

RESEARCH ARTICLE

Sedentary behaviors, physical activity, and changes in depression and psychological distress symptoms in older adults

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Background: Television (TV) viewing and computer use have been associated with higher risk of depression, but studies specifically assessing the impact of these and other types of sedentary behaviors (SBs) on the mental health of older adults are scarce and their results are inconclusive. Similarly, the association between specific types of recreational physical activity (rPA) and mental health in older adults is poorly understood.

Methods: In 2012, information on SBs, rPA, and other health behaviors was collected with validated questionnaires from community-dwelling older adults participating in the Seniors-ENRICA cohort. In 2012 and 2015, symptoms of depression and mental distress were assessed using the GDS-10 and the General Health Questionnaire-12 (GHQ-12), respectively.

Results: Time spent watching TV was prospectively associated with higher (worse) GDS-10 scores in women (β [95% confidence interval (CI)] comparing the second and third tertiles of TV viewing to the first: 0.21 [-0.04 to 0.46] and 0.37 [0.13–0.62], respectively; P -trend: < 0.01), but not in men (-0.11 [-0.35 to 0.13] and -0.18 [-0.44 to 0.08]; P -trend: 0.16). Women, but not men, who spent more time in other SBs, including reading, using the computer and commuting, showed a lower number of depressive symptoms (-0.19 [-0.44 to 0.06] and -0.34 [-0.60 to -0.08]; P -trend: 0.01) and lower (better) GHQ-12 scores (-0.33 [-0.67 to -0.00] and -0.35 [-0.69 to -0.00]; P -trend: 0.05) at follow-up. Both in men and women, higher levels of rPA, such as walking, practicing sports, and do-it-yourself activities, were associated with lower GDS-10 scores (-0.07 [-0.25 to 0.11] and -0.19 [-0.36 to -0.01]; P -trend: 0.04) and with lower GHQ-12 scores (-0.02 [-0.26 to 0.22] and -0.23 [-0.47 to -0.00]; P -trend: 0.06).

Conclusions: Older women who spent more time watching TV and less time in other SBs showed a higher number of depressive symptoms. Data suggest that increasing rPA may improve mental health in older adults, particularly among women.

KEYWORDS

depression, psychological distress, recreational physical activity, sedentariness

1 | INTRODUCTION

Depression is the most prevalent mental disorder among older adults and is the leading cause of disability worldwide (Alexopoulos, 2005). Around 10% of people aged ≥ 60 years and 1–5% of those aged ≥ 65 years suffer from depression (World Health Organization, 2017). It is associated with an increased prevalence of chronic diseases, such as cardiovascular disease, diabetes, or cancer (Wilmot et al., 2012).

Particularly among older adults, depression also increases the use of medical care and health care costs (Ekman, Granstrom, Omerov, Jacob, & Landen, 2013), is associated with poor adherence to medical treatment, and raises the risk of suicide and nonsuicide mortality (Saz & Dewey, 2001). As a result, in 2015, depression was one of the main causes of disease burden, and accounted for 2.15% of total disability-adjusted life years (DALYs) and 6.37% of total years lived with disability (YLDs) in adults aged 50–69 years, and 1% of total DALYs and 3.75%

of total YLDs in those aged ≥ 70 years (Global Burden of Disease 2015 DALYs and HALE Collaborators, 2016).

Psychological distress is defined as “a range of symptoms and experiences of a person's internal life that are commonly held to be troubling, confusing, or out of the ordinary.” Prevalence of psychological distress in the EU ranges from 3% to 30%, depending on the questionnaire used to measure symptoms, and is also linked to an increased risk of health-related cardiovascular disease and mortality (Batty, Russ, Stamatakis, & Kivimaki, 2017).

Older people spend most of their awake time in sedentary behavior (SB), which is defined as any activity in seated or reclined position that is performed at or slightly above the resting metabolic rate (Ainsworth et al., 2011). SBs include a range of activities such as television (TV) viewing, computer use, reading, or listening to music. TV watching is the most widely studied SB and has been associated with an increased risk of obesity, cardiovascular disease, type 2 diabetes, cancer, hospitalization, and all-cause and cause-specific mortality, regardless of physical activity levels (Biswas et al., 2015; Schmid & Leitzmann, 2014). In 2015, a meta-analysis of 24 observational studies concluded that TV viewing and computer or Internet use were associated with the risk of depression (Zhai, Zhang, & Zhang, 2015). However, only two longitudinal studies in this meta-analysis are focused on older adults, while adjusting for physical activity (Hamer & Stamatakis, 2014; Lucas et al., 2011). Moreover, in one of these two studies, researchers from the *English Longitudinal Study of Ageing* (ELSA) could not confirm their cross-sectional findings and showed no association between TV viewing time or internet use and changes in depressive symptoms over follow-up (Hamer & Stamatakis, 2014). Regarding psychological distress, only a few studies, most of them cross-sectional and none of them centered on older adults, have suggested an inverse association between SBs and scores of the General Health Questionnaire-12 (GHQ-12) (Atkin, Adams, Bull, & Biddle, 2012; Hamer, Coombs, & Stamatakis, 2014). The largest of these studies, based on a sample of adults aged 16–95 years from the *Health Survey for England*, showed that both self-reported ($n = 11,658$) and accelerometer-measured ($n = 1,947$) sedentary time were associated with a higher prevalence of psychological distress ($\text{GHQ-12} \geq 4$).

The benefits of physical activity on health have been widely studied, with evidence showing that it protects against the development of cardiovascular disease (Li & Siegrist, 2012), hypertension (Liu et al., 2017), and cancer (Moore et al., 2016). A recent meta-meta-analysis of randomized trials has found that exercise has a moderate reductive effect on depression and a small reductive effect on anxiety in nonclinical populations (Rebar et al., 2015). Physical activity has also proved to be an effective treatment for depression in older patients (Schuch et al., 2016) and could reduce the risk of depression among elderly people living in the community (Ku, Fox, Chen, & Chou, 2012; Roh et al., 2015; Yoshida et al., 2015). Still, the development of specific public health recommendations requires understanding whether different types of habitual physical activity have an impact on mental health in older adults.

Accordingly, the aim of the present study is to examine the prospective association of several types of SBs (TV viewing, sitting at the computer, sitting while commuting, lying in the sun, listening music, and

reading) and physical activities (walking, cycling, playing sports, household chores), with depressive and psychological distress symptoms in community-dwelling older adults in Spain.

2 | METHODS

2.1 | Study participants

Data have been taken from the seniors-ENRICA cohort, formed by 2,614 individuals aged ≥ 60 years selected between 2008 and 2010 (wave 1) by stratified cluster sampling of the noninstitutionalized population of Spain (García-Esquinas et al., 2017). These individuals were invited to participate in a follow-up study consisting of biannual phone interviews and home visits to obtain data on sociodemographic factors, lifestyle and morbidity, collect biological samples, perform a physical examination, and obtain a diet history. During follow-up (wave 2 in 2012 and wave 3 in 2015), 176 participants died and 617 were lost, leading to a final sample size of 1,821 individuals. Because we lacked information on specific SBs in wave 1, the present study obtained baseline information from wave 2 and follow-up information from wave 3.

All personnel involved in data collection received appropriate training and were certified before starting the fieldwork. Study participants provided written informed consent, and the Clinical Research Ethics Committee of “La Paz” University Hospital in Madrid approved both the baseline and the follow-up studies.

2.2 | Study variables

2.2.1 | Sedentary behaviors

SBs were ascertained with the questionnaire of the Nurses' Health Study validated in Spain (Martínez-Gonzalez, López-Fontana, Varo, Sánchez-Villegas, & Martínez, 2005). Participants reported the average weekly hours during the preceding year that they are sitting or lying in six activities: watching TV, commuting, using the computer, during sunbath in summer and winter, listening to music (except in transportation), and reading (except in transportation). Time spent in different SBs was categorized into sex-specific tertiles, with the highest tertiles reflecting the greatest time.

2.2.2 | Physical activity

Physical activity was assessed using a validated questionnaire developed from that used in the EPIC-cohort study in Spain, and expressed in MET-hr/day (Pols et al., 1997). Subjects reported their participation in the following recreational activities: walking, cycling, and practicing sports other than cycling (mainly running, playing soccer, doing aerobics, swimming and playing tennis), as well as in the following household activities: household chores (cleaning, cooking, doing laundry, children rearing), home repair (do-it-yourself work), and gardening. The assigned MET values (using the EPIC data manual guidelines) were 3.0 for walking and house-working, 4.0 for gardening, 4.5 for home repair, and 6.0 for cycling and sports.

2.2.3 | Depression

Depression was ascertained at baseline and follow-up with the 10-item version of the Geriatric Depression Scale (GDS-10) (Yesavage et al., 1982). In the GDS-10, the following yes–no questions were considered: (1) “Are you basically satisfied with your life?”; (2) “Have you dropped many of your activities and interests?”; (3) “Do you feel that your life is empty?”; (4) “Are you afraid that something bad is going to happen to you?”; (5) “Do you feel happy most of the time?”; (6) “Do you often feel helpless?”; (7) “Do you feel you have more problems with your memory than most?”; (8) “Do you feel full of energy?”; (9) “Do you feel that your situation is hopeless?”; and (10) “Do you think that most people are better off than you are?”. The total number of “yes” responses to questions 2, 3, 4, 6, 7, 9, and 10, and “no” responses to questions 1, 5, and 8 were added to estimate a total depressive symptom score ranging from 1 to 10. Higher scores correspond to greater levels of depression.

2.2.4 | Psychological distress

Psychological distress was estimated at baseline and follow-up using the GHQ-12, a screening tool that assesses the respondent's current psychological state and asks if that differs from his/her usual state (Sánchez-López & Dresch, 2008). The GHQ-12 included the following questions: “Have you recently...” (1) “Lost much sleep over worry?”; (2) “Felt constantly under strain?”; (3) “Felt you couldn't overcome your difficulties?”; (4) “Been feeling unhappy or depressed?”; (5) “Been losing confidence in yourself?”; (6) “Been thinking of yourself as a worthless person?”; (7) “Been able to concentrate on what you're doing?”; (8) “Felt that you are playing a useful part in things?”; (9) “Felt capable of making decisions about things?”; (10) “Been able to enjoy your normal day-to-day activities?”; (11) “Been able to face up your problems?”; and (12) “Been feeling reasonable happy, all things considered?” The response options were worded in terms of “less than usual,” “no more than usual,” “rather more than usual,” or “much more than usual.” Questions 1 through 6 were scored 1 point if participants answered “rather more than usual,” or “much more than usual,” whereas questions 7 through 12 were scored 1 point if they answered “less than usual” or “no more than usual.” The final scale ranged from 0 to 12, with higher scores indicating higher short-term psychological distress.

2.2.5 | Other variables

Self-reported information was collected on age, sex, educational level (\leq primary, secondary, and university studies), tobacco smoking (current, former, and never smoker), and alcohol consumption (nondrinkers, ex-drinkers, moderate drinkers, and heavy drinkers, with the threshold between moderate and heavy drinking being 40 g/day in men and 24 g/day in women). Adherence to the Mediterranean diet was summarized using the Mediterranean Diet Adherence Screener (MEDAS) index and categorized into sex-specific tertiles. Participants also reported physician diagnosed morbidities including cardiovascular disease (ischemic heart disease, stroke, and heart failure), diabetes, chronic respiratory disease (asthma or chronic bronchitis), osteomuscular disease (osteoarthritis or arthritis), and cancer.

Weight and height were measured at home twice using electronic scales and portable extendable stadiometers with standardized procedures. Mean values of the two measurements were used for analyses. Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m). Normal weight was defined as a BMI < 25 kg/m², overweight as BMI 25–29.9 kg/m², and obesity as BMI ≥ 30 kg/m².

2.3 | Statistical analysis

From the sample of 1,821 participants followed until wave 3, we excluded two subjects with incomplete data on SB or recreational physical activity (rPA). Additionally, for analyses on the GDS-10 we also excluded 358 subjects who lacked information on this scale at baseline or at follow-up, and for analyses on psychological distress we excluded 53 individuals with missing information on the GHQ-12 scale at baseline or at follow-up. The association between baseline exposure variables (watching TV, performing other SBs and rPA) and follow-up GDS-10 and GHQ-12 scores was analyzed with linear regression models. Results were expressed as β coefficients and their 95% confidence intervals (CIs). Two models were built. The first model adjusted for age, sex, education, and the baseline values of the corresponding dependent variable, whereas the second further adjusted for tobacco smoking, alcohol consumption, household physical activity, MEDAS index, BMI, morbidities, and number of medications taken by the participant. Additionally, models for TV viewing adjusted for time in other SBs and for rPA, models for other SBs adjusted for TV viewing time and for rPA, and models for rPA adjusted for TV viewing time and for time in other SBs. *P*-values for linear trend were estimated by modeling the categories of tertile-transformed baseline exposure variables as continuous variables.

To evaluate the consistency of results across subgroups, we checked for effect modification by testing interaction terms defined as products of tertiles of TV viewing time, time spent in other SBs and rPA, by age (< 70 , ≥ 70 years), sex (male, female), smoking (never, ever, current), education (\leq primary, secondary, university), alcohol consumption (nondrinker, ex-drinker, moderate drinker, heavy drinker), and BMI (< 25 , ≥ 25 – < 30 , ≥ 30). Because we found an effect modification by sex, main analyses were conducted in men and women separately.

As sensitivity analyses, we also adjusted the models for occupation-based social class, sleep time (hr/day) and for type of activity at work (sedentary, standing, manual, heavy manual), and we repeated all the analyses categorizing the exposure variables into sex-specific quartiles instead of tertiles, with similar findings (data not shown in tables).

Statistical significance was set at two-sided $P < 0.05$. All analyses were performed using STATA® (version 13.1; StataCorp LP, College Station, TX).

3 | RESULTS

At baseline, men and women in the Seniors-ENRICA cohort spent 2.6 and 2.9 hr/day watching TV, and 2.4 and 1.4 hr/day in other SBs, respectively. All but eight participants owned a TV at home. Most sedentary time other than watching TV was spent reading (40% of the time in

men, 50% in women), on the computer (34% in men, 23% in women) and on transportation (12% in men, 10% in women). Women displayed a higher number of depressive symptoms (1.2 vs. 0.6) and psychological distress symptoms (1.9 vs. 0.9) than men.

Table 1 shows the main characteristics of study participants by tertiles of TV viewing time and time spent in other SBs, stratified by sex. Both men and women with primary older age, less rPA, lower MEDAS scores, higher BMI, osteomuscular disease, and higher number of drug treatments spent more time watching TV than their counterparts. Women in the highest tertile of TV time were more likely to suffer cardiovascular disease or diabetes. Both men and women who spent more time in other SBs were younger, had a higher education level, did more rPA, and had a lower prevalence of diabetes. Additionally, women with less time in other SBs more frequently had obesity and used ≥ 3 medications.

Table 2 displays the results for the prospective association of SBs and physical activity, with results from the GDS-10 scores, overall and stratified by sex. After adjustment for main confounders, including baseline rPA, time spent watching TV was prospectively associated with higher (worse) GDS-10 scores in women (β [95% CI] comparing the second and third tertiles of TV viewing to the first: 0.21 [−0.04 to 0.46] and 0.37 [0.13–0.62], respectively; P -trend: < 0.01), but not in men (−0.11 [−0.35 to 0.13] and −0.18 [−0.44 to 0.08]; P -trend: 0.16); P -interaction by sex: < 0.01 . Conversely, women, but not men, who spent more time in other SBs displayed lower GDS-10 scores (−0.19 [−0.44 to 0.06] and −0.34 [−0.60 to −0.08]; P -trend: 0.01; P -interaction by sex: 0.02). Higher levels of rPA were associated with lower GDS-10 scores both in men and women (−0.07 [−0.25 to 0.11] and −0.19 [−0.36 to −0.01]; P -trend: 0.04; P -interaction by sex: 0.45), although the effects were only significant and had a stronger magnitude among women (0.00 [−0.25 to 0.25] and −0.26 [−0.51 to −0.00]; P -trend: 0.05). Household physical activity was not associated with depression scores.

Table 3 displays the results for the corresponding associations with the GHQ-12 scores, overall and stratified by sex. In partially adjusted models, watching TV was associated with higher (worse) GHQ-12 scores in women (β coefficient [95% CI] comparing the third tertile of TV viewing time to the first: 0.39 [0.07–0.71]); however, this association was not maintained in fully adjusted models. By contrast, women with more time spent in other SBs showed lower GHQ-12 scores (β [95% CI] comparing the second and third tertiles to the first: −0.33 [−0.67 to −0.00] and −0.35 [−0.69 to −0.00]; P -trend: 0.05; P -interaction by sex: 0.05) at follow-up. Also in women, higher levels of rPA were associated with lower follow-up GHQ-12 scores (0.11 [−0.22 to 0.44] and −0.39 [−0.73 to −0.06]; P -trend: 0.02). Household physical activity was not associated with psychological distress scores.

Table 4 shows the association of specific SBs other than TV viewing and specific physical activities with GDS-10 and GHQ-12 scores. These results suggest that most of the observed protective effect of SBs on depression in older women is driven by engagement in three activities: reading, using the computer and commuting. They also show that time walking and practicing sports is inversely associated with depression symptoms (with stronger effects seen among women), and that some household activities like performing home repairs may protect against depression.

4 | DISCUSSION

In this longitudinal analysis of community dwelling older adults, we observed that women, but not men, who had spent more time watching TV and less time in other SBs (particularly reading and using the computer) presented a higher number of depressive and psychological distress symptoms at follow-up. To our knowledge, only a few previous studies have evaluated the prospective association between sedentary time and risk of depression in older adults while adjusting for physical activity (Hamer et al., 2014; Lucas et al., 2011; Wassink-Vossen et al., 2016). The first of these, based on 49,821 U.S. women from the *Nurses' Health Study* followed during 10 years, reported a dose–response association between TV viewing time and risk of self-reported depression, and a negative relationship between levels of rPA and risk of self-reported depression (Lucas et al., 2011). The second study, though, could not confirm a link between TV viewing time or Internet use and changes in depressive symptoms among 6,539 men and women mean aged 64.9 years from the ELSA followed during 2 years (Hamer & Stamatakis, 2014). Similarly, the third study, which did not differentiate between specific SBs, showed that total sedentary time was not a significant predictor of depression diagnosis or increased depressive symptoms among 231 older adults from the *Netherlands Study of Depression in Older Persons* followed during 2 years (Wassink-Vossen et al., 2016).

Our results suggest that not all forms of SBs have the same effects on mental health: while time spent in “cognitively engaging sedentary activities” (i.e., reading, using the computer) was associated with a decreased number of depression symptoms in older women, time spent in “passive sedentary behaviors” (i.e., TV viewing, listening to music, sunbathing) was not. Different SBs have previously shown to have different health effects (García-Esquinas et al., 2017; Kikuchi et al., 2014), with evidence that TV viewing negatively impacts cognitive function in older adults (Kesse-Guyot et al., 2012; Wang et al., 2006), while reading (Wang et al., 2006) or using the computer (Kesse-Guyot et al., 2012) helps them maintain their cognitive function. Therefore, it seems that the mentally stimulating characteristics of certain SBs may counterbalance their passive nature regarding their impact on the brain and on mental health. Also, interestingly, our results suggest that the protective effect of SBs against depression and psychological distress may be stronger among women who watch TV less frequently (please see Supporting Information Material).

Previous cross-sectional literature has suggested that the impact of SBs on mental health may vary according to sex (Copeland et al., 2017). For instance, investigators from the *Australian Diabetes, Obesity and Lifestyle Study* observed a positive association between TV viewing time and lower vitality in men ($n = 4,483$), but not in women ($n = 5,424$) (Dempsey, Howard, Lynch, Owen, & Dunstan, 2014). Likewise, in the national *Well@Work* project, conducted with around 2,700 employees from 32 workplaces in nine regions in England, computer use was associated with lower GHQ-12 scores in both men and women, but TV viewing and total nonoccupational sitting time were adversely associated with mental well-being only in women (Atkin et al., 2012). Also, a study on 247 and 242 Nepalese older men and women, respectively, showed that TV viewing time and listening to the radio were

TABLE 1 Sex-stratified characteristics of study participants in the Seniors-ENRICA cohort by tertiles of time spent watching television (TV) watching time and time spent in other sedentary behaviors (SBs)

	Watching TV ^a (hr/day)						Other SB ^b (hr/day)									
	Men (n = 849)			Women (n = 917)			Men (n = 849)			Women (n = 917)						
	First tertile	Second tertile	Third tertile	p ⁱ	First tertile	Second tertile	Third tertile	p ⁱ	First tertile	Second tertile	Third tertile	p ⁱ				
Number of participants	412	237	199		375	255	288		295	270	284		328	280	309	
Age, mean(SD)	70.6(5.9)	70.3(5.6)	71.7(6.0)	0.03	70.4(5.6)	71.7(5.6)	72.5(5.7)	<0.01	71.4(6.2)	71.2(5.7)	69.7(5.5)	<0.01	72.0(5.9)	71.9(5.6)	70.5(5.4)	
Educational level (%)																
≤Primary	35.4	39.7	51.0		52.3	57.2	69.3		63.7	34.4	21.5		83.2	58.2	34.0	
Secondary	29.4	29.5	30.0		25.1	25.1	22.0		25.1	35.2	28.9		11.9	26.8	34.6	
University	35.2	30.8	19.0	<0.01	22.6	17.7	8.7	<0.01	11.2	30.4	49.6	<0.01	4.9	15.0	31.4	
Tobacco smoking (%)																
Never	32.8	35.9	25.5		80.5	78.0	81.2		34.9	33.7	27.1		87.8	85.4	67.0	
Former	53.4	52.7	59.9		16.0	15.3	13.9		50.5	53.7	59.5		8.2	10.7	26.5	
Current	13.8	11.4	13.5	0.19	3.5	6.7	4.9	0.42	14.6	12.6	13.4	0.22	4.0	3.9	6.5	
Alcohol consumption (%)																
Never drinker	6.8	5.1	4.5		28.5	24.7	26.5		4.4	8.9	4.2		29.6	25.7	24.9	
Ex-drinker	12.1	9.3	10.0		13.6	19.6	21.2		10.9	10.4	11.3		20.7	18.2	13.9	
Moderate drinker	67.9	65.8	59.5		41.1	41.2	41.5		68.8	63.3	70.8		38.7	44.3	41.1	
Heavy drinker	6.6	10.6	3.5		3.7	3.1	3.1		5.8	8.9	6.3		2.1	2.1	5.8	
Unknown	6.6	9.3	12.5	0.04	13.1	11.4	7.7	0.17	10.1	8.5	7.4	0.18	8.9	9.6	14.3	
Recreational physical activity ^c (MET·hr/week) (%)																
First tertile	39.6	36.7	40.5		32.8	29.4	43.5		46.1	38.9	31.7		43.9	37.5	24.0	
Second tertile	25.7	25.3	32.0		30.7	32.9	31.4		27.8	27.8	25.7		32.9	28.6	32.7	
Third tertile	34.7	38.0	27.5	0.17	36.5	37.7	25.1	<0.01	26.1	33.3	42.6	<0.01	23.2	33.9	43.3	
Household physical activity ^d (MET·hr/week) (%)																
First tertile	32.3	28.3	39.5		31.5	30.6	39.7		34.9	25.6	37.7		30.0	30.7	41.8	
Second tertile	33.0	39.2	30.0		32.8	32.6	32.1		33.2	35.9	33.1		32.9	34.3	30.4	
Third tertile	34.7	32.5	30.5	0.09	35.7	38.8	28.2	0.09	31.9	38.5	29.2	0.03	38.1	35.0	27.8	
MEDAS score ^e (%)																
First tertile	38.4	35.9	46.5		43.2	47.8	55.8		42.0	39.6	37.0		52.2	48.2	44.7	
Second tertile	23.3	21.5	19.0		20.2	22.0	14.3		21.4	22.2	21.8		18.6	21.4	16.8	
Third tertile	31.8	32.5	22.0		23.5	18.8	22.3		26.4	28.9	33.8		20.4	20.7	24.3	
Unknown score	6.5	10.1	12.5	0.02	13.1	11.4	7.6	0.01	10.2	9.3	7.4	0.54	8.8	9.7	14.2	

(Continues)

TABLE 1 (Continued)

	Watching TV ^a (hr/day)			Other SB ^b (hr/day)												
	Men (n = 849)			Women (n = 917)												
	First tertile	Second tertile	Third tertile	P ⁱ	First tertile	Second tertile	Third tertile	P ⁱ	First tertile	Second tertile	Third tertile	P ⁱ				
BMI kg/m ^{2f} (%)																
<25	22.6	14.8	14.0		32.9	25.1	19.2		16.3	18.9	20.1		20.7	25.4	33.4	
≥25- < 30	51.9	51.4	47.5		45.2	42.8	36.9		48.1	52.6	51.8		38.4	45.0	42.9	
≥30	25.5	33.8	38.5	<0.01	21.9	32.1	43.9	<0.01	35.6	28.5	28.1	0.28	40.9	29.6	23.7	<0.01
Morbidity (%)																
Cardiovascular disease ^g	9.2	8.9	11.0	0.72	6.7	6.7	12.5	0.01	8.8	10.7	9.2	0.71	8.8	9.6	7.1	0.53
Diabetes	25.0	25.3	29.5	0.47	14.7	12.9	22.0	<0.01	30.9	23.7	23.6	0.08	18.0	18.9	12.6	0.08
Respiratory disease ^h	11.4	10.6	15.5	0.24	18.7	14.9	18.8	0.40	11.9	13.0	11.6	0.88	17.4	19.6	16.2	0.54
Osteomuscular disease ⁱ	43.0	46.8	55.5	0.01	67.5	68.6	85.4	<0.01	53.9	44.4	42.3	0.01	80.5	76.4	63.1	<0.01
Cancer	4.6	3.8	6.5	0.41	3.2	4.3	2.4	0.47	6.1	4.8	3.5	0.35	3.7	3.9	2.3	0.47
Medications (%)																
<3	43.5	43.9	27.0		36.5	40.0	26.8		38.0	39.3	41.9		27.7	32.9	43.0	
≥3	50.0	46.8	60.5		50.4	49.2	65.5		51.9	52.2	50.7		62.4	57.9	42.7	
Unknown	6.5	9.3	12.5	<0.01	13.1	11.0	7.7	<0.01	10.1	8.5	7.4	0.74	8.8	9.2	14.3	<0.01
GDS at baseline, mean (SD)	0.62 (1.32)	0.49 (0.90)	0.67 (1.24)	0.24	0.88 (1.48)	1.05 (1.56)	1.49 (2.09)	<0.01	0.61 (1.30)	0.65 (1.14)	0.52 (1.14)	0.45	1.56 (2.14)	1.02 (1.47)	0.74 (1.31)	<0.01
GDS at follow-up, mean (SD)	0.62 (1.14)	0.49 (1.00)	0.60 (1.11)	0.38	0.83 (1.44)	1.13 (1.79)	1.55 (2.18)	<0.01	0.62 (1.20)	0.62 (1.12)	0.51 (0.96)	0.48	1.52 (2.22)	1.12 (1.80)	0.75 (1.18)	<0.01
GHQ at baseline, mean (SD)	0.95 (2.97)	0.73 (1.38)	1.36 (2.29)	<0.01	1.92 (2.64)	2.00 (2.74)	2.46 (3.11)	0.04	1.13 (2.18)	0.95 (1.76)	0.86 (1.79)	0.23	2.69 (3.20)	2.11 (2.81)	1.51 (2.25)	<0.01
GHQ at follow-up, mean (SD)	0.91 (2.00)	0.76 (1.59)	1.07 (1.96)	0.22	1.64 (2.48)	1.67 (2.46)	2.35 (2.94)	<0.01	1.02 (2.05)	0.80 (1.63)	0.88 (1.94)	0.39	2.39 (2.87)	1.78 (2.69)	1.40 (2.23)	<0.01

BMI, body mass index.

^aSex-specific cutoff points (hr/day): first tertile: ≤2 men and women; second tertile: > 2-≤3 men and women; third tertile: > 3 men and women.

^bSex-specific cutoff points (hr/day): first tertile: ≤1.3 men and ≤0.6 women; second tertile: > 1.3-≤2.7 men and > 0.6-≤1.7 women; third tertile: > 2.7 men and > 1.7 women.

^cSex-specific cutoff points (MET-hr/week): first tertile: ≤17.5 men and ≤12.5 women; second tertile: > 17.5-≤31.3 men and > 12.5-≤23 women; third tertile: > 31.3 men and > 23 women.

^dSex-specific cutoff points (MET-hr/week): first tertile: ≤7 men and ≤35 women; second tertile: > 7-≤22 men and > 35-≤56 women; third tertile: > 22 men and > 56 women.

^eSex-specific tertiles for Mediterranean Diet Adherence Screener (MEDAS, range 0-14): first tertile: ≤7 men and women; second tertile: > 7-≤8 men and women; third tertile: > 8 men and women.

^fIschemic heart disease, stroke or heart failure.

^gAsthma or chronic bronchitis.

^hOsteoarthritis or rheumatoid arthritis.

ⁱP-values from chi-square test for categorical variables and ANOVA or Kruskal-Wallis, as appropriate, for continuous variables.

TABLE 2 Beta regression coefficients (95% confidence interval) for the association of time spent watching television (TV) and in other sedentary behaviors (SBs)—recreational and household physical activity with scores on the 10-item Geriatric Depression Scale (GDS-10) after a mean 3.3 year follow-up of participants in the Seniors-ENRICA cohort

	Overall (n = 1,461)			Men (n = 715)			Women (n = 746)			P-interaction for sex ^b
	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	
Watching TV ^a										
First tertile	661	Ref.	Ref.	349	Ref.	Ref.	312	Ref.	Ref.	
Second tertile	400	0.03 (-0.14, 0.21)	0.04 (-0.13, 0.22)	199	-0.11 (-0.35, 0.13)	-0.11 (-0.35, 0.13)	201	0.19 (-0.06, 0.44)	0.21 (-0.04, 0.46)	
Third tertile	400	0.19 (0.00, 0.36)	0.11 (-0.70, 0.30)	167	-0.08 (-0.34, 0.18)	-0.18 (-0.44, 0.08)	233	0.42 (0.18, 0.66)	0.37 (0.13, 0.62)	
P trend ^c		0.05	0.23		0.48	0.16		<0.01	<0.01	<0.01
Other SB ^a										
First tertile	511	Ref.	Ref.		Ref.	Ref.	269	Ref.	Ref.	
Second tertile	451	-0.10 (-0.28, 0.08)	-0.08 (-0.26, 0.10)	242	0.00 (-0.25, 0.27)	0.04 (-0.22, 0.29)	221	-0.20 (-0.45, 0.05)	-0.19 (-0.44, 0.06)	
Third tertile	499	-0.17 (-0.37, 0.02)	-0.14 (-0.34, 0.05)	230	0.02 (-0.24, 0.29)	0.07 (-0.20, 0.33)	256	-0.36 (-0.61, -0.10)	-0.34 (-0.60, -0.08)	0.02
P trend ^c		0.07	0.15		0.87	0.62		<0.01	0.01	
Recreational physical activity ^a										
First tertile	545	Ref.	Ref.	281	Ref.	Ref.	264	Ref.	Ref.	
Second tertile	435	-0.09 (-0.27, 0.08)	-0.07 (-0.25, 0.11)	198	-0.17 (-0.42, 0.09)	-0.15 (-0.41, 0.10)	237	-0.03 (-0.28, 0.21)	0.00 (-0.25, 0.25)	
Third tertile	481	-0.24 (-0.42, -0.07)	-0.19 (-0.36, -0.01)	236	-0.18 (-0.42, 0.07)	-0.12 (-0.36, 0.13)	245	-0.31 (-0.56, -0.06)	-0.26 (-0.51, -0.00)	0.45
P trend ^c		<0.01	0.04		0.14	0.34		0.01	0.05	
Household physical activity ^a										
First tertile	494	Ref.	Ref.	238	Ref.	Ref.	256	Ref.	Ref.	
Second tertile	465	0.05 (-0.13, 0.23)	0.09 (-0.09, 0.27)	236	0.01 (-0.24, 0.27)	0.07 (-0.19, 0.32)	229	0.09 (-0.16, 0.34)	0.10 (-0.15, 0.36)	
Third tertile	502	0.05 (-0.14, 0.22)	0.10 (-0.08, 0.28)	241	0.09 (-0.16, 0.35)	0.16 (-0.09, 0.42)	261	-0.00 (-0.25, 0.24)	0.03 (-0.22, 0.27)	
P trend ^c		0.65	0.30		0.48	0.17		0.97	0.89	0.37

Note. Bold values are statistically significant $P < 0.05$. CI, confidence interval.

^aSex-specific cutoff points as in Table 1. Model 1: Adjusted for age (continuous), educational level (\leq primary, secondary, university) and baseline GDS scores. Model 2: Additionally adjusted for tobacco smoking (never/former/current), alcohol consumption (never drinker/ex-drinker/moderate drinker/heavy drinker/unknown), MEDAS score (tertiles/unknown), body mass index (≤ 25 , $25-29.9$, ≥ 30 kg/m²), cardiovascular disease, respiratory disease, osteoarthropathy, diabetes, cancer, number of medications (< 3 , ≥ 3 , unknown), TV viewing time, time in other SBs, recreational physical activity, and household physical activity.

^bP-value for the interaction term between tertile-transformed variables and sex in fully adjusted models.

^cP-values for linear trend were estimated by modeling the categories of tertile-transformed variables as continuous variables.

TABLE 3 Beta regression coefficients (95% confidence interval) for the association of time spent watching television (TV) and in other sedentary behaviors (SBs)—recreational and household physical activity with scores on 12-item General Health Questionnaire (GHQ-12) after a mean 3.3 year follow-up of participants in the Seniors-ENRICA cohort

	Overall (n = 1,766)			Men (n = 849)			Women (n = 917)			P-interaction for sex ^b
	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	n	Model 1 Beta (95% CI)	Model 2 Beta (95% CI)	
Watching TV^a										
First tertile	787	Ref.	Ref.	412	Ref.	Ref.	375	Ref.	Ref.	
Second tertile	492	-0.06 (-0.30, 0.17)	-0.04 (-0.27, 0.19)	237	-0.06 (-0.39, 0.27)	-0.05 (-0.38, 0.28)	255	-0.06 (-0.39, 0.27)	-0.02 (-0.35, 0.31)	
Third tertile	487	0.19 (-0.05, 0.42)	0.09 (-0.15, 0.34)	200	-0.07 (-0.42, 0.28)	-0.15 (-0.50, 0.20)	287	0.39 (0.07, 0.71)	0.29 (-0.03, 0.62)	
P trend ^c		0.18	0.51		0.66	0.40		0.02	0.09	0.07
Other SB^a										
First tertile	623	Ref.	Ref.	295	Ref.	Ref.	328	Ref.	Ref.	
Second tertile	550	-0.22 (-0.47, 0.02)	-0.20 (-0.45, 0.04)	270	-0.09 (-0.44, 0.25)	-0.06 (-0.41, 0.28)	280	-0.34 (-0.68, -0.00)	-0.33 (-0.67, -0.00)	
Third tertile	593	-0.16 (-0.42, 0.09)	-0.12 (-0.38, 0.14)	284	0.09 (-0.26, 0.45)	0.11 (-0.24, 0.47)	309	-0.40 (-0.74, -0.06)	-0.35 (-0.69, -0.00)	0.05
P trend ^c		0.20	0.34		0.61	0.53		0.02	0.05	
Recreational physical activity^a										
First tertile	654	Ref.	Ref.	331	Ref.	Ref.	323	Ref.	Ref.	
Second tertile	519	-0.07 (-0.31, 0.17)	-0.02 (-0.26, 0.22)	230	-0.21 (-0.55, 0.14)	-0.19 (-0.54, 0.15)	289	0.03 (-0.30, 0.36)	0.11 (-0.22, 0.44)	
Third tertile	593	-0.28 (-0.51, -0.05)	-0.23 (-0.47, 0.00)	288	-0.09 (-0.42, 0.23)	-0.07 (-0.40, 0.26)	305	-0.47 (-0.80, -0.14)	-0.39 (-0.73, -0.06)	0.18
P trend ^c		0.02	0.06		0.55	0.66		<0.01	0.02	
Household physical activity^a										
First tertile	589	Ref.	Ref.	279	Ref.	Ref.	310	Ref.	Ref.	
Second tertile	587	0.05 (-0.19, 0.29)	0.08 (-0.16, 0.32)	289	0.02 (-0.32, 0.36)	0.06 (-0.28, 0.40)	298	0.08 (-0.25, 0.41)	0.09 (-0.24, 0.42)	
Third tertile	590	-0.14 (-0.38, 0.10)	-0.09 (-0.33, 0.15)	281	-0.08 (-0.43, 0.26)	-0.04 (-0.39, 0.30)	309	-0.19 (-0.52, 0.14)	-0.13 (-0.46, 0.20)	
P trend ^c		0.25	0.46		0.62	0.82		0.26	0.41	0.69

Note. Bold values are statistically significant $P < 0.05$. CI, confidence interval.

^aSex-specific cutoff points as in Table 1.

Model 1: Adjusted for age (continuous), educational level (\leq primary, secondary, university) and baseline GHQ-12 scores.

Model 2: Additionally adjusted for tobacco smoking (never/former/current), alcohol consumption (never drinker/ ex-drinker/moderate drinker/heavy drinker/unknown), MEDAS score (tertiles/unknown), body mass index (≤ 25 , 25–29.9, ≥ 30 kg/m²), cardiovascular disease, respiratory disease, osteomuscular disease, diabetes, cancer, number of medications (< 3 , ≥ 3 , unknown), TV viewing time, time in other SBs, recreational physical activity and household physical activity.

^bP-value for the interaction term between tertile-transformed variables and sex in fully-adjusted models.

^cP-values for linear trend were estimated by modeling the categories of tertile-transformed variables as continuous variables.

TABLE 4 Beta regression coefficients (95% confidence interval) for the association of specific sedentary behaviors (SBs) other than TV viewing and specific physical activities with scores on 10-item Geriatric Depression Scale and the 12-item General Health Questionnaire after a mean 3.3 year follow-up of participants in the Seniors-ENRICA cohort

	Geriatric Depression Scale-10				General Health Questionnaire-12			
	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a
Sedentary behaviors								
Reading (hr/day)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
First tertile								
Men: 0-0.4, women: 0-0.1								
Second tertile	-0.10	0.04	-0.25		-0.17	-0.03	-0.32	
Men: 0.5-1, women: 0.3-1	(-0.28, 0.07)	(-0.20, 0.29)	(-0.49, -0.01)		(-0.40, 0.06)	(-0.36, 0.31)	(-0.62, 0.00)	
Third tertile	-0.03	0.16	-0.26		0.03	0.2	-0.19	
Men: 1.1-5.7, women: 1.1-5.7	(-0.24, 0.18)	(-0.12, 0.43)	(-0.57, 0.04)		(-0.25, 0.30)	(-0.16, 0.56)	(-0.58, 0.21)	
P trend ^b	0.68	0.27	0.06	0.02	0.98	0.3	0.24	0.11
Computer use (hr/day)								
<Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥Median	-0.23	-0.07	-0.42		-0.17	-0.11	-0.26	
Men: 0.1-6, women: 0.1-6	(-0.40, -0.05)	(-0.29, 0.15)	(-0.66, -0.17)		(-0.41, 0.06)	(-0.41, 0.19)	(-0.59, 0.07)	
P trend ^b	0.01	0.54	<0.01	0.03	0.15	0.66	0.14	0.48
Sitting while commuting (hr/day)								
First tertile	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
Second tertile	-0.00	0.06	-0.04		0.12	-0.01	0.26	
Men: 0.1-0.3, women: 0.1-0.2	(-0.20, 0.18)	(-0.19, 0.31)	(-0.33, 0.25)		(-0.13, 0.37)	(-0.35, 0.32)	(-0.12, 0.64)	
Third tertile	0.03	0.22	-0.15		-0.17	-0.29	-0.08	
Men: 0.4-2.9, women: 0.2-2	(-0.15, 0.21)	(-0.04, 0.48)	(-0.39, 0.10)		(-0.41, 0.07)	(-0.63, 0.06)	(-0.41, 0.25)	
P trend ^b	0.76	0.1	0.26	0.05	0.22	0.11	0.83	0.31
Listening to music (hr/day)								
<Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥Median	-0.01	-0.04	0.02		-0.15	-0.14	-0.15	
Men: 0.1-3, women: 0.1-4	(-0.20, 0.17)	(-0.27, 0.20)	(-0.26, 0.30)		(-0.39, 0.09)	(-0.46, 0.17)	(-0.52, 0.22)	
P trend ^b	0.87	0.76	0.91	0.78	0.23	0.37	0.42	0.98

(Continues)

TABLE 4 (Continued)

	Geriatric Depression Scale-10				General Health Questionnaire-12			
	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a
Sunbathing (hr/day)								
<Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥Median	-0.01 (-0.10, 0.08)	-0.07 (-0.34, 0.19)	0.2 (-0.03, 0.44)		0.06 (-0.18, 0.29)	0.06 (-0.29, 0.40)	0.06 (-0.25, 0.37)	
P trend ^b	0.87	0.6	0.09	0.13	0.63	0.76	0.72	0.99
Recreational physical activities								
Walking (hr/week)								
First tertile	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0-6, women: 0-4								
Second tertile	-0.04 (-0.21, 0.13)	-0.09 (-0.34, 0.15)	0 (-0.22, 0.24)		-0.07 (-0.30, 0.16)	0.04 (-0.30, 0.37)	-0.16 (-0.47, 0.15)	
Men: 6.1-9, women: 4.1-7								
Third tertile	-0.18 (-0.37, -0.00)	-0.12 (-0.38, 0.13)	-0.25 (-0.52, 0.01)		-0.37 (-0.62, -0.12)	-0.29 (-0.63, 0.05)	-0.45 (-0.81, -0.09)	
Men: 9.1-24.5, women: 7.1-19.5								
P trend ^b	0.06	0.33	0.09	0.57	<0.01	0.11	0.02	0.53
Cycling (hr/week)								
<Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥Median	0.03 (-0.23, 0.28)	0.05 (-0.25, 0.34)	-0.04 (-0.54, 0.47)		-0.12 (-0.25, 0.10)	-0.19 (-0.60, 0.21)	-0.41 (-1.09, 0.27)	
Men: 0.1-7.5, women: 1-4								
P trend ^b	0.84	0.75	0.88	0.78	0.16	0.35	0.24	0.59
Practicing sports (hr/week)								
First tertile	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
Second tertile	-0.08 (-0.34, 0.19)	0.09 (-0.31, 0.49)	-0.21 (-0.56, 0.14)		-0.03 (-0.38, 0.31)	-0.22 (-0.76, 0.31)	0.11 (-0.35, 0.57)	
Men: 0.1-1, women: 0.1-1								
Third tertile	-0.15 (-0.32, 0.01)	-0.04 (-0.85, 0.18)	-0.27 (-0.50, -0.03)		0 (-0.22, 0.23)	0.12 (-0.19, 0.43)	-0.12 (-0.44, 0.19)	
Men: 1.1-14, women: 1.5-7								
P trend ^b	0.07	0.73	0.02	0.15	0.99	0.49	0.5	0.33

(Continues)

TABLE 4 (Continued)

	Geriatric Depression Scale-10				General Health Questionnaire-12			
	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a	Overall Beta (95% CI)	Men Beta (95% CI)	Women Beta (95% CI)	P-interaction for sex ^a
Household physical activities								
House-working (hr/week)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
First tertile								
Men: 0, women: 0–14								
Second tertile	0.07	0.05	0.11		-0.10	-0.18	0.01	
Men: 1–4, women: 15–21	(-0.11, 0.25)	(-0.20, 0.30)	(-0.15, 0.36)		(-0.33, 0.15)	(-0.52, 0.16)	(-0.32, 0.34)	
Third tertile	0.13	0.22	0.03		0.03	0.1	-0.05	
Men: 5–70, women: 22–70	(-0.04, 0.31)	(-0.03, 0.47)	(-0.22, 0.27)		(-0.20, 0.27)	(-0.24, 0.44)	(-0.38, 0.27)	
P trend ^b	0.14	0.09	0.73	0.32	0.75	0.56	0.78	0.54
Gardening (hr/week)								
< Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥ Median	-0.05	-0.02	-0.12		-0.09	-0.19	0.01	
Men: 0.1–13, women: 0.1–7.5	(-0.21, 0.11)	(-0.25, 0.20)	(-0.35, 0.11)		(-0.31, 0.12)	(-0.49, 0.10)	(-0.29, 0.32)	
P trend ^b	0.56	0.83	0.32	0.56	0.39	0.2	0.94	0.34
Home repair (hr/week)								
< Median	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Men: 0, women: 0								
≥ Median	-0.23	-0.13	-0.40		-0.11	-0.21	-0.26	
Men: 1–8, women: 1–4	(-0.48, 0.01)	(-0.46, 0.20)	(-0.77, -0.02)		(-0.28, 0.05)	(-0.65, 0.23)	(-0.77, 0.26)	
P trend ^b	0.06	0.43	0.04	0.29	0.18	0.35	0.33	0.89

Note. Bold values are statistically significant $P < 0.05$. CI, confidence interval.

All models adjusted for age (continuous), educational level (\leq primary, secondary, university), baseline GDS-10 or GHQ-12 scores, tobacco smoking (never/former/current), alcohol consumption (never drinker/ex-drinker/moderate drinker/heavy drinker/unknown), TV viewing time (hr/day), MEDAS index (tertiles/unknown), body mass index (≤ 25 , 25–29.9, ≥ 30 kg/m²), cardiovascular disease, respiratory disease, osteomuscular disease, diabetes, cancer, and number of medications (< 3 , ≥ 3 , unknown). Models for sedentary behaviors additionally adjusted for time in each sedentary behavior and for total recreational physical activity. Models for physical activity additionally adjusted for time in each activity and for total sedentary time.

^a P-value for the interaction term between tertile-transformed variables and sex.

^b P-values for linear trend were estimated by modeling the categories of tertile-transformed variables as continuous variables.

associated with a lower prevalence of GDS-measured depression in both men and women, but other activities such as saying prayers were only correlated to lower depression in men (Gautam, Saito, & Kai, 2007). In this last study, watching TV was also associated with greater life satisfaction in women, but not in men. Whether these differences are biological, depend on cultural norms about social behaviors, or are affected by gender differences in reporting SBs or mental health problems should be explored in future studies.

Our results are in line with those of previous research advocating that physical exercise supports emotional well-being and reduces the risk of depressive symptomatology in old age (Bridle, Spanjers, Patel, Atherton, & Lamb, 2012; Schuch et al., 2016). Moreover, they suggest that certain actions such as walking, playing sports, or doing house repairs may be more effective to lower the risk of depressive symptoms in older adults than others such as cleaning, cooking, doing laundry, children rearing, or gardening. Activities such as walking and playing may improve mental health directly through physiological pathways (i.e., by increasing the synthesis and metabolism of certain neurotransmitters, reducing certain inflammatory markers, or promoting changes in the immune system) (Hamer, Molloy, de Oliveira, & Demakakos, 2009; Mazzeo et al., 2000), as well as indirectly by providing a sense of enjoyment and increasing social interactions. Additionally, engaging in house repairs may improve mental health by enhancing older adult's feelings of self-worth and self-esteem.

Lastly, our results are of clinical significance. For example, women who watch TV > 3 hr/day show on average 0.37 more GDS-10 symptoms than those who watch TV < 1.3/day, whereas those who spend > 1.7 hr/day in other SBs display 0.34 less GDS symptoms compared to those who spend < 1.3 hr/days in these behaviors. Previous studies have found that, among older adults, an increase in only one GDS symptom is associated with declines in physical function (Brandler, Wang, Oh-Park, Holtzer, & Vergheze, 2012), cognitive performance (Rosenberg, Mielke, Xue, & Carlson, 2010), and quality of life (Chan et al., 2009) over time. In this sense, for instance, the Einstein Aging Study showed that a one-point increase in the 15-item GDS adversely affected gait speed with decreases of 2.98 cm/s in velocity, 2.39 cm in stride length, and 1.17 steps/min in cadence (Brandler et al., 2012). Also, the Women's Health and Aging Study II showed that for each 1-point increase in the 30-item GDS, participants presented a 6–7% increase in their annual risk of cognitive impairment in all evaluated cognitive domains (immediate recall, delayed recall, psychomotor speed, and executive function) (Rosenberg et al., 2010).

Several limitations of the present study warrant consideration. The main limitation is that information on SBs and physical activity was self-reported with the corresponding risk of recall bias. However, given that objective measurement methods only estimate total sitting time and total physical activity time, self-report is the only way to assess different SBs and activities. Also, we could not evaluate the presence of breaks in sedentary time, which, as suggested by previous studies, may be an important factor in some of the studied associations. Second, although we used validated depression and psychological distress scales, mental health variables were not confirmed by a clinical diagnosis. Third, we did not have information on the context in which these activities were performed, which may have helped us understand some

of the sex-observed differences (i.e., watching TV alone vs. accompanied, or at home vs. outside, may pose different risks for depression). Finally, we did not have information regarding the use of screen devices other than TV and the PC (i.e., smartphones or tablets).

Still, our study has notable strengths compared to published research. First, we used data from a longitudinal study allowing us to model prospective associations. Second, we adjusted for a wide range of potentially confounding factors, including lifestyle factors such as dietary quality or physical activity engagement, and important chronic conditions (i.e., osteomuscular problems) that have been associated with increased sedentary time and are well-known risk factors for depression. Third, as far as we are aware of, this is the first study to provide detailed analyses on the association between such a broad range of sedentary activities and mental health outcomes; it shows that not all types of SBs and physical activities have the same association with mental health.

Further research should elucidate the mechanisms of the different associations found for TV viewing versus other SBs. Moreover, if our results are confirmed in future studies, they suggest that in order to reduce the mental health burden associated with sedentariness and low physical activity, clinical and public health interventions should focus on specific types of SBs and on recreational activity.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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