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Metabolic Syndrome and Economic Strain Among Sexual Minority Young Adults

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Abstract

Purpose: The study tested if sexual orientation is associated with metabolic syndrome (MetS) in young adulthood (ages 24–32), and if economic strain impacts associations.
Methods: Gender-stratified logistic regressions were fit among 11,575 young adults (1644 sexual minority [SM]) in Wave IV of The National Longitudinal Study of Adolescent to Adult Health.
Results: MetS was not associated with sexual orientation for either gender, yet economic strain was more prevalent among both SM males and females. Additional MetS risk factors (smoking, binge drinking, and lower education) emerged for SM females.
Conclusion: Although MetS did not differ by sexual orientation, emergent sexual orientation disparities among females suggest increased future risk.

Keywords: cardiovascular disease risk factors, metabolic syndrome, socioeconomic factors, young adults

Introduction

Lesbian, gay, and bisexual (i.e., sexual minority [SM]) adults are disproportionately burdened by cardiovascular disease (CVD) and CVD risk factors (e.g., increased risk of obesity among SM women and increased risk of tobacco use and psychosocial stress among both SM women and men) relative to heterosexual peers.[1] Analyses of sexual orientation differences in a variety of clinical measures and biomarkers of cardiometabolic/CVD risk have found mixed results. Clark et al.[2] found that SM women (but not men) in the National Longitudinal Study of Adolescent to Adult Health (Add Health) had higher 30-year CVD risk, using a Framingham-based measure incorporating clinical information such as systolic blood pressure (SBP) and body mass index (BMI). Two studies[3,4] estimated sexual orientation differences in 10-year CVD risk in the National Health and Nutrition Examination Survey (NHANES) using the Framingham General Risk Score, a cluster of biomarkers (e.g., high-density lipoprotein [HDL]), behaviors (e.g., smoking), and demographics. The studies found, respectively, that SM women had increased CVD risk compared with heterosexual women,[3] and bisexual but not gay men had increased risk compared with heterosexual men.[4] However, Hatzenbuehler et al.[5] found no association between sexual orientation and a multibiomarker measure of ''cardiometabolic risk'' (BP, pulse, waist circumference, C-reactive protein, and hemoglobin A1c [HbA1c]).

Given inconsistencies in findings and measures used to assess CVD risk, there is a need for additional study with validated, clinically measured outcomes such as metabolic syndrome (MetS), a clinically validated clustering of anthropometric and physiological biomarkers (e.g., hypertension, dyslipidemia, dysglycemia, inflammation, and obesity) known to double CVD risk in the general population.[6] Only one study has explored MetS among SM individuals, finding in a nonrepresentative convenience sample of women that MetS rates were significantly higher among SM women (ages 35–65) than heterosexual women.[7] Additional studies that utilize representative samples and include men are needed.

There is a need to move beyond simple prevalence estimates of CVD risk, and instead utilize theory-based models to explore upstream determinants. Previous studies of CVD risk among SM individuals have often focused on lifetime stress as a key determinant, using the lens of minority stress theory, which posits that mental and physical health disparities arise from differential exposure to stressors throughout the life course.[8] Most studies (including those on minority stress theory itself) have focused exclusively on psychosocial stress (harassment, discrimination, etc.), ignoring socioeconomic status (SES), despite its well-established link with

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health[9–12] and growing evidence from population-based studies of SES disadvantage among SM individuals.[13,14] Incorporation of SES measures into minority stress models to test their impact on minority stress pathways is thus needed. As a more chronic, multifaceted measure, economic strain (accumulation of insufficient resources to meet one's needs)[15,16] is an appropriate SES determinant of chronic disease (e.g., MetS) risk to explore among SM individuals. This is the first study to explore the association between MetS and sexual orientation in a nationally representative sample, and to assess the impact of economic strain on results.

Methods

Study sample

Data came from Add Health, a nationally representative longitudinal study of 20,745 U.S. respondents recruited as adolescents (grades 7–12) during the 1994–1995 school year. As described elsewhere,[17] four waves of data have been collected. The present study, analyzed in 2016–2017, focused on Wave IV outcomes collected in 2008 (respondents in young adulthood [ages 24–32]) among 11,575 respondents who participated in Waves I and IV, had valid survey weights, and complete data on all analysis variables (77.4% of eligible respondents).

Measures

Wave IV sexual orientation was dichotomized from self-reported identity (''the description that best fits how you think about yourself''). Respondents who selected ''100% heterosexual (straight)'' were categorized as ''heterosexual''; those who identified as ''mostly heterosexual (straight), but somewhat attracted to people of their own sex''; ''bisexual, that is, attracted to men and women equally''; ''mostly homosexual (gay), but somewhat attracted to people of the opposite sex''; or ''100% homosexual (gay)'' were categorized as ''SM.'' Wave IV MetS is modeled on the National Cholesterol Education Program Adult Treatment Panel III (NCEP/ATP III) clinical definition,[18] following adapted criteria previously used with Add Health,[19] accounting for differences between available biomarkers (collection described elsewhere)[20–22] and NCEP criteria. MetS was defined as ≥3 of the following five biomarkers meeting high-risk cut points (dichotomized yes/no): blood pressure (SBP ≥135 and/or diastolic BP ≥85); waist circumference (>88 [females]/>102 [males] cm); HbA1c (>5.7%); triglycerides (≥2 [females]/≥3 [males] deciles); and HDL (≤3 [females]/≤2 [males] deciles).

Young adult economic strain reflected whether, in the 12 months before the Wave IV interview, respondents experienced zero, one, or ≥ two of the following: inability to pay rent/mortgage, inability to pay utilities, utilities shut off, eviction, and food insecurity.

Controls included demographics and behavioral factors known to impact biomarker measurement: Wave IV age (continuous); race/ethnicity (non-Hispanic White [referent], non-Hispanic Black, non-Hispanic other, or Hispanic ethnicity); nativity (U.S. born, yes [referent] / no); low physical activity (<5 bouts of moderate physical activity [e.g. biking, aerobic exercise, and team sports] in the previous 7 days vs. ≥5 [referent]); tobacco use (daily cigarette use during the previous 30 days [current], intermittent or former use, or never use [referent]); frequent binge drinking (≥2 instances in the past 30 days of drinking ≥ five [male] or ≥ four [female] drinks in a row vs. ≤1 instance [referent]); BMI (underweight [<18.5 kg/m^2] or normal weight [18.5 to <25 kg/m^2] [referent], overweight [25 to <30 kg/m^2], or obese [≥30 kg/m^2]); and three separate measures of current medication use (all dichotomized yes/no [referent]: antidiabetes, antihypertension, and/or antidepressant). In addition, analyses controlled for measures of Wave IV SES previously associated with sexual orientation:[12,14,23,24] educational attainment (<high school diploma, high school diploma/general equivalency degree, some college or vocational training, or bachelor's degree or higher [referent]); receipt of household assistance before age 18 (proxy for adolescent SES, dichotomized as yes/no [referent]); and household income (≥$50,000 [referent] vs. <$50 k).

Statistical analysis

Descriptive analyses (cross-tabs/Pearson's chi-squared test) were conducted within gender to test for statistically significant ($p < 0.05$) differences in distributions of variables (weighted proportions and unweighted numbers) across sexual orientation. To assess whether sexual orientation is associated with MetS and whether economic strain accounted for identified associations, we fit five logistic regression models, stratified by gender, incorporating survey weights and adjustments for the Add Health complex sampling design: association between sexual orientation and MetS in crude models (model 1[M1]), and with adjustment for demographics and biomarkers (M2); association between economic strain and MetS adjusted for demographics and biomarkers (M3); M3 additionally adjusted for sexual orientation (M4); M4 additionally adjusted for SES controls (M5). Add Health data collection procedures were approved by the University of North Carolina, Chapel Hill Institutional Review Board; analyses for this study were deemed not to be human subjects research (as they were secondary analyses of deidentified data) and thus exempt from review.

Results

Approximately 13.6% ($n = 1644$) of the sample was categorized as a SM: 355 males (6.6% of all males) and 1289 females (20.4% of all females). Among all respondents, 20.7% ($n = 2454$) met the diagnostic criteria for MetS (25.7% of males, $n = 1373$; 16.0% of females, $n = 1081$). More than 10% of males, and 13.8% of females, had experienced ≥2 instances of economic strain.

Among males, the crude proportion of MetS (Table 1) did not differ by sexual orientation, although a significantly higher proportion of heterosexual than SM males had high-risk waist circumference (36.3% vs. 27.9%, respectively, $p = 0.018$). SM males were significantly more likely than heterosexual males to have experienced economic strain, despite higher educational attainment, and were significantly less likely to be overweight/obese. In adjusted regression models, neither sexual orientation nor economic strain emerged as significant predictors of MetS for males (Table 2). However lower educational attainment, low physical activity, obesity/overweight, older age, and antihypertension medication use were associated with significantly increased odds of MetS.

Table 1. Characteristics of the Sample, by Sexual Orientation and Gender, at Wave IV of the National Longitudinal Study of Adolescent to Adult Health (2008)

	Males (N = *5230*)			*Females* (N = *6345*)		
	SM (n = *355; 6.6%*) n *(%)*	*Heterosexual* (n = *4875; 93.4%*) n *(%)*	p	*SM* (n = *1289; 20.4%*) n *(%)*	*Heterosexual* (n = *5056; 79.6%*) n *(%)*	p
High-risk biomarkers						
Blood pressure (SBP ≥135 and/or DBP ≥85)	176 (52.5)	46.1 (2213)	0.138	280 (21.5)	1145 (23.2)	0.336
Waist circumference (>88 cm [F]/>102 cm [M])	**110 (27.9)**	**1723 (36.3)**	**0.018**	804 (60.9)	3249 (64.4)	0.080
HbA1c (>5.7%)	89 (20.5)	1396 (26.8)	0.096	**239 (15.1)**	**1058 (18.3)**	**0.047**
Triglycerides (≥2 [F]/≥3 [M] deciles)	122 (33.2)	1884 (39.1)	0.110	197 (15.1)	703 (14.2)	0.523
HDL (≤3 [F]/ ≤ 2 [M] deciles)	89 (22.2)	1268 (25.7)	0.325	318 (25.1)	1173 (24.4)	0.699
MetS (≥3 high-risk biomarkers)	87 (21.6)	1286 (26.0)	0.243	223 (14.3)	858 (16.4)	0.169
Instances of economic strain						
0	**266 (70.5)**	**3930 (79.7)**		**883 (64.7)**	**3844 (75.2)**	**<0.001**
1	**52 (18.4)**	**491 (10.3)**	**0.003**	**195 (15.3)**	**613 (12.6)**	
2+	**37 (11.2)**	**454 (10.1)**		**261 (20.1)**	**599 (12.2)**	
Age (continuous) mean (SE)	28.3 (.20)	28.4 (.12)	0.382	**27.9 (.13)**	**28.3 (.12)**	**<0.001**
Race/ethnicity						
Hispanic	**67 (15.2)**	**766 (11.6)**		**177 (10.0)**	**796 (12.0)**	**0.001**
Non-Hispanic White	**212 (72.1)**	**2748 (68.1)**	**0.036**	**761 (73.4)**	**2711 (66.2)**	
Non-Hispanic Black	**46 (6.8)**	**866 (13.4)**		**237 (9.9)**	**1124 (16.0)**	
Non-Hispanic Other	**30 (5.9)**	**495 (6.9)**		**114 (6.6)**	**425 (5.8)**	
Non-U.S. nativity	25 (5.1)	381 (5.4)	0.851	59 (3.9)	384 (5.5)	0.066
Low physical activity[a]	127 (37.6)	2042 (42.9)	0.127	598 (46.7)	2518 (50.7)	0.066
Tobacco use						
Never	155 (39.7)	2291 (43.9)		**495 (34.7)**	**3054 (55.7)**	**<0.001**
Intermittent/former	114 (33.5)	1360 (27.9)	0.245	**453 (35.9)**	**1105 (23.8)**	
Current	86 (26.8)	1224 (28.2)		**341 (29.3)**	**897 (20.5)**	
Frequent binge drinking[b]	91 (28.2)	1322 (28.4)	0.957	**289 (25.0)**	**593 (12.5)**	**<0.001**
BMI[c]						
Underweight/normal weight	**131 (38.5)**	**1291 (27.4)**		459 (37.3)	1820 (36.2)	0.627
Overweight	**111 (33.0)**	**1763 (35.1)**	**0.004**	327 (23.3)	1292 (25.1)	
≥Obese	**113 (28.5)**	**1821 (37.5)**		503 (39.4)	1944 (38.6)	
Antidiabetes medication use	6 (1.5)	41 (0.7)	0.170	32 (1.7)	85 (1.7)	0.930
Antihypertension medication use	13 (3.3)	165 (3.8)	0.702	39 (3.3)	163 (3.2)	0.969
Antidepressant medication use	34 (6.9)	168 (4.2)	0.100	**152 (13.5)**	**378 (8.3)**	**<.001**
Received public assistance in adolescence	55 (13.9)	820 (17.6)	0.214	**302 (23.8)**	**906 (17.4)**	**<.001**
Respondent educational attainment						
<HS diploma	**24 (7.1)**	**429 (9.7)**		**97 (8.7)**	**278 (6.8)**	**0.029**
HS graduate/GED	**39 (11.4)**	**911 (21.1)**	**0.001**	**166 (13.3)**	**679 (13.7)**	
Some college or vocational training	**142 (39.1)**	**2217 (42.8)**		**630 (48.7)**	**2249 (45.1)**	
≥Bachelor's degree	**150 (42.4)**	**1318 (26.5)**		**396 (29.3)**	**1850 (34.5)**	
Household income						
≥$50,000	82 (25.6)	1444 (28.7)	0.338	160 (11.9)	756 (13.0)	0.487
<$50,000	273 (74.4)	3431 (71.3)		1129 (88.1)	4300 (87.0)	

Boldface indicates statistically significant ($p < 0.05$) within-gender association between sexual orientation and each variable, using Pearson's chi-squared tests of association. All proportions in the table are weighted to reflect Add Health sampling weights/complex survey design; all Ns are unweighted counts. Respondents who self-identified as 100% heterosexual (total: 86.4% weighted, unweighted $n = 9931$; males: 93.4%, $n = 4875$; females: 79.6%, $n = 5056$) were categorized as "heterosexual." Respondents who self-identified as mostly heterosexual (total: 10.1%, $n = 1200$; males: 3.6%, $n = 181$; females: 16.3%, $n = 1019$); bisexual (total: 1.5%, $n = 181$; males: 0.6%, $n = 33$; females: 2.3%, $n = 148$); mostly homosexual (total: 0.7%, $n = 97$; males: 0.6%, $n = 44$; females: 0.8% $n = 53$); or 100% homosexual (total: 1.4%, $n = 166$; males: 1.7%, $n = 97$; females: 1.0%, $n = 69$) were categorized as "SM."

[a]Low physical activity was defined as <5 bouts of moderate physical activity (e.g., biking, aerobic exercise, and team sports) in a week.

[b]Frequent binge drinking was defined as ≥2 instances in the past 30 days of consuming ≥5 (male) or ≥4 (female) drinks in a row. Respondents were categorized as yes/no (referent) having met criteria for binge drinking, although only the proportion/N who did meet criteria is reported in the table.

[c]BMI cut points for each level were defined as follows: underweight (<18.5 kg/m^2) or normal weight (18.5 to <25 kg/m^2) (referent), overweight (25 to <30 kg/m^2), or obese (≥30 kg/m^2).

SBP, systolic blood pressure; DBP, diastolic blood pressure; F, Female; M, Male; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; MetS, metabolic syndrome; SE, standard error; BMI, body mass index; HS, high school; GED, general equivalency diploma; SM, sexual minority.

Table 2. Crude and Adjusted Odds of Metabolic Syndrome for Males in Wave IV of the National Longitudinal Study of Adolescent to Adult Health (2008)

	Model 1 OR (95% CI)	*Model 2* aOR (95% CI)	*Model 3* aOR (95% CI)	*Model 4* aOR (95% CI)	*Model 5* aOR (95% CI)
Sexual orientation					
SM	0.78 (0.52–1.18)	1.03 (0.63–1.66)		1.04 (0.65–1.68)	1.10 (0.68–1.78)
Heterosexual	1.00	1.00		1.00	1.00
Instances of economic strain					
0			1.00	1.00	1.00
1			0.79 (0.57–1.08)	0.79 (0.57–1.08)	0.76 (0.54–1.05)
2+			1.21 (0.87–1.69)	1.21 (0.87–1.69)	1.14 (0.82–1.58)
Age		**1.06* (1.01–1.12)**	**1.06* (1.00–1.11)**	**1.06* (1.00–1.11)**	**1.06* (1.00–1.11)**
Race/ethnicity					
Hispanic		1.24 (0.96–1.60)	1.25 (0.97–1.62)	1.25 (0.97–1.62)	1.19 (0.92–1.54)
Non-Hispanic White		1.00	1.00	1.00	1.00
Non-Hispanic Black		1.23 (0.98–1.55)	1.22 (0.97–1.54)	1.22 (0.97–1.55)	1.19 (0.94–1.51)
Non-Hispanic Other		1.14 (0.71–1.83)	1.16 (0.73–1.85)	1.16 (0.73–1.85)	1.16 (0.73–1.84)
Non-U.S. nativity		0.68 (0.38–1.23)	0.67 (0.37–1.21)	0.67 (0.37–1.20)	0.69 (0.38–1.23)
Low physical activity		**1.46*** (1.18–1.82)**	**1.45** (1.16–1.81)**	**1.45** (1.17–1.81)**	**1.43** (1.15–1.77)**
Tobacco use					
Never		1.00	1.00	1.00	1.00
Intermittent/former		0.96 (0.74–1.24)	0.96 (0.74–1.24)	0.96 (0.74–1.24)	0.94 (0.72–1.21)
Current		1.19 (0.91–1.58)	1.19 (0.90–1.58)	1.19 (0.90–1.58)	1.11 (0.83–1.47)
Frequent binge drinking		**0.78* (0.64–0.96)**	**0.79* (0.64–0.97)**	**0.79* (0.64–0.97)**	**0.78* (0.64–0.96)**
BMI					
Underweight/normal weight		1.00	1.00	1.00	1.00
Overweight		**3.65*** (2.56–5.20)**	**3.69*** (2.59–5.27)**	**3.70*** (2.59–5.28)**	**3.71*** (2.61–5.28)**
≥Obese		**23.05*** (16.3–32.6)**	**23.34*** (16.51–33.00)**	**23.38*** (16.53–33.07)**	**23.23*** (16.41–32.89)**
Antidiabetes medication use		2.01 (0.65–6.20)	2.06 (0.66–6.43)	2.05 (0.65–6.44)	1.98 (0.64–6.14)
Antihypertension medication use		**2.07** (1.26–3.40)**	**2.10** (1.28–3.46)**	**2.10** (1.28–3.46)**	**2.11** (1.29–3.45)**
Antidepressant medication use		1.16 (0.78–1.73)	1.17 (0.79–1.75)	1.17 (0.78–1.75)	1.18 (0.78–1.78)
Received public assistance in adolescence					1.01 (0.85–1.25)
Respondent educational attainment					
<HS diploma					1.35 (0.90–2.03)
HS graduate/GED					**1.49* (1.08–2.05)**
Some college or vocational training					1.19 (0.90–1.58)
≥Bachelor's degree					1.00
Household income <$50,000					1.03 (0.84–1.26)

Boldface indicates statistically significant ($p < 0.05$) aOR for association between MetS and the given predictor, adjusting for all other coefficients in the model.

MetS was defined as meeting high-risk cut point criteria for ≥3 of the following biomarkers: blood pressure (SBP ≥135 and/or DBP ≥85); waist circumference (>88 cm [female]/ > 102 cm [male]); HbA1c (>5.7%); triglycerides (≥2 [female] or ≥3 [male] deciles); and HDL (≤ 3 [female] or ≤2 [male] deciles). Model 1 reflects the crude association between sexual orientation and MetS. Model 2 reflects the association between sexual orientation and MetS adjusting for demographics (age, race/ethnicity, and nativity) and biomarker-associated controls (physical activity, BMI, substance use, and medication use). Model 3 reflects the association between economic strain and MetS adjusting for demographics (age, race/ethnicity, and nativity) and biomarker-associated controls (physical activity, BMI, substance use, and medication use). Model 4 contains all variables in Model 3 with additional adjustment for sexual orientation. Model 5 contains all variables in Model 4 with additional adjustment for SES (income, respondent educational attainment, and pre-18 public assistance).

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

CI, confidence interval; OR, odds ratio; aOR, adjusted odds ratio; SES, socioeconomic status.

Table 3. Crude and Adjusted Odds of Metabolic Syndrome for Females in Wave IV of the National Longitudinal Study of Adolescent to Adult Health (2008)

	Model 1 *OR (95% CI)*	*Model 2* *aOR (95% CI)*	*Model 3* *aOR (95% CI)*	*Model 4* *aOR (95% CI)*	*Model 5* *aOR (95% CI)*
Sexual orientation					
SM	0.85 (0.67–1.07)	0.86 (0.61–1.13)		0.87 (0.66–1.14)	0.88 (0.67–1.16)
Heterosexual	1.00	1.00		1.00	1.00
Instances of economic strain					
0			1.00	1.00	1.00
1			1.03 (0.76–1.38)	1.03 (0.77–1.39)	0.97 (0.72–1.30)
2+			0.88 (0.68–1.14)	0.89 (0.69–1.16)	0.82 (0.62–1.08)
Age		**1.06* (1.00–1.12)**	**1.06* (1.00–1.12)**	**1.06* (1.00–1.12)**	**1.06* (1.00–1.13)**
Race/ethnicity					
Hispanic		1.08 (0.78–1.50)	1.10 (0.79–1.51)	1.09 (0.79–1.51)	1.03 (0.74–1.42)
Non-Hispanic White		1.00	1.00	1.00	1.00
Non-Hispanic Black		**1.74*** (1.33–2.28)**	**1.77*** (1.36–2.30)**	**1.76*** (1.35–2.30)**	**1.76*** (1.34–2.31)**
Non-Hispanic Other		**1.66* (1.11–2.48)**	**1.67* (1.12–2.49)**	**1.67* (1.12–2.48)**	**1.69** (1.15–2.49)**
Non-U.S. nativity		1.33 (0.80–2.19)	1.33 (0.80–2.19)	1.33 (0.80–2.20)	1.31 (0.80–2.14)
Low physical activity		1.20 (0.99–1.45)	1.20 (0.99–1.46)	1.20 (0.98–1.45)	1.17 (0.96–1.43)
Tobacco use					
Never		1.00	1.00	1.00	1.00
Intermittent/former		1.06 (0.83–1.35)	1.04 (0.83–1.31)	1.06 (0.84–1.35)	0.99 (0.77–1.28)
Current		**1.56*** (1.20–2.03)**	**1.57*** (1.21–2.04)**	**1.59*** (1.23–2.06)**	**1.42** (1.11–1.82)**
Frequent binge drinking		0.72 (0.51–1.00)	**0.70* (0.50–0.98)**	**0.72* (0.51–1.00)**	0.74 (0.53–1.04)
BMI					
Underweight/normal weight		1.00	1.00	1.00	1.00
Overweight		**11.06*** (6.91–17.71)**	**11.08*** (6.93–17.73)**	**11.08*** (6.92–17.76)**	**10.83*** (6.73–17.41)**
≥Obese		**28.82*** (18.65–44.52)**	**28.80*** (18.72–44.30)**	**28.88*** (18.72–44.57)**	**27.27*** (17.59–42.28)**
Antidiabetes medication use		**2.28* (1.19–4.39)**	**2.28* (1.19–4.38)**	**2.29* (1.19–4.39)**	**2.27* (1.20–4.32)**
Antihypertension medication use		**2.84*** (1.77–4.56)**	**2.80*** (1.75–4.48)**	**2.82*** (1.76–4.54)**	**2.86*** (1.76–4.63)**
Antidepressant medication use		1.06 (0.76–1.07)	1.05 (0.76–1.45)	1.06 (0.76–1.47)	1.08 (0.77–1.50)
Received public assistance in adolescence					0.80 (0.63–1.02)
Respondent educational attainment					
<HS diploma					**2.07** (1.35–3.17)**
HS graduate/GED					**1.77** (1.25–2.51)**
Some college or vocational training					**1.39* (1.03–1.87)**
≥Bachelor's degree					1.00
Household income <$50,000					1.11 (0.79–1.55)

Boldface indicates statistically significant ($p < 0.05$) aOR for association between MetS and the given predictor, adjusting for all other coefficients in the model.

MetS was defined as meeting high-risk cut point criteria for ≥3 of the following biomarkers: blood pressure (SBP ≥135 and/or DBP ≥85); waist circumference (>88 cm [female]/ > 102 cm [male]); HbA1c (>5.7%); triglycerides (≥2 [female] or ≥3 [male] deciles); and HDL (≤3 [female] or ≤2 [male] deciles). Model 1 reflects the crude association between sexual orientation and MetS. Model 2 reflects the association between sexual orientation and MetS adjusting for demographics (age, race/ethnicity, and nativity) and biomarker-associated controls (physical activity, BMI, substance use, and medication use). Model 3 reflects the association between economic strain and MetS adjusting for demographics (age, race/ethnicity, and nativity) and biomarker-associated controls (physical activity, BMI, substance use, and medication use). Model 4 contains all variables in Model 3 with additional adjustment for sexual orientation. Model 5 contains all variables in Model 4 with additional adjustment for SES (income, respondent educational attainment, and pre-18 public assistance).

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Among females, neither the crude proportion (Table 1) nor the adjusted odds of MetS (Table 3) differed by sexual orientation, although SM females reported significantly more experiences of economic strain, frequent binge drinking, tobacco use, and lower educational attainment, the latter two of which were associated with increased odds of MetS in regression modeling. As with males, economic strain was not associated with MetS in final adjusted models, yet age, non-White race/ethnicity, and higher BMI significantly increased odds of MetS.

Discussion

This is the first study to explore the association between sexual orientation and MetS in a nationally representative sample, and the first to examine if adjusting for economic strain impacts sexual orientation/MetS associations. SM females and SM males experienced more economic strain than their heterosexual peers, but sexual orientation was not statistically significantly associated with MetS. Why MetS did not differ by sexual orientation is unclear. One possibility is that MetS is strongly associated with obesity,[6] yet in our sample, physical activity did not differ by sexual orientation for either males or females. SM males were less likely to be overweight/obese (or meet the high-risk waist circumference criterion), and BMI did not differ for females. This latter finding contradicts findings that SM women are more likely to be overweight/obese than heterosexual peers.[25] However, it is important to note that half of our SM female sample identified as mostly heterosexual (not shown), a group previously found to have lower stress and higher SES than lesbian, bisexual, and mostly homosexual individuals.[26] Including these individuals within the SM group may have suppressed obesity patterns.

The results further revealed that economic strain was more prevalent among both SM males and females relative to their heterosexual counterparts. The minority stress theory posits that health disparities arise from differential exposure to multiple stressors throughout the life course.[8] The lived experience of economic hardship (e.g., eviction and inability to pay for food or utilities) can be thought of as one such set of stressors, but it may be the combination of multiple stressors leading to MetS development. Furthermore, how gender interacts with stressors is also worthy of note.

Factors predictive of increased chronic disease risk, including smoking, binge drinking, and lower educational attainment,[12,27] were more prevalent among SM females—but not SM males. Yet, the pathways to MetS may be quite complex. Preliminary models (not shown) found that, among females, education fully explained away significant associations between economic strain and MetS (adjusting for sexual orientation), suggesting that it is education, not economic strain that is driving SES pathways for females. Higher rates of tobacco use and binge drinking, although risk promoting for CVD, may be a protective stress coping mechanism during young adulthood, although a maladaptive one,[28] partially explaining why incorporating these factors into regression models attenuated associations (and why binge drinking was associated with decreased odds of MetS). Taken together, our results suggest a gender-specific cumulating pattern of stressors that may forebode increased risk for MetS among SM females later in life. However, given the preventability of such stressors, the findings also suggest potential points of intervention. For example, primordial programs that successfully combat substance use among SM young adult females, before it becomes a lifelong habit, could protect against future development of CVD and/or MetS.[29]

In contrast, prevalence of smoking and binge drinking did not differ between SM and heterosexual males, suggesting that substance use does not serve as a ''coping'' mechanism for SM males in the same way that it does for females—a pattern seen elsewhere in the literature.[30,31] Similarly, that SM male's higher educational attainment (relative to heterosexual males) did not translate to higher income, nor was protective against economic strain, suggests that an entirely different interplay between economic strain and other aspects of SES may be occurring among males, one that is worthy of further exploration.

Limitations

Our study faced several limitations. Most notably, we collapsed nonheterosexual respondents into a single SM group, rather than analyzing separate subgroups of SM individuals. Preliminary models found that associations did not differ when sexual orientation was disaggregated into individual identities (Supplementary Tables S1 and S2; Supplementary Data are available online at www.liebertpub.com/lgbt); however, this may be due to lack of statistical power/sample size, rather than lack of ''true'' associations. Future population-based studies that oversample on the basis of sexual orientation are needed to explore identity-based differences in MetS, economic strain, and other SES/health outcomes.

Another potential limitation may be that respondents were too young to develop MetS, contributing to null findings. Although MetS has been detected in similarly aged cohorts elsewhere (e.g., in NHANES 2003–2006, 20.3% of males and 15.6% of females, ages 20–39, met criteria for MetS),[32] in Add Health itself,[19] and even among children and adolescents,[33] MetS typically has been observed in older cohorts: in NHANES 2003–2012, MetS prevalence was 18.3% among 20–39-year olds, compared with 47% among adults age 60 or older.[34] Furthermore, the only study to explore sexual orientation differences in MetS utilized a sample that, at ages 35–65, was older than the Add Health sample.[7] Given that older age was significantly associated with increased odds of MetS for SM males and females in our analysis, associations should be reexamined as Add Health Wave V data (respondents ages 32–42) become available.

Conclusion

Although sexual orientation differences in MetS did not emerge, our findings suggest that SM individuals may still be at risk for developing MetS (and/or other chronic diseases) as they age, as a result of current SES disparities (e.g., higher economic strain), with risk potentially further enhanced for SM females, who also exhibited increased rates of smoking and binge drinking. These results speak to the potential of targeting SM young adults for ''preclinical disease'' preventive interventions, as many of these risk factors are modifiable. Preventing MetS and other forms of CVD risk/chronic illness, rather than simply treating chronic disease as it emerges, has the potential for substantial health impact among SM

populations. Uncovering the factors driving these disparities, and devising interventions to address them, may help prevent future CVD risk among SM populations.

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Disclaimer

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Author Disclosure Statement

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