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ORIGINAL ARTICLE

Different levels of physical activity and depression symptoms among older adults from 18 countries: A population-based study from the Survey of Health, Ageing and Retirement in Europe (SHARE)

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Abstract

Objective: Analyse the relationship between different levels of physical activity (PA) and depression symptoms in a representative sample of European older adults. **Methods:** Data on PA, depression symptoms and sociodemographic variables from 64688 (28015 men) older adults participating in SHARE wave 6 was collected through a face-to-face interview. The EURO-D 12-item scale was administered for depression symptoms. Participants reported the frequency they engaged in moderate-intensity PA (MPA) and vigorous-intensity PA (VPA). **Results:** Men and women engaging in MPA and VPA once or more than once a week had less depression symptoms than those who engage less than once a week. MPA and VPA once or more than once a week were inversely associated with the depression symptoms score. Furthermore, engaging in MPA and VPA decreased the odds of depression (cut-off point of ≥4 depression symptoms) compared to engaging in PA less than once a week. **Conclusions:** Policies for promoting mental health should include PA for the prevention or treatment of depression symptoms. PA presents physical and psychological benefits and can be used as an overall health-promoting strategy, facing numerous problems at a time.

Keywords: Quantitative study, ageing, exercise

Highlights

- Both moderate physical activity (MPA) and vigorous physical activity (VPA) have beneficial effects on depression symptoms, even if participated only once a week.
- MPA and VPA had a similar effect on depression symptoms in men and women.
- Policies for promoting mental health should include physical activity promotion for the prevention or treatment of depression.

Introduction

Depression is a leading cause of disease burden worldwide in terms of years lost to disability and prevalence (GBD, 2018; WHO, 2018), affecting quality of life, relationship with others, education and work opportunities (Ferrari et al., 2013; WHO, 2017). It is also associated with physical comorbidity, such as diabetes, arthritis, asthma, chronic lung disease, angina and stroke (Lotfaliany et al., 2018), and other major groups of mental disorders (Plana-Ripoll et al., 2019), health costs (Chisholm et al., 2016), poor adherence to medical treatment (Saz & Dewey, 2001), risk of suicide (Ferrari et al., 2013), and premature mortality (Walker, McGee, & Druss, 2015). Although depression is a global health problem, there is gender heterogeneity. Women have almost twice the odds of being diagnosed with major depression than men (Salk, Hyde, & Abramson, 2017).

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Low physical activity (PA) is one of the modifiable risk factors for the onset of depression (Hallgren et al., 2017). PA is associated with lower risk of depression and suggested to be a an n evidence-based treatment for depression (Mammen & Faulkner, 2013; Rebar et al., 2015; Schuch et al., 2018; Schuch, Vancampfort, Richards, et al., 2016). Among older people, exercise was found to have a similar effect to antidepressants in the treatment of depression (Blumenthal, Babyak, & Moore, 1999), and seems that there is an underestimation of the positive clinical effects (Schuch, Vancampfort, Rosenbaum, et al., 2016). The underlying mechanisms that may explain the benefits of PA for depression are suggested to be twofold: biological and psychosocial. Proposed biological mechanisms include the neuroplasticity, anti-inflammatory and antioxidant benefits of regular PA. Several reviews have associated depression to the inflammatory profile (Kohler et al., 2017; Valkanova, Ebmeier, & Allan, 2013), and regular PA is known to reduce a number of inflammatory markers (Fedewa, Hathaway, & Ward-Ritacco, 2017; Fedewa, Hathaway, Ward-Ritacco, Williams, & Dobbs, 2018). Similarly, oxidative stress may contribute towards the pathophysiology of depression, and PA could can have a counterbalancing role (Kandola, Ashdown-Franks, Hendrikse, Sabiston, & Stubbs, 2019). Also, literature has shown that people with depression have lower levels of peripheral brain derived neurotrophic factor (BDNF) (Molendijk et al., 2014), which may contribute to the pathophysiology of depression. Regular PA increases concentration of several neurotrophic factors, including BDNF, thus possibly having a protective effect on depression (Coelho et al., 2013; Huang, Larsen, Ried-Larsen, Moller, & Andersen, 2014). As for psychosocial mechanisms, PA is associated to improved self-esteem and self-efficacy and more social support, that represent protective factors for depression symptoms (Kandola et al., 2019).

However, the effect of PA on depression for both genders is not consensual. Even though most studies have found PA to be associated to depression in men and women (Mammen & Faulkner, 2013; Rebar et al., 2015; Schuch et al., 2018), some studies have reported gender differences. In a systematic review of prospective studies Mammen and Faulkner (2013) identified four studies reporting a significant effect of PA in reducing the risk of depression only for women. The authors suggested that this might be because women benefit more from the social aspects of PA than men, resulting in a greater effect on depression. On the opposite, some studies have reported this association to be significant only for men, proposing that women's PA may be more related to household chores than to leisure-time and thus not benefiting as much as men's PA (de Oliveira, Oancea, Nucci, & Vogel-tanz-Holm, 2018; Werneck, Oyeyemi, & Silva, 2018).

When examining the associations between PA and depression few studies make direct comparisons between different PA intensities. A recent randomized controlled trial has found that, among adults, vigorous PA (VPA) was more effective in lowering depression severity than moderate PA (MPA) and that light intensity PA was the only one that remained associated with lower depression severity at 12-month follow-up (Helgadottir, Forsell, Hallgren, Moller, & Ekblom, 2017). However, older adults are less likely to engage in VPA (Jansen et al., 2015) and it is still unclear if VPA brings greater benefit than MPA among older adults. These two factors combined yield for a better understanding of the associations of both MPA and VPA on depression symptoms. Considering this, the main research question this study sought to answer was whether greater intensity and frequency of PA had a stronger association with depressive symptoms among older adults. Therefore, this study aimed to analyse the relationship between different levels of PA and depression symptoms, considering important socio-demographic variables, in a representative sample of European older adults.

Methods

Participants and procedures

Data from the population based Survey of Health, Aging, and Retirement in Europe (SHARE) wave 6 was used for the analysis in this manuscript. The SHARE is a biennial cross-national survey on ageing. It collects information on individuals aged 50 and over in several European countries and Israel since 2000 and has previously been described (Börsch-Supan et al., 2013). The total sample of SHARE wave 6 was 68231 participants. For this analysis, those participants who reported on PA participation and depression symptoms were included. The final sample comprised 64688 participants (28015 men, 36673 women), from the 18 following countries: Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Greece, Israel, Italy, Luxembourg, Poland, Portugal, Slovenia, Spain, Sweden, and Switzerland.

Data were collected through face-to-face interviews at the participant's house location and had a duration of approximately 90 minutes. A translation of the questionnaires for each country was carried out and pilots were performed to enhance

comparability. 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.

Measures

Exposure: physical activity. Participants reported the number of days they engage in MPA (e.g. brisk walking, gardening or household activities); as well as in VPA (e.g. hiking, sports, carrying heavy loads). Response options were more than once a week, once a week, up to 3 times a month, and hardly ever or never. The last two response options were grouped into "less than once a week", as performed previously (Marques, Peralta, Martins, de Matos, & Brownson, 2017).

Outcome: depression symptoms. The EURO-D 12-item scale was administered as a screening measure for depression symptoms. The scale description and its validating process are described in detail elsewhere (Prince et al., 1999). It has been demonstrated that an optimal cut-off point of ≥4 depression symptoms diagnoses a clinically significant case of depression (Gallagher, Savva, Kenny, & Lawlor, 2013; Prince et al., 1999).

Covariates: sociodemographic variables. Age, education level, marital status, and living place were self-reported. Education was categorized according to the International Standard Classification of Education Degrees (UNESCO, 2006), and grouped in three levels: low educational level (up to lower secondary education, ISCED code 0 to code 2), medium educational level (secondary education, ISCED codes 3 and 4), and high educational level (higher education, ISCED codes 5 and 6). Marital status was dichotomized into married (including in a registered partnership) or not married (including never married, separated, divorced or widowed). Living place was categorized in a big city, a suburb or the outskirts of a big city, a large town, a small town, or a rural area.

Based on a list of 14 diseases, participants were asked to report the presence or absence of diseases that were diagnosed by a doctor. Participants could also add other diseases diagnosed by a doctor unnamed in the list (Börsch-Supan et al., 2013). To produce a single score, the number of chronic diseases was summed as performed previously (Marques, Peralta, Martins, Matos, & Brownson, 2017). Body mass index (BMI) was calculated from self-reported height and weight (kg/m^2). BMI categories were calculated in accordance with World Health Organization guidelines (WHO, 2000): normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2). The limitation to perform the daily life activities was assessed by Global Activity Limitation Indicator (GALI) (Berger et al., 2015). Participants were asked about their smoking behaviour and alcohol consumption in the last 3-months. Responses were from "not at all" to "daily or almost every day".

Statistical analysis. Descriptive statistics were calculated for all variables (means, standard deviation, and percentages). ANOVA was performed, to analyse the relationships between MPA, VPA and depression symptoms. General linear models were used to calculate the parameters estimates for the depression symptoms score according to different levels of PA intensity. Logistic regressions were conducted to analyze the relationship between MPA, VPA and depression (cut-off point of ≤4 depression symptoms). First, an unadjusted model was performed. After that, analyses were adjusted for age, marital status, educational level, living place, country, number of non-communicable diseases, body mass index, limitations to perform daily activities, smoking habits, and alcohol consumption. Analyses were stratified by gender because an interaction effect was observed between gender and PA on depression symptoms. Data analysis was performed using SPSS 25. Statistical significance was set at $p < 0.05$.

Results

Participants' characteristics are presented in Table I.

Table II depicts the parameters estimates for depression symptoms score according to different levels of PA intensity. In the unadjusted model, for men and women, the engagement in MPA or VPA once or more than once a week was negatively correlated with the depression symptoms score. When the model was adjusted, MPA once a week (men: $\beta = -0.55$, 95% CI: −0.88, −0.22; women: $\beta = -0.33$, 95% CI: −0.63, −0.03) and more than once a week (men: $\beta = -0.96$, 95% CI: −1.22, −0.69; women: $\beta = -0.40$, 95% CI: −0.62, −0.18) were negatively associated with the depression symptoms score. Similarly, VPA once a week (men: $\beta = -0.70$, 95% CI: −1.11, −0.28; women: $\beta = -0.37$, 95% CI: −0.71, −0.22) and more than once a week (men: $\beta = -0.99$, 95% CI: −1.31, −0.66; women: $\beta = -0.49$, 95% CI: −0.76, −0.22) were also negatively associated with the depression symptoms score.

Table I. Participants' characteristics – Survey of Health, Aging, and Retirement in Europe (SHARE)

	% or Mean (95% CI)		
	Total sample (n = 64688)	Men (n = 28015)	Women (n = 36673)
Age	67.3 (67.2, 67.4)	67.8 (67.7, 67.9)	67.0 (66.9, 67.1)
Age group			
50-64 years	41.7 (41.3, 42.1)	40.1 (39.5, 40.7)	43.0 (42.5, 43.5)
≥65 years	58.3 (57.9, 58.7)	59.9 (59.3, 60.5)	57.0 (56.5, 57.5)
Education			
Low	40.0 (39.6, 40.4)	36.5 (35.9, 37.1)	42.6 (42.1, 43.1)
Middle	37.5 (37.1, 37.9)	38.7 (38.2, 39.3)	36.6 (36.1, 37.1)
High	22.5 (22.2, 22.8)	24.7 (24.2, 25.3)	20.8 (20.4, 21.2)
Marital status			
Not married	31.5 (30.7, 32.2)	22.8 (21.8, 23.8)	38.5 (37.4, 39.5)
Married	68.5 (67.8, 69.3)	77.2 (76.2, 78.2)	61.5 (60.5, 62.6)
Living place			
Big city	17.0 (16.7, 17.4)	16.0 (15.5, 16.5)	17.7 (17.2, 18.1)
Suburbs of a big city	10.3 (10.0, 10,6)	10.9 (10.5, 11.4)	9.9 (9.6, 10.3)
Large town	15.0 (14.6, 15.3)	14.5 (14.0, 15.1)	15.2 (14.8, 15.7)
Small town	25.4 (25.0, 25.8)	25.6 (25.0, 26.3)	25.2 (24.7, 25.7)
Rural area	32.3 (31.9, 32.8)	32.9 (31.2, 33.6)	32.0 (31.4, 32.5)
EURO depression scale (score)	2.5 (2.4, 2.5)	2.0 (2.0, 2.0)	2.8 (2.8, 2.8)
EURO depression scale (score)			
No	72.6 (72.3, 73.0)	80.5 (80.0, 80.9)	66.6 (66.2, 67.1)
Yes	27.4 (27.0, 27,7)	19.5 (19.1, 20.0)	33.4 (32.9, 33.8)
Moderate PA			
Less than once a week	17.4 (17.1, 17.6)	16.0 (15.6, 16.4)	18.4 (18.0, 18.8)
Once a week	13.6 (13.3, 13.8)	13.7 (13.3, 14.1)	13.5 (13.1, 13.8)
More than once a week	69.1 (68.7, 69.4)	70.3 (69.8, 70.8)	68.1 (67.7, 68.6)
Vigorous PA			
Less than once a week	52.1 (51.7, 52.5)	48.2 (47.6, 48.8)	55.2 (54.6, 55.7)
Once a week	14.3 (14.0, 14.6)	14.2 (13.8, 14.6)	14.2 (13.9, 14.6)
More than once a week	33.6 (33.2, 33.9)	37.7 (37.1, 38.2)	30.4 (29.9, 30.9)

Table III presents the results of the relationship between depression (using the cut-off point of ≥4 depression symptoms) and PA. In the adjusted model, MPA once a week for men (OR = 0.67, 95% CI: 0.46, 0.97) or more than once a week for men and women (men: OR = 0.42, 95% CI: 0.31, 0.57; women: OR = 0.59, 95% CI: 0.43, 0.79) decreased the odds of depression (cut-off point of ≥4 depression symptoms) compared to those who engage in MPA less than once a week. Men who engage in VPA once a week (OR = 0.67, 95% CI: 0.46, 0.97) and men and women who engage in VPA more than once a week (men: OR = 0.58, 95% CI: 0.45, 0.76; women: OR = 0.72, 95% CI: 0.56, 0.93) also had lower likelihood of having depression (cut-off point of ≥4 depression symptoms) when compared to those who rarely engage in VPA.

Discussion

This study sought to investigate the associations of different PA levels with depression symptoms, using a large sample of older adults from 18 countries. It was found that for men and women engaging in MPA and VPA once a week or more was associated with lower depression symptoms. Furthermore, MPA and VPA once a week or more decreased the odds of depression (cut-off point of ≥4 depression symptoms) compared to those who engage in PA less than once a week.

The association between PA and depression symptoms is well documented (De Mello et al., 2013; Rebar et al., 2015; Schuch et al., 2018). The results of the present study support those of previous study results (Mammen & Faulkner, 2013; Rebar et al., 2015; Schuch et al., 2018). However, this study results add that engaging in PA at least once a week was associated with lower depression symptoms score in men and women, and odds of depression (cut-off point of ≥4 depression symptoms) in men, irrespectively of intensity. Also, MPA was found to be associated with depression symptoms. This means that low amounts of PA, in this case MPA once a weak, is associated to reduced depression symptoms in older people, mainly in men, further supporting current literature (Werneck et al., 2018).

Table II. Parameters estimates of depression score according to physical activity intensity levels and frequency – Survey of Health, Aging, and Retirement in Europe (SHARE)

	Parameters estimates for the depression score	
	Model 1 β (95% CI)	Model 2 β (95% CI)
Men		
MPA		
Less than once a week	1.00 (ref.)	1.00 (ref.)
Once a week	−1.02 (−1.10, −0.93)***	−0.55 (−0.88, −0.22)**
More than once a week	−1.37 (−1.43, −1.31)***	−0.96 (−1.22, −0.69)***
VPA		
Less than once a week	1.0 (ref.)	1.00 (ref.)
Once a week	−0.79 (−0.86, −0.72)***	−0.70 (−1.11, −0.28)**
More than once a week	−0.84 (−0.89, −0.79)***	−0.99 (−1.31, −0.66)***
Women		
MPA		
Less than once a week	1.00 (ref.)	1.00 (ref.)
Once a week	−1.11 (−1.20, −1.03)***	−0.33 (−0.63, −0.03)*
More than once a week	−1.58 (−1.64, −1.52)*	−0.40 (−0.62, −0.18)***
VPA		
Less than once a week	1.00 (ref.)	1.00 (ref.)
Once a week	−0.79 (−0.86, −0.72)***	−0.37 (−0.71, −0.22)*
More than once a week	−0.91 (−0.96, −0.85)***	−0.49 (−0.76, −0.22)***

Abbreviation: CI, confidence interval; MPA, moderate physical activity; VPA, vigorous physical activity.
Model 1: Unadjusted analyses. Model 2: Analyses were adjusted for age, marital status, educational level, living place, country numbers of non-communicable diseases, body mass index, limitation to perform activities, smoking habits and alcohol consumption.
*$p < 0.05$, **$p < 0.01$, *$p < 0.001$.

Table III. Relationship between depression (cut-off point of ≥4 depression symptoms) and physical activity at different levels of intensity and frequency – Survey of Health, Aging, and Retirement in Europe (SHARE)

	Depression (≥4 depression symptoms)	
	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Men		
MPA		
Less than once a week	1.00 (ref.)	1.00 (ref.)
Once a week	0.45 (0.36, 0.58)***	0.67 (0.46, 0.97)*
More than once a week	0.32 (0.27, 0.38)***	0.42 (0.31, 0.57)***
VPA		
Less than once a week	1.00 (ref.)	1.0 (ref.)
Once a week	0.46 (0.36, 0.58)***	0.67 (0.46, 0.97)*
More than once a week	0.39 (0.33, 0.46)***	0.58 (0.45, 0.76)***
Women		
MPA		
Less than once a week	1.00 (ref.)	1.0 (ref.)
Once a week	0.54 (0.45, 0.65)***	0.76 (0.52 10.12)
More than once a week	0.39 (0.34, 0.44)***	0.59 (0.43, 0.79)***
VPA		
Less than once a week	1.00 (ref.)	1.0 (ref.)
Once a week	0.67 (0.57, 0.79)***	0.88 (0.64, 10.20)
More than once a week	0.53 (0.47, 0.61)***	0.72 (0.56, 0.93)*

Abbreviation: OR, odds ration; CI, confidence interval; MPA, moderate physical activity; VPA, vigorous physical activity.
Model 1: Unadjusted analyses. Model 2: Analyses were adjusted for age, marital status, educational level, living place, country, numbers of non-communicable diseases, body mass index, limitation to perform activities, smoking habits and alcohol consumption.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

These results are particularly important for older people because they have more difficulties to achieve the recommended levels of PA. In addition, due to age related changes in multiple body systems, they also do not engage in PA with higher intensity levels, such as VPA (Jansen et al., 2015). It means that even older people who engage in MPA may benefit from PA practice.

Several mechanisms may explain the association between MPA, VPA and depression. Both depression and PA are associated with inflammatory markers and oxidative stress. On the one hand, the inflammatory profile and oxidative stress may contribute towards the pathophysiology of depression (Kandola et al., 2019; Kohler et al., 2017; Valkanova et al., 2013). On the other hand, regular PA presents anti-inflammatory and antioxidant benefits (Fedewa et al., 2017, 2018; Kandola et al., 2019). These associations may partly explain why PA is associated with lower risk of depression and less depression symptoms. Furthermore, PA has psychosocial benefits, including improving self-esteem, self-efficacy and social support, which may also represent protective factors for depression symptoms (Kandola et al., 2019). This is of importance, especially among older adults, as lower levels of social interaction and self-esteem are more common in older ages.

The role of gender in the relationship between PA and depression is not fully clear. Although previous studies found contradicting results according to gender (Mikkelsen et al., 2010; Werneck et al., 2018), other found evidence of no gender differences (Mammen & Faulkner, 2013; Rebar et al., 2015; Schuch et al., 2018). In this study, it was observed that MPA and VPA were associated with depression symptoms in both men and women, strengthening the idea that PA associations with depression maybe regardless of gender in older people. Notwithstanding, some gender differences were found. Among men, engaging in MPA and VPA once a week was associated with lower odds of depression (cut-off point of ≥4 depression symptoms). Whereas for women, only those who reported practicing MPA and VPA more than once a week seemed to benefit from it to the extent of reducing the odds of depression (cut-off point of ≥4 depression symptoms), suggesting that older women may need to more regularly engage in PA than men, in order to benefit in the same way. Taking into account that women are more prone to have depression than men (Ferrari et al., 2013; Salk et al., 2017), practicing PA, may be a relevant strategy to reduce depression symptoms specially among women.

In order to understand the relationship between PA and depression, it is important to consider the characteristics of PA, such as frequency and intensity (Helgadottir et al., 2017). Nonetheless, most studies simply account for PA intensity or PA frequency. Rarely, studies considered at the same time PA intensity and frequency (Schuch et al., 2018). Recognizing this gap, the present study provides PA frequency and intensity differentiation. One of the main strengths of this study was the use of a representative sample from several countries. The large and representative sample, as well as the heterogeneity of the participants, allows these results to be generalized. Despite the strengths, some limitations have to be recognized. The main limitation is the cross-sectional design, which precludes making causal inferences. Furthermore, PA was self-reported, which is subject to bias (Grimm, Swartz, Hart, Miller, & Strath, 2012). Nonetheless, self-reported PA is a reliable method for epidemiologic studies (Craig et al., 2003) and it is still the mainstay of surveillance studies (Pedisic & Bauman, 2015). Also, the lack of information on PA, such as duration and more detail about frequency, is a limitation. Lastly, depression was not clinically diagnosed. The EURO-D 12-item scale is a screening tool for depression symptoms. Notwithstanding, a cut-off point of ≥4 depression symptoms has been demonstrated to diagnose clinically significant cases of depression (Gallagher et al., 2013; Prince et al., 1999).

Conclusion

Regardless of gender, MPA and VPA were associated with lower depression symptoms and lower odds of depression (cut-off point of ≥4 depression symptoms). Policies for promoting mental health should include PA, as even a low amount (MPA once a weak) was associated with depression. Additionally, PA presents physical and psychological benefits and can be used as an overall health-promoting strategy, facing numerous problems at a time.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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