



Published in final edited form as:

Pediatr Diabetes. 2018 November ; 19(7): 1137–1146. doi:10.1111/pedi.12720.

Risk Factors for Diabetes are Higher among Non-Heterosexual US High School Students

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Abstract

Low physical activity (PA), high sedentary behavior (SB), and overweight and obesity have been shown to associate with increased Type 2 diabetes risk among adolescents. We investigated PA, SB, and overweight and obesity among Youth Risk Behavior Survey (YRBS) respondents to determine if non-heterosexual youth may be at increased diabetes risk compared to heterosexual youth.

Weighted city and state YRBS data were pooled across 44 jurisdictions biennially from 2009–2015, resulting in a sample size of 350,673 students. Overall, 88.4% identified as heterosexual, 2.1% as gay or lesbian, 5.7% as bisexual, and 3.7% as unsure.

With the exception of lesbian female students, after adjusting for age, race/ethnicity, BMI, and survey year, all non-heterosexual youth reported significantly fewer days per week of PA compared to their sex-matched heterosexual counterparts. Similarly, compared to heterosexual female youth, bisexual and not sure female youth reported significantly more hours per day of SB. These PA and SB findings remained significant after adjustment for depressive symptoms and in-school bullying among bisexual female youth only. In fully adjusted models, lesbian students were 1.85 times more likely to be overweight and lesbian, bisexual, and not sure female youth were 1.55–2.07 times more likely to be obese than heterosexual female students. No significant differences in SB, overweight, or obesity were found among gay, bisexual, or unsure male youth compared to heterosexual male youth.

Non-heterosexual youth may be at increased risk for developing type 2 diabetes mellitus compared to heterosexual youth. Future studies should characterize diabetes prevalence among non-heterosexual youth.

Keywords

sexual minorities; epidemiology; obesity; exercise; adolescent

INTRODUCTION

As of 2017, 30.3 million Americans, or 9.4% of the population, are living with diabetes.(1) Within the general population, 95% of cases are classified as type 2 diabetes; among youth, however, diabetes epidemiology differs markedly. In total, approximately 193,000 Americans under the age of 20 are living with diabetes,(1) with ~17,900 and 5,300 annually diagnosed with type 1 and type 2 diabetes, respectively.(2) The prevalence of type 2 diabetes, moreover, is increasing among U.S. adolescents,(2–4) and is driven by increases in body-mass index (BMI) during childhood and adolescence, as well as by social and behavioral factors.(5; 6)

The American Diabetes Association (ADA) recommends screening all adults aged 45 and older for diabetes.(7; 8) Screenings are recommended for younger patients if they present with two or more known diabetes risk factors,(7; 8) including being obese or overweight, being a racial/ethnic minority, or being physically inactive(7). In addition to low PA, high SB has also been shown to be an independent risk factor for the development of type 2 diabetes, particularly among adolescents.(5; 6; 9; 10). Within epidemiological studies, older age, greater BMI, and non-White race have been shown to be the strongest risk factors for the development of diabetes.(11) Increasingly, research has also demonstrated that sexual minorities may be at increased risk for the development of diabetes.(12; 13)

In this study, we used a multiyear pooled dataset of high school youth to articulate the prevalence of major diabetes risk factors identified by the American Diabetes Association and within the epidemiologic scientific literature, including PA, SB, and BMI, and to identify significant differences in these risk factors based on sexual identity. Based on prior research, we hypothesized that, even after adjusting for other known diabetes risk factors, sexual minority youth will have greater behavioral risk factors for type 2 diabetes and be more likely to be overweight or obese than their sex-matched heterosexual counterparts.

RESEARCH DESIGN AND METHODS

Data Source

The Youth Risk Behavior Survey (YRBS) is a biennial, cross-sectional national survey that has been conducted by the Centers for Disease Control and Prevention (CDC) since 1991 to collect health data on students in grades 9–12.(13) The YRBS monitors health-related behaviors among youth.(14) For this study, we used data from local versions of the YRBS, which are administered on a state, large urban school district, or county level. In this implementation, jurisdictions use a two-stage cluster sample design to identify a representative sample of students.(13) In the first stage, schools are selected with a probability proportional to their enrollment. In the second stage, classes of a required subject or during a required period are randomly selected and all students within these classes are eligible to participate.

Analytic Sample

Local YRBS data were pooled across multiple jurisdictions (city and state) and years (biennially from 2009–2015). The entire dataset consists of 46 jurisdictions across 4 time

points, and 488,361 youth. For the present analyses, only jurisdiction-years that assessed sexual identity were included, resulting in a sample size of 44 jurisdictions and 97 jurisdiction-years (350,673 students). Students were excluded if they were missing any of the primary demographic variables of interest (sexual identity: 10.9%; age: 0.34%; race: 3.29%; sex: 0.76%; not mutually exclusive).

Measures

All measures included in these analyses were identical across all jurisdiction-years unless otherwise noted.

Sex

Sex was determined by asking participants “What is your sex?” with the choices: (1) male or (2) female. YRBS does not ask about gender identity; therefore, we refer only to “male” or “female” participants.

Sexual Identity¹

Sexual identity was assessed by asking, “Which of the following best describes you?” Response options included: (1) heterosexual (straight); (2) gay or lesbian; (3) bisexual; and (4) not sure.

Race/Ethnicity

Race/ethnicity was assessed using two questions. First, participants were asked if they identified as Hispanic or Latino (yes or no). Second, participants were asked to select all of the races that applied from the following list: American Indian or Alaska Native; Asian; Black or African American; Native Hawaiian or Other Pacific Islander; and White. For the purposes of our analyses, these variables were combined into 4 unique racial/ethnic groups: (1) White; (2) Black or African American; (3) Hispanic/Latino (regardless of reported race); (4) Other.

Hours playing video or computer games per day

In 2009 and 2011, participants were asked, “On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the Internet).” Response options included “I do not play video or computer games or use a computer for something that is not school work; Less than 1 hour per day; 1 hour per day; 2 hours per day; 3 hours per day; 4 hours per day; 5 or more hours per day.” In 2013 and 2015, participants were asked an updated version of this question that included a more comprehensive list of electronic devices, “(Count time spent on things such as Xbox, PlayStation, an iPod, an iPad or other tablet, a smartphone, YouTube, Facebook, or other social networking tools, and the Internet).” The question prompt and response options remained the same from 2009–2015.

¹In the 2007 survey, Delaware changed option 2 from “*Gay or lesbian*” to “*Homosexual (gay or lesbian)*.”

Hours watching TV per day

From 2009–2015, participants were asked, “On an average school day, how many hours do you watch TV?” Response options included, “I do not watch TV on an average school day; Less than 1 hour per day; 1 hour per day; 2 hours per day; 3 hours per day; 4 hours per day; 5 or more hours per day.”

Sedentary Behavior

SB was assessed by adding up the total number of hours per day that respondents reported 1) playing video or computer games and 2) watching TV. Students who reported spending more than 5 hours per day on each activity were classified as spending 10+ hours per day in combined SB analyses.

Physical Activity

Days of PA per Week—Participants were asked, “During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of PA that increased your heart rate and made you breathe hard some of the time.)” Response options included “0 days; 1 day; 2 days; 3 days; 4 days; 5 days; 6 days; 7 days.” Students who reported they were physically active for 7 days were classified as meeting HHS PA guidelines for adolescents(16; 17).

Days of Physical Education per Week—Participants were asked, “In an average week when you are in school, on how many days do you go to physical education (PE) classes?” Response options included “0 days; 1 day; 2 days; 3 days; 4 days; 5 days.”

Body Mass Index (BMI)—Participants were asked, “How tall are you without your shoes on?” and “How much do you weigh without your shoes on?” From these answers, a BMI (kg/m^2) was calculated for each participant. In alignment with the CDC’s Growth Chart percentiles, male and female adolescents who were in the 85th-95th percentiles of BMI for age by sex were classified as overweight, while those greater than the 95th percentile were classified as obese.

In-School Bullying—Participants were asked, “During the last 12 months, have you ever been bullied on school property?” Response options were (1) Yes and (2) No.

Feeling Sad—Participants were asked, “During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?” Response options were (1) Yes and (2) No.

Statistical Analyses—All data cleaning and recoding was conducted in SAS Version 9.4 (SAS Institute Cary, NC). SAS-Callable SUDAAN Version 11.0.1 (RTI International, Research Triangle Park, NC) was used to appropriately weight estimates and to account for the complex sampling design of the YRBS. The YRBS data weights adjust for student non-response and distribution of students by grade, sex, and race/ethnicity in each jurisdiction. (13)

We conducted descriptive analyses stratified by sex to determine the distribution of demographic characteristics and diabetes risk factors among YRBS respondents in the pooled multiyear sample. Mean values for the total number of hours per school day (SB variables) or days per week (PA variables) were calculated. BMI was analyzed categorically accordingly to the CDC's Growth Chart percentiles for adolescents. We performed sex-stratified multivariable logistic regression to calculate the odds of overweight, obesity, and meeting physical activity guidelines by sexual identity adjusting for age, race/ethnicity, and survey year (Model 1) or for these variables as well as for feeling sad and in-school bullying (Model 2). Similarly, for PA and SB, two sex-stratified linear regression models were run. Model 1 included age, race/ethnicity, survey year, and BMI, while Model 2 added feeling sad and in-school bullying. The Bonferroni method was used to correct for multiple testing(18). Results were considered significant at the $p=0.002$ ($k=\alpha/25$) level.

RESULTS

Demographic Characteristics

Within the pooled, weighted YRBS sample, 46.8% of students identified as White, 15.0% as Black, and 27.2% as Hispanic/Latino; 11.1% reported identifying as another race (Table 1). The median age of students was 16 years; 50.3% were male and 49.7% were female. By sex, 92.3% of male students and 84.7% of female students identified as heterosexual. Among male students reporting a non-heterosexual identity, 2.25% identified as gay, 2.62% as bisexual, and 2.82% as not sure. The corresponding sexual identity percentages among female students were 1.93%, 8.80%, and 4.58%, respectively.

Prevalence of Diabetes Risk Factors

The mean number of days of PA per week among all students was 3.83. Only 24.4% of students met the national PA recommendations for children and adolescents of engaging in physical activity 7 days per week (Table 1).(19) High levels of SB were reported overall within the sample; the mean number of sedentary hours reported per school day was 3.74. Additionally, 14.5% of students were overweight, and 12.1% were obese (Table 1).

Bivariable Associations with Diabetes Risk Factors

Sex—Male students reported engaging in a higher mean number of days of PA than female students (4.25 vs. 3.42, respectively). Nearly twice as many male as female students reported PA all 7 days of the past week (31.5% vs. 17.3%, Table 1). Male students also reported attending physical education classes more days per school week than female students (2.32 vs. 2.00). No significant differences in SB between males and females were found. Despite this, female students were more likely than males to be normal weight (68.3% vs. 60.9%) and approximately half as likely to be obese (8.8% vs. 15.4%).

Sexual Identity—Gay/lesbian, bisexual, and not sure students all reported approximately 1 fewer day of PA per week and were 38% to 53% less likely to meet PA guidelines than heterosexual students (Table S1). Bisexual and not sure students reported ~30 minutes more SB than heterosexual students per school day. Gay/lesbian and bisexual students were both approximately 1.5 times as likely to be obese as heterosexual students.

Race/Ethnicity—Black, Hispanic, and other race/ethnicity students engaged in 0.44 to 0.77 fewer days per week of PA, and were 20–26% less likely to meet PA guidelines than White students (Table S1). Similarly, non-White students reported 20 to 60 minutes more SB per school day. Black and Hispanic participants had ~1.5 fold higher odds of being overweight or obese compared to White students.

Multivariable Diabetes Risk Associations, Stratified by Sex

Physical Activity

Males: Gay, bisexual, and not sure male students reported fewer mean days per week of PA than heterosexual male students (Table 2, Model 1). These disparities persisted even after adjusting for feeling sad and in school bullying (Table 2, Model 2). Non-White race/ethnicity, underweight or obese BMI, and feeling sad were also all significantly associated with fewer physically active days. Compared to being 18 years or older, being 15 or younger was also significantly associated with a greater number of days of PA.

Sexual identity was also associated with lower odds of meeting PA guidelines. Gay, bisexual, and not sure male students were less likely to meet guidelines than heterosexual male students. These associations persisted in magnitude in both models, and were similar regardless of identity: gay (adjusted OR [aOR] = 0.52; 95% CI: 0.39, 0.69), bisexual (aOR = 0.59; 95% CI: 0.43, 0.81), and not sure (aOR = 0.49; 95% CI: 0.38, 0.63) (Table S3, Model 2).

Participation in physical education courses was assessed to determine if observed disparities in PA could be attributed to lower levels of participation in these courses. Gay (1.74 days/week) male students reported attending fewer days per week of physical education classes than heterosexual (2.35 days/week) male students (Table S2).

Females: Bisexual and not sure female students, but not lesbian female students, reported significantly fewer mean days of PA per week compared to heterosexual female students (Table 2, Model 1). However, the disparity between not sure and heterosexual students disappeared after adjusting for feeling sad and bullying. Similar to male students, significant differences were seen based on race/ethnicity, BMI and feeling sad. Furthermore, age was significantly associated with PA, in that days of PA decreased with lower age.

No significant associations among female students were detected in the odds of meeting physical activity guidelines by sexual identity (Table S3, Model 2). In both adjusted models, however, younger female students were significantly more likely and non-White female students were significantly less likely to meet physical activity guidelines. In Model 2, students who reported depressive symptoms were significantly less likely to meet physical activity guidelines than those who did not. No differences in the total number of days spent per week in physical education courses were detected among female students by sexual identity (Table S2).

Sedentary Behavior

Males: Sexual identity was not associated with hours of SB among male students. Although this lack of association persisted across both models, other tested correlates were significant. In Model 1, race/ethnicity, and BMI were all significantly associated with hours of SB. Specifically, all racial/ethnic minority groups reported a significantly greater number of sedentary hours per school day than White students, and both obese and underweight students had higher levels of SB than normal weight students. Finally, in Model 2, all of the previous associations remained significant, and both feelings of sadness and experiences of in-school bullying were associated with a greater number of hours of SB.

Females: In contrast to male students, there were significant differences in SB by sexual identity among female students. In Model 1, females who identified as bisexual and not sure reported significantly more hours of SB per school day than their heterosexual peers. The disparity between not sure and heterosexual students but not between bisexual and heterosexual students disappeared after adjusted for feeling sad and bullying. No significant differences were observed among lesbian compared to heterosexual female students in either model. Similar to males, significant differences in SB were also seen based on race/ethnicity and BMI (Table 3, Models 1 and 2). Specifically, having a non-White race/ethnicity or an overweight or obese BMI was associated with a greater number of sedentary hours. In Model 2, feeling sad and bullying were also associated with higher sedentary behavior. Unlike among male students, however, among female students, age was significantly associated with SB, in that hours of SB decreased with higher age.

BMI

Overweight

Males: Among male students, an overweight BMI was more prevalent among students unsure of their sexual identity (18.3%) and bisexual students (17.0%); 15.1% heterosexual and 13.8% gay students were also overweight. No significant differences in the likelihood of being overweight, however, were detected by sexual identity or any other covariates among male students in either adjusted or unadjusted models (Table 4).

Females: More than one-quarter of lesbian students (26.2%) as well as 15.0% of heterosexual, 18.0% of bisexual, and 16.2% of not sure students were overweight. Lesbian (aOR = 1.85; 95% CI: 1.29–2.63) students were significantly more likely to be overweight than heterosexual female students (Table 4, Model 2). Within adjusted models, Black and Hispanic students were 1.47–1.58 times as likely to be overweight as White female students (Table 4, Models 1 and 2), and female students who reported feeling sad were more likely than those who did not to be overweight (aOR = 1.21; 95% CI: 1.10–1.32; Table 4, Model 2).

Obese

Males: Over one-fifth of both gay (21.0%) and bisexual (21.2%) male students were obese; smaller proportions of heterosexual (16.1%) and not sure students (17.1%) had an obese BMI. In Bonferroni adjusted models, however, non-heterosexual identity was not associated

with obesity among male students. Although this lack of association persisted across both models, other tested correlates were significant (Table 4, Models 1 and 2). Black and Hispanic male students were 1.22 to 1.50 times significantly more likely to be obese than White male students. Male students who reported in school bullying (aOR = 1.30; 95% CI; 1.12–1.51) were more likely to be obese than those who did not (Table 4, Model 2).

Females: In total, 8.4% of heterosexual female vs. 13.3% of lesbian, 16.5% of bisexual and 12.9% of unsure female students were obese. Across both models, female sexual minority and not sure students were 1.55–2.07 times as likely as heterosexual female students to be obese (Table 4). Likewise, Black and Hispanic female youth were 1.62–2.06 times as likely to be obese as White female youth. Finally, female students who reported bullying were 1.26 times significantly more likely to be obese than those who did not (Table 4, Model 2).

DISCUSSION

In this study of high school youth, we examined three key factors known to contribute to the risk of type 2 diabetes: PA,(17; 20) SB,(6; 9) and BMI.(21) Our results show that, due to overweight/obese BMI, higher levels of SB, and fewer days of PA, sexual minority students and students not sure of their sexual identity may be at increased risk for future development of type 2 diabetes. The factors leading to these disparities, however, remain mostly unexplained. After adjusting for multiple demographic and health factors, disparities in diabetes risk factors among non-heterosexual student populations largely persisted in our analyses, especially among bisexual students. Notably, disparities in SB and PA among bisexual female students were not explained in any of our models. Likewise, with the exception of gay male students, differences in participation in physical education courses did not explain the lower levels of PA observed among non-heterosexual students. Taken together, these findings principally demonstrate the robustness of diabetes risk disparities as well as the need for additional studies to explore psychosocial and behavioral mechanisms leading to increased diabetes risk in these populations.

Our study is in agreement with previous findings showing that behavioral diabetes risk factors are higher among sexual minority versus heterosexual adolescent populations in previous YRBS analyses(15; 22) and within the Growing Up Today Study (GUTS)(23; 24). We, like others, also found that lesbian and bisexual female adolescents were more likely to be obese than heterosexual female students.(25; 26) Our finding that sexual minority and not sure male adolescents are not statistically more likely to be obese than heterosexual males stands in disagreement with previous YRBS analyses which have found that non-heterosexual male youth were more likely to be obese than heterosexual male youth (14). These differences are attributable to differences in p-value cut-off; prior to applying the Bonferroni method to adjust the p-value to 0.002, our analyses were in agreement with prior YRBS reports. Our results also partially contrast with reports from Add Health and GUTS that found adolescent gay males had a statistically lower BMI than heterosexual males (25; 27). These studies measured diabetes risk factors among teenage youth at much earlier points in time (1993–1994 for Add Health and 1996–2007 for GUTS) than our study, which may partially explain differences in our findings.(28) Likewise, in agreement with previous reports, we found that Black and Hispanic/Latino students have higher BMI and SB and

lower PA levels than their White counterparts.(15; 22; 29) Interestingly, prior studies reveal that psychosocial variables not included within most YRBS datasets can explain disparities in certain diabetes risk factors between non-heterosexual and heterosexual youth. For example, differences in athletic self-esteem have been shown to explain disparities in PA among sexual minority youth.(23)

In our analyses, the effect sizes for BMI disparities were similar for racial/ethnic minority and sexual minorities among both male and female students. After Bonferroni correction, however, these findings were only significant among female sexual minority youth. In sex-stratified models predicting SB adjusted for age, race/ethnicity, sexual identity, survey year, and BMI, compared to reference groups, the point estimates of the magnitude of SB disparities for bisexual (0.56 excess hours/day) and not sure (0.54 excess hours/day) female youth were greater than being obese (0.46 excess hours/day), of identifying as Hispanic (0.36 excess hours/day) or of identifying as any other racial/ethnic minority individual (0.46 excess hours/day). Identifying as Black/African American (0.96 excess hours/day) was associated with worse disparities for SB. Strikingly, among male students, non-heterosexual sexual identity was the single strongest risk factor for engaging in less PA. These results demonstrate that sexual minority youth face similar weight and behavioral diabetes risk factors as Black and Hispanic youth, populations known to be disproportionately impacted by type 2 diabetes.

The mechanisms leading to increased diabetes risk disparities not only among racial/ethnic minorities but also sexual minorities remain understudied. Minority stress models theorize that structural barriers and stigma contribute to increased stress levels and stress-linked coping behaviors, including substance use, unhealthy eating, and high risk sexual activity among a variety of vulnerable and stigmatized minority populations.(30; 31) Minority stress has been shown to contribute to diabetes disparities among racial/ethnic minority populations.(32; 33) The epidemiology of diabetes incidence and prevalence among sexual minority compared to heterosexual adolescents remains unexplored. However, among sexual minority youth, minority stress has been shown to be associated with increased risk for depression, a known risk factor for diabetes.(33) Both long-term use of certain classes of anti-depressant medications(35) and symptoms of depression have also been linked to greater type 2 diabetes prevalence among adolescents.(34;36)

While our study was strengthened by a national sample comprising multiple years of observations, the YRBS only samples from schools, and consequently excludes youth who are not enrolled or who may be less likely to attend. Other limitations include the use of self-reported measures for all variables, and the potential for differential reporting bias by demographic characteristics. A recent study investigated if mischievous responders indicating a non-heterosexual sexual identity could be responsible for disparities by sex and sexual identity detected across 20 variables in YRBS.(36) The study found that no differences in mischievous responses for bullying, feeling sad, watching television, or PA were detected by sex and sexual identity; BMI and playing video games were not assessed. (36) Differences in reporting accuracy for BMI, however, have been reported by race(37) and sex.(38) The validity of self-reported PA among adolescents has also been called into question(39): in the 2003–2004 NHANES dataset, only 8% of adolescents 12–19 whose PA

was assessed by accelerometer were found to meet guidelines, while 51% self-reported PA levels that could be interpreted to meet guidelines.(40) The low overall rate of PA reported among students in this sample indicates that there is not much room for PA levels to decrease. Obese adolescents who are less physically active have been found to be more likely to over-report their activity levels compared to those who are more active.(39) Taken together these findings indicate that true PA levels may be lower within the pooled 2009–2015 YRBS sample. This would result in an underestimation of diabetes risk, especially among inactive obese adolescents, who may be most at risk to develop diabetes later in life.

Elevated diabetes risk among sexual minority youth and youth unsure of their sexual orientation is a serious concern. Sexual minority youth already face unique health disparities(41) that may compound with diabetes risk factors to pose an additional significant health risk in an already vulnerable population. However, as of this report, these health risks are not adequately reflected in health policy. The U.S. Preventive Services Task Force (USPTF) has recommended screening all children aged 6 and older for obesity.(42) These guidelines, however, do not include sexual minorities as a priority population in special need of screening, nor do they highlight patient-centered, culturally sensitive methods for identifying sexual minority youth to ensure these screenings occur. Likewise, national recommendations to improve research to increase PA(15) and other diabetes risk factors currently do not include recommendations to develop interventions designed to decrease disparities among sexual minority and not sure youth. As our findings indicate that sexual minorities and not sure youth may face even greater physical activity disparities compared to other vulnerable populations that are specifically named in these guidelines, there is an evident need for specific focus on sexual minority status in future evidence informed intervention development. In conclusion, future work should characterize the epidemiology of diabetes among sexual minority and questioning adolescent populations. Findings from this research should be used to design and test effective interventions to improve diabetes prevention and testing practices among sexual minority and questioning youth.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

LBB conceptualized the study and served as primary drafter of the article. BT performed all statistical analyses. DF, RM, and GLP assisted in writing and editing the article. LBB takes responsibility for the contents of the article. The authors acknowledge Dr. Ronald Ackermann for helpful feedback on the conceptualization of the article. This work was supported by NIH R01AA024409 awarded to GLP from the National Institute on Alcohol Abuse and Alcoholism (NIAAA). The authors declare no conflict of interest. This work was in part submitted in abstract form to the American Diabetes Association's 2018 Annual Meeting.

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Table 1

Demographics and Diabetes Risk Factors among High School Aged Youth, YRBS 2009–2015

	Total N=349,451	Male N=169,230	Female N=180,221
Demographics			
<i>Sexual Identity</i>	Percentage	Percentage	Percentage
Heterosexual	88.42	92.31	84.69
Gay/Lesbian	2.11	2.25	1.93
Bisexual	5.72	2.62	8.8
Not sure	3.74	2.82	4.58
<i>Age</i>			
14 or younger	12.36	11.58	13.15
15 years old	25.7	25.47	25.91
16 years old	25.04	24.99	25.09
17 years old	23.29	23.41	23.22
18 or older	13.61	14.56	12.68
<i>Race/Ethnicity</i>			
White	46.8	47.35	46.23
Black	14.96	14.42	15.52
Hispanic/Latino	27.17	26.95	27.44
Other	11.07	11.29	10.81
<i>BMI (kg/m²)</i>			
Underweight	9.16	9.38	8.29
Healthy-weight	64.37	60.92	68.32
Over-weight	14.4	14.34	14.57
Obese	12.07	15.37	8.81
<i>Feel Sad</i>			
Yes	28.09	19.84	36.34
No	71.91	80.16	63.66
<i>In school Bullying</i>			
Yes	18.51	15.56	21.31
No	81.49	84.44	78.69
Diabetes Risk Factors			
<i>Days of Physical Activity per week</i>	Percentage	Percentage	Percentage
0	15.86	13.2	18.49
1	8.15	6.66	9.65
2	9.69	8.19	11.18
3	11.09	9.73	12.33
4	10.12	9.66	10.61
5	13.34	13.08	13.6

	Total N=349,451	Male N=169,230	Female N=180,221
6	7.41	8.02	6.83
7	24.35	31.47	17.3
	Mean (SD)	Mean (SD)	Mean (SD)
<i>Hrs Sedentary Behaviors</i>	3.74 (0.02)	3.76 (0.03)	3.72 (0.03)
<i>Hrs playing video or computer games</i>	2.12 (0.02)	2.15 (0.03)	2.09 (0.02)
<i>Hrs watching TV</i>	1.67 (0.01)	1.67 (0.01)	1.68 (0.02)
<i>Days of PE/week</i>	2.16 (0.04)	2.32 (0.04)	2.00 (0.04)

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Table 2

Multivariable linear regression estimating the association between days of physical activity per week and sexual identity, mental health, and bullying among high school aged youth YRBS 2009–2015.

	Males			Females		
	M1: Demographics + BMI (n=151480)		M2: M1 + Mental Health + Bullying (n=141753)	M1: Demographics + BMI (n=164369)		M2: M1 + Mental Health + Bullying (n=150889)
	β	β 95% CI	β	β 95% CI	β	β 95% CI
Demographics						
Sexual Identity						
Heterosexual (ref)		0				0
Gay or Lesbian	-1.41	(-1.68, -1.14)*	-1.22	(-1.51, -0.93)*	-0.18	(-0.45, 0.09)
Bisexual	-1.16	(-1.48, -0.83)*	-0.92	(-1.48, -0.83)*	-0.4	(-1.26, -0.58)*
Not sure	-1.29	(-1.57, -1.02)*	-1.17	(-1.47, -0.86)*	-0.50	(-0.80, -0.20)*
Age						
14 or younger	0.32	(0.15, 0.50)*	0.33	(0.15, 0.51)*	0.84	(0.62, 1.06)*
15 years old	0.30	(0.15, 0.46)*	0.30	(0.15, 0.45)*	0.77	(0.61, 0.92)*
16 years old	0.13	(-0.07, 0.34)	0.14	(-0.07, 0.34)	0.47	(0.32, 0.62)*
17 years old	0.00	(-0.14, 0.13)	0.01	(-0.14, 0.15)	0.06	(-0.11, 0.24)
18 or older (ref)		0				0
Race						
White (ref)		0				0
Black	-0.55	(-0.65, -0.45)*	-0.54	(-0.65, -0.44)*	-0.78	(-0.88, -0.69)*
Hispanic/Latino	-0.26	(-0.37, -0.15)*	-0.26	(-0.38, -0.13)*	-0.53	(-0.63, -0.42)*
Other	-0.37	(-0.60, -0.14)*	-0.40	(-0.65, -0.16)*	-0.50	(-0.68, -0.31)*
Year	0.04	(0.02, 0.06)*	0.04	(0.01, 0.06)*	0.06	(0.04, 0.08)*
BMI						
Underweight	-0.85	(-1.00, -0.70)*	-0.81	(-0.97, -0.65)*	-0.52	(-0.70, -0.34)*
Healthy-weight (ref)		1.00		1.00		1.00

	Males				Females			
	M1: Demographics + BMI (n=151480)		M2: M1 + Mental Health + Bullying (n=141753)		M1: Demographics + BMI (n=164369)		M2: M1 + Mental Health + Bullying (n=150889)	
	β	β 95% CI	β	β 95% CI	β	β 95% CI	β	β 95% CI
Overweight	-0.21	(-0.35, -0.07)	-0.2	(-0.34, -0.06)	-0.23	(-0.33, -0.12)*	-0.20	(-0.31, -0.09)*
Obese	-0.58	(-0.72, -0.44)*	-0.55	(-0.69, -0.40)*	-0.58	(-0.81, -0.36)*	-0.57	(-0.81, -0.32)*
Mental Health								
<i>Feel Sad</i>								
Yes			-0.47	(-0.57, -0.37)*			-0.39	(-0.49, -0.29)*
No (ref)				0				0
Bullying								
<i>In school Bullying</i>								
Yes			-0.12	(-0.26, 0.02)			0.09	(-0.01, 0.19)
No (ref)				0				0

* Indicates p <0.002.

Table 3

Multivariable linear regression estimating the association between number of hours of sedentary behavior on school days and sexual identity, mental health, and bullying among high school aged youth, YRBS 2009–2015.

	Males				Female			
	MI: Demographics + BMI (n=147,379)		M2: MI + Mental Health + Bullying (n=141,753)		MI: Demographics + BMI (n=160,069)		M2: MI + Mental Health + Bullying (n=155,066)	
	β	β 95% CI	β	β 95% CI	β	β 95% CI	β	β 95% CI
Demographics								
<i>Sexual Identity</i>								
Heterosexual (ref)		0		0		0		0
Gay or Lesbian	-0.15	(-0.46, 0.15)	-0.08	(-0.41, 0.24)	0.17	(-0.10, 0.44)	0.14	(-0.15, 0.42)
Bisexual	0.21	(-0.09, 0.52)	0.22	(-0.09, 0.54)	0.56	(0.39, 0.72)*	0.44	(0.27, 0.62)*
Not sure	0.2	(-0.10, 0.50)	0.25	(-0.09, 0.58)	0.54	(0.22, 0.86)*	0.44	(0.12, 0.76)
<i>Age</i>								
14 or younger	0.12	(-0.08, 0.32)	0.09	(-0.12, 0.29)	0.62	(0.38, 0.85)*	0.6	(0.35, 0.85)*
15 years old	0.26	(-0.02, 0.55)	0.23	(-0.08, 0.53)	0.47	(0.31, 0.64)*	0.44	(0.27, 0.61)*
16 years old	0.18	(-0.07, 0.42)	0.15	(-0.11, 0.41)	0.35	(0.17, 0.53)*	0.32	(0.13, 0.50)*
17 years old	0.05	(-0.15, 0.24)	0.02	(-0.19, 0.23)	0.17	(-0.00, 0.34)	0.16	(-0.01, 0.33)
18 or older (ref)		0		0		0		0
<i>Race</i>								
White (ref)								
Black	0.78	(0.66, 0.90)*	0.88	(0.75, 1.00)*	0.96	(0.84, 1.08)*	1.02	(0.90, 1.14)*
Hispanic/Latino	0.31	(0.12, 0.51)*	0.35	(0.14, 0.56)*	0.36	(0.26, 0.47)*	0.36	(0.24, 0.48)*
Other	0.39	(0.16, 0.61)*	0.42	(0.18, 0.66)*	0.46	(0.18, 0.73)*	0.44	(0.16, 0.72)*
<i>Year</i>								
Year	-0.04	(-0.06, -0.01)	-0.04	(-0.06, -0.01)	0.00	(-0.02, 0.03)	0	(-0.02, 0.02)
<i>BMI</i>								
Underweight	0.53	(0.28, 0.78)*	0.56	(0.29, 0.83)*	0.18	(0.03, 0.33)	0.18	(0.02, 0.34)
Healthy-weight (ref)		0		0		0		0

	Males				Female			
	M1: Demographics + BMI (n=147,379)		M2: M1 + Mental Health + Bullying (n=141,753)		M1: Demographics + BMI (n=160,069)		M2: M1 + Mental Health + Bullying (n=155,066)	
	β	β 95% CI	β	β 95% CI	β	β 95% CI	β	β 95% CI
Overweight	0.14	(0.00, 0.28)	0.14	(-0.01, 0.29)	0.33	(0.18, 0.48)*	0.32	(0.16, 0.47)*
Obese	0.6	(0.40, 0.79)*	0.56	(0.36, 0.77)*	0.46	(0.32, 0.59)*	0.44	(0.30, 0.58)*
Mental Health								
<i>Feel Sad</i>								
Yes			0.18	(0.07, 0.29)*			0.31	(0.21, 0.41)*
No (ref)				0				0
Bullying								
<i>In school Bullying</i>								
Yes			0.28	(0.15, 0.41)*			0.26	(0.14, 0.37)*
No (ref)				0				0

* Indicates p <0.002.

Table 4

Multivariable logistic regression estimating the association between overweight or obesity and sexual identity, mental health, and bullying among high school aged youth, YRBS 2009–2015.

Overweight 85 th -95 th percentile	Male			Female		
	M1: Demographics	M2: MI + mental health + bullying	95% CI	M1: Demographics	M2: MI + mental health + bullying	95% CI
<i>Sexual Identity</i>	AOR	AOR	95% CI	AOR	AOR	95% CI
Heterosexual (ref)	1.0	1.0		1.0	1.0	
Gay or lesbian	0.87	0.87	(0.62, 1.22)	1.92	1.85	(1.38, 2.67)*
Bisexual	1.14	1.17	(0.79, 1.66)	1.2	1.14	(0.92, 1.41)
Not Sure	1.24	1.3	(0.89, 1.75)	1.11	1.06	(0.84, 1.34)
<i>Age</i>						
14 or younger	0.87	0.84	(0.59, 1.29)	0.93	0.92	(0.75, 1.14)
15	0.87	0.84	(0.65, 1.16)	0.93	0.93	(0.76, 1.15)
16	0.72	0.7	(0.49, 1.06)	0.87	0.87	(0.72, 1.06)
17	0.79	0.78	(0.53, 1.19)	0.87	0.88	(0.74, 1.04)
18 or older (ref)	1.0	1.0		1.0	1.0	
<i>Race/Ethnicity</i>						
White (ref)	1.0				1.0	
Black	1.02	1.00	(0.90, 1.15)	1.58	1.57	(1.40, 1.77)*
Hispanic	1.26	1.27	(1.01, 1.56)	1.48	1.47	(1.29, 1.70)*
Other	0.81	0.78	(0.63, 1.05)	0.92	0.91	(0.72, 1.14)
<i>Mental Health</i>						
Feel Sad						
Yes		0.87	(0.75, 1.01)		1.21	(1.10, 1.32)*
No (ref)		1.0			1.0	
<i>In school Bullying</i>						
Yes		1.08	(0.95, 1.23)		1.04	(0.91, 1.19)
No (ref)		1.0			1.0	

Overweight 85 th -95 th percentile	Male				Female			
	M1: Demographics		M2: M1 + mental health + bullying		M1: Demographics		M2: M1 + mental health + bullying	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Obese	Female							
>95 th Percentile	Male				Female			
	M1: Demographics		M2: M1 + mental health + bullying		M1: Demographics		M2: M1 + mental health + bullying	
<i>Sexual Identity</i>	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Heterosexual (ref)								
Gay or lesbian	1.35	(1.04, 1.74)	1.3	(0.99, 1.71)	1.55	(1.22, 1.98)*	1.56	(1.21, 2.01)*
Bisexual	1.39	(1.08, 1.78)	1.26	(0.96, 1.65)	2.07	(1.75, 2.45)*	1.88	(1.54, 2.29)*
Not Sure	1.06	(0.79, 1.43)	1.01	(0.74, 1.38)	1.66	(1.26, 2.18)*	1.57	(1.18, 2.09)*
<i>Age</i>								
14 or younger	1.05	0.87, 1.26	1.00	0.82, 1.21	1.01	(0.77, 1.33)	0.97	(0.72, 1.31)
15	0.92	0.78, 1.07	0.91	0.77, 1.07	0.91	(0.73, 1.13)	0.87	(0.69, 1.09)
16	1.03	(0.89, 1.20)	1.03	(0.88, 1.20)	0.84	(0.72, 0.99)	0.82	(0.69, 0.96)
17	1.03	(0.88, 1.20)	1.02	(0.86, 1.20)	0.97	(0.75, 1.27)	0.95	(0.71, 1.27)
18 or older (ref)	1.0		1.0		1.0		1.0	
<i>Race/Ethnicity</i>								
White (ref)	1.0		1.0		1.0		1.0	
Black	1.25	(1.12, 1.40)*	1.25	(1.12, 1.40)*	2.06	(1.83, 2.33)*	1.22	(1.09, 1.36)*
Hispanic	1.5	(1.34, 1.67)*	1.50	(1.34, 1.67)*	1.65	(1.40, 1.95)*	1.45	(1.29, 1.62)*
Other	0.97	(0.71, 1.33)	0.97	(0.71, 1.33)	0.92	(0.68, 1.20)	0.97	(0.73, 1.30)
<i>Mental Health</i>								
<i>Feel Sad</i>								
Yes			1.21	(1.06, 1.38)			1.22	(1.07, 1.41)
No (ref)			1.0				1.0	
<i>In school Bullying</i>								
Yes			1.3	(1.12, 1.51)*			1.26	(1.09, 1.46)*
No (ref)			1.0				1.0	

* Indicates p < 0.002.