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Association between physical activity and mental disorders among adults in the United States

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Abstract

Objective. The objective of this study was to determine the association between regular physical activity and mental disorders among adults in the United States.

Method. Multiple logistic regression analyses were used to compare the prevalence of mental disorders among those who did and did not report regular physical activity using data from the National Comorbidity Survey ($n = 8098$), a nationally representative sample of adults ages 15–54 in the United States.

Results. Slightly over one-half of adults reported regular physical activity (60.3%). Regular physical activity was associated with a significantly decreased prevalence of current major depression and anxiety disorders, but was not significantly associated with other affective, substance use, or psychotic disorders. The association between regular physical activity and lower prevalence of current major depression (OR = 0.75 (0.6, 0.94)), panic attacks (OR = 0.73 (0.56, 0.96)), social phobia (OR = 0.65 (0.53, 0.8)), specific phobia (OR = 0.78 (0.63, 0.97)), and agoraphobia (OR = 0.64 (0.43, 0.94)) persisted after adjusting for differences in sociodemographic characteristics, self-reported physical disorders, and comorbid mental disorders. Self-reported frequency of physical activity also showed a dose–response relation with current mental disorders.

Discussion. These data document a negative association between regular physical activity and depressive and anxiety disorders among adults in the U.S. population. Future research that investigates the mechanism of this association using longitudinal data to examine the link between physical activity and incident and recurrent mental disorders across the lifespan is needed.

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Introduction

Previous studies have consistently found that physical activity is associated with improved psychological well-being, physical health, life satisfaction, and cognitive functioning [1–17]. Clinical and epidemiologic studies have also shown an association between physical activity and decreased symptoms of anxiety and depression [11–17]. These studies have documented a consistently negative relationship between physical activity and symptoms of depression and anxiety. Evidence of a dose–response relationship between physical activity and protection against symptoms of depression and anxiety

has also been documented [17], although these positive effects may be restricted to men [15]. Previous research has also shown that physical inactivity is associated cross-sectionally, and prospectively with increased risk of depressive episodes at 8-year follow-up [8]. Other clinical data suggest that physical activity is related to positive mood and well-being, as well as improved physical health, and, more specifically, shows that aerobic activity, but not anaerobic, is related to reduced depressive symptoms [16]. Further, data from animal models support a neurochemical pathway for the relation between physical activity and depression [10,11]. As depression can be characterized by low energy, it is possible that depression leads to decreased physical activity [18].

Taken together, previous findings overwhelmingly suggest that physical activity is beneficial for physical

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and mental health. The identification of prevention and intervention strategies aimed at decreasing depression and anxiety disorders, which can be applied to populations inexpensively and without side effects, is needed, as depression is projected to be the leading burden of disease worldwide by the year 2020 [19]. There are, however, several methodological shortcomings of previous studies that limit conclusions about the relationship between physical activity and mental health in the community, and which therefore hamper their ability to inform the development of community-based intervention approaches. First, the use of symptom subscales in previous studies, rather than diagnostic survey instruments, does not provide information about the relationship between physical activity and mental disorders. As the epidemiology and extent of need for treatment is assessed using DSM-IV [20] criteria for mental disorders, knowledge of the link between physical activity and mental health using consistent definitions is needed to estimate the public health significance of this association. Second, previous studies have limited their investigation to the relation between physical activity and any depressive and anxiety symptoms, grouped. Therefore, it is not clear whether physical activity is associated with any or all symptoms of depression and anxiety, or whether there is specificity to type of depression or anxiety symptoms, which could have implications for etiology and treatment. Third, previous studies have examined the association between physical activity and mental health exclusively in terms of depression and anxiety, but have not looked at whether this association is evident in relation to other mental disorders as well. Fourth, previous studies have not investigated this association in a sample nationally representative of adults in the United States and therefore previous findings may not be generalizable to this population.

The goal of the current study was to determine the association between regular physical activity and mental disorders among adults in the community, overcoming methodological shortcomings of previous studies. First, the study aimed to determine whether regular physical activity was associated with decreased prevalence of mental disorders among adults in the U.S. adult population. Second, the study aimed to determine whether the relation between physical activity and mental disorders was independent of the effects of potential confounders, such as demographic characteristics (e.g., age, income) and physical health problems. Third, the study examined whether there was a dose–response relationship between self-reported frequency of physical activity and the likelihood of each mental disorder. Based on previous findings, we hypothesized that regular physical activity, compared with occasional or seldom, would be associated with a significantly decreased likelihood of current mental disorders.

Methods

Sample

The National Comorbidity Survey is based on a national probability sample ($n = 5877$) of individuals of ages 15 to 54 in the noninstitutionalized population [21]. This was a random sample, and the survey was administered by trained lay interviewers. Fieldwork was carried out between September 1990 and February 1992. There was an 82.4% response rate. The data were weighted for differential probabilities of selection and nonresponse. A weight was also used to adjust the sample to approximate the cross-classification of the population distribution on a range of sociodemographic characteristics. Weights and a full description of the study methodology are provided in detail elsewhere [21,22]. Respondents were each interviewed by a trained lay interviewer. The goal of the original study was to examine the prevalence, comorbidity, and correlates of mental disorders among adults in the community; therefore there was a disproportionate number of questions focusing on symptoms of mental disorders, and although questions on physical health behaviors and physical health were included, these were not the emphasis of the original study.

Diagnostic assessment

Psychiatric diagnoses were generated from a modified version of the World Health Organization (WHO) Composite International Diagnostic Interview [23], a structured interview designed for use by trained interviewers who are not clinicians. WHO field trials [24] and National Comorbidity Survey clinical reappraisal studies [25–27] documented acceptable reliability and validity of all these diagnoses. Psychiatric disorders examined include major depressive disorder, generalized anxiety disorder (GAD), agoraphobia, specific phobia, social phobia, panic attacks, dysthymia, alcohol dependence, and substance dependence (all past 12-month). Physical disorders include severe arthritis/rheumatism, or other bone or joint problems; severe asthma, bronchitis, emphysema, tuberculosis, or other lung problems; AIDS; high blood pressure or hypertension; diabetes or high blood sugar; heart attack or other serious heart trouble; severe hernia or rupture; severe kidney or liver disease; lupus, thyroid disease, or other autoimmune disorders; multiple sclerosis, epilepsy, or other neurological disorders; chronic stomach or gall bladder trouble; stroke; and ulcer (all past 12-months).

Physical activity

Respondents were verbally queried, “How often do you get physical exercise—either on your job or in a recreational activity?” Response choices were: regularly, occasionally, rarely, and never. Regular physical activity was defined by answering “regularly” to this question, and a

binary variable was created for use in the multiple logistic regression analyses. We compared “regular” exercise with all others (never, “occasionally,” and “rarely”) in order to use a more conservative and generalizable approach, rather than comparing those who exercised “regularly” versus never, and “regular” exercise is our variable of interest and its impact from a clinical and public health perspective and therefore we felt it important to separate this group from the less frequent exercise groups.

Analytic strategy

First, *F*-based tests of independence were used to determine differences in sociodemographic characteristics and current mental disorders between those with and without regular physical activity. All tests were two-sided and significance was set at 0.05. Second, multiple logistic regression analyses were used to determine the relationship between regular physical activity and current mental disorders, adjusting for age, race, gender, marital status, education, and income, then additionally for physical disorders, and finally for all comorbid mental disorders in the final model. Kendall’s tau-b was used to determine the dose–response relation between self-reported frequency of physical activity and likelihood of mental disorder. Associations are reported using odds ratios with 95% confidence intervals. Analyses were conducted using STATA 6.0 [28].

Results

Regular physical activity was reported by 60.3% of adults of ages 15–54 in the U.S. adult population. This is consistent with previous estimates in the United States [29]. In this sample, there were no statistically significant differences in gender, race, marital status, age, or income between those who reported regular physical activity and those who did not (see Table 1). Regular physical activity was reported more often by males and by adults less formal education, compared with those who did not report regular physical activity.

Relation between current mental disorders and regular physical activity

Regular physical activity was associated with a significantly decreased likelihood of having current major depression, agoraphobia, panic attacks, GAD, specific phobia, and social phobia (see Table 2). There was no significant relation between regular physical activity and bipolar disorder, dysthymia, alcohol dependence, or substance dependence after adjustment for comorbidity.

The relation between regular physical activity and major depression, agoraphobia, social phobia, specific phobia, GAD, and panic attacks persisted after controlling for differences in sociodemographic characteristics and self-re-

Table 1
Sociodemographic characteristics associated with regular physical activity among adults in the United States population

Characteristic	No regular activity <i>n</i> = 2170 (%)	Regular activity <i>n</i> = 3,707 (%)	<i>F</i> , <i>df</i> , <i>P</i> value
Age			<i>F</i> = 70.68, <i>df</i> (3,118), <i>P</i> = 0.1
15–24	24.78	24.78	
25–34	27.72	32.25	
35–44	29.61	26.45	
45–54	17.89	16.51	
Gender			<i>F</i> = 34.13, <i>df</i> (1,42), <i>P</i> < 0.0001
Male	42.84	54.59	
Female	57.16	45.41	
Race			<i>F</i> = 1.68, <i>df</i> (2,82), <i>P</i> = 0.19
Caucasian	73.05	77.05	
African American	12.84	10.92	
Hispanic	10.19	8.9	
Other	3.92	3.14	
Marital status			<i>F</i> = 1.68, <i>df</i> (2,82), <i>P</i> = 0.19
Married	62.5	58.8	
Separated/divorced	10.2	11.8	
Never married	27.3	29.4	
Education			<i>F</i> = 3.69, <i>df</i> (3,118), <i>P</i> = 0.016
Less than 8th grade	19.25	22.93	
9th–11th grade	35.21	34.96	
HS diploma	21.99	23.86	
College degree	23.55	18.25	
Income			<i>F</i> = 2.07, <i>df</i> (3,120), <i>P</i> = 0.11
<\$19,000	25.53	25.37	
\$20,000–34,999	24.21	24.68	
\$35,000–70,000	33.66	37.08	
>\$70,000	16.6	12.87	

ported physical illnesses (see Table 3). After additionally adjusting for comorbid mental disorders, the links between physical activity and major depression, agoraphobia, social phobia, specific phobia, and panic attacks persisted, but GAD were no longer statistically significant. Table 4 displays data describing the relationship between self-reported frequency of physical activity and each mental disorder. A dose–response relation between self-reported frequency of physical activity and likelihood of having each mental disorder was evident, with the exception of alcohol dependence.

Discussion

These data provide evidence of a negative association between physical activity and major depression and anxiety disorders, independent of demographic characteristics and

Table 2
Relation between regular physical activity and current mental disorders among adults in the United States population

	No regular physical activity <i>n</i> = 2170 (%)	Regular physical activity <i>n</i> = 3706 (%)	<i>F</i> , <i>df</i> (1, 42), <i>P</i> value
Major depression	13.04	8.24	<i>F</i> = 25.43, <i>P</i> < 0.0001
Dysthymia	3.16	2.16	<i>F</i> = 3.87, <i>P</i> = 0.056
Bipolar disorder	1.47	1.05	<i>F</i> = 1.1, <i>P</i> = 0.3
Agoraphobia	5.19	2.73	<i>F</i> = 14.95, <i>P</i> = 0.0004
Social phobia	10.51	6.63	<i>F</i> = 24.45, <i>P</i> < 0.0001
Specific phobia	11.21	7.35	<i>F</i> = 22.3, <i>P</i> < 0.0001
Generalized anxiety disorder	4.06	2.26	<i>F</i> = 12.11, <i>P</i> = 0.001
Panic attack	5.82	3.32	<i>F</i> = 23.88, <i>P</i> < 0.0001
Alcohol dependence	7.11	7.22	<i>F</i> = 0.02, <i>P</i> = 0.9
Substance dependence	3.13	2.60	<i>F</i> = 0.93, <i>P</i> = 0.3

physical illness, among adults in the United States [1–17]. The current study adds to existing knowledge in this area by making several methodological improvements over previous studies. These include the investigation of the relationship between physical activity and specific mood (e.g., major depression) and anxiety (e.g., social phobia, agoraphobia) disorders, rather than symptom scales. Also, examination of the relation between regular physical activity and the range of DSM-IV disorders in a large sample that is representative of adults in the United States, rather than selected clinical samples, increases the potential utility of this information in the development of population-based prevention programs. Our results suggest that after adjusting for all comorbid mental disorders, current major depression, panic attacks, social phobia, specific phobia, and agoraphobia were significantly less common among those who reported regular physical activity compared with those who did not report regular physical activity. In contrast, current bipolar disorder, dysthymia, GAD, alcohol dependence, and substance dependence did not show the same links. These data provide initial evidence of an association between

regular physical activity and lower prevalence of current depression and anxiety disorders in the general population, and are consistent with previous studies showing an association between physical activity and decreased likelihood of symptoms of anxiety and depression [11–17]. Furthermore, these results document some degree of specificity in the relationship between physical activity and major depression and specific anxiety disorders in a nationally representative population sample.

The reason for the association between regular physical activity and lower likelihood of specific anxiety and depressive disorders remains unclear. The cross-sectional nature of these data does not allow inferences about causality. It might be that the neurochemical effects of physical activity lower the likelihood of onset of specific mental disorders through common inflammatory [18] and neurochemical pathways [18,29,30]. For instance, a relationship between increased serotonin and decreased risk of major depression has been demonstrated in clinical samples, and these data would be consistent with data showing a link between serotonin levels and depression [31,32]. The specificity of

Table 3
Adjusted relation between regular physical activity and current mental disorders among adults in the United States population

Mental disorder	Adjusted ^a odds ratio (95% CI)	Adjusted ^b odds ratio (95% CI)	Adjusted ^c odds ratio (95% CI)
Major depression	0.62* (0.51, 0.77)	0.66* (0.53, 0.82)	0.75* (0.6, 0.94)
Dysthymia	0.7 (0.48, 1.04)	0.74 (0.5, 1.09)	0.86 (0.58, 1.28)
Bipolar disorder	0.65 (0.33, 1.28)	0.72 (0.37, 1.38)	0.94 (0.49, 1.82)
Agoraphobia	0.52* (0.36, 0.75)	0.56* (0.39, 0.82)	0.64* (0.43, 0.94)
Social phobia	0.58* (0.47, 0.71)	0.6* (0.49, 0.74)	0.65* (0.53, 0.8)
Specific phobia	0.68* (0.56, 0.83)	0.71* (0.58, 0.88)	0.78* (0.63, 0.97)
Generalized anxiety disorder	0.58* (0.4, 0.82)	0.61* (0.42, 0.88)	0.76 (0.52, 1.11)
Panic attacks	0.59* (0.46, 0.76)	0.64* (0.50, 0.84)	0.73* (0.56, 0.96)
Alcohol dependence	0.85 (0.65, 1.1)	0.87 (0.66, 1.13)	0.97 (0.73, 1.3)
Substance dependence	0.71 (0.18, 1.03)	0.76 (0.51, 1.13)	0.92 (0.62, 1.37)

* *P* < 0.05.

^a Adjusted for age, gender, race, marital status, education, and income.

^b Adjusted for age, gender, race, marital status, education, income, and physical illnesses.

^c Adjusted for age, gender, race, marital status, education, income, physical illnesses, and mental disorders.

Table 4
Dose–response relation between self-reported frequency of physical activity and current mental disorders among adults in the United States

	Regularly <i>n</i> = 3707 (%)	Occasional <i>n</i> = 1417 (%)	Rarely <i>n</i> = 596 (%)	Never <i>n</i> = 157 (%)	<i>P</i> value
Major depression	8.24	11.55	15.58	16.80	<0.0001
Dysthymia	2.16	2.34	4.76	4.43	=0.046
Generalized anxiety disorder	2.26	2.97	5.93	6.49	=0.0001
Panic attacks	3.32	4.85	7.33	8.52	=0.0003
Specific phobia	7.35	9.59	13.52	17.13	<0.0001
Social phobia	6.63	9.49	12.29	12.95	<0.0001
Agoraphobia	2.73	3.33	8.26	10.28	<0.0001
Bipolar disorder	1.05	1.05	1.79	3.97	=0.0376
Alcohol dependence	7.22	6.82	7.52	8.22	=0.9
Substance dependence	2.60	2.41	3.20	9.30	=0.0004

this association to anxiety and depressive disorders, but not substance use disorders, provides further support for this hypothesis. Moreover, recent evidence of an inverse relationship between regular physical activity and decreased inflammation is also consistent with this link, although the direction of the effect is not known [5], as previous data have shown links between depression and anxiety and increased inflammation [18,29,30]. Alternatively, it is also conceivable that there is a third common factor (e.g., personality trait, life event) that predicts the co-occurrence of being physically active and better mental health.

The observed association between physical activity and decreased major depression and anxiety disorders could also be explained through the reverse pathway (i.e., having a mental disorder may be a barrier to regular physical activity). For instance, the association between physical activity and decreased social phobia may be because those with social phobia are less likely to join team sports or to engage in active recreational pass-times with others because of fears of social evaluation, as has been observed in a previous clinical study [33]. Also, people who are depressed may be less likely to engage in physically strenuous activities because of low energy or apathy [34]. It is also possible that good mental health and positive mood increases likelihood of engaging in physical activity and other recreation, contributing to this association [17]. Additionally, it could be that the self-perception that one is active could be associated with positive mood, independent of actual activity level, and could add to this link.

Limitations of this study should be carefully considered when interpreting results. First, the question used to assess level of physical activity does not define the word “regularly”; therefore the actual frequency with which individuals engage in activity may vary widely. In addition, since there is no available information on the type of activity or precise frequency in which people are participating, it is difficult to draw specific conclusions about whether specific activities are associated with health benefits or whether feeling that one is very active is associated with a decreased likelihood

of having mental disorders. For instance, it is not known whether physical activity reported is aerobic, which has been associated with depression in previous studies, or anaerobic which has not [11]. Physical fitness is not what is assessed here, as the question asked only about physical activity, and the relationship between physical fitness and level of physical activity is complex and multidetermined [35]. Future studies that use longitudinal design to more precisely measure level and type of physical exercise, and include biological measures of physical fitness as well as comprehensive assessment of mental health will improve our understanding of these links. The original purpose of the NCS study [21] was to investigate the prevalence, correlates, and patterns of comorbidity between mood and anxiety disorders and alcohol/substance use disorders among adults in the community. This is likely to contribute to the paucity of information on physical activity, as this was not the focus of the original investigation. The use of current (past 12-month) DSM diagnoses for most disorders, compared with lifetime diagnoses, should minimize recall bias. Lifetime recall of mental disorders can be biased [36], especially if episodes occurred decades earlier, and therefore use of current prevalence rates may help to minimize this potential problem. Finally, the information on physical disorders is imprecise, which could lead to report bias or uncontrolled confounding of results.

These findings are consistent with and extend previous data by showing a specific association between physical activity and decreased prevalence of major depression and anxiety disorders, which is generalizable to adults in the United States. This association persists independent of differences in sociodemographic characteristics, comorbid mental disorders, and self-reported physical illnesses. Replication of these findings and future studies that can more directly address the nature of the association, possibly using longitudinal epidemiologic data, including specific information on frequency and type of physical activity, are needed.

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