Physical Activity Mode and Mental Distress in Adulthood

By: Christopher N. Sciamanna, Joshua M. Smyth, Shawna E. Doerksen, Barrett R. Richard, Jennifer L. Kraschnewski, Andrew J. Mowen, Benjamin D. Hickerson, Liza S. Rovniak, Erik B. Lehman, Chengwu Yang

Sciamanna, C. N., Smyth, J. M., Doerksen, S. E., Richard, B. R., Kraschnewski, J. L., Mowen, A. J., Hickerson, B. D., Rovniak, L. S., Lehman, E. B., & Yang, C. (2017). Physical Activity Mode and Mental Distress in Adulthood. *American Journal of Preventive Medicine, 52*(1), 85-93. doi:10.1016/j.amepre.2016.09.014

Made available courtesy of Elsevier: http://dx.doi.org/10.1016/j.amepre.2016.09.014

Abstract:

Introduction

Nearly one fifth of American adults suffer from mental health issues, yet many treatments have side effects and stigma attached. Physical activity can be an effective treatment for mental health disorders, but most promotion efforts fail. One understudied aspect of physical activity is the specific mode, including if it engages others, and how this may relate to mental health. This study examined the potential relationship between different modes of physical activity and the frequency of mental distress.

Methods

Data from the 2000 Behavioral Risk Factor Surveillance System were analyzed in 2015 to determine the relationship between participation in different modes of physical activity and frequent mental distress.

Results

Data were obtained on physical activity and frequent mental distress from 183,341 adults (aged 18–99 years, 51.9% female, 57.4% overweight/obese, 9.5% frequent mental distress). Prevalence of mental distress for those reporting activities was contrasted against walking alone. People who participated in tennis had 46% lower odds (95% CI=0.35, 0.84) of frequent mental distress. Approaching significance, non-team play sports were associated with 18% lower odds (95% CI=0.66, 1.01) of frequent mental distress, compared with walking alone.

Conclusions

Activity modes are associated with mental health outcomes above and beyond the frequency and duration of activity. Given the social and play nature of the activities, this may reflect the relational aspect, enjoyment, or a combination of both. These results suggest that adding social or affective components to physical activity may enhance engagement and retention in activity promotion efforts and their benefits on mental health.

Keywords: Physical activity | Mental health | Mental distress

Article:

Introduction

Recent prevalence data estimate that 18.5% (43.8 million) of American adults have a mental, behavioral, or emotional disorder. Additionally, 4.2% (10 million) American adults have a serious mental illness resulting in functional impairment.[1] Mental health impairments are associated with multiple health risks, including increased prevalence of cardiovascular disease,[2] decreased use of medical services, and premature death.[3] People with serious mental illness have significantly shorter life expectancies than the general population.[4] The economic cost of mental health disorders is estimated at $57.5 billion each year.[5] Effective treatment of mental health disorders is essential to decrease the effects and costs of poor mental health on society.

Physical activity, or body movement resulting in caloric expenditure above resting rate,[6] may be an effective treatment for mental health disorders. Components of physical activity include intensity (i.e., amount of exerted effort), duration (i.e., amount of time engaged in activity), frequency (i.e., how often the activity is done), and mode (i.e., the type of activity). Exercise is a subset of physical activity that is deliberate, with the expected outcome of increased physical fitness.[6] Aerobic physical activity has been found to be as effective as pharmacologic treatment of major depressive disorder.[7] A recent Cochrane review and meta-analysis noted that physical activity improves mental health.[8, 9] Moreover, activity offers the benefit of minimal side effects and little treatment-associated stigma. Physical activity has also been found to protect against anxiety, depression, and distress in adults without clinical mental health disorders.[6]

Despite the importance of physical activity in the treatment/prevention of mental health problems (in addition to other health outcomes), fewer than 10% of adults meet American Heart Association and American College of Sports Medicine activity guidelines (i.e., at least 150 minutes of moderate-intensity activity, 60 minutes of vigorous-intensity activity, or a combination thereof).[10, 11, 12] Often, interventions attempt to increase personal efficacy or decrease barriers associated with activity by focusing on simpler activities (mainly walking) and encouraging active lifestyles. However, many interventions fail to change behavior or maintain that change.[13] One potential reason for these failures is a relative underappreciation for the affective and social processes (e.g., enjoyment) that drive participation in certain behaviors.

The PERMA behavioral model[14] highlights the affective component of motivation for behavior. Seligman and colleagues[14] posit that humans pursue activities that provide positive emotions, engagement, relationships, meaning, and accomplishment. That is, people are more likely to

engage in activities that increase positive affect, allow for absorption within the activity, provide connection with others, allow the individual to be part of something bigger, and give an opportunity to reach goals. Viewed through this lens, physical activities that people would pursue the most would be ones that were fun, create enjoyment, and were social. This model also suggests that social physical activities may have mental health benefits beyond the anxiolytic effect of aerobic physical activity alone, given the importance of relationships to mental well-being. In support of the PERMA model, perceived enjoyment of physical activity has consistently been predictive of physical activity levels.[15, 16] Furthermore, results from the Scottish Mental Health study showed differential effects on mental health based on activity mode, with sports being the strongest.[17] This study was designed to extend these findings and examine a broader range of activities and their relationship with mental health.

Using data from the Behavioral Risk Factor Surveillance Survey (BRFSS), the relationship between activity mode and mental health outcomes was examined. It was hypothesized that sport or team-based physical activities would be more highly related to positive mental health outcomes than activities that are primarily exercise based and do not require social interaction (e.g., walking).

Methods

This analysis was conducted during 2015 using data from BRFSS, a cross-sectional national survey, collected by state health departments in collaboration with the Centers for Disease Control and Prevention. Details about the sampling and methodology are published elsewhere.[18] Briefly, telephone interviews were conducted with a random sampling of adults in each of 50 states plus the District of Columbia, Puerto Rico, and the Virgin Islands. The majority of states used disproportionate stratified sampling. Puerto Rico employed a simple random sample and Minnesota used the Mitofsky−Waksberg design.[19]

Measures

Data from the 2000 BRFSS were analyzed, as that year asked participants to name specific activity modes (e.g., basketball) rather than just intensity (e.g., vigorous). Participants were asked: *What type of physical activity or exercise did you spend the most time doing during the past month?* and *What other type of physical activity gave you the next most exercise during the past month?*, providing their two most common activities.[20] Participants provided frequency and duration of participation to allow categorization of each participant's total physical activity using standard categories used in BRFSS at the time: none (no activity), irregular (<20 minutes or fewer than three times/week), regular (≥20 minutes, three or more times/week, <50% capacity), regular and vigorous (≥20 minutes, three or more times/week, 50% capacity).[21] Fifty-six physical activities were included. This analysis focused on the more common activities (i.e., performed by ≥0.3% of participants), which allowed a range of sport activities to be included, yet provided a sufficiently large sample to adjust for potential confounders. Sport activities were classified as team-based if they would traditionally be played in teams of people, and non−team-based if they did not require a team, but still had an element of game/sport involved. For the purpose of this study, the assumption that walking was done individually was made, but some walking may have

been done socially. However, a social component to walking would potentially weaken estimates of the impact of team-based activities.

The dependent variable was frequency of mental distress, based on 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?*[22] Those reporting poor mental health for ≥14 days were categorized as having frequent mental distress (FMD), consistent with previously established definitions.[23, 24] The 14-day threshold corresponds with the timeframe clinicians often use when diagnosing clinical mental health disorders.[23] This mental health question has demonstrated both content and criterion validity and correlates with other health and quality of life outcomes in the expected directions.[22]

Statistical Analysis

To control for potential confounders, demographic as well as health behavior variables were included, namely, age (continuous), gender (male/female), educational level (never attended through some high school were combined/high school graduate/some college/college graduate or more), income (<$10,000–$24,999, $25,000–$49,999, ≥$50,000), employment status (employed/unemployed), race (white/black/Asian or Pacific Islander/American Indian or Alaskan Native/Other), ethnicity (Spanish/Hispanic origin, yes/no), binge drinking (consuming five or more drinks during one occasion), smoking (former or never/everyday or some), physical activity, frequent physical distress (i.e., ≥14 days/past 30 days in which physical health was not good), and BMI.[25,26] Standard cutpoints were used to create three categories of normal, overweight, and obese.[27] These potential confounders were included as they have been shown to be related to both physical activity and mental health.[6,28, 29]

Analyses were performed using SAS, version 9.4. A weighted analysis employing procedures that take into consideration the complex sampling stratification and clustering used by BRFSS was used for all analyses. Weighting accounted for unequal probabilities of selection by area code and household density (within a geographic area), number of telephone numbers and adults in a household, cluster size, and number of people in a population category (either age by sex, age by race, or ethnicity by sex). A detailed description of the weighting process can be found elsewhere.[19] Bivariate associations between demographic characteristics and likelihood of reporting FMD were assessed using logistic regression. Logistic regression was used to determine any associations between FMD and specific physical activities. This analysis of FMD with specific physical activities was carried out in several ways: overall, by gender, and adjusting for covariates. Six models were run. Models 1–4 used “no activity” as the reference. Model 1 was unadjusted, Model 2 compared gender, Model 3 adjusted for demographics, and Model 4 adjusted for demographics, physical health, and health behaviors. Models 5–6 used “walking” as the reference. Model 5 adjusted for demographics, and Model 6 adjusted for demographics, physical health, and health behaviors. AORs and 95% CIs were used to quantify the magnitude and direction of the independent association of FMD and activity mode after controlling for covariate variables in the model. Model fit was assessed with the C-statistic and R^2 statistics. As data are anonymized and publically available, this study was determined to be exempt from review by the Pennsylvania State University College of Medicine IRB.

Results

Data were available from 183,341 adults. Table 1 presents the distribution of demographics, health behaviors, and FMD. Overall, more respondents were female (51.9%) and only 22.9% were aged >60 years (range, 18–99 years). Most were overweight (37.0%) or obese (20.4%) and 27.8% reported no leisure time physical activity. FMD was reported by 9.5% of participants.

Table 1. Association of Demographic Characteristics With Prevalence of FMD

Variable (*n*=183,341)	***n* (%)**[a]	**FMD, % (95% CI)**[a]	***p*-value**[b]
Age			**<0.001**
18–29 years	32,154 (21.7)	11.0 (10.4, 11.6)	
30–44 years	58,176 (30.8)	10.1 (9.7, 10.6)	
45–59 years	48,178 (24.6)	10.2 (9.7, 10.6)	
60+ years	44,833 (22.9)	6.7 (6.3, 7.1)	
Gender			**<0.001**
Female	109,680 (51.9)	11.6 (11.3, 11.9)	
Male	74,770 (48.1)	7.3 (7.0, 7.6)	
Race			**<0.001**
White	153,695 (82.0)	9.2 (9.0, 9.4)	
Black	15,680 (10.4)	11.0 (10.2, 11.8)	
Asian	4,796 (2.7)	6.5 (4.4, 8.7)	
AI/AN	3,695 (1.1)	13.8 (11.3, 16.4)	
Other	5,138 (3.7)	13.1 (11.2, 15.0)	
Ethnicity			0.377
Hispanic or Latino	16,400 (13.1)	9.9 (9.0, 10.7)	
Not Hispanic or Latino	166,988 (86.9)	9.5 (9.2, 9.7)	
Education			**<0.001**
Less than HS	22,041 (13.3)	13.9 (13.1, 14.7)	
HS or GED	58,049 (31.0)	10.8 (10.4, 11.3)	
Some college	50,664 (27.4)	9.9 (9.5, 10.4)	
College grad	53,225 (28.3)	5.7 (5.4, 6.1)	
Income			**<0.001**
<$25,000	51,582 (29.9)	14.3 (13.7, 14.8)	
$25,000 to <$50,000	55,794 (34.2)	9.0 (8.6, 9.4)	
≥$50,000	50,784 (35.9)	6.3 (6.0, 6.7)	
Employment			**<0.001**
Employed	117,420 (64.2)	8.3 (8.0, 8.6)	
Not employed	66,703 (35.8)	11.7 (11.3, 12.1)	
Smoker			**<0.001**
Yes	41,416 (22.2)	16.3 (15.7, 17.0)	
No	142,514 (77.8)	7.6 (7.4, 7.8)	
Binge drinker			**<0.001**
Yes	6,202 (3.8)	11.6 (10.3, 13.0)	
No	178,174 (96.2)	9.4 (9.2, 9.7)	
Amount of physical activity			**<0.001**

None	51,682 (27.8)	13.0 (12.5, 13.5)	
Irregular	50,121 (28.0)	9.3 (8.9, 9.7)	
Regular	54,282 (30.2)	8.5 (8.0, 8.9)	
Regular and vigorous	26,306 (14.0)	5.8 (5.3, 6.3)	
BMI			**<0.001**
Normal	77,166 (42.6)	9.7 (9.3, 10.0)	
Overweight	63,138 (37.0)	8.0 (7.6, 8.4)	
Obese	35,878 (20.4)	11.9 (11.3, 12.5)	
Frequent physical distress			**<0.001**
Yes	19,396 (10.1)	29.9 (28.7, 31.2)	
No	162,217 (89.9)	7.2 (7.0, 7.5)	
Frequent mental distress			N/A
Yes	17,901 (9.5)	N/A	
No	163, 691 (90.5)	N/A	

Note: Boldface indicates statistical significance ($p<0.05$). [a]All percentages are population percentages estimated from a weighted analysis taking into consideration the complex sampling stratification and clustering. [b]All *p*-values are from weighted logistic regression taking into consideration the complex sampling stratification and clustering. AI/AN, American Indian/Alaska Native; FMD, frequent mental distress; GED, General Educational Development test; HS, high school; N/A, not applicable.

Of the 72.2% of participants who reported leisure time physical activity, walking was the most common activity (44.4%), followed by gardening (7.9%), weight lifting (7.1%), running (6.8%), and biking (4.2%) (Table 2). Sport activities were less common, with the most common being golf (4.1%), basketball (2.8%), tennis (1.0%), volleyball (0.5%), soccer (0.8%), and racquetball (0.3%). As sport activities were performed less commonly, two composite variables were created to include the most commonly performed team-based (basketball, volleyball, soccer), and non−team-based (golf, tennis, racquetball) sports.

Table 2. Bivariate Relationship of Activity Types to FMD

Activity type	**FMD**				
	Total			**Male, OR (95% CI)**[b]	**Female, OR (95% CI)**[b]
	***n* (%)**[a]	**%**[c] **(95% CI)**	**OR (95% CI)**[b]		
No activity					
Yes	51,682 (27.8)	13.0 (12.5, 13.5)	**1.66 (1.57, 1.76)*****	**1.57 (1.41, 1.75)*****	**1.65 (1.53, 1.76)*****
No	130,709 (72.2)	8.3 (8.0, 8.5)	ref	ref	ref
Non-play activities					
Walking only					
Yes	43,329 (44.4)	9.7 (9.2, 10.2)	**0.72 (0.67, 0.78)*****	**0.76 (0.66, 0.88)*****	**0.67 (0.61, 0.73)*****

No	51,682 (55.6)	13.0 (12.5, 13.5)	ref	ref	ref
Gardening					
Yes	14,973 (7.9)	7.8 (7.1, 8.6)	**0.80 (0.71, 0.89)*****	0.81 (0.65, 1.01)	**0.75 (0.66, 0.85)*****
No	169,477 (92.1)	9.7 (9.4, 9.9)	ref	ref	ref
Weight lifting					
Yes	11,424 (7.1)	7.9 (7.0, 8.9)	**0.80 (0.70, 0.92)*****	0.97 (0.82, 1.14)	0.86 (0.67, 1.10)
No	173,026 (92.9)	9.7 (9.4, 9.9)	ref	ref	ref
Running					
Yes	10,548 (6.8)	6.7 (5.8, 7.6)	**0.67 (0.58, 0.77)*****	**0.68 (0.57, 0.81)*****	0.85 (0.67, 1.07)
No	173,902 (93.2)	9.7 (9.5, 10.0)	ref	ref	ref
Biking					
Yes	7,444 (4.2)	6.4 (5.5, 7.3)	**0.64 (0.55, 0.74)*****	**0.80 (0.64, 1.0)***	**0.57 (0.46, 0.70)*****
No	177,006 (95.8)	9.7 (9.4, 9.9)	ref	ref	ref
Aerobics class					
Yes	6,269 (3.1)	7.1 (6.0, 8.1)	**0.72 (0.61, 0.84)*****	**0.47 (0.28, 0.80)****	**0.64 (0.53, 0.75)*****
No	178,181 (96.9)	9.6 (9.4, 9.8)	ref	ref	ref
Home exercise					
Yes	5,808 (2.9)	9.0 (7.7, 10.2)	0.93 (0.80, 1.09)	0.93 (0.68, 1.28)	0.87 (0.73, 1.05)
No	178,642 (97.1)	9.5 (9.3, 9.8)	ref	ref	ref
Swimming					
Yes	4,668 (2.6)	9.8 (8.1, 11.6)	1.04 (0.85, 1.27)	0.88 (0.65, 1.18)	1.07 (0.84, 1.38)
No	179,782 (97.4)	9.5 (9.3, 9.8)	ref	ref	ref
Health club					
Yes	3,202 (1.7)	6.5 (5.2, 7.7)	**0.65 (0.53, 0.81)*****	**0.70 (0.51, 0.98)***	**0.63 (0.48, 0.83)*****
No	181,248 (98.3)	9.6 (9.3, 9.8)	ref	ref	ref

Calisthenics					
Yes	2,940 (2.0)	8.5 (6.8, 10.2)	0.88 (0.71, 1.09)	0.96 (0.70, 1.30)	0.90 (0.66, 1.22)
No	181,510 (98.0)	9.5 (9.3, 9.8)	ref	ref	ref
Jogging					
Yes	2,352 (1.5)	5.8 (4.3, 7.4)	**0.58 (0.44, 0.78)*****	**0.49 (0.32, 0.74)*****	0.86 (0.58, 1.27)
No	182,098 (98.5)	9.6 (9.3, 9.8)	ref	ref	ref
Exercise bike					
Yes	2,232 (1.3)	6.4 (5.0, 7.9)	**0.65 (0.51, 0.83)*****	**0.47 (0.30, 0.72)*****	**0.72 (0.54, 0.96)***
No	182,218 (98.7)	9.6 (9.3, 9.8)	ref	ref	ref
Hiking					
Yes	1,969 (0.8)	8.1 (5.5, 10.8)	0.84 (0.59, 1.20)	1.10 (0.66, 1.83)	0.70 (0.45, 1.08)
No	182,481 (99.2)	9.5 (9.3, 9.8)	ref	ref	ref
Team-based sports					
Basketball					
Yes	4,055 (2.8)	7.2 (5.8, 8.6)	**0.73 (0.60, 0.90)****	0.91 (0.73, 1.14)	1.09 (0.60, 2.0)
No	180,395 (97.2)	9.6 (9.4, 9.8)	ref	ref	ref
Volleyball					
Yes	931 (0.5)	7.5 (3.8, 11.2)	0.77 (0.45, 1.32)	0.65 (0.36, 1.19)	0.92 (0.43, 1.98)
No	183,519 (99.5)	9.5 (9.3, 9.8)	ref	ref	ref
Soccer					
Yes	845 (0.8)	7.0 (4.0, 10.0)	0.71 (0.45, 1.12)	0.87 (0.51, 1.51)	0.87 (0.42, 1.80)
No	183,605 (99.2)	9.5 (9.3, 9.8)	ref	ref	ref
Team-based[c]					
Yes	5,729 (4.0)	7.2 (6.0, 8.4)	**0.73 (0.61, 0.87)*****	0.87 (0.71, 1.06)	1.01 (0.66, 1.52)
No	178,721 (96.0)	9.6 (9.4, 9.9)	ref	ref	ref
Non−team-based sports					
Golfing					

Yes	6,748 (4.1)	4.8 (3.9, 5.6)	**0.46 (0.39, 0.56)*****	**0.57 (0.46, 0.71)*****	**0.51 (0.36, 0.71)*****
No	177,702 (95.9)	9.7 (9.5, 10.0)	ref	ref	ref
Tennis					
Yes	1,716 (1.0)	3.0 (1.9, 4.0)	**0.29 (0.20, 0.42)*****	**0.28 (0.16, 0.50)*****	**0.33 (0.21, 0.52)*****
No	182,734 (99.0)	9.6 (9.4, 9.8)	ref	ref	ref
Racquetball					
Yes	524 (0.3)	5.2 (1.8, 8.7)	0.52 (0.26, 1.05)	0.67 (0.29, 1.56)	0.50 (0.20, 1.26)
No	183,926 (99.7)	9.5 (9.3, 9.8)	ref	ref	ref
Non−team-based[d]					
Yes	8,836 (5.4)	4.4 (3.8, 5.1)	**0.43 (0.36, 0.50)*****	**0.53 (0.43, 0.65)*****	**0.44 (0.33, 0.57)*****
No	175,614 (94.6)	9.8 (9.6, 10.1)	ref	ref	ref

Note: Boldface indicates statistical significance ($^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$). [a]All percentages are population percentages estimated from a weighted analysis taking into consideration the complex sampling stratification and clustering. [b]All *p*-values and ORs are from weighted logistic regression taking into consideration the complex sampling stratification and clustering. [c]Any of the following: basketball, volleyball, soccer. [d]Any of the following: golfing, tennis, racquetball. FMD, frequent mental distress.

The frequency of each activity and its association with FMD was examined (Table 2). FMD was reported by 13.0% of adults reporting no activity versus 8.3% of the rest of the sample ($p<0.001$). FMD was less common among those who reported walking, gardening, weight lifting, running, biking, jogging, exercise bike, and all of the sport activities other than soccer and racquetball, both of which were reported by <1% of participants. FMD was no less common among those who did home exercise (9.0% vs 9.5% in all other respondents), those who swam (9.8% vs 9.5%), or those who reported doing calisthenics (8.5% vs 9.5%). Gender differences in the association between FMD and activities were generally small.

Model fit was assessed with C-statistics and R^2 statistics for logistic regression. R^2 ranged from 0.011 for the unadjusted bivariate comparisons to 0.145 for the multivariable models that adjusted for demographics, physical health, and health behaviors; C-statistics ranged from 0.498 for the unadjusted bivariate comparisons to 0.754 for the multivariable models adjusting for demographics, physical health, and health behaviors. Higher R^2 and a C-statistic >0.7 are generally considered indicators of better prediction and fit of the model.[30]

After adjusting for covariates, FMD was reported less by those who did almost any activity, versus those who did no activity (Table 3). For example, those who reported walking or gardening had an OR of 0.81 (95% CI=0.72, 0.91) and 0.77 (95% CI=0.65, 0.91), respectively,

for reporting FMD, versus those who did no activity. Not all activities had this relationship. Those who did weight lifting, running, biking, aerobics class, home exercise, swimming, calisthenics, jogging, exercise bike, hiking, basketball, racquetball, and soccer were not significantly less likely to report FMD. Most ORs favored the activity, however, with the exception of calisthenics (OR=1.09, 95% CI=0.76, 1.55) and soccer (OR=1.54, 95% CI=0.67, 3.56).

Table 3. Odds of FMD for Specific Physical Activities, Versus No Activity and Walking

Activity type	Versus no activity, adjusted for demographics	Versus no activity, adjusted for demographics, physical health, health behaviors[a]	Versus walking only, adjusted for demographics	Versus walking only, adjusted for demographics, physical health, health behaviors[a]
Non-sport activities				
Walking only	**0.74 (0.68, 0.80)*****	**0.81 (0.72, 0.91)*****	—	—
Gardening	**0.65 (0.57, 0.74)*****	**0.77 (0.65, 0.91)****	0.94 (0.83, 1.07)	0.98 (0.84, 1.14)
Weight lifting	**0.76 (0.64, 0.90)*****	1.0 (0.81, 1.23)	0.98 (0.83, 1.16)	1.18 (0.98, 1.43)
Running	**0.63 (0.53, 0.76)*****	0.98 (0.77, 1.23)	**0.79 (0.66, 0.94)***	1.02 (0.83, 1.25)
Biking	**0.56 (0.46, 0.66)*****	0.75 (0.57, 1.0)	**0.74 (0.61, 0.88)*****	0.85 (0.70, 1.02)
Aerobics class	**0.51 (0.43, 0.61)*****	0.71 (0.50, 1.01)	**0.75 (0.63, 0.90)****	0.92 (0.75, 1.13)
Home exercise	**0.68 (0.57, 0.81)*****	0.81 (0.61, 1.09)	0.96 (0.79, 1.15)	0.97 (0.79, 1.19)
Swimming	0.82 (0.66, 1.02)	0.97 (0.70, 1.32)	1.15 (0.93, 1.43)	1.25 (1.0, 1.57)
Exercise club	**0.56 (0.44, 0.71)*****	**0.62 (0.45, 0.86)****	**0.78 (0.61, 1.0)***	0.90 (0.70, 1.16)
Calisthenics	0.81 (0.64, 1.03)	1.09 (0.76, 1.55)	1.10 (0.86, 1.40)	1.21 (0.93, 1.58)
Jogging	**0.53 (0.39, 0.73)*****	0.64 (0.40, 1.04)	**0.68 (0.50, 0.93)***	0.82 (0.59, 1.14)
Exercise bike	**0.53 (0.40, 0.69)*****	0.58 (0.31, 1.06)	0.78 (0.59, 1.03)	0.93 (0.69, 1.26)
Hiking	**0.64 (0.44, 0.94)***	0.58 (0.31, 1.06)	0.86 (0.58, 1.26)	0.98 (0.66, 1.48)
Team-based sports				
Basketball	**0.72 (0.56, 0.93)***	1.03 (0.72, 1.48)	0.82 (0.63, 1.07)	0.95 (0.71, 1.26)
Volleyball	0.67 (0.37, 1.21)	**0.57 (0.33, 0.96)***	0.85 (0.47, 1.54)	0.90 (0.48, 1.70)
Soccer	0.72 (0.43, 1.20)	1.54 (0.67, 3.56)	0.77 (0.46, 1.27)	0.87 (0.52, 1.46)

Team-based[b]	**0.70 (0.57, 0.88)****	0.98 (0.71, 1.35)	0.81 (0.64, 1.02)	0.91 (0.71, 1.16)
Non−team-based sports				
Golfing	**0.55 (0.45, 0.68)*****	**0.72 (0.53, 0.99)***	**0.77 (0.62, 0.95)***	0.87 (0.69, 1.08)
Tennis	**0.30 (0.20, 0.45)*****	**0.46 (0.26, 0.84)***	**0.42 (0.28, 0.64)*****	**0.54 (0.35, 0.84)****
Racquetball	0.53 (0.26, 1.08)	0.21 (0.03, 1.31)	0.70 (0.35, 1.42)	0.95 (0.45, 1.99)
Non−team-based[c]	**0.50 (0.41, 0.61)*****	**0.67 (0.50, 0.90)****	**0.69 (0.57, 0.84)*****	0.82 (0.66, 1.01)

Note: Data are OR (95% CI). Boldface indicates statistical significance (*p<0.05,**p<0.01,***p<0.001). [a]Health behaviors include BMI, binge drinking, amount of physical activity, and smoking. [b]Any of the following: basketball, volleyball, soccer. [c]Any of the following: golfing, tennis, racquetball. FMD, frequent mental distress.

All activities, other than swimming, calisthenics, gardening, and running, were associated with lower odds of FMD when compared with walking alone. After adjusting for demographic and behavioral covariates, only tennis was associated with significantly lower odds of FMD (OR=0.54, 95% CI=0.35, 0.84). However, comparison between walking alone and non−team-based sport activities approached significance, with those people having 18% lower odds of FMD (OR=0.82, 95% CI=0.66, 1.01).

Discussion

Current physical activity recommendations focus on how much activity is done and whether activity is aerobic or muscle strengthening. However, these results suggest that the activity mode may also be important to mental health. Exercises that are typically completed by a single person (i.e., health club, weight lifting, swimming, gardening) were associated with no lower odds of FMD when compared with walking. By contrast, people who reported participating in tennis and other non−team-based sports had a lower odds of FMD versus walking.

It is well established that physical activity positively affects mental health[8, 9] and current physical activity guidelines recommend aerobic activity for mental health benefits.[12] However, the possible differential effect based on the mode of activity has received little attention. Results from the Scottish Health Survey showed associations between activity mode and mental health outcomes that were consistent with the current investigation.[17] Participation in sports was associated with the lowest risk of psychological distress (versus walking, gardening, and housework). The Scottish Health Survey gave the first look at the possible effect of activity mode, but only examined a basic categorization of activities. The present study extended this scope by allowing for the inclusion of several types of activities that were classified as sports, and including team- and non−team-based activities.

After adjusting for amount and intensity of physical activity, non−team-based sport activities were associated with lower odds of FMD when compared with other physical activities (such as

swimming and home exercise). Initially, only tennis showed an association with lower odds of FMD, but this was likely because the other types of sport activities (e.g., racquetball, golf) were reported by too few people and lacked the statistical power to demonstrate results. However, when these activities were combined into a variable representing any non−team-based sport, the association with lower FMD was still observed. It would appear that something about these sports activities may be a contributing factor to enhanced mental health, over and above the aerobic activity component. Another explanation for this finding is that people experiencing FMD may be less likely to seek team-based activities.[31] Non−team-based sports are still social, but social groups may be smaller and less structured than with team-based activities. This relationship requires further investigation, using study designs that permit causal inferences. Future research may include RCTs comparing participation in sport/play/team physical activities with participation in individual activities. However, the interpretation that activity is associated with lower odds of FMD is consistent with an emerging body of literature.[32]

These results may be explained using the PERMA model.[14] Of the five components of happiness outlined in the model, individual physical activity may support positive emotions, engagement, achievement, and meaning. However, the relationship component is not accounted for by individual pursuits. Social engagement, fostered through physical activity, has been found to be a significant predictor of well-being in older adults,[33] supporting the hypothesis that playing sport may relate to positive mental health. Additionally, physical play is typically associated with positive changes in mood,[34] which may increase the role these activities play in the positive emotion component. Physical play encourages friendships, by increasing the number of unplanned, unstructured interactions.[35] The social and play aspects of sport activities may satisfy the relationship component that may otherwise be unaccounted for by solo activities, explaining the lower odds of FMD.

Another possible mechanism is enjoyment and motivation. A study of college students found that students' motivations for sport were intrinsic (e.g., enjoyment/challenge), whereas motivations for exercise were extrinsic (e.g., weight/stress management/appearance).[36] These sport-related motivations may link to mental health. An early study found that enjoyment and competence (related to sport participation) were linked to positive psychological outcomes, whereas body motivation (related to exercise) was related to anxiety and depression.[37]

The minimal gender differences observed for the associations between activity mode and mental health may suggest that the activity mode exerts similar mental health effects across men and women. However, future research should aim to separate the effect of an activity's mode from its intensity or duration to more comprehensively explore how physical activity characteristics may influence gender differences in mental health outcomes.

Limitations

Although this study had many strengths including the large, nationally representative sample and variety of activities, it was not without limitations. First, BRFSS includes no explicit information on whether activities were done alone or socially. It is possible that participants played soccer by themselves and, people who "only walked" did so with friends. Thus, these results should be

viewed as preliminary and require replication. Second, these data are cross-sectional, making causative conclusions impossible. Additionally, sports such as golf and tennis require skill and practice. Other factors like personality (i.e., resilience) or age (i.e., older adults may have more leisure time) could influence mental distress. Also, having the income to participate in sports may be indicative of higher SES, which is related to mental health.[28] These potential confounding variables should be considered in future research. Third, many of the ORs are somewhat close to 1.0, making it possible that unmeasured confounding variables could reduce the observed associations completely. Finally, self-report measures for physical activity and mental health are subject to measurement bias (e.g., recall problems, over-/under-reporting).[38, 39] As such, people in this study may have inaccurately described their activity/mental health, potentially influencing the results. Objective physical activity measures should be used in future, along with observational measures of mental health. However, to obtain data on a sample of this size, self-report is the most feasible option.

Conclusions

Despite these limitations, these results are consistent with prior findings that participation in social physical activities may have mental health benefits.[40] Also, these results suggest that a new direction for exercise promotion may hold promise. The American College of Sports Medicine, in partnership with the American Medical Association, has widely spread the message that "Exercise is Medicine,"[41] in part to encourage providers to counsel patients about physical activity. Providers, however, consistently hear that a primary barrier to increasing activity is that it is not enjoyable.[42] Clinic-sponsored group activities and community recreational sports leagues may be effective venues to promote social play. For those patients who are less likely to join group activities (e.g., those with introversion or with child care barriers), having small or family-oriented groups may be effective. A focus on encouraging physical play that is enjoyable and social may be a promising approach for encouraging physical activity, and could yield important benefits to mental well-being.

Acknowledgments

Benjamin D. Hickerson completed this work while with the Department of Recreation, Park and Tourism Management, Pennsylvania State University, University Park, Pennsylvania.

No financial disclosures were reported by the authors of this paper.

References

1. Center for Behavioral Health Statistics and Quality. Behavioral health trends in the United States: Results from the 2014 National Survey on Drug Use and Health (HHS Publication No. SMA 15-4927, NSDUH Series H-50). www.samhsa.gov/data/. Published 2015. Accessed November 11, 2015.
2. Newcomer, J.W. and Hennekens, C.H. **Severe mental illness and risk of cardiovascular disease.***JAMA*. 2007; 298: 1794–1796DOI: https://doi.org/10.1001/jama.298.15.1794

3. Druss, B.G. and Rosenheck, R.A. **Mental disorders and access to medical care in the United States.***Am J Psychiatry*. 1998; 155: 1775–1777DOI: https://doi.org/10.1176/ajp.155.12.1775

4. Chang, C.-K., Hayes, R.D., Perera, G. et al. **Life expectancy at birth for people with serious mental illness and other major disorders from a secondary mental health care case register in London.** *PLoS One*. 2011; 6: e19590DOI: https://doi.org/10.1371/journal.pone.0019590

5. Soni A. The Five Most Costly Conditions, 1996 and 2006: Estimates for the U.S. Civilian Noninstitutionalized Population. Statistical Brief #248. July 2009. www.meps.ahrq.gov/mepsweb/data_files/publications/st248/stat248.pdf. Accessed December 29, 2015.

6. Physical Activity Guidelines Advisory Committee. **2008 Physical Activity Guidelines Advisory Committee Report.** U.S. DHHS, Washington, DC; 2008

7. Blumenthal, J.A., Babyak, M.A., Doraiswamy, P.M. et al. **Exercise and pharmacotherapy in the treatment of major depressive disorder.** *Psychosom Med*. 2007; 69: 587–596DOI: https://doi.org/10.1097/PSY.0b013e318148c19a

8. Cooney, G.M., Dwan, K., Greig, C.A. et al. **Exercise for depression.** *Cochrane Database Syst Rev*. 2013;9: CD004366DOI: https://doi.org/10.1111/jebm.12076

9. Windle, G., Hughes, D., Linck, P., Russell, I., and Woods, B. **Is exercise effective in promoting mental well-being in older age? A systematic review.** *Aging Ment Health*. 2010; 14: 652–669DOI: https://doi.org/10.1080/13607861003713232

10. Hagströmer, M., Troiano, R.P., Sjöström, M., and Berrigan, D. **Levels and patterns of objectively assessed physical activity—a comparison between Sweden and the United States.** *Am J Epidemiol*. 2010; 171: 1055–1064DOI: https://doi.org/10.1093/aje/kwq069

11. Tucker, J.M., Welk, G.J., and Beyler, N.K. **Physical activity in U.S.: adults compliance with the Physical Activity Guidelines for Americans.** *Am J Prev Med*. 2011; 40: 454–461DOI: https://doi.org/10.1016/j.amepre.2010.12.016

12. Haskell, W.L., Lee, I.-M., Pate, R.R. et al. **Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association.** *Med Sci Sports Exerc*. 2007; 39: 1423–1434DOI: https://doi.org/10.1249/mss.0b013e3180616b27

13. Prestwich, A., Sniehotta, F.F., Whittington, C. et al. **Does theory influence the effectiveness of health behavior interventions? Meta-analysis.** *Health Psychol*. 2014; 33: 465–474DOI: https://doi.org/10.1037/a0032853

14. Seligman, M.E.P., Steen, T.A., Park, N., and Peterson, C. **Positive psychology progress: empirical validation of interventions.** *Am Psychol*. 2005; 60: 410–421DOI: https://doi.org/10.1037/0003-066X.60.5.410

15. Sallis, J.F., Prochaska, J.J., Taylor, W.C., Hill, J.O., and Geraci, J.C. **Correlates of physical activity in a national sample of girls and boys in grades 4 through 12.** *Health Psychol*. 1999; 18: 410–415DOI: https://doi.org/10.1037/0278-6133.18.4.410

16. Van Dyck, D., Cerin, E., Conway, T.L. et al. **Interacting psychosocial and environmental correlates of leisure-time physical activity: a three-country study.** *Health Psychol*. 2014; 33: 699–709DOI: https://doi.org/10.1037/a0033516

17. Hamer, M., Stamatakis, E., and Steptoe, A. **Dose-response relationship between physical activity and mental health: the Scottish Health Survey.** *Br J Sports Med*. 2009; 43: 1111–1114DOI: https://doi.org/10.1136/bjsm.2008.046243

18. Yore, M.M., Ham, S.A., Ainsworth, B.E. et al. **Reliability and validity of the instrument used in BRFSS to assess physical activity.** *Med Sci Sports Exerc*. 2007; 39: 1267–1274DOI: https://doi.org/10.1249/mss.0b013e3180618bbe

19. Centers for Disease Control and Prevention. Overview: BRFSS 2000. https://www.cdc.gov/brfss/annual_data/2000/pdf/overview_00.pdf. Accessed October 3, 2016.

20. Centers for Disease Control and Prevention. **Physical activity trends—United States, 1990-1998.***MMWR Morb Mortal Wkly Rep*. 2001; 50: 166–169

21. Brownson, R.C., Jones, D.A., Pratt, M., Blanton, C., and Heath, G.W. **Measuring physical activity with the behavioral risk factor surveillance system.** *Med Sci Sports Exerc*. 2000; 32: 1913–1918DOI: https://doi.org/10.1097/00005768-200011000-00015

22. Moriarty, D.G., Kobau, R., Zack, M.M., and Zahran, H.S. **Tracking healthy days—a window on the health of older adults.** (Accessed December 22, 2015)*Prev Chronic Dis*. 2005; 2 www.ncbi.nlm.nih.gov/pmc/articles/PMC1364525/

23. Centers for Disease Control and Prevention. **Self-reported frequent mental distress among adults—United States, 1993-1996.** *MMWR Morb Mortal Wkly Rep*. 1998; 47: 326–331

24. Strine, T.W., Hootman, J.M., Okoro, C.A. et al. **Frequent mental distress status among adults with arthritis age 45 years and older, 2001.** *Arthritis Care Res*. 2004; 51: 533–537DOI: https://doi.org/10.1002/art.20530

25. Washburn, R.A., Heath, G.W., and Jackson, A.W. **Reliability and validity issues concerning large-scale surveillance of physical activity.** *Res Q Exerc Sport*. 2000; 71: S104–S113DOI: https://doi.org/10.1080/02701367.2000.11082793

26. Centers for Disease Control and Prevention. **Prevalence of physical activity, including lifestyle activities among adults—United States, 2000-2001.** *MMWR Morb Mortal Wkly Rep*. 2003; 52: 764–769

27. Stevens, J. **Ethnic-specific revisions of body mass index cutoffs to define overweight and obesity in Asians are not warranted.** *Int J Obes Relat Metab Disord*. 2003; 27: 1297–1299DOI: https://doi.org/10.1038/sj.ijo.0802417

28. Sareen, J., Afifi, T.O., McMillan, K.A., and Asmundson, G.G. **Relationship between household income and mental disorders: findings from a population-based longitudinal study.** *Arch Gen Psychiatry*. 2011;68: 419–427DOI: https://doi.org/10.1001/archgenpsychiatry.2011.15

29. Mcelroy, S.L., Kotwal, R., Malhotra, S., and Nemeroff, C.B. **Are mood disorders and obesity related? A review for the mental health professional.** *J Clin Psychiatry*. 2004; 65: 634–651DOI: https://doi.org/10.4088/JCP.v65n0507

30. Hosmer, D.W. and Lemeshow, S. **Applied Logistic Regression.** 2nd ed. John Wiley & Sons, New York, NY; 2000DOI: https://doi.org/10.1002/0471722146

31. Leary, M.R. **Responses to social exclusion: social anxiety, jealousy, loneliness, depression, and low self-esteem.** *J Soc Clin Psychol*. 1990; 9: 221–229DOI: https://doi.org/10.1521/jscp.1990.9.2.221

32. Hawkley, L.C. and Cacioppo, J.T. **Loneliness matters: a theoretical and empirical review of consequences and mechanisms.** *Ann Behav Med*. 2010; 40: 218–227DOI: https://doi.org/10.1007/s12160-010-9210-8

33. McAuley, E., Blissmer, B., Marquez, D.X. et al. **Social relations, physical activity, and well-being in older adults.** *Prev Med*. 2000; 31: 608–617DOI: https://doi.org/10.1006/pmed.2000.0740

34. Wenner, M. **The serious need for play.** *Sci Am Mind*. 2009; 20: 22–29DOI: https://doi.org/10.1038/scientificamericanmind0209-22

35. Gray, P. **The decline of play and the rise of psychopathology in children and adolescents.** *Am J Play*. 2011; 3: 443–463

36. Kilpatrick, M., Hebert, E., and Bartholomew, J. **College students' motivation for physical activity: differentiating men's and women's motives for sport participation and exercise.** *J Am Coll Health*. 2005; 54: 87–94DOI: https://doi.org/10.3200/JACH.54.2.87-94

37. Frederick, C.M. and Ryan, R.M. **Differences in motivation for sport and exercise and their relations with participation and mental health.** *J Sport Behav*. 1993; 16: 124–146

38. Kessler, R.C., Wittchen, H.-U., Abelson, J., and Zhao, S. **Methodological issues in assessing psychiatric disorders with self-reports.** in: A.A. Stone, A.S. Turkkan, C.A. Bachrach, (Eds.) **The Science of Self-Report: Implications for Research and Practice**. Lawrence Erlbaum Associates, Inc., Mahwah, NJ; 2000: 229–256

39. Prince, S.A., Adamo, K.B., Hamel, M.E. et al. **A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review.** *Int J Behav Nutr Phys Act*. 2008; 5: 56DOI: https://doi.org/10.1186/1479-5868-5-56

40. Wen, C.P., Wai, J.P.M., Tsai, M.K. et al. **Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study.** *Lancet*. 2011; 378: 1244–1253DOI: https://doi.org/10.1016/S0140-6736(11)60749-6

41. Herbert, D.L. **The exercise is medicine initiative.** *Exerc Stand Malpract Rep*. 2007; 21: 89

42. Booth, M.L., Bauman, A., Owen, N., and Gore, C.J. **Physical activity preferences, preferred sources of assistance, and perceived barriers to increased activity among physically inactive Australians.***Prev Med*. 1997; 26: 131–137DOI: https://doi.org/10.1006/pmed.1996.9982