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# THE EFFECT OF CHANGES IN PHYSICAL ACTIVITY BEHAVIOUR ON DEPRESSIVE SYMPTOMS AMONG EUROPEAN OLDER ADULTS

original paper

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## ABSTRACT

**Purpose.** Physical activity is associated with lower odds of depression symptoms among older adults. However, little is known about the effect of changing physical activity behaviour on depressive symptoms. The present study aimed to analyse the effects of changing physical activity trajectory on depressive symptoms in older people.

**Methods.** Data from the Survey of Health, Ageing and Retirement in Europe wave 5 and wave 6 were analysed. The EURO-D 12-item scale measured depressive symptoms, and physical activity (of moderate and vigorous intensity) was self-reported. Multivariate binary logistic regressions were conducted to assess the association between physical activity and depression symptoms.

**Results.** The study involved 6431 participants (mean age: 72.7 years). Moderate and vigorous physical activity was significantly associated with lower odds of depression symptoms in men and women. Moderate physical activity, performed once a week (men: OR = 0.31, 95% CI: 0.21–0.45; women: OR = 0.67, 95% CI: 0.54–0.84) and more than once a week (men: OR = 0.41, 95% CI: 0.32–0.52; women: OR = 0.56, 95% CI: 0.47–0.66), decreased the odds of having depression compared with remaining less active. Similar results were seen for vigorous physical activity in both men and women.

**Conclusions.** Moderate-to-vigorous physical activity, undertaken at least once a week, is a safe and feasible behaviour to deal with depressive symptoms among older adults.

**Key words:** mental health, depression, exercise, sport, Europe

## Introduction

Mental health disorders have a major impact on individual wellbeing and daily functioning [1]. The prevalence of mental disorders is high among older adults [2–4], and depression is one of the most preva-

lent mental disorders in this population [2]. Despite the prevalence rates of depression varying among studies owing to methodological discrepancies (e.g. different definitions used to identify depression and differences in the populations studied) [2], the World Health Organization estimated that 3.8% of the pop-

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ulation were affected by depression in 2021, including 5% of middle-aged adults and 5.7% of adults older than 60 years [5].

Among older adults, depressive symptoms are associated with other chronic conditions, such as cardiovascular disease [6], musculoskeletal disorders [7], and cancer [8]. Furthermore, previous research has demonstrated that depression is correlated with premature mortality [9, 10]. Depending on the severity and pattern of the depressive episodes over time, the treatment of depression symptoms mainly involves pharmacotherapy, psychotherapy, or a combination of both [5]. Nonetheless, pharmacotherapy can cause several adverse effects [11]. On the other hand, physical activity is a safe and feasible alternative, consistently reported as having anti-depressive effects [12]. Even low doses of physical activity are associated with a reduced risk of depression [13].

Evidence supports a protective relationship between objective physical activity assessment and major depressive disorder [14]. A meta-analysis of prospective cohort studies showed that those with high physical activity levels had lower odds of developing depression [12]. Among older adults, physical activity had a protective effect against the emergence of depression [12]. However, little is known about the impact of changing the trajectory in the practice of physical activity on depressive symptoms. Currently, different studies are examining physical activity changes during the COVID-19 pandemic and their effects on depressive symptoms. A cross-sectional study revealed that those who practised physical activity had lower odds of prevalent depressive symptoms [15, 16]. Other national studies point to the same way, maintaining that enhanced physical activity may mitigate depressive symptoms [17, 18]. However, this evidence comes from national and cross-sectional studies. In this context, this study aimed to analyse the effects of changing physical activity behaviour on depressive symptoms in older people.

## Material and methods

### Participants and procedures

For the present study, data from the Survey of Health, Ageing and Retirement in Europe (SHARE) were used. SHARE is a cross-national panel database of individual-level health, socio-economic status, and social and family networks of individuals aged 50 years or older from 27 European countries and Israel. More details about the project can be found elsewhere [19]. The pre-

sent study analysed data from SHARE wave 5 (collected in 2013) and wave 6 (collected in 2015). Data from waves 5 and 6 included 14 countries: Austria, Germany, Sweden, Spain, Italy, France, Denmark, Switzerland, Belgium, the Czech Republic, Luxembourg, Slovenia, Estonia, and Israel. Face-to-face interviews to answer the questionnaires, lasting approximately 90 minutes, performed at the participant's home, were used to collect data. Translation experts translated the questionnaires into each country's language. In this study, the population included those who reported in 2013 that they practised moderate physical activity and vigorous physical activity less than once per week. Moreover, all participants reported depressive symptoms and information that allowed their characterization (sex, age, and education level). The Ethics Committee of the University of Mannheim and the Ethics Council of the Max Planck Society for the Advancement of Science approved the SHARE protocol, verifying confidentiality and data privacy (<http://www.share-project.org/organisation/dates-facts.html>). Training researchers collected data in each country, following the SHARE protocol. The survey is fully described elsewhere [19, 20].

### Measures

The participants were asked to report the frequency of moderate-intensity physical activity (activities such as walking and household activities) and vigorous-intensity physical activity (sporting activities or carrying heavy loads). The frequency of moderate and vigorous physical activity was classified as (1) more than once a week; (2) once a week; (3) up to 3 times a month; (4) rarely or never. Responses that included categories 3 (up to 3 times a month) and 4 (rarely or never) were grouped into a new category called 'less than once a week'.

The EURO-D 12-item scale measured depressive symptoms. The scale details and validation are described elsewhere [21]. The scores range between 0 and 12, with higher results indicative of higher levels of depressive symptoms. Depression was analysed as a continuous variable and a dichotomic variable. A cut-off value of  $\geq 4$  points diagnoses clinically significant depression symptoms [21].

Age was analysed in years. In accordance with the International Standard Classification of Education 1997, the education level was grouped as low, middle, or high. The participants reported if they lived in a big city, the suburbs or outside of a big city, a large town, a small town, or a rural area or village.

## Data analysis

Statistical analyses were conducted by using the IBM SPSS Statistics software version 25 (SPSS Inc., IBM Company, Chicago, IL, USA). Descriptive statistics for all variables were calculated (percentage, mean and 95% confidence interval [CI]). The chi-square test was applied to compare the association between physical activity frequency and depression symptoms by sex. Multivariate binary logistic regression reporting odds ratio (OR) and 95% CI was conducted to assess the association between physical activity change trajectory and depression symptoms. The analysis was adjusted for age, education, and place of residence. Statistical significance was set as 2-sided  $p < 0.05$ .

## Ethical approval

The SHARE protocol was approved by the Ethics Committee of the University of Mannheim and by the Ethics Council of the Max Planck Society for the Advancement of Science, verifying the procedures to guarantee confidentiality and data privacy. Written informed consent was obtained from all participants involved in the study.

## Results

In the present study, 6431 participants were enrolled. Table 1 presents their characteristics. Most individuals were women (61.5%) and had a low educational level (54.2%, 95% CI: 52.9–55.3). The respondents' mean age was 72.7 (95% CI: 72.4–72.9) years. The mean depression score equalled 3.4 (95% CI: 3.3–3.4), and 42.3% of the sample had depression.

Table 2 presents the relationship between the depression score and physical activity intensity in 2015, stratified by sex. In 2013, all participants were engaged in physical activity less than once a week. Men and women who participated in physical activity once a week or more than once a week exhibited lower depression scores than those who practised physical activity less than once a week ( $p < 0.001$  for all analyses).

Table 3 presents the relationship between depression (cut-off score of  $\geq 4$  points) and physical activity intensity, stratified by sex. Men and women engaging in moderate or vigorous physical activity once a week or more than once a week did not have depression. Among those diagnosed with depression, there was a difference of more than 15% between those who con-

Table 1. Participants' characteristics in 2015

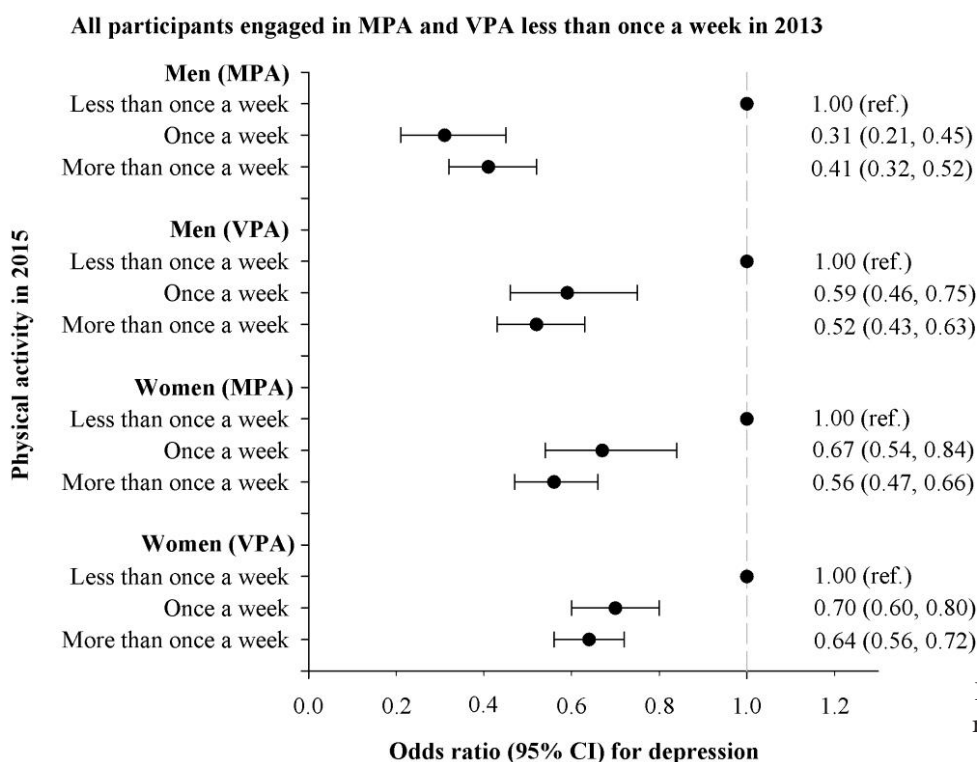
Characteristics	<i>n</i> = 6431 % or mean (95% CI)	Depression symptoms		<i>p</i>
		No % or mean (95% CI)	Yes % or mean (95% CI)	
Sex				< 0.001
Male	38.5 (37.3–39.7)	44.9 (43.3–46.5)	29.8 (28.1–31.5)	
Female	61.5 (60.2–62.6)	55.1 (53.5–56.7)	70.2 (68.5–71.9)	
Age	72.7 (72.4–72.9)	71.7 (71.4–72.0)	74.0 (73.6–74.4)	< 0.001
Education				< 0.001
Low	54.2 (52.9–55.3)	48.6 (47.0–50.3)	66.6 (64.8–68.4)	
Middle	31.7 (30.5–32.8)	35.0 (33.4–36.5)	47.9 (46.0–49.8)	
High	14.1 (13.3–15.0)	16.4 (15.2–17.6)	22.4 (20.8–24.0)	
Moderate physical activity				< 0.001
Less than once a week	47.8 (46.6–49.0)	47.9 (46.3–49.5)	65.5 (63.7–67.2)	
Once a week	15.1 (14.2–15.9)	34.4 (32.9–36.0)	47.1 (45.2–48.9)	
More than once a week	37.1 (35.9–38.2)	16.1 (14.9–17.3)	22.0 (20.5–23.6)	
Vigorous physical activity				< 0.001
Less than once a week	80.5 (79.5–81.4)	47.9 (46.3–49.5)	65.5 (63.7–67.2)	
Once a week	8.4 (7.7–9.0)	34.4 (32.9–36.0)	47.1 (45.2–48.9)	
More than once a week	11.1 (10.4–11.9)	16.1 (14.9–17.3)	22.0 (20.5–23.6)	
Depression symptoms score	3.4 (3.3–3.4)	1.5 (1.5–1.6)	5.9 (5.8–6.0)	< 0.001
Depression symptoms				
No	57.7 (56.5–58.9)			
Yes	42.3 (41.0–43.4)			

Table 2. Relationship between depression score and physical activity intensity in 2015, stratified by sex

Physical activity changes 2013–2015 All participants engaged in physical activity less than once a week in 2013	Depression score, mean (95% CI)			
	Men	<i>p</i>	Women	<i>p</i>
Moderate physical activity in 2015		< 0.001		< 0.001
Less than once a week	3.4 (3.3–3.6)		4.4 (4.2–4.5)	
Once a week	2.4 (2.1–2.6)		3.4 (3.2–3.6)	
More than once a week	2.2 (2.1–2.3)		3.1 (3.0–3.2)	
Vigorous physical activity in 2015		< 0.001		< 0.001
Less than once a week	3.0 (2.9–3.1)		4.0 (3.9–4.1)	
Once a week	1.9 (1.6–2.2)		2.8 (2.6–3.1)	
More than once a week	1.9 (1.7–2.1)		2.9 (2.7–3.1)	

Table 3. Relationship between depression diagnoses and physical activity intensity in 2015, stratified by sex

Physical activity changes 2013–2015 All participants engaged in physical activity less than once a week in 2013	Depression (cut-off value of $\geq 4$ points)					
	Men			Women		
	No (%)	Yes (%)	<i>p</i>	No (%)	Yes (%)	<i>p</i>
Moderate physical activity in 2015			< 0.001			< 0.001
Less than once a week	55.8 (52.8–58.6)	44.2 (41.3–47.1)		43.0 (40.8–45.2)	57.0 (54.8–59.2)	
Once a week	75.9 (71.3–79.9)	24.1 (20.0–28.7)		56.7 (52.6–60.6)	43.3 (39.4–47.4)	
More than once a week	77.2 (74.5–79.7)	22.8 (20.2–25.5)		61.9 (59.3–64.4)	38.1 (35.6–40.7)	
Vigorous physical activity in 2015			< 0.001			< 0.001
Less than once a week	63.5 (61.3–65.6)	36.5 (34.4–38.6)		48.7 (46.9–50.4)	51.3 (49.6–53.1)	
Once a week	82.3 (76.6–86.8)	17.7 (13.2–23.3)		65.3 (59.9–70.3)	34.7 (29.7–40.0)	
More than once a week	80.3 (75.5–84.2)	19.7 (15.7–24.5)		65.8 (61.0–70.3)	34.2 (29.7–38.9)	



CI – confidence interval  
MPA – moderate physical activity  
VPA – vigorous physical activity  
Analyses were adjusted for age,  
education and living place.

Figure 1. Adjusted odds ratios for the relationship between physical activity trends and depression symptoms



tinued to practise physical activity less than once a week and those who changed their routine from less than once a week to more than once a week, in moderate-intensity (men: 44.2–22.8%; women: 57–38.1%) and vigorous-intensity (men: 36.5–19.7%; women: 51.3–34.2%) physical activity.

Figure 1 presents the likelihood of having depression depending on physical activity change from 2013 to 2015. Changing the physical activity pattern for a more frequent one decreased the odds of having depression. Engaging in moderate physical activity once a week (men: OR = 0.31, 95% CI: 0.21–0.45; women: OR = 0.67, 95% CI: 0.54–0.84) and more than once a week (men: OR = 0.41, 95% CI: 0.32–0.52; women: OR = 0.56, 95% CI: 0.47–0.66) decreased the odds of having depression compared with remaining less active. For vigorous physical activity, men and women who became more active and started engaging in physical activity once a week (men: OR = 0.59, 95% CI: 0.46–0.75; women: OR = 0.70, 95% CI: 0.60–0.80) and more than once a week (men: OR = 0.52, 95% CI: 0.43–0.63; women: OR = 0.59, 95% CI: 0.64–0.72) also presented a smaller likelihood of having depression compared with those who kept practising physical activity less than once a week.

## Discussion

This study aimed to investigate the association between changes in physical activity (intensity and frequency) and depression among older adults who did not practise any physical activity in 2013 and changed their behaviour in 2015. Data from a transnational population-based study among 14 European countries were used. It was found that moderate and vigorous physical activity were significantly associated with lower odds of depression among men and women. These findings are important from the public health point of view because they demonstrate that physical activity practised at present, even if only once a week, has a significant effect in reducing the odds of depression. Because physical activity, when properly prescribed, does not have contraindications and can be performed for free, it presents a great potential for health and for reducing health expenses.

Our results are in accordance with previous meta-analyses and systematic reviews that found that higher physical activity levels were associated with a decreased odds of developing future depression [12, 13]. Also, physical activity presents a protective effect for both prevalence and incidence of depression symptoms in older adults, regardless of financial strain, chronic con-

ditions, disability, body mass index, alcohol consumption, smoking, and social relations [22]. However, our study advanced the knowledge as it analysed different intensities and frequencies of physical activity among older adult men and women. We demonstrated that moderate physical activity was slightly more efficient than vigorous physical activity to prevent depression symptoms among men and women. Regarding the frequency, moderate physical activity undertaken more than once per week or once per week by women and men was the best to prevent depression symptoms. These results are in line with other studies which showed that low-intensity exercise effectively improved depressive symptoms among sedentary older adults [23, 24]. In addition, a study with college students revealed that even low-intensity physical activity levels tended to be moderately correlated with a lower prevalence of depressive symptoms [25]. A large epidemiological study with 261,121 European adults found favourable associations between any domain (leisure-time, transport and work-related) of physical activity and depressive symptom severity [26]. This means that sociological aspects of physical activity, such as practising with other people, are likely important for preventing or treating depression.

We established that the potential protective effect of physical activity was stronger among men than women. A possible justification is that older women scored higher than older men on the dimensional measures of depressive symptoms, as it happens in other age groups [27]. The literature that underlines this difference between the sexes uses mainly self-report instruments of assessing depressive symptoms [27]. Although self-report instruments are not the same as diagnostic clinical interviews, they are valid in older adults [28]. Furthermore, the self-report measure is sensitive to subclinical levels of depressive symptoms, and these contribute substantially to a decreased quality of life, including cognitive decline, longer hospital stays, and poorer health in later life [29].

Several mechanisms have been suggested by which physical activity might reduce depression symptoms. After exercise, the increased level of neurotransmitters named dopamine, noradrenaline, and serotonin can work against neurological disorders, such as depression [30, 31]. The preventive aspect of physical activity for developing severe chronic conditions such as diabetes or heart disease could be important because of the strong link between physical health and depression in old age [32, 33]. In addition, increased self-esteem due to increased physical activity [34] has been reported. Generally, social relations must be con-

sidered since it has been established that older adults who engage in physical activity programs may interact more and strengthen relationships. The social network structure is strongly intertwined with anxiety and depression symptoms in the general population of older adults [35].

Regarding practical implications, we highlight that it is never too late to start physical activity. Our sample presents a mean age of 72 years. Two years earlier, the participants had engaged in physical activity less than once per week. The changes in their behaviour were associated with better mental health. Health professionals should emphasize that changes in physical activity could improve mental health.

This study presents some strengths and limitations that must be acknowledged. Regarding strengths, the study includes large representative samples from several countries with multiple cultures. Therefore, the external validity of the study results is a major strength. Also, the analyses were stratified by sex and adjusted to important covariates. However, we did not adjust the analyses for disability, which is an important confounder variable. In addition, the main limitation is that depressive symptoms and physical activity were self-reported and therefore direct measurements could show slight differences. Future studies should explore possible mediators of the relation between physical activity and depression symptoms, as well as investigate why participants changed their behaviour and what factors might drive this change.

## Conclusions

Physical activity seems to be a safe and feasible alternative to deal with depressive symptoms among older people. Both moderate and vigorous physical activity was associated with lower odds of depression symptoms among older men and women. It is worth mentioning that those who practised less than once a week and started to engage in only a little physical activity (once a week) exhibited significantly reduced odds of having depressive symptoms.

## Disclosure statement

No author has any financial interest or received any financial benefit from this research.

## Conflict of interest

The authors state no conflict of interest.

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