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The association between physical exercises and health-related quality of life in subjects with mental disorders: results from a cross-sectional survey

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Abstract

Objectives. The present study examines the relationship between health-related quality of life and physical activity among adults with affective, anxiety, and substance dependence disorders.

Methods. Analyses were conducted among participants in the German National Health Interview and Examination Survey (GHS), a nationally representative multistage probability survey, conducted from 1997 to 1999. Multiple linear regression analyses were used to determine the relationship between health-related quality of life and physical activity among subjects with mental disorders.

Results. Affective, anxiety, and substance dependence disorders were associated with substantial impairment in health-related quality of life. Higher levels of physical activity were associated with higher health-related quality of life among persons with mental disorders. Even after controlling for sociodemographic characteristics, physically inactive subjects reported poorer quality of life.

Conclusions. Physical activity can be considered as beneficial for people suffering from mental disorders. The promotion of a physically active lifestyle is an important public health objective.

Keywords: Quality of life; Exercise; Mental disorders; Health survey

Introduction

Over the past decades, there has been a growing interest on the role of physical activity in the enhancement of health. Physical activity appears to improve health status by enhancing psychological well-being and by improving physical functioning in persons compromised by poor health. For example, physical exercise is widely perceived to be beneficial for risk reduction of coronary heart disease, stroke, type 2 diabetes mellitus, certain cancers, and osteoporosis [1]. The relationship between physical activity and all-cause mortality has been examined in several prospective studies, and virtually all have indicated a reduction in risk [2–4]. Furthermore, there appears to be a dose–response relationship between physical activity and disease prevention: Higher levels of activity appear to have the most benefit, but lower levels have demonstrable benefits for some disease as well [5,6]. The recent surgeon general's report on physical activity and health [1] underscores the pivotal role physical activity plays in health promotion and disease prevention.

Epidemiologic and intervention studies on the relationship of physical activity and mental health suggest that physical activity can improve mental health status, particularly depression, anxiety, and general well-being. Several studies have reported a therapeutic effect in both clinical and nonclinical populations. There are a number of experimental studies reported improved mental health among subjects who have participated in exercise programs over a period of weeks or months [7–10]. The strongest evidence comes from studies of patient groups, where exercise programs have been used as part of the therapeutic program [11–13]. Cross-sectional, population-based studies have shown an inverse

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association between exercise and psychological distress [14], while prospective studies of exercise and mental health have yielded mixed results. Some studies reported that a low level of activity was related to the risk of developing mental disorders [15,16], while other studies did not find a beneficial effect for later mental disorders [17–19].

Although the exact mechanism for the effect of exercises on mental health is still unknown, several physiological and psychological mechanisms have been proposed, including increased feelings of self-efficacy, self-perceptions of control, reduced emotional strain and physiological responses to stress, and beneficial effects on neurotransmitters [20]. Others have suggested that that regular participation in physical exercise programs provides a distraction from negative preoccupations. Social contact may be an important mechanism, and subjects who take regular exercise may, as a result, get positive feedback from other people and an increased sense of self-worth [21].

It is now widely acknowledged that the personal burden of illness cannot be described fully by measures of disease status. Psychosocial factors such as pain, restricted mobility, and other functional impairments must also be encompassed. The area of research that has resulted from this recognition is termed ''health-related quality of life'' [22,23]. It moves beyond direct manifestations of illness to study the patients personal morbidity—that is, the various effects that illnesses have on daily life and life satisfaction. Data about quality of life can be used to estimate the impact of different diseases on functioning and well-being to compare outcomes between different treatment modalities [24].

During the last years, several studies have shown that exercise intervention might enhance health-related quality of life and psychological well-being. These associations have been observed in clinical and nonclinical samples [25–27].

In summary, previous research has demonstrated both the beneficial effect of physical exercise on the risk of morbidity and a positive association between physical exercise and health-related quality of life in subjects suffering from somatic illness. However, there is a lack of information regarding the association between physical exercise and health-related quality of life in subjects suffering from mental disorders. Therefore, the purpose of the present study was to examine the relationship between health-related quality of life and physical activity in subjects suffering from mental disorders.

Methods

Sample

The German National Health Interview and Examination Survey (GHS) is based on a stratified, multistage, cross-sectional, national representative sample of individuals aged 18–79 years from the noninstitutionalized population of Germany [28–30]. The survey was conducted by the German Ministry of Science to provide comprehensive data with regard to physical and mental conditions and other health-related issues. Data collection occurred from October 1997 to March 1999. The interviews and examination were carried out in two parts. The main survey consisted of a comprehensive health status examination by a medical doctor; respondents also completed a self-administered questionnaire that include questions regarding quality of life, psychological and physical symptoms, health care utilization, and chronic illness.

In addition to the main survey, the mental health supplement gathered data on a range of psychiatric disorders based on a structured, clinical psychopathological interview.

The GHS surveyed 7,124 persons, 18–79 years of age. The overall response rate in the main survey was 61.5%, while the response rate in the second stage (psychiatric interview, 4,181 persons) was 87.6%. Nonresponse was mainly due to refusal to participate and inability to reach the selected respondent. Rates of nonresponse did not differ significantly between screen-negative and screen-positive respondents from the main survey [31].

Data were weighted by demographic characteristics and by selection probabilities.

Assessment

All participants completed the Composite International Diagnostic Screener (CID-S [32] for mental disorders. Subjects aged 65 years and younger who screened positive and a 50% random sample of those who screened negative were selected for stage 2 of the survey in which participants were administered the full Composite International Diagnostic Interview (M-CIDI [32]) for DSM-IV disorders by clinical interviewers (n = 4,181). Main survey participants aged 66 years and older were excluded from the mental health supplement because the psychometric properties of the M-CIDI have not yet been satisfactorily established for use in older populations [33]. Mental health interviews took place within 2 weeks of the main survey. Two-stage designs provide a means of reducing study costs by ascertaining data on (expensive) diagnostic interviews only for a subsample of study subjects. However, the two-stage screening design implies an overrepresentation of subjects with psychopathology. Therefore, a weighting procedure was employed, redressing the effect of unequal sampling probabilities. Data were weighted by demographic characteristics (age, gender, and geographical location) and by selection probabilities (screen-negatives received twice the weight of screen-positives). In the following analyses, only weighted data are used.

The diagnoses in the present paper included affective disorders (major depression, dysthymia, mania, bipolar disorders), anxiety disorders (panic disorder, agoraphobia, social phobia, simple phobia, generalized anxiety disorder), and substance abuse or dependence disorders (alcohol and drug abuse and dependence).

Current diagnoses (12- and 1-month prevalence) for all disorders were used for evaluating the relationship between physical activity and mental disorders. The test–retest reliability of M-CIDI was found to be acceptable. Diagnoses were made without diagnostic hierarchy rules, meaning that individuals could meet criteria for any disorder regardless of the presence of other disorders. Details of the psychometric properties of the CIDI are reported elsewhere [34].

The data were released for public use in 2000 [35,36].

Health-related quality-of-life domains were measured using the 36-Item Short-Form Health Survey (SF-36) [37]. This generic health measure is a self-administered 36-item questionnaire comprising eight health dimensions: bodily pain, physical function, role limitations related to physical health (physical role function), mental health, role limitations related to emotional health (emotional role function), social functioning, vitality, and general health, as well as two summary measures: physical component summary and mental component summary. In the present study, subscale scores were calculated according to standard procedures. Raw scores for each scale were computed by summing across all items in that scale. Each raw scale score was then transformed to a 0–100 scale such that scores represented the percentage of the total possible score attainable. Thus, higher scores indicate better quality of life. The survey's utility for monitoring general and specific populations, measuring treatment benefits, and comparing the burden of different diseases has been documented in a number of studies.

A physical activity score was derived from an item regarding frequency of overall sport and exercise participation in the last 3 months (0 = no physical exercise; 1 = less then 1 h/week; 2 = regularly, 1–2 h/week; 3 = regularly, 2–4 h/week; 4 = regularly, more then 4 h/week). Response to this item was dichotomized for ease of interpretation: respondents were classified as physically inactive if they reported no regular physical activity or exercise during the preceding 3 months (scores 0 and 1). Subjects were considered as physically activate if they reported regular physical activity (score 2–4). Additional questions about physical activity were asked in the main survey. We focused on the item described above since we were interested in a general measure of physical activity.

Data analysis

Because of the large numbers of subjects involved in some of the analyses, effect sizes were used to compare health-related quality-of-life dimensions for different diagnostic groups. Effect sizes for cross-sectional data comparing two groups were calculated by dividing the difference between the means of the two groups by the pooled standard deviation for that scale. Effect sizes of 0.20 are considered small; 0.50, moderate; and 0.80 or greater, large [38].

Multiple linear regression models were used to evaluate the relationships between physical activity and health-related quality of life in subjects suffering from affective, anxiety, and substance abuse or dependence disorders. The dependent variables were the summary measures of the SF-36. The independent variables were physical activity and sociodemographic variables (sex, age, socioeconomic status, and marital status).

Fit of the model was assessed using the R^2 value, and the significance of each independent variable was assessed using the t statistic for the variable. Interactions among age, sex, and physical activity were tested in each model. A two-tailed P value less than 0.05 was considered statistically significant.

All analyses were performed separately for affective disorders, anxiety disorders, and substance use or abuse disorders.

Analyses were performed using Stata [39] software that included commands for the analysis of complex survey data.

Results

Characteristics of the sample

Among the subjects who were interviewed at the second stage, approximately 59% (SE = 0.9%) were physically inactive regarding self-reported physical activity. The difference by sex in the proportion of respondents in the physically active and physically inactive subsamples was not statistically significant (χ^2 = 2.38, df = 1, P = 0.18). However, there were statistically significant differences between the subsamples in the distributions of age, socioeconomic status, and marital status. Physically active subjects were younger, more often single, and had higher socioeconomic status. Characteristics of the study population are presented in Table 1.

Prevalences of DSM-IV disorders

Substance abuse or dependence disorders were estimated to be the most prevalent of the three broad classes of disorders [12-month prevalence: 15.8% (SE = 0.6%);

Table 1
Demographic characteristics according to physical activity

Variable	Subjects with regular exercises	Subjects without regular exercises	P
Sex			0.178
female, % (SE)	48.3 (1.4)	50.8 (1.2)	
Age, years, mean (SD)	42.8 (12.8)	39.7 (13.6)	<0.001
Socioeconomic status			<0.001
low, % (SE)	15.7 (1.0)	21.5 (0.9)	
medium, % (SE)	55.9 (1.4)	59.1 (1.1)	
high, % (SE)	28.4 (1.3)	19.4 (0.9)	
Marital status			<0.001
married, % (SE)	59.3 (1.4)	67.2 (1.1)	
divorced/widowed/ separated, % (SE)	9.2 (0.8)	12.4 (0.7)	
single, % (SE)	31.6 (1.3)	20.4 (0.9)	

Weighted data are presented.

1-month prevalence: 12.4% (SE = 0.6%)]. The prevalence of affective disorders in the last year was 11.9% (SE = 0.5%), while the corresponding prevalence for cases in the previous month was 6.3% (SE = 0.4%). The 12- and 1-month prevalence of anxiety disorders were 14.5% (SE = 0.6%) and 9.0% (SE = 0.5%), respectively. The overall prevalence of at least one mental disorders was considerably higher for women than for men. Women had higher rates of affective and anxiety disorders and lower rates of substance abuse or dependence disorders than men. Additionally, married subjects had lower rates of all disorders than those who had never married or were presently separated, divorced, or widowed. In general, disorders were more frequent in those with less socioeconomic status.

Health-related quality of life

Existing population studies using the SF-36 have reported group differences by age, sex, and social class. Similar differences were found in the present study. With one exception (general health), men had higher scores than women for all domains and the two summary scales. Older subjects scored lower on the physical dimensions. Only weak associations were observed between age and the mental dimensions. There were inverse associations between the scale scores of the SF-36 and socioeconomic status for most of the scales, with higher status reporting better health.

Subjects who reported regular physical activity showed higher scores on all SF-36 dimensions. As expected, the largest differences were seen in measures of general health and physical function. There were still substantial differences in the mental health dimensions of the SF-36 with respect to physical activity.

Health-related quality of life, physical activity, and mental disorders

Tables 2 and 3 present the health-related quality-of-life dimensions of the subjects with and without mental disorders with respect to self-reported physical activity. We found a different pattern of quality of life in the three diagnostic groups. Subjects with substance abuse or dependence disorders reported a better quality of life than subjects with affective and anxiety disorders.

The results suggest that physical activity is associated with better quality of life for both subjects with and without mental disorders. In comparing physically active (regular exercises) and physically inactive responders, substantial differences were found on all dimensions of the questionnaire, and physically inactive subjects with affective disorders were more likely to report lower quality of life than the other subjects in all domains tapped by the quality-of-life instrument. The highest effect sizes were obtained on the mental health components of the SF-36 for subjects with affective disorders, while there were similar effect sizes for

Table 2
Associations among health-related quality of life, mental disorders (12-month prevalence), and physical activity

	Subjects without mental disorders last year			Subjects with affective disorders last year			Subjects with anxiety disorders last year			Subjects with substance use or abuse disorders last year		
	Regular exercise (n = 1,100)	No regular exercise (n = 1,531)		Regular exercise (n = 172)	No regular exercise (n = 310)		Regular exercise (n = 217)	No regular exercise (n = 359)		Regular exercise (n = 247)	No regular exercise (n = 388)	
	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size
Physical functioning	92.0 (15.1)	87.4 (19.5)	0.26	86.9 (18.5)	78.0 (21.0)	0.44	85.6 (17.9)	78.7 (20.7)	0.35	92.3 (13.0)	85.8 (18.4)	0.40
Physical role functioning	91.0 (24.5)	85.8 (30.4)	0.19	78.9 (33.8)	65.7 (37.1)	0.37	75.8 (35.1)	67.8 (34.9)	0.23	87.6 (26.2)	79.1 (32.0)	0.29
Bodily pain	75.2 (24.6)	69.8 (25.1)	0.22	60.5 (25.1)	51.7 (23.0)	0.37	58.3 (25.5)	54.2 (22.8)	0.17	69.8 (23.3)	63.2 (24.0)	0.28
General health	73.4 (16.4)	68.0 (17.2)	0.32	63.5 (17.3)	53.6 (17.2)	0.57	62.7 (17.9)	54.9 (17.8)	0.44	69.5 (17.0)	62.2 (17.2)	0.43
Vitality	65.6 (16.1)	62.2 (16.7)	0.21	53.1 (17.5)	41.6 (16.7)	0.68	53.5 (17.7)	46.4 (16.8)	0.41	60.0 (16.3)	53.0 (18.4)	0.40
Social functioning	91.9 (15.2)	89.4 (17.0)	0.15	73.9 (23.8)	65.7 (24.2)	0.34	77.8 (23.4)	70.2 (23.5)	0.32	85.7 (18.5)	81.2 (22.3)	0.22
Role emotional functioning	94.8 (18.0)	92.9 (22.3)	0.09	76.1 (34.1)	61.6 (38.3)	0.39	78.4 (33.9)	69.5 (34.8)	0.26	89.6 (23.7)	82.0 (31.9)	0.26
Mental health	78.0 (13.4)	75.5 (14.2)	0.18	61.5 (16.6)	50.2 (17.8)	0.65	63.7 (17.2)	56.9 (18.2)	0.38	71.1 (14.9)	65.9 (18.8)	0.30
Mental summary	52.5 (7.8)	51.7 (8.5)	0.10	42.5 (11.4)	35.9 (11.4)	0.58	44.3 (11.3)	40.2 (12.4)	0.34	48.4 (9.4)	45.4 (12.5)	0.26
Physical summary	53.2 (8.2)	50.5 (9.7)	0.30	50.9 (9.2)	47.6 (10.1)	0.34	49.5 (10.3)	46.9 (9.9)	0.26	52.9 (7.6)	49.8 (9.4)	0.36

Note. Effect sizes were calculated on the basis of means and standard deviations [M(regular exercise) − M(no regular exercise)] / S(pooled).

Table 3
Associations among health-related quality of life, mental disorders (1-month prevalence), and physical activity

	Subjects without mental disorders last year			Subjects with affective disorders last month			Subjects with anxiety disorders last month			Subjects with substance use or abuse disorders last month		
	Regular exercise (n = 1,100)	No regular exercise (n = 1,531)		Regular exercise (n = 69)	No regular exercise (n = 183)		Regular exercise (n = 122)	No regular exercise (n = 238)		Regular exercise (n = 183)	No regular exercise (n = 316)	
	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size	M (SD)	M (SD)	Effect size
Physical functioning	92.0 (15.1)	87.4 (19.5)	0.26	84.6 (22.8)	73.7 (22.9)	0.48	84.8 (18.1)	76.8 (21.4)	0.39	92.4 (13.4)	85.8 (18.0)	0.40
Physical role functioning	91.0 (24.5)	85.8 (30.4)	0.19	76.5 (38.7)	60.2 (38.6)	0.42	76.2 (33.8)	63.7 (35.7)	0.36	86.8 (27.1)	78.1 (32.3)	0.29
Bodily pain	75.2 (24.6)	69.8 (25.1)	0.22	58.2 (30.0)	46.2 (20.3)	0.53	55.7 (24.9)	51.2 (22.0)	0.20	69.8 (24.0)	62.5 (23.9)	0.30
General health	73.4 (16.4)	68.0 (17.2)	0.32	62.2 (19.9)	48.9 (16.7)	0.76	61.2 (18.0)	53.0 (17.7)	0.46	69.1 (16.6)	61.7 (17.0)	0.44
Vitality	65.6 (16.1)	62.2 (16.7)	0.21	50.3 (18.9)	38.4 (15.6)	0.72	50.5 (16.7)	44.4 (16.4)	0.37	59.8 (16.2)	52.4 (18.7)	0.42
Social functioning	91.9 (15.2)	89.4 (17.0)	0.15	69.7 (28.3)	60.8 (23.9)	0.36	75.6 (24.5)	68.2 (23.4)	0.31	86.6 (17.8)	80.0 (23.3)	0.31
Role emotional functioning	94.8 (18.0)	92.9 (22.3)	0.09	65.3 (41.9)	52.2 (39.9)	0.32	71.1 (37.1)	65.3 (35.7)	0.16	90.2 (22.7)	80.0 (33.1)	0.35
Mental health	78.0 (13.4)	75.5 (14.2)	0.18	56.2 (18.4)	44.8 (16.4)	0.67	59.9 (16.9)	54.5 (17.3)	0.31	70.2 (15.2)	65.2 (19.5)	0.28
Mental summary	52.5 (7.8)	51.7 (8.5)	0.10	38.8 (13.4)	32.5 (12.6)	0.49	41.5 (12.1)	38.6 (12.5)	0.23	48.3 (9.2)	44.7 (13.0)	0.31
Physical summary	53.2 (8.2)	50.5 (9.7)	0.30	51.2 (10.9)	46.1 (10.7)	0.47	50.0 (9.5)	46.0 (9.9)	0.41	52.9 (7.9)	49.7 (9.2)	0.37

Note. Effect sizes were calculated on the basis of means and standard deviations [M(regular exercise) − M(no regular exercise)] / S(pooled).

the physical and mental dimensions for the other subjects. As can be seen from the tables presented here, physical activity improves health-related quality of life in subjects with mental disorders, but subjects without mental disorders still have still higher level of quality of life, regardless of physical activity.

To further explore the influence of sociodemographic characteristics on physical activity and quality of life, we used linear regression modeling. The physical and mental component summaries of the SF-36 were used as dependent variables in separate models to examine whether sociodemographic characteristics may have explained the differences in health-related quality of life between physically active and inactive subjects. After controlling for age, gender, socioeconomic status, and marital status, physical activity remained a significant predictor of health-related quality of life as measured by the scales of the SF-36. This holds for the three diagnostic groups and the two summary scores. The results of the regression analyses are presented in Table 4.

Discussion

Mental disorders are a major part of the global burden of disease [40]. People with mental disorders experience significant disability and poor quality of life, and their families and communities are greatly affected. Physical activity confers a host of health benefits, including psychological well-being and quality of life. Numerous epidemiological studies suggest that physical activity reduces morbidity and mortality from chronic diseases and conditions [41,42]. Findings from research on the relationship between physical activity and mental disorders or psychological distress have been inconsistent, with a negative relationship reported in some studies [14,43–46] but not in others [47–49].

Therefore, the main objective of this study was to identify the association between physical activity and health-related quality of life in subjects suffering from mental disorders, using data from a large representative community sample.

The present study shows that exercise is cross sectionally associated with health-related quality of life among persons with affective, anxiety, substance abuse or dependence disorders. Physically inactive subjects had much lower scores than physically active subjects on all SF-36 dimensions. The reduced level of functioning of physically inactive subjects with affective and anxiety disorders is remarkable. These subjects reported poorer health-related quality of life on most of the SF-36 dimensions than subjects with chronic somatic illnesses (e.g., cardiovascular conditions, chronic respiratory diseases, dermatologic conditions) when comparing our results with results from an epidemiological survey in the Netherlands [50].

The current study adds to existing knowledge by providing information on the association between physical

Table 4
Associations among health-related quality of life, mental disorders, physical activity, and sociodemographic characteristics

	SF-36 mental component summary				SF-36 physical component summary			
	Coefficient	SE	95% CI	*P*	Coefficient	SE	95% CI	*P*
Subjects with affective disorders (12-month prevalence)								
Intercept	37.4	4.67	(28.3–46.6)	<0.001	58.9	3.71	(51.6–66.3)	<0.001
Physical activity	5.67	1.345	(3.03–8.31)	<0.001	8.48	3.11	(2.36–14.6)	0.007
Gender	−1.33	1.37	(−4.03–1.37)	0.334	0.09	1.30	(−2.46–2.64)	0.943
Age	−0.07	0.07	(−0.20–0.06)	0.262	−0.35	0.04	(−0.44 to−0.27)	<0.001
Socioeconomic status	−0.10	1.08	(−2.21–2.02)	0.930	2.57	0.74	(1.12–4.04)	<0.001
Marital status (married)	4.39	2.81	(−1.14–9.92)	0.119	−1.26	1.81	(−4.82–2.31)	0.489
Marital status (single)	4.93	2.87	(−0.71–10.5)	0.087	−3.06	1.90	(−6.79–0.67)	0.108
Gender × physical activity					−3.79	1.90	(−7.53 to−0.04)	0.048
	$R^2 = 0.07$				$R^2 = 0.21$			
Subjects with anxiety disorders (12-month prevalence)								
Intercept	41.0	5.55	(30.1–51.9)	<0.000	52.6	3.56	(45.6–59.6)	<0.000
Physical activity	3.82	1.18	(1.49–6.14)	0.001	l11.4	3.18	(5.10–17.6)	0.000
Gender	−1.33	1.25	(−3.78–1.12)	0.288	1.64	1.19	(−0.70–3.98)	0.169
Age	−0.08	0.05	(−0.19–0.02)	0.122	−0.30	0.04	(−0.38 to−0.22)	0.000
Socioeconomic status	0.55	0.89	(−1.19–2.30)	0.533	3.18	0.67	(1.86–4.50)	0.000
Marital status (married)	4.43	4.32	(−4.05–12.9)	0.306	−0.92	2.03	(−4.92–3.07)	0.652
Marital status (single)	3.59	4.51	(−5.25–12.4)	0.427	−2.18	2.15	(−6.40–2.04)	0.312
Gender × physical activity					−5.92	1.81	(−9.48 to−2.37)	<0.001
	$R^2 = 0.04$				$R^2 = 0.18$			
Subjects with substance abuse or dependence disorders (12-month prevalence)								
Intercept	46.3	4.45	(37.5–55.0)	<0.000	58.5	3.09	(52.4–64.5)	<0.000
Physical activity	−4.28	2.85	(−9.89–1.31)	0.133	6.44	2.10	(2.31–10.5)	0.002
Gender	−6.15	1.49	(−9.07 to−3.23)	<0.000	1.65	1.01	(−0.34–3.64)	0.104
Age	−0.03	0.05	(−0.12–0.07)	0.625	−0.25	0.06	(−0.36 to−0.14)	<0.000
Socioeconomic status	0.18	0.81	(−1.41–1.79)	0.820	2.61	0.64	(1.35–3.86)	<0.000
Marital status (married)	10.0	3.45	(3.23–16.7)	0.004	−6.07	1.35	(−8.72 to−3.42)	<0.000
Marital status (single)	7.00	3.44	(0.23–13.7)	0.043	−6.70	1.58	(−9.80 to−3.60)	<0.000
Gender × physical activity	5.28	2.05	(1.25–9.31)	0.010	−3.38	1.44	(−6.21 to−0.55)	0.019
	$R^2 = 0.09$				$R^2 = 0.17$			

Note. CI indicates confidence interval. The independent variable age was entered as a continuous variable. Physical activity (0 = no regular exercises, 1 = regular exercises), gender (1 = male, 2 = female), socioeconomic status (1 = low, 2 = medium, 3 = high), and marital status (married: 1 = married, 0 = others; single: 1 = single, 2 = others) were entered as categorical variables.

exercises and health-related quality of life in subjects with mental disorders that had not previously been studied. Previous studies focused mainly on the association between physical activity and mental disorders in clinical and non-clinical samples or on the association between physical activity and health-related quality of life in subjects suffering from somatic illness. The strengths of the present study are its diagnostic assessment (disorders rather than symptom scales) and its large sample size (representative community sample rather than selected clinical sample).

There is little evidence in the current study to suggest that group differences on dimensions of quality of life are due to substantive differences in socioeconomic and sociodemographic factors. Confounding by these factors is unlikely to be an explanation for the findings because controlling for these variables did not remove the significance of the relations. Although physical activity per se was associated with health-related quality of life, we found a different pattern for the three diagnostic groups. The largest differences between physically active and physically inactive subjects were found for subjects with affective disorders. However, when comparing differences among groups, it is important to notice that subjects with affective disorders reported the poorest quality of life. Although similar results have been reported in other studies [51], it should be kept in mind that it is more likely to find larger effect sizes in groups with poor quality of life.

The present findings place the quality of life in physically active subjects with mental disorders as better than that of physically inactive subjects with mental disorders but still markedly lower than that of subjects without mental disorders (with and without physical activity). The reason for the association between regular physical activity and health-related quality of life in subjects suffering from mental disorders remains unclear [52]. A variety of mechanisms have been proposed. Biochemical pathways highlight increases in substances including endorphins, norepinephrine, and central seratonin [53,54]. Psychosocial mechanisms were suggested, including an association between physical activity and social network: physically active persons may

interact more and form relations with those with whom they come into contact as a result of their physical activity [46]. This may results in an improved health-related quality of life. Other plausible mechanisms include improved fitness and increased self-esteem, as a result of greater physical activity. Multiple mechanisms are likely to underlie the relationship. Further research is needed to understand how exercise improves quality of life. For example, it is possible that physical activity and mental health vary together, in which case a third variable, such as physical impairment, social network, or personality characteristics, would mediate this relationship. Additionally, it is possible that psychosocial status of subjects and their ability to engage in physical activities may influence each other in a bidirectional manner so that changes in one may lead to changes in the other. Nevertheless, moderate exercise is usually safe and regularly exercise may alleviate the vicious cycle of mental illness, physical inactivity, and reduced qualify of life.

Taken together with findings from prior studies, this demonstration of reduced quality of life in physically inactive subjects should encourage public health policy makers in the promotion of a physically active lifestyle. Despite the substantial benefits associated with involvement in physical activity, studies have shown that the majority of Europeans and North Americans are sedentary [55,56].

The present findings are constrained by several limitations. First, our measure of physical activity is imprecise. It does not assess type and frequency of physical exertion, nor does it assess physical fitness. Participation in physical activity may have different meaning meanings for subjects, for example, Farmer et al. [57] suggested that women and men differentially report physical activity because of cultural expectations and habits. Nevertheless, the simple question we used was associated with body mass index in the expected direction. Physically active subjects had a lower body mass index ($M = 25.6$, SD = 4.1) than physically inactive subjects ($M = 26.8$, SD = 4.9). Additionally, moods such as depression and anxiety may be tied more to cardiovascular and pulmonary function associated with aerobic exercise than to resistance training. It is also possible that exercising in groups is key to psychological effects.

Second, the data are cross-sectional and although the German National Health Interview and Examination Survey is population-based, we are unable to longitudinally determine the relationship among quality of life, physical activity, and mental disorders. Since we were interested in the association between physical activity and quality of life in subjects suffering from mental disorders, we focused only on 1- and 12-month prevalence of mental disorders. Prospective longitudinal studies are required to clarify these interactions and to find out the temporal order between physical activity on quality of life in these subjects. It is possible that physical inactivity in subjects suffering from mental disorders decreases perceived quality of life. On the other hand, it is possible that functional impairment, associated with lower quality of life, results in a physically inactive behavior.

Third, subjects aged 66 and above were excluded from the second stage of the survey due to psychometric shortcomings of the Composite International Diagnostic Interview in older populations. Therefore, we can draw no conclusions about the associations in older populations.

Fourth, we have no valid information about received mental treatment in the last year. It is possible that psychiatric treatment increases perceived quality of life, independent from physical activity.

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