Overweight and obesity among U.S. adults with and without disability, 1999–2012

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ABSTRACT

Objective. Examine the relationship between disability and overweight/obesity among U.S. adults.

Methods. Study sample (N = 30,363) came from the National Health and Nutrition Examination Survey 1999–2012 waves. Disability was classified into five domains using standardized indices. Any disability was defined as having any difficulty in performing at least one of the activities in any of the five disability domains. Logistic regressions were conducted to estimate the association between disability and overweight/obesity, adjusted by individual characteristics and multiyear complex sampling design.

Results. Over a quarter (25.99%) of U.S. adults 20 years and older reported having any disability. The overweight/obesity rates across all disability domains were substantially higher than their nondisabled counterparts. The rate of overweight and obesity combined (BMI ≥ 25 kg/m^2), obesity (BMI ≥ 30 kg/m^2), grade 2 and 3 obesity combined (BMI ≥ 35 kg/m^2), and grade 3 obesity (BMI ≥ 40 kg/m^2) among people with any disability were 1.14 (73.54% versus 64.50%), 1.38 (41.37% versus 29.99%), 1.71 (19.81% versus 11.60%), and 1.94 (8.60% versus 4.43%) times the corresponding rate among people without disability, respectively. Compared with their nondisabled counterparts, the adjusted odds of overweight and obesity combined, obesity, grade 2 and 3 obesity combined, and grade 3 obesity were 24% (95% confidence interval [CI]: 14%–36%), 32% (95% CI: 22%–44%), 49% (95% CI: 35%–64%), and 55% (95% CI: 27%–89%) higher among people with any disability, respectively.

Conclusion. People with disabilities have substantially higher risk of obesity compared to their nondisabled peers.

Introduction

Obesity is a leading risk factor for many adverse health outcomes such as type 2 diabetes, hypertension, dyslipidemia, coronary heart disease and certain types of cancer (Villareal et al., 2005). From 1976–1980 to 2011–2012, the prevalence of obesity more than doubled in the U.S. adult population (An, 2014; Fryar et al., 2014). People with disability face various daily challenges, such as pain, financial strain, lack of healthy food choices, difficulty with chewing or swallowing food, medications that cause weight gain or changes in appetite, and functional limitations that reduce one's ability to exercise, which may expose them to an elevated risk of unhealthy body weight (Centers for Disease Control and Prevention, 2014a).

Existing studies that document disparities in obesity rate between people with and without disability typically focus on one specific disability type (e.g., physical mobility or activities of daily living) and/or use non-nationally representative data (Alley and Chang, 2007; Bowen, 2012; Evers and Mattsson, 2001; Himes, 2000; Houston et al.,

2009; Lamb et al., 2000; Launer et al., 1994; Spyropoulos et al., 1991; Sturm et al., 2004; Vincent et al., 2010). This brief report added a new data point to the literature by examining the relationship between various domains of self-reported disability and measured overweight/obesity status using 14 years of data from a national health survey representative of the U.S. population.

Methods

Survey participants

Individual-level data came from the National Health and Nutrition Examination Survey (NHANES) 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010 and 2011–2012 waves. NHANES is a program of studies conducted by the National Center for Health Statistics to assess the health and nutritional status of children and adults (Centers for Disease Control and Prevention, 2014b). A multistage probability sampling design is used to select participants representative of the civilian, non-institutionalized U.S. population.

Among the 38,024 adults 20 years of age and above who participated in the NHANES 1999–2012 waves, the following individuals were

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excluded from the analyses: missing data on disability measures, body height/weight and/or other covariates, 6310; and pregnant women, 1351. The remaining 30,363 participants were included in the analysis.

Disability domains

Nineteen validated questions were administered to assess five domains of disability (Cook et al., 2006; Farnsworth et al., 2015): activities of daily living (ADLs), instrumental activities of daily living (IADLs), leisure and social activities (LSAs), lower extremity mobility (LEM) and general physical activities (GPAs). Each question item evaluated the difficulty an individual had in performing a task without the aid of any equipment, and participants were required to choose from among four difficulty levels: "no difficulty", "some difficulty", "much difficulty", and "unable to do". ADLs consist of four activities: dressing oneself; walking between rooms on the same floor; getting in and out of bed; and using a fork, knife and drinking from a cup. IADLs consist of three activities: managing money; doing household chores; and preparing meals. LSAs consist of three activities: going out to movies and events; attending social events; and performing leisure activities at home. LEM consists of two activities: walking a quarter mile and walking up 10 steps. GPAs consist of seven activities: stooping, crouching and kneeling; lifting and carrying; standing up from an armless chair; standing for long periods; sitting for long periods; reaching up over one's head; and grasping/holding small objects. A disability is defined as having any difficulty in performing at least one of the activities within a given domain. Five dichotomous variables for ADLs, IADLs, LSAs, LEM, and GPA conditions were constructed, with no disability as their common reference group. No disability refers to having no difficulty in performing any activities within any of the five disability domains. In contrast, any disability refers to having any difficulty in performing at least one of the activities in any of the five disability domains. Among the total effective sample of 30,363, there are 3838, 5309, 3924, 3692, and 9242 participants who reported having ADLs, IADLs, LSAs, LEM, and GPAs (not mutually exclusive as one may qualify for multiple disability domains), respectively, whereas 10,150 participants reported having any disability.

Overweight/obesity status

NHANES respondents' body weight and height were measured by digital scale and stadiometer in the Mobile Examination Center. Specific anthropometry procedures apply to wheelchair users, amputees and people with comprehension or language difficulties. Body mass index (BMI) is defined by weight in kilograms divided by height in meters squared. Four overweight/obesity measures were examined: overweight and obesity combined (BMI $\geq$ 25 kg/m^2), obesity (BMI $\geq$ 30 kg/m^2), grade 2 and 3 obesity combined (BMI $\geq$ 35 kg/m^2), and grade 3 obesity (BMI $\geq$ 40 kg/m^2).

Individual characteristics

The following individual characteristics were controlled in regression analyses: a dichotomous variable for sex (male as the referent group), four age categories (35–49 years of age, 50–64 years of age, and 65 years of age and above, with 20–34 years of age as the referent group), four categories for race/ethnicity (non-Hispanic African American, non-Hispanic other race or multi-race, and Hispanic, with non-Hispanic white as the referent group), a dichotomous variable for education (high school education or lower as the referent group), three categories for marital status (divorced or separated or widowed, and never married, with married as the referent group), three categories for annual household income to poverty ratio (IPR) (IPR < 1.3, and 1.3 $\leq$ IPR < 3.0, with IPR $\geq$ 3.0 as the referent group), a dichotomous variable for smoking status (never smoker as the referent group), a dichotomous variable for public or private health insurance coverage (without

any health insurance coverage as the referent group), a dichotomous variable for general health status (being in fair or poor health as the referent group), five disease conditions: diabetes, arthritics, coronary health disease, stroke, and cancer (no corresponding diseases as the referent groups), and seven NHANES waves to account for potential nationwide temporal trend and survey wave difference: 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, and 2011–2012, with 1999–2000 as the referent group.

Statistical analyses

Logistic regressions were conducted to examine the relationship between disability (five disability domains and any disability) and overweight/obesity status, adjusted by individual characteristics. The four outcome variables are overweight and obesity combined (BMI $\geq$ 25 kg/m^2), obesity (BMI $\geq$ 30 kg/m^2), grade 2 and 3 obesity combined (BMI $\geq$ 35 kg/m^2), and grade 3 obesity (BMI $\geq$ 40 kg/m^2).

In sensitivity analysis, we included interaction terms between disability and age groups, and between disability and racial/ethnic groups, besides their respective main effects in the regression. The estimated coefficients of those interaction terms were mostly nonsignificant at P < 0.05. We therefore reported modeling outcomes from logistic regressions without interaction terms.

All statistical analyses were conducted using Stata 13.1 SE version (StataCorp, College Station, TX). NHANES sampling design was incorporated in both descriptive statistics and regression analyses.

Results

Table 1 reports the prevalence of overweight/obesity and individual characteristics of the study sample with and without disability. During 1999–2012, 66.90% of adults 20 years of age and above were overweight or obese (BMI $\geq$ 25 kg/m^2), and 33.01%, 13.78%, and 5.53% were obese (BMI $\geq$ 30 kg/m^2), grade 2 or 3 obese (BMI $\geq$ 35 kg/m^2), and grade 3 obese (BMI $\geq$ 40 kg/m^2), respectively. Over a quarter (25.99%) of adults reported having any disability in a year. The prevalence of overweight/obesity differed substantially between people with and without disability. The rate of overweight and obesity combined (BMI $\geq$ 25 kg/m^2), obesity (BMI $\geq$ 30 kg/m^2), grade 2 and 3 obesity combined (BMI $\geq$ 35 kg/m^2), and grade 3 obesity (BMI $\geq$ 40 kg/m^2) among people with any disability were about 1.14 (73.54% vs. 64.50%), 1.38 (41.37% vs. 29.99%), 1.71 (19.81% vs. 11.60%), and 1.94 (8.60% vs. 4.43%) times the corresponding rate among people without disability, respectively. Compared with their nondisabled counterparts, people with any disability were more likely to be female, older, non-Hispanic white, of lower education and income level, divorced or separated or widowed, former or current smoker, in fair/poor health, covered by health insurance (mostly Medicare), and with various chronic diseases.

Across disability domains, the prevalence of ADLs, IADLs, LSAs, LEM and GPAs in the U.S. adult population were 9.31%, 9.65%, 13.33%, 9.23% and 23.79%, respectively (not shown in table). The obesity rate in any of the 5 disability domains was noticeably higher than their nondisabled counterparts. For instance, the rate of overweight and obesity combined (BMI $\geq$ 25 kg/m^2), obesity (BMI $\geq$ 30 kg/m^2), grade 2 and 3 obesity combined (BMI $\geq$ 35 kg/m^2), and grade 3 obesity (BMI $\geq$ 40 kg/m^2) among people with LEM were about 1.18, 1.53, 2.02, and 2.32 times the corresponding rate among people without disability, respectively. People with multiple disabilities tended to have even higher obesity rate compared to those with a single disability condition. The rate of overweight and obesity combined (BMI $\geq$ 25 kg/m^2), obesity (BMI $\geq$ 30 kg/m^2), grade 2 and 3 obesity combined (BMI $\geq$ 35 kg/m^2), and grade 3 obesity (BMI $\geq$ 40 kg/m^2) among people with a single disability condition was 71.92%, 34.50%, 12.77%, and 5.07%, respectively, whereas that among people with four or more disability conditions was 76.67%, 51.27%, 27.91%, and 13.32%.

Table 1
Prevalence of obesity and individual characteristics among U.S. adults with and without disability, 1999–2012.

Sample characteristics	All	Any disability	No disability
Sample size	30,363	10,063	20,300
Weighted proportion (%)	100	25.99	74.01
Overweight/obesity (%)			
Overweight and obesity combined (BMI ≥ 25 kg/m²)	66.90 (65.95, 67.86)	73.54 (72.50, 74.58)	64.50 (63.36, 65.64)
Obesity (BMI ≥ 30 kg/m²)	33.01 (32.09, 33.94)	41.37 (40.21, 42.52)	29.99 (28.93, 31.04)
Grade 2 and 3 obesity combined (BMI ≥ 35 kg/m²)	13.78 (13.18, 14.39)	19.81 (18.87, 20.76)	11.60 (10.97, 12.23)
Grade 3 obesity (BMI ≥ 40 kg/m²)	5.53 (5.17, 5.90)	8.60 (7.83, 9.37)	4.43 (4.05, 4.80)
Gender (%)			
Female	51.19 (50.68, 51.71)	57.05 (56.04, 58.06)	49.08 (48.40, 49.76)
Age (%)			
20–34 years of age	28.16 (27.03, 29.29)	8.95 (8.08, 9.81)	35.10 (33.73, 36.46)
35–49 years of age	31.26 (30.28, 32.24)	18.95 (17.76, 20.15)	35.71 (34.55, 36.87)
50–64 years of age	24.08 (23.22, 24.93)	28.77 (27.54, 30.00)	22.38 (21.30, 23.46)
65 years of age and above	16.51 (15.72, 17.29)	43.33 (41.69, 44.97)	6.81 (6.33, 7.29)
Race/ethnicity (%)			
White, non-Hispanic	70.94 (68.52, 73.36)	75.74 (73.17, 78.31)	69.20 (66.75, 71.66)
African American, non-Hispanic	10.96 (9.62, 12.30)	10.80 (9.25, 12.34)	11.02 (9.70, 12.34)
Other race/multi-race, non-Hispanic	5.60 (4.92, 6.28)	5.00 (4.12, 5.88)	5.82 (5.10, 6.54)
Hispanic	12.50 (10.69, 14.31)	8.46 (6.56, 10.37)	13.96 (12.12, 15.79)
Education (%)			
College education and above	56.97 (55.35, 58.60)	45.01 (43.09, 46.94)	61.30 (59.63, 62.96)
Marital status (%)			
Married	63.78 (62.56, 65.00)	58.25 (56.66, 59.83)	65.77 (64.42, 67.13)
Divorced or separated or widowed	18.57 (17.90, 19.24)	31.27 (30.01, 32.53)	13.99 (13.26, 14.71)
Never married	17.65 (16.45, 18.85)	10.48 (9.49, 11.48)	20.24 (18.84, 21.64)
Income to poverty ratio (IPR) (%)			
IPR < 1.3	21.37 (20.11, 22.62)	29.62 (27.56, 31.69)	18.38 (17.25, 19.52)
1.3 ≤ IPR < 3.0	28.98 (27.97, 29.99)	33.77 (32.28, 35.25)	27.25 (26.14, 28.36)
IPR ≥ 3.0	49.65 (47.89, 51.42)	36.61 (34.48, 38.74)	54.37 (52.53, 56.21)
Smoking (%)			
Former or current smoker	47.66 (46.46, 48.87)	55.71 (54.31, 57.11)	44.76 (43.43, 46.09)
Current health status (%)			
Good, very good or excellent health	82.88 (82.09, 83.68)	61.98 (60.30, 63.65)	90.44 (89.85, 91.03)
Health insurance (%)			
With health insurance	81.25 (80.24, 82.26)	88.49 (87.49, 89.49)	78.63 (77.45, 79.81)
Chronic condition (%)			
Diabetes	7.80 (7.36, 8.23)	16.95 (15.87, 18.04)	4.49 (4.15, 4.83)
Arthritis	23.64 (22.76, 24.52)	52.99 (51.64, 54.33)	13.03 (12.35, 13.71)
Coronary artery disease	3.36 (3.07, 3.65)	8.65 (7.88, 9.42)	1.44 (1.22, 1.67)
Stroke	2.73 (2.49, 2.97)	7.92 (7.19, 8.66)	0.85 (0.71, 0.99)
Cancer	8.77 (8.33, 9.20)	17.56 (16.59, 18.53)	5.59 (5.16, 6.03)
Survey wave (%)			
1999–2000	11.07 (9.31, 12.84)	9.49 (7.63, 11.35)	11.65 (9.81, 13.48)
2001–2002	13.82 (12.57, 15.08)	13.05 (11.46, 14.64)	14.10 (12.81, 15.39)
2003–2004	14.42 (12.63, 16.20)	16.66 (13.96, 19.37)	13.61 (12.01, 15.20)
2005–2006	15.00 (13.32, 16.67)	14.83 (12.67, 16.99)	15.06 (13.30, 16.82)
2007–2008	14.83 (13.26, 16.40)	15.05 (12.71, 17.38)	14.75 (13.09, 16.41)
2009–2010	15.10 (13.54, 16.66)	15.15 (13.35, 16.94)	15.08 (13.52, 16.65)
2011–2012	15.76 (13.99, 17.53)	15.77 (13.32, 18.22)	15.75 (13.88, 17.63)

Notes: Individual-level data from NHANES 1999–2012 waves. NHANES sampling design was incorporated in estimating the percentages. 95% confidence intervals are in parentheses.

Table 2 reports the estimated odds ratios of obesity from logistic regressions. Compared to those without disability, the adjusted odds of overweight and obesity combined (BMI ≥ 25 kg/m²), obesity (BMI ≥ 30 kg/m²), grade 2 and 3 obesity combined (BMI ≥ 35 kg/m²), and grade 3 obesity (BMI ≥ 40 kg/m²) were 24% (adjusted odds ratio [AOR] = 1.24, 95% confidence interval [CI] = 1.14, 1.36), 32% (AOR = 1.32, 95% CI = 1.22, 1.44), 49% (AOR = 1.49, 95% CI = 1.35, 1.64), and 55% (AOR = 1.55, 95% CI = 1.27, 1.89) higher among people with any disability, respectively. The estimated odds ratios of obesity (BMI ≥ 30 kg/m²), grade 2 and 3 obesity combined (BMI ≥ 35 kg/m²), and grade 3 obesity (BMI ≥ 40 kg/m²) across all five disability domains (ADLs, IADLs, LSAs, LEM and GPAs) were statistically significant at

P < 0.001. For instance, compared to those without disability, the adjusted odds of obesity (BMI ≥ 30 kg/m²), grade 2 and 3 obesity combined (BMI ≥ 35 kg/m²), and grade 3 obesity (BMI ≥ 40 kg/m²) were 26% (AOR = 1.26, 95% CI = 1.09, 1.45), 51% (AOR = 1.51, 95% CI = 1.29, 1.78), and 59% (AOR = 1.59, 95% CI = 1.23, 2.06) higher among people with a disability in ADLs, respectively.

Discussion

One fundamental goal in the Healthy People 2020 is to "achieve health equity, eliminate disparities, and improve the health of all groups" (US Department of Health and Human Services, 2008). This

Table 2
Estimated odds ratios of obesity among U.S. adults, 1999–2012.

Disability domain	Overweight and obesity combined (BMI ≥ 25 kg/m²)	Obesity (BMI ≥ 30 kg/m²)	Grade 2 and 3 obesity combined (BMI ≥ 35 kg/m²)	Grade 3 obesity (BMI ≥ 40 kg/m²)
Any disability	1.24 (1.14, 1.36)	1.32 (1.22, 1.44)	1.49 (1.35, 1.64)	1.55 (1.27, 1.89)
Activities of daily living (ADLs)	1.15 (0.99, 1.33)	1.26 (1.09, 1.45)	1.51 (1.29, 1.78)	1.59 (1.23, 2.06)
Instrumental activities of daily living (IADLs)	1.11 (0.99, 1.25)	1.21 (1.09, 1.35)	1.43 (1.25, 1.65)	1.43 (1.12, 1.82)
Leisure and social activities (LSAs)	1.11 (0.98, 1.26)	1.31 (1.16, 1.47)	1.60 (1.37, 1.86)	1.55 (1.22, 1.97)
Lower extremity mobility (LEM)	1.38 (1.20, 1.59)	1.54 (1.37, 1.73)	1.86 (1.59, 2.19)	1.85 (1.38, 2.49)
General physical activities (GPAs)	1.28 (1.16, 1.40)	1.36 (1.24, 1.48)	1.54 (1.38, 1.71)	1.61 (1.30, 1.99)

Notes: Individual-level data (N = 30,363) from NHANES 1999–2012 waves. Logistic regressions were conducted to estimate the odds ratios of obesity among U.S. adults, adjusted by individual characteristics (gender, age, race/ethnicity, education, marital status, household income, smoking status, health insurance coverage, general health status, chronic conditions, and NHANES survey wave) and accounting for NHANES sampling design. 95% confidence intervals are in parentheses.

study found that substantial disparities in overweight/obesity prevalence are present between U.S. adults with and without disability, and the gap persists even after accounting for differences in individual sociodemographics and health/disease conditions. The exceptionally high obesity risk may prevent people with disability from achieving their fullest health potential, interfere with daily activities, and significantly reduce quality of life.

This study has important limitations. Participants' disability conditions were self-reported and subject to social desirability bias. The study design is observational and cross-sectional, so that the estimated relationship between disability status and obesity should be interpreted as an association rather than causation. Using data from a nationally representative longitudinal survey of community-dwelling middle-aged and older adults, An and Shi (2015) found prior-wave unhealthy body weight to prospectively predict disability onset. This brief report examined obesity in relation to different disability domains. Future studies are warranted to explore the relationship between unhealthy body weight and disability severities (ranging from no difficulty to unable to do certain activities), and more importantly, the potential mediation effects from diet and physical activity.

In conclusion, using 14 years of data from a nationally representative survey, people with disability are found to have a markedly higher overweight/obesity rate compared to their nondisabled peers.

Conflict of interest statement

The authors declare that there is no conflict of interest. The authors declare that there is no funding source related to this study.

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