



Original article

The moderating effect of physical activity on the relationship between bullying and mental health among sexual and gender minority youth

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Abstract

Purpose: Sexual and gender minority youth frequently experience bullying, which often contributes to higher depressive symptoms and lower self-esteem. Given that physical activity (PA) can mitigate depressive symptoms and improve self-esteem, we examined the moderating effect of PA on the relationship between bullying and mental health among sexual and gender minority youth.

Methods: Data from the Lesbian, Gay, Bisexual, Transgender, and Queer National Teen Survey ($n = 9890$) were analyzed. Hierarchical regression analyses examined the influence of history and frequency of being bullied, PA, and the interaction of these variables on depressive symptoms and self-esteem. Simple slopes analyses were used to probe significant interactions.

Results: Results indicated the importance of accounting for bullying history when examining effects of PA on mental health. PA was negatively related to depression ($t = -4.18, p < 0.001$) and positively related to self-esteem ($t = -12.11, p < 0.001$). Bullying frequency was positively related to depression ($t = 19.35, p < 0.001$) and negatively related to self-esteem ($t = -12.46, p < 0.001$). There was a significant interaction between bullying frequency and PA for depression ($t = 4.45, p < 0.001$) and self-esteem ($t = -4.69, p < 0.001$). *Post hoc* analyses suggested that the positive effects of PA on mental health may be limited to those not bullied because it had a negligible effect on those who were bullied.

Conclusion: Results suggest that sexual and gender minority youth exercise interventions aiming to improve mental health should first address bullying history; otherwise, their effectiveness may be limited to those who have been bullied.

Keywords: Bullying; Depression; Exercise; LGBTQ; Self-esteem; Youth

1. Introduction

Sexual and gender minority (SGM) students, or those identifying as lesbian, gay, bisexual, transgender, and questioning (LGBTQ), are significantly more at risk for bullying, teasing, perceived discrimination, and violent events than their non-LGBTQ peers.^{1–4} Despite a decline in school-related violence victimization over the past 20 years, rates of LGBTQ students being bullied at school have not declined.⁵ One study of LGBTQ students found that a majority were harassed at school based on their sexual orientation and over half were harassed based on gender identity.² In the same study, nearly half of LGBTQ students reported that they had experienced cyberbullying, or harassment on the Internet, in the past year.² Bullying based on sexual orientation and gender

identity continues to be a significant problem for LGBTQ youth and can impact their mental health. Given the potential mental health impacts of bullying, it is worth exploring how physical activity (PA) can improve depression and self-esteem among this vulnerable population.

1.1. The minority stress model and effects of discrimination on mental health

The minority stress model posits that LGBTQ individuals face higher levels of mental health disorders than non-LGBTQ individuals, in part due to the social stressors from stigma and prejudice related to being LGBTQ.⁶ Furthermore, the minority stress model categorizes LGBTQ-specific prejudice into multiple categories, which include external prejudice events such as discrimination or violence and expectations of these events.^{3,6} Not only does being bullied contribute to poorer mental health, but it can also contribute to worry about bullying occurring again.

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Perceived discrimination and bullying based on sexual orientation are associated with increased depressive symptoms.^{1,3,4} More specifically, bullying has been found to contribute to LGBTQ youth suicidal tendencies and lack of school belongingness.⁷⁻⁹ LGBTQ youth who experience higher levels of victimization based on their sexual orientation report higher levels of depression than their LGBTQ peers who report lower levels of victimization, suggesting that the more victimization they face, the more severe depression they experience.² Negative self-schemas and low self-esteem may also result from stigma-related stress, which can contribute to depression in minority groups.¹⁰ Being bullied and frequency of being bullied negatively impact LGBTQ youth's mental health.

High self-esteem has been shown to be a protective factor against depression and suicidal tendencies in LGBTQ youth.^{1,7} However, many LGBTQ youth report lower levels of self-esteem compared to their non-LGBTQ peers.^{11,12} LGBTQ youth who report higher levels of in-school victimization and discrimination based on sexual orientation and gender expression report lower levels of self-esteem compared to both their heterosexual peers and LGBTQ peers who had not experienced victimization or discrimination.^{2,13} Given that bullying based on being LGBTQ can lead to poor mental health, it is imperative to explore the relationships among bullying, exercise, and mental health for this vulnerable population.

1.2. PA

PA has been shown to reduce feelings of sadness and depression and increase self-esteem in adolescents.¹⁴⁻¹⁹ One systematic review found a medium effect size ($d = -0.50$) for exercise on depression among youth and a small-to-medium effect size ($d = -0.48$) for exercise on clinical depression among youth.²⁰ For youth, participation in physical education classes has been associated with a lower risk of sadness.¹⁵ Importantly, for LGBTQ youth, participation in sports can contribute to decreased feelings of hopelessness.²¹ Exercise has also been shown to have a positive effect on self-esteem among healthy adolescents.²² A recent meta-analysis found small-to-medium effect sizes for PA interventions on both self-concept (Hedges' $g = 0.49$) and self-worth (Hedges' $g = 0.31$).²³ Despite the multiple benefits of PA, many youths are insufficiently active.²⁴ The U.S. Department of Health and Human Services recommends that youth ages 5-17 years engage in at least 60 min of PA daily.²⁵ Many LGBTQ youth are insufficiently active and report engaging in less moderate-to-vigorous PA in general than their heterosexual peers.²⁶ This could be due to their lower levels of athletic self-esteem or a reluctance to engage in sports due to feelings of exclusion, isolation, or unsafety because of their sexual orientation or gender identity.^{2,26,27} The benefits of PA for improving mental health in a diverse range of populations is well established; therefore, it is worth exploring how PA may influence depression among LGBTQ youth.

1.3. The current study

Previous research has established that PA can reduce depression symptoms and increase self-esteem in many

populations, including high school youth. The links between perceived discrimination, bullying, and teasing based on SGM identity and mental health is also well established. However, to the best of our knowledge, no studies have examined the effect that PA has on the relationship between bullying based on SGM identity and depression and self-esteem.

In order to bridge this gap, this study used a large national sample of SGM youth to better understand the moderating effect of PA on the relationship between bullying and depression and between bullying and self-esteem in SGM youth. This study tested the following hypotheses: (1) bullying based on being SGM would be positively related to depression severity and negatively related to self-esteem; (2) PA levels would be negatively related to depression severity and positively related to self-esteem; and (3) PA would moderate the effect of bullying on depression and self-esteem such that, as levels of PA increase, the relationships between bullying and depression and bullying and self-esteem would be weakened. The term "SGM youth" will be used henceforth to describe the population studied here. "LGBTQ" will still be used to describe previous research that used this terminology.

2. Methods

2.1. Procedures

This study used data from the LGBTQ National Teen Survey, a nationwide survey assessing health behaviors, school experiences, victimization, and family relationships of SGM adolescents in the United States. Data were collected through an anonymous online survey on Qualtrics.com. Recruitment of SGM adolescents took place on Twitter, Instagram, Snapchat, Reddit, and Facebook. Social media influencers shared the survey, and the Human Rights Campaign shared the link with their community partners. Eligible participants were between 13 and 17 years old, resided in the United States at the time they took the survey, and were English-speaking. Participants were offered a chance to win a gift card to a popular online retailer for completing the survey, and all participants could receive Human Rights Campaign wristbands. The University of Connecticut Institutional Review Board approved all study protocols. Online informed assent was obtained from all youth participants in the study. A waiver of parental consent related to this study was obtained from the Institutional Review Board.

Further details about recruitment, data collection, screening procedures, and the sample composition are reported elsewhere.²⁸ The full sample for this survey as originally collected was $n = 17,112$; however, in this study we limited the sample to those who responded to at least one of the survey items related to bullying, resulting in a sample size of $n = 9890$. All demographic data and results are based on this limited sample.

2.2. Measures

2.2.1. Demographics

For this analysis, participants' sexual orientation, gender identity, sex assigned at birth, age, race/ethnicity, and body mass

index (BMI) (calculated from reported height and weight) were included. For gender identity and race/ethnicity, participants could choose all options that applied.

For sexual orientation, participants were asked “How do you describe your sexual identity?” Participants chose one of the following: “gay or lesbian”, “bisexual”, “straight, that is, not gay”, or “something else”. If a participant chose “something else”, the options of “queer”, “pansexual”, “asexual”, “questioning”, or “other” were presented. Participants who chose “other” were presented with an open-ended text entry. For this analysis, all text entries were labeled as “other”.

To assess gender identity, participants were asked “What is your current gender identity?” Participants could select “Male”, “Female”, “Trans male/Trans boy”, “Trans female/Trans girl”, “Non-binary”, “Genderqueer/Gender non-conforming”, or “Different identity”. If participants selected “Different Identity”, they were prompted to write in their gender identity. Participants were asked “What sex were you assigned at birth?” and were given the choices “Male” or “Female”. For this analysis, a new variable with the categories “Cis-male”, “Cis-female”, “Trans male/Trans boy”, “Trans female/Trans girl”, “assigned male at birth (AMAB)/Non-binary”, and “assigned female at birth (AFAB)/Non-binary” was created. Participants categorized as “Cis-male” and “Cis-female” selected a gender identity that was congruent with their sex assigned at birth.

2.2.2. PA

PA was measured using the Godin Leisure-Time Exercise Questionnaire, a common self-report measure of PA that has been tested on and published about in studies with adolescent populations.^{29–31} Participants indicated how many times per week they engaged in strenuous, moderate, and mild exercise for a period of 15 min or more, with definitions provided for each category (mild exercise is minimal effort activity, moderate exercise is activity that is not exhausting, and strenuous exercise is activity where one’s heart beats rapidly). Response choices included “never”, “1–2 times a week”, “3–4 times a week”, and “5 or more times a week”. A PA score was calculated by multiplying the frequency of each level of exercise (*Never* = 0, *1–2 times* = 1, *3–4 times* = 2, *5 or more times* = 3) by metabolic equivalent values for each level of activity and summing the products of each component ($3 \times \text{mild} + 5 \times \text{moderate} + 9 \times \text{strenuous} = \text{leisure-time PA score}$).^{29,30} This scale has been used across multiple studies and has demonstrated consistent concurrent validity.^{32,33}

2.2.3. Depression

Depression was measured using the Kutcher Adolescent Depression Scale 11,^{34,35} an 11-item self-report instrument that measures frequency of depression symptoms in adolescents ages 12–17 years. Items included statements such as “Irritable, losing your temper easily, feeling pissed off, losing it”, and “Feelings of worthlessness, hopelessness, letting people down, not being a good person”. Respondents indicated the frequency over the past week that they experienced each statement on a 4-point scale: 0 (*hardly ever*), 1 (*much of the time*), 2 (*most of the time*), and 3 (*all of the time*). A single

item asking about self-harm and suicide was excluded from this survey in order to waive parental consent. Responses were summed (Cronbach’s $\alpha = 0.90$), and scores could range from 0 to 30, with higher scores indicating more depression symptoms. The scale as designed does not categorize participants based on specific ranges of scores.

2.2.4. Self-esteem

Self-esteem was measured using 18 items from 3 scales. Facets of multiple scales that assessed both self-esteem and beliefs about control over life experiences were combined to form a more comprehensive measure. All items from the Rosenberg Self-Esteem Scale, which is the most commonly used for scale for self-esteem in LGBTQ youth, were used and included statements such as “All in all, I am inclined to feel that I am a failure” and “I take a positive attitude towards myself”.³⁶ The majority of items from the Pearlin Mastery Scale and 2 items from the Levenson Multidimensional Locus of Control Scale were used.^{37,38} Respondents indicated how much they agreed with each statement on a 4-point scale: 0 (*strongly disagree*), 1 (*disagree*), 2 (*agree*), and 3 (*strongly agree*). Some items were reverse scored. Total scores were calculated by summing all items, and higher scores indicated higher self-esteem (possible range 0–54). Because multiple scales were combined, there are no standardized diagnostic cut-offs for specific scores. Cronbach’s α for the 18 self-esteem items was 0.91.

2.2.5. Bullying

Bullying was measured with 2 items. Participants were asked, “Have you ever been teased or bullied because of your actual or perceived LGBTQ identities at school?” Answer choices included “Yes, because I am LGBTQ and I have told others”, “Yes, because someone thought I was LGBTQ”, and “No”. For this analysis, the first 2 choices were condensed to “Yes” to make the response dichotomous. If participants responded “Yes” to the first question, then a second question to assess for frequency of bullying in the past year was displayed: “Has this happened to you within the past year?” Response choices ranged from *Never* = 0 to *Very Often* = 4. Only 2 items were selected due to lack of consensus on a multi-item scale that is universally applied to measure bullying, as well as survey space limitations.

2.2.6. Statistical analyses

Data were analyzed using SPSS Version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for sexual orientation, gender identity, race/ethnicity, age (birth year), and BMI. Multiple regression analyses were performed to examine predictors of depression and self-esteem, with the independent variables of level of PA, bullying based on being LGBTQ, and the interaction of these 2 variables. These regression analyses all contained several demographic variables used as controls, including sexual orientation, gender identity, race/ethnicity, age, and BMI. All categorical variables that were non-dichotomous were dummy coded. There was no dummy coding for race/ethnicity and gender identity because

participants could select multiple options. Analyses were first run to examine the effect of PA on depression and self-esteem. Next, the impact of bullying (independent of PA) was examined by including either the variable of whether or not participants had ever been bullied or how frequently they had been bullied in the past year. To examine the moderating effect of PA on the relationship between bullying and mental health, analyses were run containing the independent variables of PA, bullying (whether or not respondents had ever been bullied or how frequently they were bullied in the past year), and an interaction term created by multiplying one of the bullying variables (having ever been bullied and frequency of bullying in the past year) with PA. All continuous variables were mean centered, and all variables met multicollinearity assumptions. Simple slopes analyses were completed to obtain further detail about any significant interactions found.

3. Results

Demographic information ($n = 9890$) is listed in Table 1. The most common sexual orientations were gay/lesbian (38.2%) and bisexual (33.5%). The sample was predominantly White (76.2%), with 16.2% identifying as Hispanic/Latino, 8.5% as Black, 7.2% as Asian American, 4.2% as American Indian or Alaskan Native, and 3.4% as other.

Depression scores ranged from 0 to 30 (13.36 ± 7.61 , mean \pm SD), and self-esteem scores ranged from 0 to 54 (26.46 ± 10.15). PA scores ranged from 0 to 51 (19.33 ± 13.48). Only 14.3% of the sample reported engaging in moderate or strenuous PA for at least 6 days per week, suggesting that the majority of the sample did not meet suggested PA guidelines for adolescents.²⁵ More than 18% reported engaging in no moderate or strenuous PA each week. Almost two-thirds of participants (65.3%) reported ever being teased or bullied due to being LGBTQ. The average frequency of bullying in the past year was 1.92 ± 1.11 , which indicates that for those students who were bullied in past year, most reported being bullied “sometimes”.

Regression results are provided in Tables 2–5 and are discussed in further detail in the sections below. To improve readability, these tables only include standardized estimates and statistical significance for each predictor; full regression tables are available upon request. Many demographic variables were consistently related to the outcomes across the various models. For sexual orientation, individuals who identified as bisexual, pansexual, and asexual frequently had significantly higher depression scores and lower self-esteem scores compared to people who identified as gay/lesbian. Conversely, individuals who identified as straight had statistically lower depression scores and higher self-esteem scores. For gender identity, cis-males had significantly lower depression scores and higher self-esteem scores than all other gender identities (cis-females, trans-males, trans-females, and those who identify as non-binary). American Indian, Hispanic/Latino, and other individuals had higher depression scores, and Asian American individuals had consistently lower self-esteem scores. As BMI increased, participants had significantly higher depression scores and lower self-

Table 1
Sample demographics and baseline measures.

	<i>n</i>	%
Age (year)		
13	733	7.4
14	1443	14.6
15	2041	20.6
16	2575	26.0
17	3098	31.3
Race		
White	7538	76.2
Black	845	8.5
American Indian/Alaska Native	417	4.2
Asian American	711	7.2
Hispanic/Latino	1591	16.2
Other	340	3.4
Sexual orientation		
Gay/lesbian	3782	38.2
Bisexual	3311	33.5
Heterosexual	158	1.6
Something else	2639	26.7
Queer	402	4.1
Pansexual	1292	13.1
Asexual	451	4.6
Questioning	217	2.2
Other	276	2.8
Did not specify	1	<0.1
Gender identity		
Cis-male	2276	23.0
Cis-female	4273	42.8
Trans-male	849	8.6
Trans-female	113	1.1
AMAB/NB	255	2.6
AFAB/NB	2160	21.8
Sex assigned at birth		
Male	2644	26.7
Female	7246	73.3
Bullying in last year	6458	65.3

Note: some categories do not total 100% (9890) because of rounding (age, gender identity) or respondents could select multiple options (race, sexual orientation).

Abbreviations: AFAB = assigned female at birth; AMAB = assigned male at birth; NB = non-binary.

esteem scores. Finally, as age increased, individuals had higher depression scores and lower self-esteem scores.

3.1. PA and mental health

The model examining the effect of PA on depression was significant ($F(21, 8426) = 56.68, p < 0.001$) (Model 1 in Table 2). The variable of PA was significantly related to depression ($t = -4.176, p < 0.001; sr^2 = 0.002$; 95% confidence interval (95%CI): -0.04 to 0.01); as PA increased, depression decreased. PA level was also positively related to self-esteem; the full model was significant $F(21, 8482) = 63.57, p < 0.001$, as was as the PA variable ($t = 12.11, p < 0.001; sr^2 = 0.02$, 95%CI: 0.08 – 0.11) (Model 1 in Table 3).

3.2. Bullying and mental health

Overall, the model examining the effect of ever being bullied on depression was statistically significant $F(21, 8246) = 77.80, p < 0.001$ (Model 2 in Table 2). Ever being

Table 2
Summary of regression analysis (β) for the effects of physical activity, ever being bullied, and their interaction on depression.

Variable	Model 1	Model 2	Model 3
Sexual orientation (Ref. = gay/lesbian)			
Bisexual	0.049***	0.029*	0.047***
Straight	-0.029**	-0.034**	-0.027**
Queer	-0.002	-0.007	-0.003
Pansexual	0.062***	0.051***	0.060***
Asexual	0.037**	0.018	0.036**
Questioning	0.014	0.003	0.014
Other	0.038***	0.034**	0.037***
BMI	0.096***	0.099***	0.091***
Gender identity (Ref. = cis-male)			
Cis-female	0.181***	0.137***	0.177***
Trans-male	0.223***	0.238***	0.220***
Trans-female	0.047***	0.046***	0.045***
AMAB/NB	0.288***	0.295***	0.282***
AFAB/NB	0.061***	0.068***	0.059***
Race/ethnicity			
White	-0.031*	-0.016	-0.027
Black	0.013	0.008	0.012
Native American	0.035**	0.044***	0.036***
Asian American	0.019	0.010	0.020
Hispanic/Latino	0.029*	0.031*	0.028*
Other	0.027**	0.035**	0.029**
Age (years)	0.043***	0.057***	0.047***
Physical activity	-0.043***	-	-0.112***
Ever bullied	-	0.211***	0.216***
Ever bullied \times physical activity	-	-	0.069***
Adjusted R^2	0.122	0.160	0.165
Overall model significance	$F(21, 8426) = 56.68***$	$F(21, 8426) = 77.80***$	$F(23, 8424) = 73.47***$

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

Abbreviations: AFAB = assigned female at birth; AMAB = assigned male at birth; BMI = body mass index; NB = non-binary; Ref. = reference.

bullied was significantly related to depression ($t = 20.17$, $p < 0.001$; $sr^2 = 0.05$, 95%CI: 3.05–3.71) such that those who were ever bullied had higher levels of depression. For the regression examining the impact of frequency of bullying (Model 2 in Table 4), the overall model was also significant ($F(21, 5711) = 58.06$, $p < 0.001$). Frequency of bullying in the past year was positively related to depression (Table 4), $t = 19.35$, $p < 0.001$; $sr^2 = 0.05$; 95%CI: 1.47–1.81) such that more frequent bullying led to higher depression levels.

In examining self-esteem, the model with the independent variable of ever being bullied based on being LGBTQ was significant ($F(21, 8520) = 68.44$, $p < 0.001$ (Model 2 in Table 3). Ever being bullied was significantly related to self-esteem ($t = -15.23$, $p < 0.001$; $sr^2 = 0.02$; 95%CI: -3.87 to -2.99) such that individuals who reported being bullied had lower self-esteem. For the regression examining the impact of frequency of bullying, the overall model was also significant ($F(21, 5766) = 46.22$, $p < 0.001$ (Model 2 in Table 5). Frequency of bullying in the past year was negatively related to self-esteem ($t = -12.46$, $p < 0.001$; $sr^2 = 0.02$; 95%CI: -1.66 to -1.21) (Table 4) such that individuals who were bullied more frequently had lower self-esteem.

3.3. The interaction between PA and bullying as a predictor of mental health

There were significant interaction effects between PA and bullying on depression and self-esteem, but not in the expected

direction. For the variable of ever being bullied, the overall model for depression was significant ($F(23, 8424) = 73.47$, $p < 0.001$ (Model 3 in Table 2), as was the model for self-esteem ($F(23, 8480) = 72.88$, $p < 0.001$ (Model 3 in Table 3). The independent variables of PA ($t = -6.56$, $p < 0.001$; $sr^2 = 0.004$; 95%CI: -0.08 to -0.04), bullying ($t = 20.65$, $p < 0.001$; $sr^2 = 0.04$; 95%CI: 3.13 – 3.79), and the interaction term ($t = 4.09$, $p < 0.001$; $sr^2 = 0.002$; 95%CI: 0.03–0.07) were all significantly related to depression. Similarly, the independent variables of PA ($t = 12.54$, $p < 0.001$; $sr^2 = 0.02$; 95%CI: 0.14–0.19), bullying ($t = -16.35$, $p < 0.001$; $sr^2 = 0.03$; 95%CI: -4.09 to -3.21), and the interaction term ($t = -5.82$, $p < 0.001$; $sr^2 = 0.003$; 95%CI: -0.13 to -0.06) were significant predictors of self-esteem.

Simple slopes analyses were conducted to probe the significant interactions. Results indicated that the relationships between bullying and depression and bullying and self-esteem were stronger with increased levels of PA (Table 6). However, a visual examination of the data (Supplementary Fig. 1) indicated that while increased PA was associated with lower depression and higher self-esteem among individuals who reported not experiencing bullying, the positive effects of PA were less pronounced among those who reported experiencing bullying. To further probe this finding, regression analyses were re-run while limiting the sample to only those who had not experienced bullying and then comparing the regression coefficients and effect sizes. Among individuals who had

Table 3
Summary of regression analysis (β) for the effects of physical activity, ever being bullied, and their interaction on self-esteem.

Variable	Model 1	Model 2	Model 3
Sexual orientation (Ref. = gay/lesbian)			
Bisexual	-0.044***	-0.060***	-0.058***
Straight	0.043***	0.043***	0.036**
Queer	-0.002	-0.008	-0.005
Pansexual	-0.068***	-0.077***	-0.075***
Asexual	-0.040***	-0.057***	-0.054***
Questioning	-0.026*	-0.036**	-0.035**
Other	-0.039***	-0.043***	-0.041***
BMI	-0.075***	-0.080***	-0.068***
Gender identity (Ref.= cis males)			
Cis-female	-0.118***	-0.157***	-0.149***
Trans-male	-0.212***	-0.205***	-0.198***
Trans-female	-0.046***	-0.050***	-0.044***
AMAB/NB	-0.279***	-0.280***	-0.268***
AFAB/NB	-0.067***	-0.063***	-0.060***
Race/ethnicity			
White	-0.015	-0.002	-0.007
Black	0.016	0.010	0.013
Native American	-0.029**	-0.020	-0.023*
Asian American	-0.023*	-0.029*	-0.031**
Hispanic/Latino	0.002	0.002	0.004
Other	-0.011	-0.002	-0.007
Age (year)	-0.093***	-0.076***	-0.088***
Physical activity	0.124***	–	-0.171***
Ever bullied	–	-0.161***	0.214***
Ever bullied \times physical activity	–	–	-0.099***
Adjusted R^2	0.134	0.144	0.165
Overall model significance	$F(21, 8482) = 63.57***$	$F(21, 8520) = 68.44***$	$F(23, 8480) = 72.88***$

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

Abbreviations: AFAB = assigned female at birth; AMAB = assigned male at birth; BMI = body mass index; NB = non-binary; Ref. = reference.

never experienced bullying, PA was a significant predictor of depression ($t = -6.65$, $p < 0.001$; $\beta = -0.119$; $sr^2 = 0.013$; 95%CI: -0.08 to -0.05) and self-esteem ($t = 11.71$, $p < 0.001$; $\beta = 0.204$; $sr^2 = 0.04$; 95%CI: 0.13 – 0.18). Among those who had experienced bullying, PA was also a significant predictor of depression ($t = -1.97$, $p < 0.05$; $\beta = -0.025$; $sr^2 = 0.001$; 95%CI: -0.03 to 0.00) and self-esteem ($t = 7.56$, $p < 0.001$; $\beta = 0.096$; $sr^2 = 0.009$; 95%CI: 0.05 – 0.09), but it had a much weaker effect. Thus, while the relationship between bullying and mental health is stronger as individuals have higher levels of PA, this result appears to be due to the fact that PA has a strong impact among individuals who had not been bullied but almost no effect among individuals who had experienced bullying.

For the analysis containing the variable examining frequency of bullying, the overall model was significant for depression ($F(23, 5530) = 53.86$, $p < 0.001$) and self-esteem ($F(23, 5512) = 47.74$, $p < 0.001$) (Model 3 in Table 4). For depression, the variables of bullying frequency ($t = 19.18$, $p < 0.001$; $sr^2 = 0.06$; 95%CI: 1.49 – 1.83), PA ($t = -5.57$, $p < 0.001$; $sr^2 = 0.005$; 95%CI: -0.05 to -0.03), and their interaction ($t = 4.45$, $p < 0.001$; $sr^2 = 0.003$; 95%CI: 0.02 – 0.04) were all statistically significant predictors. Similarly, the independent variables of bullying frequency ($t = -12.97$, $p < 0.001$; $sr^2 = 0.03$; 95%CI: -1.74 to -1.28), PA ($t = 11.41$, $p < 0.001$; $sr^2 = 0.01$; 95%CI: 0.09 – 0.13), and the interaction term ($t = -4.69$, $p < 0.001$; $sr^2 = 0.003$; 95%CI: -0.05

to -0.02) were significant predictors of self-esteem (Model 3 in Table 5).

Simple slopes analysis revealed that, like the previous analysis, the relationships between bullying and depression and bullying and self-esteem were stronger as the level of PA increased (Table 6). However, when conducting a visual inspection of the data (Supplementary Fig. 2), it became apparent that increased PA was indeed associated with decreased depression scores and higher self-esteem scores among those who reported more infrequent bullying. However, as bullying frequency increased, the effects of PA on depression and self-esteem were almost nonexistent. To further probe this finding, the regression analyses were re-run when limiting the data, first to individuals with scores below the mean for frequency of bullying and next to individuals with scores at the mean or higher for frequency of bullying. Among individuals who scored below the mean for bullying, PA was a significant predictor of depression ($t = -6.15$, $p < 0.001$; $sr^2 = 0.016$; $\beta = -0.130$; 95%CI: -0.10 to -0.05) and self-esteem ($t = 9.05$, $p < 0.001$; $sr^2 = 0.03$; $\beta = 0.19$; 95%CI: 0.11 – 0.17). Among individuals who scored at the mean or higher for frequency of bullying, PA had a statistically significant but weaker effect on self-esteem ($t = 3.71$, $p < 0.001$; $sr^2 = 0.003$; $\beta = 0.06$; 95%CI: 0.02 – 0.06) and did not have a significant effect on depression.

Table 4
Summary of regression analysis (β) for the effects of physical activity, bullying frequency, and their interaction on depression.

Variable	Model 1	Model 2	Model 3
Sexual orientation (Ref. = Gay/lesbian)			
Bisexual	0.049***	0.032*	.032*
Straight	-0.029**	-0.031**	-0.028*
Queer	-0.002	-0.003	-0.005
Pansexual	0.062***	0.049**	0.048**
Asexual	0.037**	0.019	0.019
Questioning	0.014	0.006	0.007
Other	0.038***	0.028*	0.028*
BMI	0.096***	0.105***	0.098***
Gender identity (Ref. = Cis-male)			
Cis-female	0.181***	0.144***	0.138***
Trans-male	0.223***	0.214***	0.210***
Trans-female	0.047***	0.040**	0.039**
AMAB/NB	0.288***	0.286***	0.278***
AFAB/NB	0.061***	0.067***	0.064***
Race/ethnicity			
White	-0.031*	-0.022	-0.017
Black	0.013	0.009	0.009
Native American	0.035**	0.037**	0.040**
Asian American	0.019	0.016	0.017
Hispanic/Latino	0.029*	0.031*	0.032*
Other	0.027**	0.028*	0.030*
Age (year)	0.043***	0.012	0.016
Physical activity	-0.043***	-	-0.069***
Bullying frequency		0.239***	0.241***
Bullying frequency \times physical activity			0.054***
Adjusted R^2	0.122	0.176	0.180
Overall model significance	$F(21, 8426) = 56.68***$	$F(21, 5711) = 58.06***$	$F(23, 5530) = 53.86***$

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

Abbreviations: AMAB = assigned male at birth; AFAB = assigned female at birth; BMI = body mass index; NB = non-binary; Ref. = reference.

4. Discussion

Most of our findings were consistent with our hypotheses. Depression levels were positively related to bullying based on being LGBTQ, while self-esteem was negatively related to bullying based on being LGBTQ. A history of being bullied and frequency of bullying were significant predictors of depression and self-esteem. These results are consistent with previous research that found a relationship between being bullied based on LGBTQ identity and increased depression and lower self-esteem.^{1,2,4,39} Results are also consistent with the minority stress theory, which states that individuals with marginalized identities who experience perceived discrimination are at risk for poor mental health.³

PA levels were negatively related to depression and positively related to self-esteem. The more active youth were, the lower their reported levels of depression were. These findings aligned with previous research, which found that youth who exercise tend to experience less depression than those who do not exercise.^{14,15} The physiological effects of PA, such as the "endorphin hypothesis", which states that the release of endorphins may reduce pain and increase feelings of euphoria, could explain decreases in depression symptoms in youth who exercise.⁴⁰ The link between social connection and better mental health outcomes is well established; therefore, social interactions while exercising might also contribute to reduced depression symptoms in youth who exercise.^{41,42}

Our predictions that PA would moderate the effects of bullying on depression and self-esteem were partially supported. Surprisingly, results indicated that as PA increased, the relationships between bullying and depression and bullying and self-esteem became stronger. Upon further examination, it appeared that bullying may moderate the effect of PA on depression and self-esteem, instead of the predicted relationship, which posited that PA would moderate the effect of bullying on depression/self-esteem. Specifically, whereas increased PA led to lower levels of depression in youth who had not been bullied, it had a very weak or no effect on depression among youth who were bullied. Those who reported being bullied had higher levels of depression, and their depression scores remained high regardless of activity level. Likewise, as PA increased, the relationship between bullying and self-esteem weakened. For non-bullied youth, increased levels of PA were positively related to self-esteem, but for youth who had been bullied, PA had little to no effect on self-esteem.

These findings contradict the existing literature, which found that youth who participate in PA and sports are less likely to report being bullied and feeling depressed, and are more likely to report higher self-esteem than those who are not physically active.^{21,43-45} Most of this research, however, has been conducted with heterosexual and cisgender populations, or with populations where sexual and gender identity were not examined. A consistent body of literature has found that the

Table 5
Summary of regression analysis (β) for the effects of physical activity, bullying frequency, and their interaction on self-esteem

Variable	Model 1	Model 2	Model 3
Sexual orientation (Ref. = Gay/lesbian)			
Bisexual	-0.044***	-0.047**	-0.046**
Straight	0.043***	0.045**	0.038**
Queer	-0.002	-0.006	-0.003
Pansexual	-0.068***	-0.068***	-0.066***
Asexual	-0.040***	-0.043**	-0.041**
Questioning	-0.026*	-0.030*	-0.029*
Other	-0.039***	-0.036**	-0.035**
BMI	-0.075***	-0.086***	-0.073***
Gender identity (Ref. = Cis-male)			
Cis-female	-0.118***	-0.129***	-0.118***
Trans-male	-0.212***	-0.201***	-0.193***
Trans-female	-0.046***	-0.045***	-0.041**
AMAB/NB	-0.279***	-0.280***	-0.266***
AFAB/NB	-0.067***	-0.068***	-0.064***
Race/ethnicity			
White	-0.015	-0.005	-0.015
Black	0.016	0.013	0.015
Native American	-0.029**	-0.022	-0.027*
Asian American	-0.023*	-0.026	-0.028*
Hispanic/Latino	.002	0.001	.001
Other	-0.011	0.003	.008
Age (year)	-0.093***	-0.057***	-0.065***
Physical activity	0.124***	-	0.143**
Bullying frequency	-	-0.156***	-0.165***
Bullying frequency \times physical activity	-	-	-0.058***
Adjusted R^2	0.134	0.141	0.163
Overall model significance	$F(21, 8482) = 63.57***$	$F(21, 5766) = 46.22***$	$F(23, 5512) = 47.74***$

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

Abbreviations: AFAB = assigned female at birth; AMAB = assigned male at birth; BMI = body mass index; NB = non-binary; Ref. = reference.

majority of LGBTQ individuals report some sort of homophobic or heterosexist behavior or language, discrimination, and lack of support from teachers in grade school physical education settings.^{27,46} The unwelcoming environment, rife with opportunities for bullying, could discourage SGM youth from wanting to participate in PA and sports. Unsurprisingly, LGBTQ youth report not wanting to participate in high school athletics due to not feeling safe.⁴⁷ Even though PA has the ability to reduce depression and increase self-esteem, concerns about bullying, safety, and discrimination likely have a greater influence on SGM youth's desire not to participate in sports and exercise than the potential to reduce depression.

In all models, the control variables of gender identity, age, and BMI were significant predictors of depression. These findings are similar to previous literature in that BMI was related to self-esteem and depressive symptoms in adolescents, though the direction of this relationship remains unclear.⁴⁸ Students who identify as a gender minority tend to experience more depressive symptoms and suicidality than their cisgender peers.^{49–51} Non-binary individuals in particular report lower levels of self-esteem.⁵² Identifying as Native American or Hispanic/Latino were significant predictors of depression in all models. Regarding race/ethnicity, our results are consistent with previous research, which found that Hispanic/Latino and Native American/Pacific Islander youth are at an increased risk for depression and suicidality.⁵³ Identifying as bisexual, heterosexual, pansexual, or asexual was a significant predictor

of depression in all models. Previous research has found that individuals with emerging sexual identities experience higher rates of anxiety and depression than their heterosexual, gay, and lesbian counterparts.⁵¹ While our results were congruent with the literature, further research on demographic control variables is needed to determine the unique interaction among each variable and bullying, PA, and mental health.

Future research should examine the interaction between overall school environment on bullying, self-esteem, and depression symptoms in SGM youth. Previous research has found that being bullied at school can lead to youth skipping school, which is associated with lower levels of PA.⁵⁴ If SGM students are bullied in school, they likely will not seek out activities, such as team sports, that might encourage bullying. Since our study did not examine school-based sport participation in particular, future research should examine differences in school-based and non-school-based athletic participation among SGM youth in order to explore students' experiences of bullying in different sport settings. Future research should also examine what sports or exercise might be more accepting for SGM youth.

Recruitment occurred online, which limited reach to youth with Internet access, potentially excluding low-income youth, homeless youth, or youth without social media profiles. Recruitment occurred through "mainstream" SGM organizations and social media influencers, who tend to have predominantly cisgender and White followers. Thus, given that the

Table 6
Summary of unstandardized simple slopes for moderating effects of physical activity.

Predictor	Simple slopes of bullying variables at three points of physical activity score					
	Depression			Self-esteem		
	1SD below	Mean	1SD above	1SD below	Mean	1SD above
Ever bullied	1.45***	1.86***	2.27***	-1.33***	-2.02***	-2.72***
Frequency of bullying	1.50***	1.88***	2.27***	-1.35***	-1.85***	-2.35***

*** $p < 0.001$.

majority of the sample identified as White, recruitment efforts may have missed youth of color and youth who do not follow SGM accounts, limiting the generalizability of the sample. The survey recruited SGM youth and might have missed youth who do not identify as SGM. The survey design was cross-sectional; therefore, causality could not be determined. Our analysis combined bullying based on both known and perceived SGM identity and, as a result, we were unable to describe differences between the two perceived causes of bullying. Future research should employ a longitudinal design to determine if one factor (bullying, PA, or depression) precedes another. All survey items were self-report and, thus, participant recall might have been inaccurate. Future research could use wearable technology to measure PA, ask further questions about perceived causes of bullying, and use diagnostic interviews with self-report measures to assess for depression.

5. Conclusion

Youth who are bullied and youth who exercise less report higher levels of depression and lower self-esteem than youth who exercise more and youth who are not bullied. In addition to the need for increased PA in youth, these results highlight the need for continued anti-bullying and anti-discrimination initiatives in schools. For participants who have never been bullied, results of this study align with previous research in that exercise appears to decrease levels of depression while increasing self-esteem, but for SGM youth who have been bullied, exercise has less of an effect on depression or self-esteem levels. While exercise can still have many positive effects on both physical and mental health, our results reveal the importance of taking into account SGM youths' history of bullying before initiating an exercise intervention if the primary goal is improving mental health. Alternatively, in order to improve both mental and physical health for this vulnerable population, it may be beneficial to integrate mental health support with an exercise intervention in order to better address history of SGM identity-based bullying.

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Authors' contributions

SJK created the tables and wrote the introduction, methods, and discussion sections; CL ran the analyses, wrote the results section, created the tables, and provided edits; RJW collected the data and reviewed the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.jshs.2020.11.013](https://doi.org/10.1016/j.jshs.2020.11.013).

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