

Title: College student aerobic and muscle-strengthening activity: Disparities between cisgender and transgender students in the United States

Running Head: Cisgender / transgender activity

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Abstract

Objective: To examine aerobic and muscle-strengthening activity disparities among college cisgender and transgender students adjusting for other socio-demographic characteristics (age, race/ethnicity, sexual orientation). **Methods:** National College Health Assessment (NCHA) data collected between Fall 2015 and Fall 2018 were analyzed using chi-square tests for independence and odds ratios. **Results:** Cisgender women were significantly less likely to meet aerobic and muscle-strengthening activity recommendations compared to cisgender men. Transgender men and transgender women were less likely to meet aerobic and muscle-strengthening activity recommendations compared to cisgender peers. Differences were also revealed among transgender individuals, with transgender women more and less likely to meet aerobic and muscle-strengthening recommendations respectively compared to transgender men. **Conclusions:** Considerable aerobic and muscle-strengthening activity participation disparities exist between cisgender and transgender emerging adults. The unique constraints that transgender college students experience in relation to both aerobic and muscle-strengthening activity participation require further examination to ensure the provision of equitable opportunities to be physically active.

Key words: exercise; health; young adults; gender; race; sexual orientation

While physical activity disparities based on sex, i.e. between men and women, have been widely examined, disparities between transgender (i.e., those who experience incongruence between their gender assigned at birth and gender identity) and cisgender individuals have received less attention.¹ Physical activity is beneficial for both physical² and mental health³⁻⁵ and thus offers a means to improve the physical and mental health of transgender and non-binary (i.e., those who do not subscribe to binary gender identities) individuals who tend to have poorer mental health compared to cisgender individuals.⁶⁻⁸ For example, among transgender young adults the prevalence of serious psychological distress is five times that of cisgender individuals of a similar age.

Physical activity and sport participation research involving transgender individuals is severely lacking,⁹ and has been limited by small sample sizes. Much of the existing literature has focused on sport participation, in which transgender individuals tend to be constrained by specific barriers associated with their identity, including discriminatory behaviors and policies.^{10,11} While less research has focused on physical activity disparities, transgender individuals have consistently been found to be less active than cisgender individuals.^{12,13} Prior research has also focused on adults, with emerging adult focused research lacking¹ despite the importance of this time in life for establishing healthy behaviors.¹⁴ In addition, little research has examined disparities in muscle-strengthening activity, which is potentially more impacted by the aforementioned discriminatory behaviors and policies compared to aerobic activity^{10,11} as participation often requires equipment more so than aerobic activity.

In addition to sex, college student physical activity disparities have been reported based on a number of other socio-demographic characteristics such as race/ethnicity,¹⁵⁻¹⁷ sexual orientation,¹⁸ and year of study.^{19,20} Physical activity disparities based on race/ethnicity and sexual

orientation tend to follow a social gradient, with those most advantaged (i.e. cisgender, non-Hispanic white, and heterosexual) tending to be the most physically active.²¹ With respect to year of study, physical activity tends to decline during college, consistent with the trend observed as age increases.²² Thus, the purpose of this study was to examine aerobic and muscle-strengthening activity disparities among cisgender and transgender college students controlling for other socio-demographic characteristics that influence physical activity (age, race, sexual orientation, etc.).²²⁻

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Methods

Data from the American College Health Association (ACHA) National College Health Assessment (NCHA) collected between Fall 2015 and Fall 2018 were included in the analyses.²⁵

Measures

Participant characteristics

Age

Age was assessed to the nearest year.

Gender identity

Participants specified their gender identity as either man, women, transgender man, transgender woman, genderqueer, or another identity. Those who identified as genderqueer or another identity were excluded due to small cell sizes.

Race/ethnicity

Participants specified their race by selecting all that apply from the following options in response to how they usually describe themselves (White; Black; Hispanic or Lation/a; Asian or Pacific Islander; American Indian, Alaskan Native or Native Hawaiian; Biracial or Multi-racial; or other). Participants were categorized into those who identify as: NH white; NH black; Hispanic/Latinx;

NH Asian or Pacific Islander; NH Indigenous (American Indian, Alaskan Native or Native Hawaiian); NH Biracial or Multiracial; or NH other.

Sexual orientation

Participants specified their sexual orientation by selecting which of the following terms best describes their sexual orientation (asexual, bisexual, gay, lesbian, pansexual, queer, questioning, same gender loving, straight/heterosexual, or another identity). These same categories were used for analyses.

Year in school

Participants specified their year in school as: first year undergraduate, second year undergraduate, third year undergraduate, fourth year undergraduate, fifth year or more undergraduate, graduate or professional, not seeking a degree, or other

Enrollment status

Participants specified their enrollment as: full-time, part-time, or other

Health status

Participants specified their health status by responding to the question “How would you describe your general health?” with: excellent, very good, good, fair, poor, or I don’t know.

Physical activity behaviors

Participants responded to the following three questions regarding how many of the past seven days they did the following (0 to 7 days):

- Do **moderate-intensity** cardio or aerobic exercise (caused a noticeable increase in heart rate, such as a brisk walk) for at least **30 minutes**?
- Do **vigorous-intensity** cardio or aerobic exercise (caused large increases in breathing or heart rate, such as jogging) for at least **20 minutes**?

- Do 8-10 **strength training exercises** (such as resistance weight machines) for 8-12 repetitions each?

For aerobic physical activity the existing NCHA physical activity requirements variable that is based on the 2007 American College of Sports Medicine and American Heart Association guidelines²⁶ was used to allow researchers to compare findings with past and future research using the NCHA dataset. For muscle-strengthening activity participants were categorized into those who did/not meet muscle-strengthening activity recommendations based on the 2018 national physical activity guidelines.²⁷

Statistical analyses

All analyses were conducted using SPSS Version 26.0 (IBM, Armonk, NY). Before exclusion the sample was comprised of 358,543 participants. Those who were not full-time non-varsity athlete undergraduate students aged ≤ 24 years, as well as those who provided insufficient data to determine whether they met both physical activity and muscle-strengthening activity recommendations were excluded (n=141,214). Analyses were conducted on the remaining participants (n=217,329). Adjusting for multiple comparisons, the significance levels for all analyses were set at $p \leq 0.001$ and confidence intervals at 99.9%.

Descriptive statistics were computed to characterize the data. Differences in the prevalence of meeting aerobic and muscle-strengthening recommendations between gender identities were examined using chi-square tests for independence. Logistic regression analyses were conducted given chi-square tests for independence do not allow the magnitude of disparities between specific gender identities to be examined while controlling for other factors. Logistic regression analyses were conducted to determine odds ratios and quantify the magnitude of disparities in meeting aerobic and muscle-strengthening recommendations. Factors known to influence physical activity

among college students (age, sexual orientation, year in school, and health status) were adjusted for in analyses. Regression analyses were conducted both with and without weighting the gender identity independent (predictor) variable. Weighting, whereby the number of participants in the underrepresented group is increased, was conducted to reduce the limitation of the small number of transgender individuals. Further analyses with this dataset included the intersection of gender identity and race/ethnicity, as well as the intersection of gender identity and sexual orientation. These results fell beyond the scope of this study and are reported elsewhere.^{17,18} The likelihood of meeting activity recommendations relative to cisgender men were calculated.

Results

Participant characteristics

The mean age of participants was 20.0±1.5years. The majority of participants identified as cisgender women, NH white, and straight/heterosexual. The majority of participants perceived reported their health status as good, and a similar number of participants were upper and lower years of study in college (Table 1).

Table 1. Participant characteristics

	n	%
Gender identity		
Man	64363	29.6
Woman	152452	70.1
Transgender man	397	0.2
Transgender woman	117	0.1
Race		
NH White	133323	61.3
NH Black	9287	4.3
Hispanic/Latinx	32051	14.7
NH Asian or Pacific Islander	25162	11.6
NH Indigenous	774	0.4
NH Biracial or Multiracial	14062	6.5
NH Other	2670	1.2
Sexual Orientation		
Straight/Heterosexual	178209	82.0
Asexual	7931	3.6
Bisexual	14400	6.6
Gay	3700	1.7
Lesbian	2249	1.0
Pansexual	3378	1.6
Queer	1630	0.8
Questioning	4269	2.0
Same-Gender Loving	93	0.0
Another identity	1470	0.7
Year in school		
1st year undergraduate	62677	28.8
2nd year undergraduate	51214	23.6
3rd year undergraduate	51578	23.7
4th year undergraduate	41973	19.3
5th year or more undergraduate	9887	4.5
Health status		
Poor	4969	2.3
Fair	29962	13.8
Good	77037	35.4
Very good	81569	37.5
Excellent	23792	10.9

Note. NH = Non-Hispanic

Differences in meeting activity recommendations between gender identities

Chi-square tests for independence revealed that the number of students meeting activity recommendations differed significantly between gender identities. Less transgender men and women met aerobic activity recommendations than cisgender men and women, and less cisgender women met recommendations compared to cisgender men $\chi^2 (3 n = 217,239) = 3759, p < 0.001, \phi_c = 0.058$

Similarly, less transgender men and women met muscle-strengthening recommendations compared to cisgender men and women, and less cisgender women met recommendations compared to cisgender men, $\chi^2 (3 n = 217,239) = 723, p < 0.001, \phi_c = 0.131$ (Figure 1).

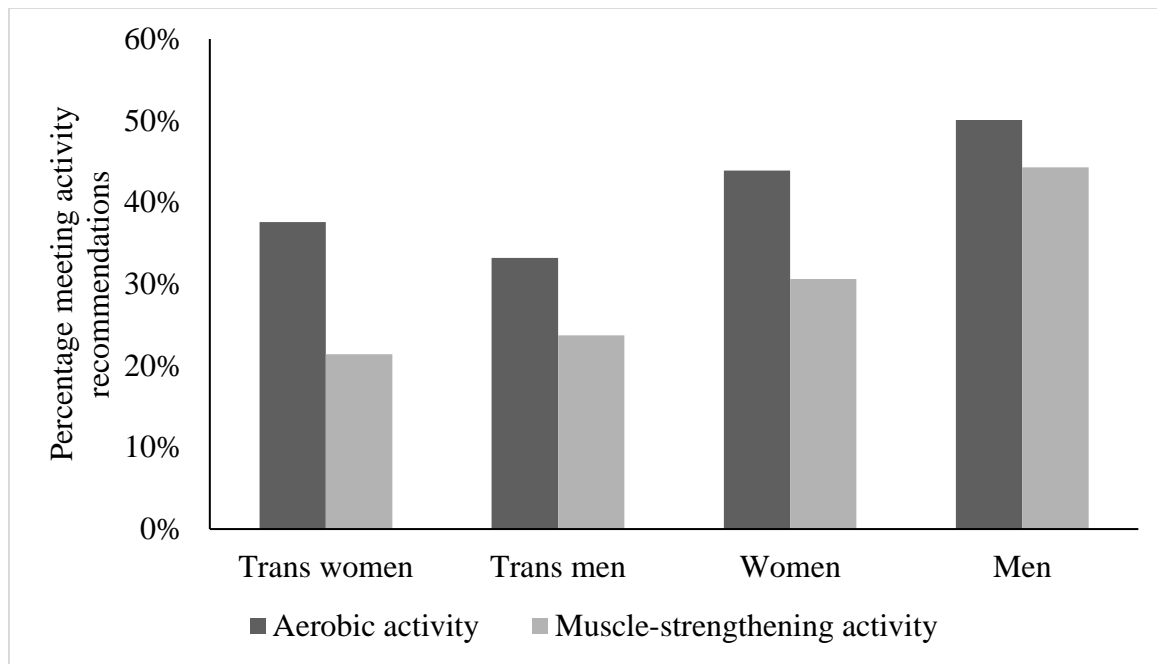


Figure 1. Percentage meeting physical activity recommendations between separated by activity and gender identity

Adjusted odds ratios reporting differences in the likelihood of meeting aerobic activity recommendations are displayed in Table 2. Weighted analyses revealed that transgender men were less likely meet recommendations compared to cisgender men. Though transgender women were less likely to meet recommendations compared to cisgender women, the difference was not statistically significant. Cisgender women were significantly less likely to meet recommendations compared to cisgender men. Transgender women were more likely to meet recommendations compared to transgender men, though the difference was not statistically significant.

Table 2. Unweighted and weighted adjusted odds ratios comparing likelihood of meeting aerobic activity recommendations between gender identities

	Unweighted					Weighted				
	Likelihood (%)	OR	99.9% CI		p	Likelihood (%)	OR	99.9% CI		p
			Lower	Upper				Lower	Upper	
Men only										
Cisgender Men - referent										
Transgender Men	-28.7	0.78	0.53	1.13	0.027	-31.2	0.76	0.58	1.00	0.001
Women only										
Cisgender Women - referent										
Transgender Women	-13.3	0.88	0.47	1.68	0.525	-13.3	0.88	0.56	1.39	0.369
Cisgender only										
Cisgender Men - referent										
Cisgender Women	-18.8	0.84	0.82	0.87	< 0.001	-18.8	0.84	0.82	0.87	< 0.001
Transgender only										
Transgender Men - referent										
Transgender Women	24.4	1.24	0.54	2.87	0.391	24.6	1.25	0.64	2.43	0.278
All										
Cisgender Men - referent										
Cisgender Women	-18.8	0.84	0.82	0.87	< 0.001	-18.8	0.84	0.82	0.87	< 0.001
Transgender Women	-33.2	0.75	0.40	1.43	0.143	-33.9	0.75	0.52	1.08	0.010
Transgender Men	-41.6	0.71	0.49	1.01	0.001	-43.7	0.70	0.58	0.84	< 0.001

Adjusted odds ratios reporting differences in the likelihood of meeting muscle-strengthening activity recommendations are displayed in Table 3. Though transgender men and women were less likely to meet recommendations compared to their cisgender peers, differences were not statistically significant. Cisgender women were significantly less likely to meet activity recommendations compared to cisgender men. Transgender women were less likely to meet recommendations compared to transgender men, though the difference was not statistically significant.

Table 3. Unweighted and weighted adjusted odds ratios comparing likelihood of meeting muscle-strengthening activity recommendations between gender identities

	Unweighted					Weighted				
	Likelihood (%)	OR	99.9% CI		p	Likelihood (%)	OR	99.9% CI		p
			Lower	Upper				Lower	Upper	
Men only										
Cisgender Men - referent										
Transgender Men	-22.5	0.82	0.54	1.24	0.110	-27.4	0.79	0.58	1.07	0.009
Women only										
Cisgender Women - referent										
Transgender Women	-35.1	0.74	0.35	1.58	0.191	-35.1	0.74	0.43	1.27	0.064
Cisgender only										
Cisgender Men - referent										
Cisgender Women	-66.7	0.60	0.58	0.62	< 0.001	-67.2	0.60	0.58	0.62	< 0.001
Transgender only										
Transgender Men - referent										
Transgender Women	-32.0	0.68	0.26	1.81	0.194	-32.5	0.68	0.31	1.46	0.094
All										
Cisgender Men - referent										
Cisgender Women	-66.7	0.60	0.58	0.62	< 0.001	-67.2	0.60	0.58	0.62	< 0.001
Transgender Women	-119.3	0.46	0.21	0.98	0.001	-122.7	0.45	0.29	0.70	< 0.001
Transgender Men	-49.9	0.67	0.45	1.00	0.001	-55.0	0.65	0.53	0.79	< 0.001

Discussion

Findings indicate that there are considerable aerobic and muscle-strengthening activity participation disparities based on gender identity among college students (emerging adults). Non-parametric analyses indicated that the prevalence of meeting aerobic and muscle-strengthening recommendations differed between gender identities but did not allow conclusions as to between what groups differences were statistically significant. Computation of odds ratios provided further detail concerning which differences between gender identities were statistically significant, while controlling for other factors known to influence student physical activity. While not all differences were statistically significant, the absence of a statistically significant difference does not imply the absence of a meaningful difference.

Transgender individuals were less likely to meet activity recommendations, though these differences were not statistically significant with the exception of aerobic activity among men. Though not statistically significant, the direction of the disparity among transgender individuals between men and women was different for aerobic and muscle-strengthening activity. Consistent with previous findings among students, cisgender men were found to be more active than cisgender women.²⁸⁻³¹ That differences involving transgender individuals were not statistically significant may be attributable to a number of factors. Though weighting analyses helped to mitigate the limitation of a small (relative to cisgender individuals) number of transgender individuals to a certain extent, this is still a limitation that may impact analyses. In future, purposive or oversampling of transgender individuals would help increase the representation of transgender individuals and alleviate this limitation. While valuable, controlling for socio-demographic characteristics such as sexual orientation lowered the alpha value by increasing the number of multiple comparisons. Finally, participants were emerging adults and therefore much younger than

participants in previous studies. Thus, they are at a stage in life where they potentially have more freedom to explore their identity, which may mean that their identity has less of an impact on behaviors such as physical activity that, by virtue of physiological adaptations resulting from participation, can influence one's appearance and therefore how individuals are perceived by others.

Regardless, findings demonstrate the need for further research concerning physical activity disparities based on gender identity, and to understand how interpersonal/community/environment/policy factors³² influence such disparities in this population and setting. Such research is necessary due to the apparent need to inform and justify policies and practices that ensure the provision of equitable opportunities to be physically active and thereby reduce disparities in physical activity and associated health outcomes.³³

This study is not without limitations, one of which is the use of self-report categorical variables to assess physical activity. In particular, aerobic physical activity items are worded to determine whether individuals meet somewhat dated physical activity recommendations²⁶ do not account for the fact that individuals may accumulate sufficient levels of moderate and/or vigorous physical activity on less than the recommended number of days/week. As such, findings regarding aerobic physical activity in particular should be interpreted with a degree of caution. Ideally continuous variables that differentiate between the volume (e.g. min/week) of moderate and vigorous aerobic physical activity would be used to examine differences. Similarly, differences in muscle-strengthening activity could be examined by analysing differences in the days/week individuals participated in such activities as opposed to whether they meet recommendations. Other limitations include the lack of heterogeneity of racial/ethnic groups. The limitations associated with the measurement of physical activity and race/ethnicity have been addressed, for

the most part, by the revised NCHA.³⁴ However, the latest iteration of the NCHA survey does not overcome the limitations stemming from the small number of transgender individuals, the exclusion of non-binary identities as well as the lack of information regarding transgender student's stage of transition and whether they had disclosed their gender.³⁵ Future researchers should consider improving the quality of physical activity measures, including better measures regarding aspects related to transgender individuals' status of medical and social transitioning.

Conclusion

In summary, to the authors' knowledge this is among the first studies to examine gender identity disparities in aerobic activity among emerging adults, and muscle-strengthening among any age group. Regardless of some disparities not being statistically significant, it is evident that there are disparities in aerobic and muscle-strengthening activity based on gender identity among emerging adults. Thus, gender identity should be considered by those conducting physical activity research, as well as those attempting to promote physical activity in future.

Conflict of interest disclosure

The opinions, findings, and conclusions presented/reported in this article are those of the authors, and are in no way meant to represent the corporate opinions, views, or policies of the American College Health Association (ACHA). ACHA does not warrant nor assume any liability or responsibility for the accuracy, completeness, or usefulness of any information presented in this article.

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