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Relationship between types of physical activity and depression among urban middle- aged and elderly adults in China

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Research Article

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Abstract

Background

Physical activity (PA) is recognized as an effective approach for preventing and managing depression. However, no studies to date have examined the effects of different types of PA on depression among middle-aged and elderly adults in China. This study aimed to analyze the potential relationship between different types of PA and depression among urban middle-aged and older adults in China.

Methods

This study utilized data from the 2020 wave of the China Health and Retirement Longitudinal Study (CHARLS). A total of 3,164 urban residents aged 45 years and older were included. Depression was assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CESD-10) and served as the dependent variable, while different types of PA were treated as independent variables. Multivariate logistic regression models were employed to analyze the role of PA in urban middle-aged and elderly adults depression.

Results

A substantial proportion (29.3%) of urban middle-aged and older adults reported depressive symptoms, with a higher prevalence among women (36.2%). High-intensity PA at work was identified as a risk factor for depression, highlighting a 51% increased risk for both sexes. Individuals engaging in moderate-intensity exercise demonstrated a 25% lower likelihood of depression compared to those engaged in moderate-intensity work-related PA. Those participating in low-intensity exercise showed a 20% reduced likelihood of depression relative to counterparts involved in low-intensity work-related PA. Among men, those engaging in moderate-intensity exercise had a 34% lower likelihood of depression, while women participating in low-intensity exercise exhibited a 23% reduction in depression likelihood.

Conclusions

The impact of different types of PA on depressive symptoms in middle-aged and older adults showed gender-specific variations. High-intensity occupational PA was associated with increased depression levels among urban middle-aged and older adults. In contrast, moderate-intensity leisure-time physical activity was linked to reduced depression levels in men, while low-intensity leisure-time physical activity was associated with decreased depression levels in women. For urban middle-aged and older adults in China, greater attention should be given to strengthening different types of PA for the prevention and alleviation of depression.

Introduction

Depression is a chronic mental disorder characterized by a high risk of recurrence and substantial multisystemic comorbidities [1]. It is associated with elevated risks of cardiovascular diseases [2], cancer [3], and all-cause mortality [4], significantly impairing the quality of life of affected individuals and their families [5]. As such, depression has emerged as a leading contributor to the global disease burden, imposing considerable healthcare expenditures and societal costs. According to the most recent estimates released by the World Health Organization, the global prevalence of depression approximates 3.8% [6]. In China, the number of depressive disorder cases surged from 34.4 million to 53.1 million between 1990 and 2019, reflecting a 54% increase over three decades [7].

Physical activity (PA) is recognized as an effective measure for both preventing and treating depression [8]. Recent studies indicated that the association between PA and depression depends on various factors, such as the intensity and domains of PA (e.g. leisure-time, occupational, transportation, and household PA) [9, 10]. In the literature concerning Chinese adults, leisure time PA was meaningfully and disparately associated with mental health burden across different people, whereas excessive PA was associated with a higher risk of depression [11, 12].

These findings contribute to an improved understanding of the relationship between PA and depression among Chinese adults. To the best of our knowledge, none of them has examined the association between PA and depression in Chinese adults by considering different combinations of PA intensity and domain. Historically, research and measurement in PA have predominantly emphasized leisure-time PA [13]. However, emerging evidence indicated that the health effects of PA may vary across different domains [14, 15]. PA performed in the work domain may have potential adverse health consequences, while the health benefits associated with transportation and household PA tend to be less pronounced compared to leisure-time PA [16, 17]. Therefore, it is essential to analyze the health effects of PA by integrating both its intensity and domain.

Accordingly, this study aimed to examine the associations between various combinations of PA domains and intensity with depression among Chinese adults, thereby addressing a critical gap in the existing literature. The mental health of middle-aged and older adults represents a significant public health priority in China [18]. Enhancing the prevention and effective intervention for depression within this population is essential, as it can mitigate the substantial public health and economic burdens at their source.

Materials and methods

Data and samples

This study utilized data from the latest wave (2020) of the China Health and Retirement Longitudinal Study (CHARLS). The national baseline survey of CHARLS was launched in 2011. It covered 150 counties and 450 communities (villages) across 28 provinces, achieving a sample size of approximately 17,000

individuals. The project adopted a multi-stage sampling method and conducts follow-up surveys biennially. The questionnaire design drew on international expertise from established studies such as the US Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). Its content encompasses multiple dimensions, including basic demographic information, health status, physical measurements, healthcare utilization, health insurance, employment, retirement, and pensions, ensuring strong analytical consistency and high representativeness for the middle-aged and elderly population in China [19].

Of the 19,367 individuals included in the CHARLS 2020 survey, 3,164 participants were ultimately enrolled in the present study after applying the following exclusion criteria: (a) age under 45 years in 2020; (b) not residing in urban centers or urban–rural integration areas; (c) non-response to PA-related questions; and (d) absence of key control variables.

Assessment of depressive symptoms (Dependent variable)

Based on the established assessment criteria, depressive symptoms were evaluated using the 10-item Center for Epidemiological Studies Depression Scale (CESD-10), which has demonstrated strong validity in identifying individuals with depression. Notably, the CESD-10 has been reported to exhibit high sensitivity among Chinese older adults [20]. This scale comprises 10 items: eight are negatively worded and two are positively worded. Each item is rated on a 4-point scale from 0 to 3, corresponding to the frequency of symptom occurrence. For the positively worded items, the scores were reversed before calculating the total score. The total score ranged from 0 to 30, with higher scores indicating more severe depressive symptoms. In line with previous research, a cut-off score of ≥ 10 was used to define clinically significant depressive symptoms.[20] Consequently, participants were categorized into either the depression group (CESD-10 score ≥ 10) or the non-depression group (CESD-10 score < 10) for subsequent analysis.

Assessment of PA (Independent variable)

The survey participants were asked, “In a typical week, do you engage in any of the following types of activities for at least 10 minutes at a time?” Responses indicating “very strenuous physical activities” were assigned a value of 1, “moderate-intensity physical activities” a value of 2, and “light physical activities” a value of 3. For each intensity level, activities were further categorized into four types: work-related, leisure, exercise/sports, and other.

Control variables

The following variables were included in the analysis as confounders: sex (male; female), educational level (primary school or below; junior high school; senior high school or above), age (45–59; 60–69; 70

and above), chronic disease status (yes; no), partner status (yes; no), and self-rated health (poor; fair; good).

Statistical analysis

The statistical analysis in this study comprised three steps. First, based on covariates, the sample was categorized into different groups, and the number and percentage of individuals with depressive symptoms in each group were calculated. Chi-square tests were employed to assess whether differences in the prevalence of depression across groups were statistically significant. Second, the number and proportion of individuals with depressive symptoms were summarized according to different types of PA categories for the overall population, as well as separately for males and females. Finally, logistic regression was used to examine the associations between depressive symptoms and different types of PA. To improve our understanding of the relationship between depressive symptoms and PA, separate models were constructed using the following reference groups: no participation in high-intensity PA, participation in moderate-intensity PA for work, and participation in low-intensity PA for work.

The results were expressed in terms of odds ratios (ORs) and 95% CIs. With respect to the statistical associations, a significance level of 5% was used. The data were exported and analyzed via version 18 of Stata (Stata Corp, College Station, TX, USA).

Results

Sample characteristics

Table 1 presents the frequency distribution of depression among urban middle-aged and elderly adults according to their characteristics. The number of female respondents was higher than that of male respondents. More than half of the respondents were aged between 45 and 59 years (54.8%). Approximately four-fifths of the participants did not have chronic diseases (79.4%). About three-fifths had an education level of junior high school or above (accounting for 30.2% of junior high school and 27.8% of senior high school or above). A large percentage of respondents were married (87.6%). A majority of the respondents (over 80%) perceived their health to be at a general level or better, with 28.8% reporting “Good” or “Very Good” and 54.6% reporting “Fair” health status. Approximately one-third of the urban middle-aged and elderly adults suffered from depression (29.3%), with a higher prevalence among females (36.2%) compared to males (19.9%). No significant differences in the prevalence of depressive symptoms were observed across different age groups. The prevalence of depression was significantly higher among those with chronic diseases (32.5%) compared to those without (17.2%). The proportion of depression was significantly higher among individuals with an education level below primary school (39.1%) compared to those with junior high school education (24.9%) or higher (19.3%). Married individuals (27.7%) and those who self-rated their health as “good” or “very good” (11.0%) had a lower prevalence of depression.

Table1 Urban middle-aged and older adults' depression characteristics

Urban middle-aged and older adults' characteristics	Total sample (%)	Urban middle-aged and older adults depression (%)	*P* value
All	3164(100.0)	928(29.3)	
Gender			0.001
Male	1333(42.1)	265(19.9)	
Female	1831(57.9)	663(36.2)	
Age groups			0.207
45-59 years	1734(54.8)	487(28.1)	
60-69 years	1025(32.4)	312(30.4)	
70 or more years	405(12.8)	129(31.9)	
Suffering from chronic disease			0.001
No	652(20.6)	112(17.2)	
Yes	2512(79.4)	816(32.5)	
Education			0.001
Elementary school and below	1329(42.0)	520(39.1)	
Junior high school	955(30.2)	238(24.9)	
Senior high school or above	880(27.8)	170(19.3)	
Marriage status Separated/divorced/widowed/never married	391(12.4)	161(41.2)	0.001
Have/is married	2773(87.6)	767(27.7)	
Self-rated health			0.001
Very poor/poor	524(16.6)	308(58.8)	
Fair	1729(54.6)	520(30.1)	
Good/very good	911(28.8)	100(11.0)	

Association between PA and depression

The prevalence of depression among urban middle-aged and older adults across different intensities and domains of PA is presented in Table 2. Generally, the overall depression prevalence ranged from 23.7%

(among individuals who were active in the moderate-intensity PA for exercise) to 39.7% (among individuals who were active in the 'others' vigorous-intensity PA domains). After stratification by gender, the prevalence among females varied between 31.6% (among individuals who were active in the moderate-intensity PA for exercise) and 55.0% (among individuals who were active in the others vigorous-intensity PA domains), while among males it ranged from 15.7% (among individuals who were active in the vigorous-intensity PA for exercise) to 24.4% (among individuals who were active in the vigorous-intensity PA for work).

Table 2 Prevalence of depression according to the type of PA by sex

Type of PA	Both sexes n (%)	Male n (%)	Female n (%)
No vigorous-intensity PA	651□28.6□	162□19.1□	489□34.2□
Vigorous-intensity PA (work)	164□33.5□	72□24.4□	92□47.4□
Vigorous-intensity PA (leisure)	10□30.3□	2□16.6□	8□38.1□
Vigorous-intensity PA (exercise)	76□25.5□	24□15.7□	52□35.6□
Vigorous-intensity PA (others)	27□39.7□	5□17.8□	22□55.0□
Moderate-intensity PA (work)	306□30.0□	112□21.7□	194□38.4□
Moderate-intensity PA (leisure)	36□26.3□	10□17.5□	26□32.5□
Moderate-intensity PA (exercise)	228□23.7□	77□15.9□	151□31.6□
Moderate-intensity PA (others)	358□34.1□	66□23.6□	292□37.9□
Light-intensity PA (work)	223□30.4□	78□21.3□	145□39.6□
Light-intensity PA (leisure)	70□28.3□	22□20.0□	48□35.0□
Light-intensity PA (exercise)	531□28.3□	147□19.1□	384□34.8□
Light-intensity PA (others)	104□33.0□	18□20.4□	86□37.9□

In the multivariate logistical regression [Table 3], when individuals who were not active in vigorous-intensity PA were used as the reference group, a greater likelihood of depression was observed among individuals who were active in vigorous-intensity PA for work (specifically, a 51% increase in the likelihood of depression). No gender differences were observed in this context, that is, in comparison with the reference group, engaging in vigorous-intensity PA for work was associated with an increased likelihood of depression in both men (OR = 1.47; 95% CI = [1.02-2.10]) and women (OR = 1.58; 95% CI = [1.13-2.20]).

Table 3 The association between vigorous-intensity PA and depression

Variables	Both sexes		Men		Women	
	OR*	95% CI	OR	95% CI	OR	95% CI
No vigorous-intensity PA	1.00		1.00		1.00	
Vigorous-intensity PA (work)	1.51	[1.19~1.93]	1.47	[1.02~2.10]	1.58	[1.13~2.20]
Vigorous-intensity PA (leisure)	1.40	[0.60~3.25]	1.26	[0.24~6.46]	1.44	[0.54~3.86]
Vigorous-intensity PA (exercise)	1.11	[0.82~1.50]	0.90	[0.54~1.48]	1.25	[0.85~1.84]
Vigorous-intensity PA (others)	1.43	[0.82~2.48]	0.78	[0.27~2.21]	1.93	[0.97~3.83]

Adjusted for age, chronic disease, education, marriage status and self-rated health.

*Adjusted for age, chronic disease, education, marriage status, self-rated health and gender.

A significant association was observed when employing individuals engaging in moderate-intensity PA for work as the reference group [Table 4]. With respect to the entire sample, moderate-intensity PA for leisure or other purposes was not significantly associated with depression, whereas activity for exercise was linked to a decreased likelihood of depression (OR = 0.75; 95% CI = [0.60-0.94]). A similar pattern of results was observed among males (OR = 0.66; 95% CI = [0.46-0.95]). However, among females, moderate-intensity PA, regardless of its domain, showed no significant association with depression.

Table 4 The association between moderate-intensity PA and depression

Variables	Both sexes		Men		Women	
	OR*	95% CI	OR	95% CI	OR	95% CI
Moderate-intensity PA (work)	1.00		1.00		1.00	
Moderate-intensity PA (leisure)	0.94	[0.61~1.46]	0.95	[0.44~2.02]	0.96	[0.56~1.67]
Moderate-intensity PA (exercise)	0.75	[0.60~0.94]	0.66	[0.46~0.95]	0.81	[0.60~1.09]
Moderate-intensity PA (others)	0.99	[0.80~1.22]	0.92	[0.62~1.37]	1.03	[0.79~1.33]

Adjusted for age, chronic disease, education, marriage status and self-rated health.

*Adjusted for age, chronic disease, education, marriage status, self-rated health and gender.

In the analysis in which the group of individuals who were active in the light-intensity PA for work was used as the reference group, different associations were observed [Table 5]. In general, individuals who were active in the light-intensity PA for exercise exhibited a decreased likelihood of experiencing depressive symptoms (OR = 0.80; 95% CI = [0.64-0.98]). In the analysis that was stratified by sex, such an association was observed among females (OR = 0.77; 95% CI = [0.58-0.94]). However, among males, light-intensity PA, regardless of its domain, showed no significant association with depression.

Table 5 The association between light-intensity PA and depression

Variables	Both sexes		Men		Women	
	OR*	95% CI	OR	95% CI	OR	95% CI
Light-intensity PA (work)	1.00		1.00		1.00	
Light-intensity PA (leisure)	0.79	0.55~1.12	0.81	0.46~1.43	0.78	0.49~1.22
Light-intensity PA (exercise)	0.80	0.64~0.98	0.84	0.59~1.18	0.77	0.58~0.94
Light-intensity PA (others)	0.82	0.60~1.12	0.68	0.36~1.29	0.85	0.58~1.24

Adjusted for age, chronic disease, education, marriage status and self-rated health.

*Adjusted for age, chronic disease, education, marriage status, self-rated health and gender.

Discussion

Based on the findings of this study, the detection rate of depressive symptoms among urban middle-aged and older adults aged 45 and above in China was approximately 29.3%. This finding is consistent with previous related research, which reported depression detection rates of 23.6% (for the period 1987–2012) and 25.5% (for the period 2010–2019) among middle-aged and older adults in China [18, 20]. This figure is higher than the rates reported in European countries and South Korea but lower than those reported in Nepal [21, 22].

Based on the findings of this study, the detection rates of depression varied significantly across populations defined by gender, presence of chronic diseases, educational attainment, partnership status, and self-rated health levels. Among women entering middle and older age, the decline in ovarian function leads to significant fluctuations in estrogen and progesterone levels, which directly impact the stability of neurotransmitters in the brain, thereby compromising emotional regulation [23]. Furthermore, women are more susceptible to chronic conditions such as cardiovascular diseases, diabetes, and chronic insomnia. These conditions interact bidirectionally with depressive symptoms through pathways involving inflammatory responses and metabolic disturbances [24].

The presence of chronic diseases and their multimorbidity often leads to a decline in physical function, which can manifest as difficulties in performing complex instrumental activities of daily living (IADL), such as shopping, cooking, and managing finances independently. This loss of functional independence frequently triggers a profound sense of uselessness and diminished self-worth, serving as a significant psychological pathway to depression in older adults [25].

Educational attainment serves as a critical foundation for securing higher-income occupations and stable economic resources, which directly influences a sense of security in later life and accessibility to healthcare services [26]. The presence of a spouse provides older adults with essential emotional attachment and intimacy, which is difficult to fully substitute with other social relationships. A supportive marital relationship fosters a sense of security and alleviates feelings of loneliness and helplessness [27]. One study revealed statistically significant differences in mean depression scores across marital statuses: married individuals exhibited the lowest scores, followed by divorced, widowed, and never-married older adults, with the latter group showing the highest depression levels [28].

Poor self-rated health tends to trigger excessive worry and feelings of helplessness regarding one's health status, financial burdens, and the perception of being a burden to family members. Such negative cognitive patterns—particularly the pessimistic interpretation of aging and illness—constitute a core factor in depression [29]. Moreover, older adults with poor self-rated health may reduce outdoor activities and social participation due to physical discomfort or diminished confidence in their functional abilities. This leads to a narrowing of social networks and heightened loneliness, limiting opportunities for emotional support through social interactions and thereby increasing the risk of depression.

This study also highlights the varying impacts of PA at different intensities—both occupational and exercise-related—on the mental health of urban middle-aged and older adults. The findings align with previous research indicating that PA is not always positively associated with mental health [30]. Notably, among urban populations, non-leisure PA elevates the risk of depression at any dose level [31].

The findings of this study indicate that low-to-moderate intensity PA, particularly when exercise-oriented, is associated with lower odds of depression. This relationship also demonstrates gender-specific characteristics: moderate-intensity exercise is linked to reduced odds of depression in men, whereas low-intensity exercise shows a stronger association with lower depression odds in women. Previous studies have consistently reported beneficial associations between PA and mental health, including a reduced incidence of depression [32]. Activities such as cycling, outdoor walking, or running often involve greater exposure to sunlight and natural environments, which can elicit positive affective experiences and contribute to better mental well-being [33]. Team-based sports may further reduce mental health burdens by fostering social interaction and enhancing social support. Moreover, mindful exercises such as yoga and tai chi are increasingly utilized as complementary or alternative interventions in the management of depression [34].

Conclusions and implications

This study investigated the associations between different types of PA and depression among middle-aged and elderly urban residents in China. The findings can be utilized to improve the mental health of this population. Depression poses a substantial global burden but can benefit from timely and effective interventions. Information derived from this study suggests that increasing the availability of safe, accessible, and supportive exercise environments—such as fitness trails, bicycle lanes, and venues for yoga and Qigong—could encourage greater participation in PA, thereby enhancing mental well-being.

Due to the use of cross-sectional data in this study, causal inferences cannot be made. Conversely, depression might prevent and hinder individuals from engaging in physical activities like exercise. Additionally, constrained by data availability, this study did not identify the associations between different specific exercise modalities and depression. It is noteworthy that combinations of various exercise activities might influence and alter the relationship between exercise and depression. Future research should focus on elucidating the mechanisms through which exercise affects depression. Such investigations would help us understand why exercise can benefit individuals with depression, moving beyond merely establishing that an association exists.

Abbreviations

CHARLS China Health and Retirement Longitudinal Study

PA Physical Activity

Declarations

Clinical trial number

not applicable

Ethics approval

The design and implementation of CHARLS comply with the ethical standards of the Declaration of Helsinki. The primary ethical approval was obtained from the Biomedical Ethics Review Committee of Peking University (IRB00001052-11015). All participants provided written informed consent.

Consent for publication

Not applicable.

Competing interests

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Author Contribution

Zeng Zhi: Conceptualization, Methodology, Investigation, Formal analysis, Writing – Original Draft, Writing – Review & Editing, Visualization, Project administration.

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Data Availability

All data reported in this manuscript is publicly available from the CHARLS website: [https://charls.pku.edu.cn/en/index.htm](https:/charls.pku.edu.cn/en/index.htm) . Additionally, the data can be made available upon request by contacting the author.

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