factor Surveillance System (BRFSS)[1] survey.

Research Methods and Procedures

Data Source

The BRFSS is a cross-sectional telephone survey designed to collect information on risk behaviors and health practices associated with leading causes of death (14). Surveys are conducted by state health departments with assistance from the Centers for Disease Control and Prevention (14). A multi-stage design based on random digit dialing methods is used to select a representative sample of respondents from the civilian, non-institutionalized population 18 years and older in each state (14). In 2002, 247,964 surveys were conducted, with response rates ranging from 42.2% in New Jersey to 82.6% in Minnesota (15).

Outcome Variable

In the 2002 BRFSS survey, seatbelt use was assessed using the question "How often do you use seatbelts when you drive or ride in a car?", with response categories always, nearly always, sometimes, seldom, and never. For this analysis, responses were coded dichotomously (always used vs. less than always) because this approach minimizes misclassification bias as a result of over-reporting frequency of seatbelt use (16).

Exposure Variable

BMI (kilograms per meter squared) was calculated using self-reported data on height and weight. Based on guidelines adapted from the World Health Organization (17), four categories were used for analysis (18): non-overweight/non-obese reference group (BMI $\leq$ 24.9), overweight (25.0 $\leq$ BMI $\leq$ 29.9), obese (30.0 $\leq$ BMI $\leq$ 39.9), and extremely obese (BMI $\geq$ 40.0).

Covariates

Age (18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65+), gender, race/ethnic group (non-Hispanic white, non-Hispanic black, Hispanic, other), and education ($\leq$high school, $>$high school) were included as potential confounders in multivariable models because they are correlated with both BMI and seatbelt use. Because type of state seatbelt law has been reported to be an effect modifier of risk factors for seatbelt use (19), we coded each state as having a primary seatbelt law (police officers can stop and cite motorists solely for violating a seatbelt law) or a secondary seatbelt law (motorists can be cited for violating a seatbelt law only after being stopped for another offense). In 2002, 18 states (AL, CA, CT, GA, HI, IN, IA, LA, MD, MI, NJ, NM, NY, NC, OK, OR, TX, WA) plus the District of Columbia had primary laws in effect; all other states except New Hampshire had secondary laws. Because secondary laws are much less effective than primary laws, New Hampshire was classified as a secondary law state for analysis. Data on study variables were available for 230,344 (92.4%) BRFSS respondents.

Statistical Analysis

Because the BRFSS uses a complex survey sampling strategy, SUDAAN software (20) was used to account for design effects. Weighted proportions of seatbelt users were calculated within strata of BMI and other covariates. Logistic regression analyses were conducted to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for seatbelt use among the overweight, obese, and extremely obese, relative to the non-overweight/non-obese reference group. ORs were adjusted for age group, gender, race/ethnicity, education, and state law. Because multiple significant second order interactions were found for each of the three BMI categories, adjusted ORs for seatbelt use were also calculated in separate models within strata of the covariates.

Results

Table 1 shows weighted proportions of seatbelt users by selected characteristics of the study population. The proportion of seatbelt users decreased linearly with increasing BMI category. Although 82.6% of persons with a BMI $\leq$ 24.9 reported always using seatbelts, the prevalence of seatbelt use dropped to 69.8% among persons with a BMI $\geq$ 40.0. Seatbelt use was lowest among persons in the 18- to 24- and 25- to 34-year-old age groups and highest among persons 65+ years old. Men were less likely to buckle up than women. Hispanics were most likely to report always using seatbelts, whereas African Americans were least likely to buckle up. Persons with education beyond high school were more likely to use seatbelts than persons with a lower level of education.

Table 2 shows adjusted ORs and 95% CIs for seatbelt use among overweight, obese, and extremely obese persons relative to the non-overweight/non-obese reference group. Adjusted ORs for seatbelt use decreased linearly with increasing BMI. The adjusted ORs for seatbelt use were 0.89 (95% CI, 0.85 to 0.93) for overweight, 0.69 (0.66 to 0.73) for obese, and 0.45 (95% CI, 0.40 to 0.50) for extremely obese persons. Stratification indicated that the association of increasing BMI with decreasing seatbelt use was strongest for ages $\geq$ 35, women, whites and Hispanics, persons with education beyond high school, and persons residing in states with a secondary seatbelt law (see Table 2).

Discussion

These data show that overweight, obesity, and extreme obesity are associated with significantly decreased use of

[1] Nonstandard abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; OR, odds ratio; CI, confidence interval.

Table 1. Weighted proportions of seatbelt users by BMI category, BRFSS 2002

	Non-obese		Overweight		Obese		Extremely obese	
Characteristic	***N****	**Use (%)†**	***N****	**Use (%)†**	***N****	**Use (%)†**	***N****	**Use (%)†**
Overall	93,058	82.6	80,887	80.1	43,329	76.6	5572	69.8
Age (yrs)								
18 to 24	10,623	74.5	4347	72.5	1953	68.7	210	72.5
25 to 34	17,096	80.8	11,954	76.5	6290	74.7	881	64.1
35 to 44	19,173	84.9	16,119	79.8	8966	76.5	1323	71.7
45 to 54	16,257	86.0	17,106	82.0	9985	77.7	1512	71.2
55 to 64	10,809	85.5	12,991	82.1	7789	77.7	1012	65.8
65+	19,100	87.4	18,370	84.0	8346	80.0	634	75.6
Sex								
Men	29,197	76.2	42,198	75.8	19,141	71.6	1642	63.9
Women	63,861	86.8	38,689	86.5	24,188	81.9	3930	73.6
Race/ethnicity								
White	77,246	82.2	65,777	78.6	33,510	74.4	4052	67.3
Black	4773	78.0	5837	80.1	4713	77.8	872	72.9
Hispanic	6338	86.6	4688	84.0	2546	76.8	337	73.8
Other	4701	86.0	4585	87.1	2560	86.8	311	74.7
Education								
≤High school	35,749	78.3	34,505	77.4	20,854	74.5	2831	70.2
>High school	57,309	85.4	46,382	82.1	22,475	78.6	2741	69.2
Seatbelt law‡								
Primary	37,217	86.8	31,582	85.1	16,930	82.6	2205	79.4
Secondary	55,841	77.7	49,305	74.1	26,399	69.4	3367	58.5

BRFSS, Behavioral Risk Factor Surveillance System.

* Unweighted total number of study participants in each substratum.

† Proportions weighted using SUDAAN to account for BRFSS complex survey sampling strategy.

‡ In states with primary enforcement, police officers can stop and cite motorists solely for violating a seatbelt law. In states with secondary enforcement, motorists can be cited for violating a seatbelt law only after being stopped for another offense.

seatbelts. The strength of associations increased linearly with increasing BMI category. In the 2002 BRFSS data set, 36.9% of respondents were overweight, 19.5% were obese, and 2.5% were extremely obese. Because seatbelts can reduce motor vehicle crash-related morbidity and mortality by 50% or more (3), these findings suggest that many American motorists are unnecessarily at risk for death or injury in motor vehicle crashes. The Healthy People 2010 Initiative has designated obesity as a leading health indicator due to increased risk of cardiovascular disease, diabetes, and some cancers (21). Our findings suggest that unintentional injury secondary to motor vehicle crashes is another potential health consequence of obesity, given the lower prevalence of seatbelt use among the obese.

Given available information on reasons for seatbelt non-use in the general population (4), discomfort is likely to be an important consideration for the obese. Factory-installed automobile seatbelts may be too small for many obese persons. Although most auto manufacturers make seatbelt extenders available, some do not, and others charge extra for them (22). Efforts should be made to raise public awareness about seatbelt extender availability, and manufacturers not offering seatbelt extenders should be encouraged, or required, to make them available. Engineering solutions such as seatbelts with wider, more cushioned bands and greater adjustability may also be helpful by making seatbelts more comfortable for overweight and obese persons.

Although BRFSS data are representative of the U.S. population, selection bias may exist because a substantial proportion of eligible respondents declined to participate in the survey. Additionally, because BRFSS data are self-reported, reporting bias may exist for both the exposure variable of BMI and the outcome variable of seatbelt

Table 2. Adjusted ORs* and 95% CIs for seatbelt use† among motorists with BMI classifications‡ of overweight, obesity, and extreme obesity compared with non-obese motorists, BRFSS, 2002

	Overweight [OR (95% CI)]	Obese [OR (95% CI)]	Extremely obese [OR (95% CI)]
Overall	0.89 (0.85 to 0.93)	0.69 (0.66 to 0.73)	0.45 (0.40 to 0.50)
Age group (yrs)			
18 to 24	0.98 (0.85 to 1.12)	0.82 (0.67 to 1.00)	0.97 (0.57 to 1.63)
25 to 34	0.93 (0.84 to 1.03)	0.80 (0.71 to 0.90)	0.44 (0.34 to 0.58)
35 to 44	0.81 (0.74 to 0.89)	0.65 (0.59 to 0.72)	0.43 (0.35 to 0.53)
45 to 54	0.85 (0.76 to 0.94)	0.62 (0.55 to 0.69)	0.42 (0.34 to 0.53)
55 to 64	0.88 (0.78 to 0.99)	0.65 (0.57 to 0.74)	0.32 (0.26 to 0.40)
65+	0.84 (0.76 to 0.93)	0.60 (0.53 to 0.67)	0.43 (0.32 to 0.58)
Sex			
Men	0.89 (0.84 to 0.95)	0.74 (0.69 to 0.79)	0.51 (0.43 to 0.61)
Women	0.90 (0.84 to 0.96)	0.63 (0.59 to 0.68)	0.40 (0.35 to 0.45)
Race/ethnicity			
White	0.88 (0.84 to 0.92)	0.67 (0.63 to 0.70)	0.43 (0.39 to 0.48)
Black	1.04 (0.88 to 1.23)	0.83 (0.70 to 0.98)	0.61 (0.45 to 0.82)
Hispanic	0.80 (0.64 to 1.00)	0.54 (0.43 to 0.69)	0.45 (0.26 to 0.77)
Other	0.95 (0.76 to 1.19)	0.90 (0.69 to 1.17)	0.40 (0.26 to 0.63)
Education			
≤High school	0.92 (0.86 to 0.98)	0.74 (0.68 to 0.79)	0.54 (0.46 to 0.63)
>High school	0.85 (0.80 to 0.91)	0.65 (0.60 to 0.69)	0.36 (0.31 to 0.42)
Seatbelt law§			
Primary	0.91 (0.84 to 0.98)	0.71 (0.65 to 0.78)	0.53 (0.44 to 0.64)
Secondary	0.87 (0.83 to 0.91)	0.67 (0.63 to 0.71)	0.39 (0.34 to 0.45)

OR, odds ratio; CI, confidence interval; BRFSS, Behavioral Risk Factor Surveillance System.

* Overall ORs are adjusted for age group, sex, race/ethnic group, education, and type of seatbelt law enforcement in state of residence. Stratum-specific ORs are adjusted for the other covariates. The reference group is BRFSS respondents with a BMI classification of non-obese (i.e., BMI ≤ 24.9).

† Seatbelt use dichotomously categorized as always use vs. do not always use, based on motorist self-report.

‡ Overweight, BMI of 25 to 29.9; obese, BMI of 30.0 to 39.9; extremely obese, BMI ≥ 40.

§ In states with primary enforcement, police officers can stop and cite motorists solely for violating a seatbelt law. In states with secondary enforcement, motorists can be cited for violating a seatbelt law only after being stopped for another offense.

use. Self-reported weights typically underestimate the prevalence of obesity, with accuracy varying by age, gender, method of data collection, and ethnicity (23–25). Self-reported seatbelt use is usually higher than rates obtained from direct observation, yet state-level estimates of seatbelt rates from self-report and direct observation are consistently correlated (26). There may be unmeasured variables, such as type of vehicle driven, which might help explain some of the interaction effects involving age, education, and gender. Nevertheless, the strength of our findings and their potential significance from the standpoint of public health underscore the need for more epidemiological research to further elucidate the association between obesity and seatbelt use.

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