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The relationship between types of physical activity and mental health among U.S. adults[☆]

Firas Bafageeh^{*}, Travis Loux

Department of Epidemiology and Biostatistics, Saint Louis University College for Public Health and Social Justice, Salus Center, 3545 Lafayette Ave, St. Louis, MO 63104, United States

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ABSTRACT

Background: Physical activity is known to have a positive relationship with an individual's mental health and well-being. However, there is not enough data on how different types of physical activity participation relate to mental health. The study aims to examine the relationship between different types of physical activities on mental health status among U.S. adults.

Methods: This study used a secondary data analysis of 316,959 participants from the 2019 Behavioral Risk Factor Surveillance System (BRFSS) survey. Seventy-four different activities were identified and categorized into eight distinct activity types. Proportional odds logistic regression was utilized to calculate crude and adjusted odds ratios between physical activity type and mental health status.

Results: Overall, walking (38.9%) was the most commonly reported physical activity type. Compared to no physical activity, the crude and adjusted odds of experiencing mental health problems were significantly lower for all physical activity types, with adjusted odds ratios from 0.65 to 0.85. Running, sports, and weightlifting had the strongest relationships to better mental health while household tasks had the weakest, though when adjusting for multiple testing there were no significant differences in mental health between different types of physical activity.

Conclusions: Individuals participating in any physical activity have lower odds of experiencing mental health problems during the previous 30 days compared to inactive individuals. Knowing what type of specific physical activity adults commonly participate in and understanding their relationships with mental health can help in physical activity promotion and strategies.

1. Introduction

Depression is the leading cause of disability globally and a significant contributor to the global burden of disease (World Health Organization, 2021). Additionally, depression can lead to suicide, which is the fourth leading cause of death in 15 to 29-year-olds. Globally, the prevalence of mental disorders (depression, anxiety, post-traumatic stress disorder, bipolar disorder, and schizophrenia) is 22.1% (Charlson et al., 2019). In 2016, more than 1 billion individuals worldwide were impacted by mental and addictive disorders. They were responsible for 7% of the global illness burden assessed in Disability-adjusted life years (DALYs) and 19% of all years lived with disability (Rehm & Shield, 2019).

There is a complex interrelationship between mental and physical health. Many observational and experimental studies have shown

exercise helps improve the individual's well-being and can be included and used as a preventative treatment option to improve mental health (Bennie et al., 2019; Costigan et al., 2016; Mikkelsen et al., 2017). For example, physical activity, particularly exercise, has an antidepressant impact through various biological and psychological pathways that help in stress regulation (Kandola et al., 2019). Aside from physical health factors, emerging evidence shows that physical inactivity and sedentary time may interact with emotional and mental health effects like anxiety (Teychenne et al., 2015). For instance, increased time spent using screens for leisure correlates with poorer mental health experiences among adolescents (Hoare et al., 2016). While there are many potential biases in observational studies looking at relationship between physical activity and mental health, such as poor measurement, recall bias, and confounding, lowering the methodological data quality to date (Bennie

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^{*} Corresponding author.

E-mail address: firmabafageeh@gmail.com (F. Bafageeh).

et al., 2019; Ham et al., 2009; Hoare et al., 2016; Spees et al., 2005), consistent findings show physical activity has a positive impact on mental health.

Though there are not specific physical activity guidelines for improving mental health, adults can meet federal Physical Activity Guidelines for Americans, which include aerobic and muscle-strengthening recommendations, by engaging in a variety of physical activities (Sallis et al., 2020). For significant health benefits, adults should engage in at least 150–300 min of moderate-intensity aerobic physical activity, or at least 75–150 min of vigorous-intensity aerobic physical exercise, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week to meet the aerobic recommendation. To meet muscle-strengthening recommendations, adults should participate in exercises involving all major muscle groups on two or more days per week, giving extra health advantages (Sallis et al., 2020).

While the link between physical activity and mental health has been consistently shown, there is insufficient data on how various types of physical activity participation relate to mental health. A study found that anxiety and depression are more frequent among young athletes who participate in individual sports than those who participate in team sports (Phubar et al., 2019). Furthermore, as compared to their colleagues in team sports, adolescent individual-sport athletes are more inclined to pursue their sport for goal-focused motives rather than for fun (Phubar et al., 2019). There are some studies indicate that outdoor exercises are connected to better emotional well-being due to nature compare to indoor exercises (Mitchell, 2015; Pasanen et al., 2014). A number of studies recommend using a combination of aerobic and strength exercises for higher adherence to training, and stronger physical and mental health benefits (Sallis et al., 2020; Gomes-Neto et al., 2019; LeBouthillier & Asmundson, 2017). Aerobic and resistance training effectively improved anxiety disorder; specifically, aerobic exercise decreased overall psychological distress and anxiety. In contrast, resistance training improved disorder-specific symptoms, anxiety sensitivity, distress tolerance, and uncertainty intolerance (LeBouthillier & Asmundson, 2017). Additionally, combined aerobic and resistance exercise enhances peak VO₂, muscular strength, and health-related quality of life (Gomes-Neto et al., 2019).

Understanding and estimating involvement in certain types of physical activities is vital because it may aid in the development of suitable and successful interventions to encourage physical activity, which can lead to better mental health status (Centers for Disease Control and Prevention (CDC), 2013; Ham et al., 2009; Spees et al., 2005; Watson et al., 2016). Additionally, knowing which activities to advocate allows interventions to be targeted to certain demographics, which aids in the planning process (Watson et al., 2016). For example, if weightlifting is a popular activity among young individuals, an intervention targeting this demographic that includes weightlifting exercises would be likely to be beneficial. For these reasons, the aim of the study to investigate the relationship between specific types of physical activities and mental health status in United States adults.

Evidence supports that physical activity benefits someone's mental health, but not many studies examine the relative effect of different types of physical activity on mental health. In this study, we use cross-sectional, nationally representative data to investigate the differential relationship with mental health across types of physical activity. We hypothesize that group activities such as team sports and outdoor activities may be associated with stronger mental health outcomes than individual indoor activities.

2. Material and methods

2.1. Survey data

The data for this study came from the 2019 Behavioral Risk Factor Surveillance System (BRFSS), a yearly state-based cross-sectional

surveillance system using random-digit-dialled landline and cellular telephone survey that assesses civilian health behaviors and conditions non-institutionalized adults aged 18 and older in the United States and its territories. The American Association of Public Opinion Research (AAPOR) Response Rate Formula #4 is used to determine BRFSS response rates as is the percentage of persons who completed the survey out of all eligible and likely-eligible people (The American Association for Public Opinion Research, 2016). Survey response rate for all states, territories and Washington, DC, ranged from 37.3 to 73.1 with a median of 49.4 (Centers for Disease Control and Prevention (CDC), 2020). The 2019 BRFSS survey included 418,268 respondents. More details about survey methodology are available elsewhere (Centers for Disease Control and Prevention CDC, 2019)

2.2. Measures

Demographic characteristics assessed were age, sex, race/ethnicity, and education level. Health characteristics assessed were body mass index (BMI) category, cigarette smoking status, physical activity time, and muscle strengthening activities.

BMI was calculated in the survey using self-reported height and weight measurements and classified into four categories: underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 25), overweight (25 ≤ BMI < 30), and obese (BMI ≥ 30); respondents without valid information on height and weight were considered missing.

Smoking status was calculated in the survey and was based on respondent's report of smoking at least 100 cigarettes (5 packs) in their lifetime and whether or not they currently smoke cigarettes every day, some days, or not at all. From these items, respondents were classified as current smoker (smoked at least 100 cigarettes in your entire life and smoke every day or some days), former smoker (smoked at least 100 cigarettes in your entire life and now not at all), and never smoked (not smoked at least 100 cigarettes in your entire life and now not at all).

Physical activity time was calculated in the survey by using self-reported answer of the following question 'During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?'. With the calculated variables from the survey of 'Minutes of total Physical Activity per week', and 'Minutes of total Vigorous Physical Activity per week.', respondents were classified into four categories following the Physical Activity Guidelines for Americans: inactive (0 min of total physical activity per week and responders with calculated variable of missing physical activity data or no physical activity during the last month), insufficiently active (1–149 min of total physical activity per week and no missing physical activity data), active (150–300 min - or vigorous equivalent - of total physical activity per week and no missing physical activity data), and highly active (> 300 min of total physical activity per week or > 150 min of total vigorous physical activity per week and no missing physical activity data).

Muscle-strengthening activity was calculated in the survey and was based on self-reported strength activity frequency per week and classified into two categories: Met-muscle strengthening recommendations (≥ 2 times per week), and did not meet muscle strengthening recommendations (< 2 times per week).

2.2.1. Physical activity types

Activity types were recorded by interviewers asking about which two physical activities or exercises the participants spent the most time doing during the past month. For this study we selected the one activity the participants reported doing the most. Interviewers used a list of 74 non-occupational physical activities. If participant responses were not on the list, they were categorized as "Other, not specified". For the current study, the 74 activities were grouped into eight categories:

- Bicycling

- Conditioning exercise: active gaming devices, aerobics video or class, bicycling machine exercise, calisthenics, dancing, elliptical/EFX machine exercise, inline skating, Pilates, rope skipping, rowing machine exercise, scuba diving, skateboarding, skating, sledding, tobogganing, snow skiing, snowshoeing, stair climbing/stair master, surfing, swimming in laps, yoga, upper body cycle
- Sports: badminton, basketball, boxing, golf, handball, hockey, lacrosse, mountain climbing, paddleball, racquetball, rock climbing, rugby, soccer, softball/baseball, squash, tai chi, tennis, touch football, volleyball, wrestling, karate/martial arts
- Household task: carpentry, gardening, mowing lawn, painting/papering house, raking lawn, snow blowing, snow shoveling by hand, childcare, farm/Ranch work, household activities, yard work
- Recreational activities: boating, bowling, canoeing/rowing in competition, fishing from river bank or boat, frisbee, horseback riding, hunting large game, hunting small game, snorkeling, stream fishing in waders, swimming, table tennis, waterskiing
- Running: running, jogging
- Walking: backpacking, hiking, walking
- Weightlifting

Participants who answered 'No' for the question 'During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?' were recorded as none and were added as a ninth category. This categorization was adapted from Hollis et al. (2020), Pharr and Lough (2017) and Nam et al. (2009) studies. Though the activity type "Other, not specified" is included in the survey, the results are not discussed further because of the mix of different activity types in that category and are removed for this study.

2.2.2. Mental health status

Mental health status was recorded by interview using the following question 'Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?' and grouped into three ordinal categories according to the following responses: zero days when mental health not good, 1–13 days when mental health not good, and ≥ 14 days when mental health not good.

2.3. Statistical methods

There were 409,489 respondents who reported on the number of days in which they had experienced mental health problems. After excluding 92,530 respondents who were missing information on physical activity type ($n = 42,604$), physical activity time ($n = 49,135$), education level ($n = 1835$), smoking status ($n = 18,928$), and BMI category ($n = 36,203$), the final analytic sample included 316,959 adults. Detailed description of the missing data and Cramer's V effect size is available in the supplemental material.

Descriptive statistics are reported as unweighted counts and percentages. Chi-squared tests were used to identify significant relationships between demographic and health characteristics and days experiencing mental health problems. Prior to modeling, the BRFSS design was taken into account by incorporating sampling strata, clusters, and weights. Proportional odds (cumulative logit) models were conducted to investigate the relationship between physical activity types and days experiencing mental health problems, with OR < 1 indicating a protective factor and OR > 1 indicating a risk factor. The unadjusted model includes only physical activity types, while the adjusted model also includes demographic and health characteristics described above. For both models, odds ratios and a 95% CIs are reported. Pairwise two-sample z tests of the regression coefficients with false discovery rate (FDR) adjustment were used to identify significant differences between different types of physical activities in the adjusted model. A p-value < 0.05 was used throughout the analysis to indicate statistical significance.

All analyses were performed in R version 4.1.1, using the survey package version 4.1–1 (Lumley, 2004) to handle the BRFSS complex sampling design.

3. Results

Table 1 shows the descriptive results of demographic and health characteristics within mental health groupings. Overall, walking was the most common nonoccupational physical activity reported by respondents (38.9%). Walking was followed by household tasks (7.6%), conditioning exercises (7.4%), running/jogging (6%), weightlifting (3.8%), sports (3.3%), bicycling (2%), and recreational activities (1.4%). There were 29.6% adults not participating in any type of physical activity. The demographic characteristics show that of adults reporting ≥ 14 days when mental health was not good, 61% were female, 23.1% were aged 65 or older, 74.2% were non-Hispanic white, 32.9% attended college or technical school. For health characteristics, 40.2% were obese, 44.4% never smoked, 44% were Insufficiently Active, 71.9% did not meet muscle-strengthening recommendations, and 42.5% didn't participate in any physical activity.

The unadjusted model (Table 2) shows all types of physical activity are associated with fewer days experiencing mental health problems when compared to no physical activity. The cumulative odds of having days when mental health is not good ranged from 0.72 (sports) to 0.91 (conditioning exercise and running and jogging) relative to the inactive group.

After adjusting for sociodemographic characteristics, body mass index (BMI) category, cigarette smoking status, physical activity time, and muscle-strengthening activities, the adjusted model (Table 3) shows all types of physical activity remained associated with decreased risk of days experiencing mental health problems when compared to no physical activity. The cumulative odds of having days experiencing mental health problems ranged from 0.65 to 0.85 relative to the inactive group.

Fig. 1 provides a visual comparison of the ORs and 95% confidence intervals in the unadjusted and adjusted models for physical activity types. Both models show that all physical activity types decrease the risk of days experiencing mental health problems (as protective factor). Furthermore, the figure shows a significant difference between models for weightlifting and running, which have much stronger associations with fewer days experiencing mental health problems in the adjusted model.

Pairwise two sample z tests of the physical activity type coefficients in the adjusted model showed running had a significantly stronger association with fewer days experiencing mental health problems than conditioning exercise, household tasks, and recreational activities prior to FDR adjustment. Additionally, sports has a stronger relationship with fewer days experiencing mental health problems than household tasks. However, after FDR adjustment for multiple testing, there are no significant differences between different types of physical activity on days experiencing mental health problems.

4. Discussion

This study confirms and expands upon what we know about the relationship between physical activity and mental health. We found that walking, which includes backpacking, hiking, and walking, was by far the most commonly reported physical activity type (38.9% of respondents), followed by household tasks (7.6%) and conditioning exercises (7.4%). This finding is consistent with other studies on non-occupational physical activity in the U.S. (Nam et al., 2009; Hollis et al., 2020; Pharr & Lough, 2017). Adults who participate in any type of physical activity have lower odds of experiencing mental health problems during the previous 30 days than inactive people. Our findings are consistent with other studies that examined the relationship between physical activity and mental health. (Searle et al., 2019; Costigan et al., 2016; Kandel et al., 2019; Mikkelson et al., 2017).

Table 1
Distribution of selected demographic characteristics and health behaviors among US adults aged 18 and older by mental health status, BRFSS 2019 (n = 316,959).

	Zero days when mental health not good	1–13 days when mental health not good	14+ days when mental health not good	Total	p
n	203,569	74,035	39,355	316,959	
Sex: Female (%)	99,413 (48.8)	44,487 (60.1)	24,001 (61.0)	167,901 (53.0)	<0.001
Age (%)					<0.001
Age 18 to 24	7737 (3.8)	7675 (10.4)	3834 (9.7)	19,246 (6.1)	
Age 25 to 34	15,856 (7.8)	11,206 (15.1)	5647 (14.3)	32,709 (10.3)	
Age 35 to 44	20,785 (10.2)	11,251 (15.2)	5540 (14.1)	37,576 (11.9)	
Age 45 to 54	27,176 (13.3)	11,819 (16.0)	6712 (17.1)	45,707 (14.4)	
Age 55 to 64	43,158 (21.2)	14,020 (18.9)	8540 (21.7)	65,718 (20.7)	
Age 65 or older	88,857 (43.6)	18,064 (24.4)	9082 (23.1)	116,003 (36.6)	
Race (%)					<0.001
White	157,631 (77.4)	57,167 (77.2)	29,183 (74.2)	243,981 (77.0)	
Black	14,362 (7.1)	5396 (7.3)	3047 (7.7)	22,805 (7.2)	
Asian	4774 (2.3)	1677 (2.3)	574 (1.5)	7025 (2.2)	
American Indian					
Alaskan Native	2910 (1.4)	1154 (1.6)	888 (2.3)	4952 (1.6)	
Hispanic	17,937 (8.8)	5865 (7.9)	3655 (9.3)	27,457 (8.7)	
Other race non Hispanic	5955 (2.9)	2776 (3.7)	2008 (5.1)	10,739 (3.4)	
Education (%)					<0.001
Did not graduate high school	12,949 (6.4)	3728 (5.0)	3905 (9.9)	20,582 (6.5)	
Graduated high school	54,021 (26.5)	17,002 (23.0)	12,313 (31.3)	83,336 (26.3)	
Attended college or technical school	54,915 (27.0)	21,578 (29.1)	12,950 (32.9)	89,443 (28.2)	
Graduated from college or technical school	81,684 (40.1)	31,727 (42.9)	10,187 (25.9)	123,598 (39.0)	
BMI category (%)					<0.001
Underweight	2923 (1.4)	1325 (1.8)	1006 (2.6)	5254 (1.7)	
Normal weight	60,396 (29.7)	23,628 (31.9)	10,753 (27.3)	94,777 (29.9)	
Overweight	76,748 (37.7)	24,412 (33.0)	11,756 (29.9)	112,916 (35.6)	
Obese	63,502 (31.2)	24,670 (33.3)	15,840 (40.2)	104,012 (32.8)	
Smoking status (%)					<0.001
Current smoker	23,399 (11.5)	10,815 (14.6)	11,355 (28.9)	45,569 (14.4)	
Former smoker	59,818 (29.4)	19,020 (25.7)	10,543 (26.8)	89,381 (28.2)	
Never smoked	120,352 (59.1)	44,200 (59.7)	17,457 (44.4)	182,009 (57.4)	
Physical activity (%)					<0.001
Highly active	74,950 (36.8)	23,390 (31.6)	9984 (25.4)	108,324 (34.2)	
Active	34,094 (16.7)	13,802 (18.6)	5127 (13.0)	53,023 (16.7)	

Table 1 (continued)

	Zero days when mental health not good	1–13 days when mental health not good	14+ days when mental health not good	Total	p
Insufficiently active	33,539 (16.5)	16,885 (22.8)	6946 (17.6)	57,370 (18.1)	
Inactive	60,986 (30.0)	19,958 (27.0)	17,298 (44.0)	98,242 (31.0)	
Did not meet muscle strengthening recommendations (%)	134,578 (66.1)	49,111 (66.3)	28,301 (71.9)	211,990 (66.9)	<0.001
Activity group (%)					<0.001
None	58,306 (28.6)	18,879 (25.5)	16,734 (42.5)	93,919 (29.6)	
Bicycling	4033 (2.0)	1608 (2.2)	521 (1.3)	6162 (1.9)	
Conditioning exercise	15,220 (7.5)	6077 (8.2)	2151 (5.5)	23,448 (7.4)	
Sports	7375 (3.6)	2428 (3.3)	762 (1.9)	10,565 (3.3)	
Household tasks	16,357 (8.0)	5189 (7.0)	2491 (6.3)	24,037 (7.6)	
Recreational activities	3033 (1.5)	1070 (1.4)	463 (1.2)	4566 (1.4)	
Running	11,378 (5.6)	5745 (7.8)	1768 (4.5)	18,891 (6.0)	
Walking	80,367 (39.5)	29,551 (39.9)	13,252 (33.7)	123,170 (38.9)	
Weightlifting	7500 (3.7)	3488 (4.7)	1213 (3.1)	12,201 (3.8)	

Abbreviations: n, number; p, P-value from chi-square test.

Table 2

Unadjusted and adjusted odd ratios from proportional odds models comparing mental health status across physical activity types, 2019 BRFSS.

Coefficient ^a	Unadjusted		Adjusted ^b	
	OR	95% CI	AOR	95% CI
Running	0.91	0.86 – 0.96	0.65	0.57 – 0.75
Sports	0.72	0.67 – 0.78	0.68	0.58 – 0.79
Weightlifting	0.90	0.84 – 0.96	0.69	0.60 – 0.80
Bicycling	0.76	0.69 – 0.84	0.78	0.66 – 0.92
Walking	0.86	0.83 – 0.89	0.79	0.69 – 0.91
Recreational activities	0.88	0.78 – 0.99	0.82	0.69 – 0.98
Conditioning exercise	0.91	0.86 – 0.97	0.83	0.73 – 0.96
Household tasks	0.78	0.73 – 0.83	0.85	0.73 – 0.98

Abbreviations: AOR, adjusted odd ratio; BRFSS, Behavioral Risk Factor Surveillance System; CI: confidence interval.

^a Reference group is not participating in any physical activities.

^b After adjusting for sociodemographic characteristics, body mass index (BMI) category, cigarette smoking status, physical activity time, and muscle-strengthening activities.

We found association between physical activity types and mental health for both crude and adjusted models. Furthermore, there was a significant change in weightlifting and running/jogging between the crude and adjusted models. This may suggest that adults who participate in these two physical activities have a higher baseline risk of having more mentally unhealthy days during the previous 30 days. Furthermore, it suggests that these two physical activities may be more effective and protective for the demographic groups that participate in them. The current study was not designed to address these hypotheses specifically, so they should be the focus of future investigations.

There was some statistically significant differences between the protective factors on days experiencing mental health problems. However, after adjustment for multiple testing, these differences did not remain statistically significant. The magnitude of the differences is

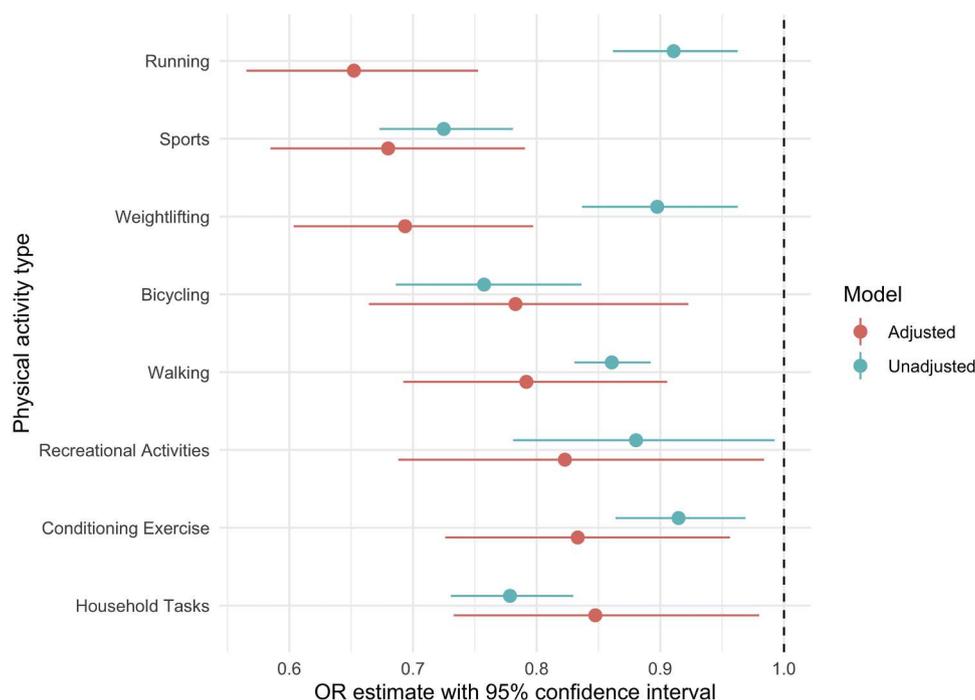


Fig. 1. ORs differences of physical activity type between adjusted and unadjusted proportional odds models with 95% confidence intervals. Activities displayed in order of their adjusted odds ratios.

potentially meaningful and the lack of statistical significance may be due to variation in effect or over-correction for multiple testing and suggests another avenue for future, more focused research. Running, sports, and weightlifting had notably smaller odds ratios than other types of activities, with all adjusted odds ratios less than 0.7, while the other activities had odds ratio ranging from 0.78 to 0.85. These three activities may be more likely to include measurable achievements such as average mile times, tournament placing, and max weight lifts, compared to the activity types with weaker relationships with mental health. Running and weightlifting are usually considered high-intensity activities, especially compared to activities such as walking or household tasks, and sports are more likely to contain a social or communal element not inherently present other activity types. Further research might consider investigating not just activity type, but activity intensity, purpose or goals of activity and how they are tracked, and social aspects of activities in their relation to mental health.

Our study is limited by substantial nonresponse, selection bias, undercoverage, and noncoverage issues; however, weighting and survey methodology employed by BRFSS helps to address this issue (Centers for Disease Control & Prevention, 2012). Additionally, item non-response could cause additional bias, though we found respondents excluded for missing data looked very similar to complete cases. This study used cross-sectional data, which restricted our ability to measure the directionality between types of physical activity and frequency of poor mental health. Another limitation is that respondents were only allowed to describe the two most often done activities might be underestimating the percentage of adults engaged in certain activities. However, in another nationwide study, when asked to record any physical activity they participated in, 81% of individuals reported two or fewer activities, so any underestimation most probably will be small. (Watson et al., 2016). Additionally, self-report bias may come from different interpretations of the question of most common physical activity, as this could be interpreted as greatest number of sessions, amount of time per session, or total amount of time. Furthermore, respondents were asked about the frequency of feeling stress and depression in the past 30 days, which is quite general and incorporates a wide range of mental health outcomes such as depression, stress, and emotional problems while

excluding other significant indicators of mental health such as anxiety or wellbeing. Additionally, the 3-level scale recorded over one month is crude compared to other more validated measures of mental health and may be impacted by annual cycles such as weather, school, or work, or recent life events that are usually not a major factor in the individual's mental health. Finally, physical activity types can be combined in many ways, potentially leading to different results. We grouped activities according previous literature (Ham et al., 2009; Hollis et al., 2020; Pharr & Lough, 2017) with minor changes, hopefully reducing risk of misinterpretation.

Better understanding which specific types of physical activities adults commonly participate in can help in guiding strategies to increase physical activity and physical activity-based mental health intervention, which can help to better allocate resources to achieve better mental health in a target population. The current study shows that any type of physical activity may reduce the number of days during which one experiences mental health problems. However, it also suggests there may be meaningful differences based on demographics, baseline risk of those likely to partake in certain types of activity, and activity type. We suggested potential areas of research to these ends earlier. Future work may also want to compare the activity patterns of adult subgroups, such as by age and gender, to develop more tailored physical activity recommendations based on likelihood of participation and effectiveness on preventing poor mental health within these groups.

Declaration of Competing Interest

Travis Loux has no conflict of interest or financial disclosures.
Firas Bafageeh has no conflict of interest or financial disclosures.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.mhp.2022.200244.

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