Self-reported health and behavioral factors are associated with metabolic syndrome in Americans aged 40 and over

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ABSTRACT

To determine whether behavioral factors differ among metabolic conditions and self-reported health, and to determine whether self-reported health is a valid predictor of metabolic syndrome (MetS). A total of 2997 individuals (≥40 years old) were selected from four biennial U.S. National Health and Nutrition Examination Surveys (2007–2014). A set of weighted logistic regression models were used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs)Individuals with light physical activity are more likely to have MetS and report poor health than those with vigorous physical activity with OR = 3.22 (95% CI: 2.23, 4.66) and 4.52 (95% CI: 2.78, 7.33), respectively. Individuals eating poor diet have greater odds of developing MetS and reporting poor health with OR = 1.32 (95% CI: 1.05, 1.66) and 3.13 (95% CI: 2.46, 3.98). The aforementioned relationships remained significant after adjustment for demographic and socio-economic status. A potential intervention strategy will be needed to encourage individuals to aggressively improve their lifestyle to reduce MetS and improve quality of life. Despite the significant association between self-reported health with MetS, a low sensitivity indicated that better screening tools for MetS, diabetes and cardiovascular disease are essential.

1. Introduction

Metabolic syndrome (MetS) is an accumulation of metabolic abnormalities characterized by central obesity, hyperglycemia, dyslipidemia and hypertension which confers an increased risk of developing type II diabetes mellitus and cardiovascular diseases (IDF, 2006). Individuals with MetS are also at increased risk of morbidity and mortality from stroke, and myocardial infarction compared to those without the syndrome (Kaur, 2014). In the United States, the number of individuals diagnosed with MetS rose from 47 million in 2000 to 76 million in 2009 with only a slight decrease in 2010 (Saylor and Friedmann, 2015). From 2011 to 2012, the overall prevalence of MetS stood at 34.7% of the US population with the greatest burden in those 60 years and older (Aguilar et al., 2015).

The likelihood of developing MetS has been attributed to behavioral factors such as smoking, poor diet, lack of physical activity and alcohol consumption (Owen and Reisin, 2015; Lee et al., 2005). These behavioral factors are also associated with self-reported health (Gallagher et al., 2016). Hence, understanding the relationship between MetS and self-reported health status can potentially provide information for identifying key risk groups. Self- reported health status is an important indicator of morbidity and has been found to be a stronger predictor of quality of life outcomes than other measures of morbidity (Bayliss et al., 2009). Collecting self-reports is more cost-effective and it can potentially be more complete than a medical record review (Lash et al., 2007).

Unlike previous studies which focus on single risk factors and small samples (Alkerwi et al., 2009; Sun et al., 2012), this study simultaneously investigates the relationship between various poor behavioral factors on developing MetS using a representative sample of the US population. Additionally, this study aims to identify specific metabolic risk factors that may significantly contribute to poor self-reported health status and the relationship of MetS and self-reported health.

2. Material and methods

2.1. Study sample

A total of 2997 individuals were selected from four biennial National Health and Nutrition Examination Surveys (2007–2014); this cross-sectional sample was representative of the US civilian noninstitutionalized population obtained through a complex multistage probability sample design.

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2.2. Outcome variables

2.2.1. Metabolic syndrome and self-reported health status

MetS consists of a cluster of five risk factors: (1) waist circumference ≥ 35 in. for women and ≥40 in. for men; (2) Fasting blood glucose ≥100 mg/dL; (3) Serum triglycerides ≥150 mg/dL; (4) Blood pressure ≥ 135/85 mm Hg; and (5) HDL ("good") cholesterol <40 mg/dL for men or <50 mg/dL for women. MetS was defined as an individual has three or more risk factors (Saylor and Friedmann, 2015).

Participants' self-reported health statuses were calibrated on a Likert scale as being excellent, very good, good, fair and poor. For the purposes of the analysis, self-reported health statuses were collapsed into 2 groups, and referred to as good and poor health.

2.3. Behavioral factors

Behavioral factors were represented by four variables: smoking status, alcohol use, physical activity and diet. These factors are widely used to as predictors of other chronic disease including diabetes and cardiovascular disease (Sun et al., 2012). However, few articles used these four factors simultaneously. The smoking frequency of current smokers was categorized as every day and some days. Alcohol consumption indicated whether a participant drank >12 alcohol beverages last year. One drink was indicated by a 12 oz. beer, a 5 oz. glass of wine or 1.5 oz. of liquor. Metabolic equivalent of task (MET) was used to measure the intensity level of physical activity and to indicate the rate of energy consumption for a specific activity. Physical activity was categorized into three intensity levels - light, moderate and vigorous according to MET score (Ainsworth et al., 2000). The participants self-evaluated the quality of their diet using a five level Likert scale including excellent, very good, good, fair and poor which was reclassified as good (excellent/very good/good) and poor (fair/poor).

2.4. Demographic and socio-economic status (SES) variables

These included age, gender, race, family income, and education. With respect to family income, categories were established based on the ratio of family income to the federal poverty threshold (FTP), adjusted for family size and composition. There were three levels described as poor (PIR (poverty income ratio) < 1), near poor (1 ≤ PIR < 3) and non-poor (PIR ≥ 3). Education reflected the highest grade completed by the participant, and described as <12 years (middle and elementary school), 12 years (high school) and >12 years (college and graduate School).

2.5. Statistical methods

We used NHANES 2007–2014 to calculate the prevalence of MetS and poor self-reported health status in the overall population stratified by demographics, SES status and health behaviors factors. A series of weighted logistic regressions were used to determine the relationship between behavioral factors, the presence of MetS and self-reported health. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated. Rao-Scott chi-square test was used to determine bivariate association between metabolic risk factors and self-reported health. All analyses were performed on SAS 9.4 and a $p < 0.05$ was used to indicate statistical significance.

3. Results

The analysis was conducted for 2997 adults aged 40 years and over who completed the mobile examination center (MEC) examination, laboratory and behaviors data in NHANES 2007–2014. Table 1 presents the prevalence of MetS and self-reported poor health within each group. The prevalence of MetS was 36.59% and 45.37% among participants aged 40–59 years and 60 years and older, respectively. More men (41.07%)

Table 1
Weighted prevalence (95% CI) of self-reported health condition and metabolic syndrome within each groups of explanatory variables from 2007 to 2014.

Explanatory variables (n)	Poor self-reported health % (95% CI)	Metabolic syndrome % (95% CI)
Overall	40.3 (38.0, 42.7)	24.9 (22.9, 26.8)
Age (years)		
40–59 (1446)	24.5 (21.7, 27.2)	36.6 (33.3, 39.8
60 and over (1551)	25.5 (22.8, 28.1)	45.4 (42.1, 48.7)
Gender		
Male (1778)	25.45 (22.8, 28.2)	41.1 (37.9, 44.3)
Female (1219)	24.1 (21.3, 26.9)	39.4 (35.9, 42.9)
Race		
Mexican American (362)	42.3 (36.6, 48.1)	47.2 (41.3, 53.1)
Other Hispanic (283)	37.2 (30.8, 43.6)	39.2 (32.8, 45.6)
Non-Hispanic White (1618)	21.8 (19.5, 24.2)	40.2 (37.3, 40.1)
Non-Hispanic Black (570)	35.3 (31.0, 39.7)	36.4 (32.1, 40.7)
Other race (164)	26.2 (17.6, 34.9)	43.2 (32.3, 54.1)
Family PIR		
Poor (807)	44.2 (39.6, 48.8)	41.0 (36.5, 45.6)
Near poor (1220)	28.0 (24.8, 31.2)	44.0 (40.3,47.7)
Non-poor (970)	14.2 (11.5, 17.0)	37.2 (33.4, 41.1)
Education		
<12 (947)	43.3 (39.1, 47.5)	44.0 (39.8, 48.4)
12 (730)	23.3 (19.4, 27.1)	43.3 (38.5, 48.0)
>12 (1320)	17.7 (15.1, 20.3)	37.3 (33.9, 40.7)
Current smoking		
Not at all (966)	20.1 (17.9, 22.9)	41.2 (38.2, 44.1)
Some days (159)	33.6 (22.1, 45.1)	43.3 (31.8, 54.7)
Every day (1872)	33.2 (29.3, 37.1)	38.2 (34.1, 42.4)
Alcohol consumption		
≥12 drinks (2527)	23.6 (21.5, 25.7)	38.7 (36.2, 41.3)
<12 drinks (470)	33.9 (28.5, 39.2)	51.3 (45.5, 57.2)
Physical activity		
Vigorous (297)	8.0 (4.5, 11.4)	20.7 (15.1, 26.4)
Moderate (839)	15.6 (12.6, 18.5)	38.0 (33.7, 42.4)
Light (1861)	33.8 (30.9, 36.6)	46.0 (42.9, 49.1)
Diet		
Good (2146)	17.9 (15.8, 19.9)	38.1 (35.4, 40.8)
Poor (851)	45.3 (40.7, 49.8)	46.7 (42.1, 51.4)

had MetS than women (39.38%). Mexican Americans had a higher prevalence of both MetS (47.22%) and poor self-reported health (42.33%) compared to other races. MetS was more common among individuals in the 'near poor' wealth category (43.96%) while poor self-reported health was more prevalent among those in the lowest economic status (SES) (44.20%). Compared to those who drank more alcohol (>12 drinks/yr), participants who consumed less alcohol (<12 drinks/yr) had a higher prevalence of MetS (51.34%) and poor self-reported health (33.86%). Nonsmokers had a lower percentage of poor self-reported health (20.10%) than smokers who smoked every day (33.19%).

Table 2 shows the association between four behavioral factors (smoking, alcohol consumption, physical activity and diet) and poor self-reported health as well as MetS with a set of weighted logistics regression models. Physical inactivity and poor diet were significantly associated with poor self-reported health. Light smokers who smoked some days in the past month are more likely to report poor health than non-smokers with an odds ratio of 1.36 (95% CI: 1.03, 1.72). Participants that engaged in light physical activity were more likely to report poor health than those engaged in vigorous physical activity, with an odds ratio of 3.33 (95% CI: 1.99, 5.57). Eating a poor diet was associated with a higher likelihood of reporting a poor health (odds ratio: 3.19, 95% CI: 2.47, 4.12) when compared to good diet. These significant observed relationships were remained after adjustment for demographics and SES.

As showed in Table 2, consumers of <12 alcoholic drinks/yr were more likely to have MetS than those who consumed >12 drinks/yr with an odds ratio of 1.51 (95% CI: 1.15, 1.96). Individuals that engaged in light and moderate physical activity had a higher likelihood of having