



Physical activity trajectories and quality of life in older adults

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ABSTRACT

Purpose. Physical activity (PA) is associated with a better quality of life and well-being in older adults. Examining PA trajectories, especially increasing habitual PA habits, makes it possible to better understand how PA behavioural changes may impact health and quality of life. This study aimed to analyse the longitudinal association between 2-year PA trajectories (changes in intensity and frequency) and quality of life.

Methods. Participants were 6,057 older adults aged ≥ 50 years (2,331 men) from 13 European countries. Regression models were performed to analyse the effects of PA trajectories on older adults' quality of life.

Results. Men and women who engaged in more PA had significantly higher quality of life scores than those with lower PA levels. At follow-up, those who increased PA frequency to more than once a week, at both moderate and vigorous intensity, had a greater quality of life score (men's moderate PA: $\beta = 1.13$, $p < 0.001$; men's vigorous PA: $\beta = 1.93$, $p < 0.001$; women's moderate PA: $\beta = 1.77$, $p < 0.001$; women's vigorous PA: $\beta = 1.72$, $p < 0.001$).

Conclusions. Increasing the frequency of moderate and vigorous intensity PA is associated with a better quality of life in older adults. Even in later life, changes in lifestyle components, such as PA, can significantly increase the quality of life. Thus, public health should encourage promoting PA as an effective strategy to improve healthy ageing and hinder vulnerability in older ages.

Key words: exercise, lifestyle, public health, vulnerability, well-being

Introduction

The older adult population is increasing at a rate of 3% yearly worldwide [1]. Projections indicate that the European older adult population will reach 129.8 million by 2050 [2]. Despite the increase in life expectancy, the additional years in life are generally affected by vulnerability and disability. Older people are more susceptible to developing functional disability, chronic diseases, and comorbidities, compromising physical,

emotional and psychological health, and reducing their quality of life [3–6]. With the increasing population longevity, more attention should be given to the quality of that longevity in terms of health status and active living [7, 8].

Although there is still no consensus regarding the definition of quality of life [9, 10], the World Health Organization defines it as an individual's perception of their position in life, in the context and value systems in which they are inserted [11]. People with greater satis-

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faction and quality of life have a lower risk of suffering from chronic diseases and mortality and better mental health [12, 13]. Thus, having a high quality of life is one of the most important determinants of healthy ageing [12, 14]. As a result, maintaining the quality of life during the ageing process is a public health priority [12].

Physical activity (PA) is known to be associated with a better quality of life and well-being in older adults [9, 12, 15–17]. Engaging in PA is associated with physical and mental health benefits [18–20]. In addition to mitigating the functional decline and risk of disability [4, 19], PA induces changes in neurotransmitters and endogenous opioids, preventing depression, anxiety and other mood disorders [15]. These aspects highlight the importance of PA in promoting older adults' quality of life.

Despite the vast literature on the positive association between PA and quality of life, evidence is often limited by examining specific countries, small sample sizes, and not accounting for frequency and intensity levels [15, 21]. Furthermore, few studies examine how longitudinal PA trajectories (changes in frequency and intensity) may affect older adults' quality of life. Despite PA being an important health behaviour, its impact on health is temporary if the behaviour is not sustained. Examining PA trajectories, especially increasing habitual PA habits, makes it possible to better understand how PA behaviour changes may impact health and quality of life. Therefore, this study aims to examine the longitudinal association between 2-year PA trajectories (changes in intensity and frequency) and quality of life in a large sample of older adults ≥ 50 years of age from 13 European countries.

Material and methods

Sample and procedures

This is a longitudinal study using data from waves 5 (baseline in 2013) and 6 (follow-up in 2015) of the Survey of Health, Ageing and Retirement in Europe (SHARE). Since 2004, SHARE has studied the effects of health, social and environmental policies in 28 European countries and Israel. Data is collected every two years on participants aged 50 and older (www.share-project.org).

For this study, 6,057 participants were included, 2,331 men and 3,726 women, with a mean age of 69.4 ± 10.2 years and 70.3 ± 11.5 years, respectively, at the beginning of the study. Participants were eligible for the analysis if they participated in waves 5 and 6 and presented PA data. Only participants with low PA levels (participating in moderate and vigorous PA less

than once a week) at baseline were included ($n = 6,155$) to analyse increasing PA trajectories. Participants with missing data on sociodemographic variables, such as age, education level and living place, quality of life, and depressive symptoms, were excluded ($n = 98$).

Data collection and measures

Data were collected through in-person interviews conducted at the participants' homes by trained individuals lasting approximately 90 minutes [22]. Health, socioeconomic, social, and family questions were asked as foreseen in the SHARE protocol [14, 23]. Data on older adults' quality of life (dependent variable), PA frequency and intensity (independent variable), sociodemographic characteristics and depression were collected at baseline (wave 5) and follow-up (wave 6).

The Control, Autonomy, Self-Realization and Pleasure (CASP) index assessed quality of life and well-being. This is a commonly used instrument to assess the quality of life based on four domains with the same level of importance [8, 14, 24]: (1) control, the ability to actively intervene in the environment [14]; (2) autonomy, the right to be free without interference from others [14]; (3) self-actualisation and (4) pleasure, seeking out the active and reflexive processes of being human [14]. The SHARE project reduced the original CASP index from 19 items to 12 based on four areas and created CASP-12. The items that most weakly reflected a dimension were excluded [8, 24]. Responses to each item were given using a Likert scale, which included the options 'often', 'sometimes', 'rarely' and 'never' [24]. The resulting score ranged from 12 to 48, with a higher score representing a higher quality of life [25].

Participants reported PA behaviour focusing on frequency and intensity. The frequency of engagement in PA was reported separately for moderate PA (e.g., housework, walking, gardening) and vigorous PA (e.g. sport, more physically demanding domestic activities, a profession that implies a high physical availability). Response options for frequency were: (1) 'more than once a week', (2) 'once a week', (3) 'up to three times a month', and (4) 'almost never or never'. Similarly to previous research, response options (3) 'up to three times a month' and (4) 'almost never or never' were combined in one category, corresponding to 'less than once a week' [26–28]. Baseline and follow-up PA data were organised to create PA trajectories for moderate and vigorous PA. Three PA trajectories for each intensity (moderate and vigorous PA) were possible: 1) engaging in PA less than once a week in 2013 to engaging in PA less than once a week in 2015, maintaining the low PA levels; 2) engaging in PA less than once a week in 2013 to engaging

in PA once a week in 2015, slightly increasing PA levels; and 3) engaging in PA less than once a week in 2013 to engaging in PA more than once a week in 2015, increasing PA levels.

Sociodemographic data comprising age, education level, living place and depressive symptomatology were used as covariates. Education was codified and hierarchically organised into three levels (low, medium and high), according to the revised version of the International Standard Classification of Education (ISCED-11) [29]. Regarding the living place, participants were asked whether they lived in a large city, suburb or outskirts of a city, large locality, small locality, or rural environment or village [23]. Depression was assessed using a scale developed and validated to determine depressive symptomatology in European countries (EURO-D) [30, 31]. The maximum score on the scale is 12 (very depressed), and zero is the minimum (not at all depressed). Individuals with a score equal to or greater than four are considered to have clinically significant depressive symptoms [25].

Data analysis

Descriptive analysis of the participants' characteristics for the whole sample and by gender was performed (mean, standard deviation and relative frequency). Student's *t*-test and chi-square were used to compare sociodemographic characteristics, quality of life index and depressive symptomatology by gender at baseline. Analysis of covariance (ANCOVA) was carried out to examine the association between moderate and vig-

orous PA and quality of life at baseline (2013) and follow-up (2015). Linear regression models were employed to examine the association between PA trajectories (frequency and intensity) and quality of life using β coefficients and 95% confidence intervals (95%CI). Analysis was adjusted for age, education level, living place and depressive symptoms. All analyses were performed using SPSS v. 28 (SPSS Inc., IBM Corp., Armonk, New York, NY, USA). Statistical significance was set at $p < 0.05$.

Ethical approval

The procedures that ensured the confidentiality and data privacy of the SHARE protocol survey were reviewed and 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. All survey procedures were carried out following the ethical guidelines and regulations of the Declaration of Helsinki.

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Participants' baseline (2013) characteristics, CASP score, and EURO-D score are shown in Table 1. Women averaged greater depressive symptomatology than men (3.8 ± 2.7 vs. 2.9 ± 2.5 , $p < 0.001$) and lower quality of life (33.6 ± 6.8 vs. 34.7 ± 6.6 , $p < 0.001$).

Table 1. Characteristics of the participants by gender at baseline (2013)

	Total	Men	Women	<i>p</i>
	Mean \pm SD or %			
Age (years)	69.9 \pm 11.1	69.4 \pm 10.2	70.3 \pm 11.5	< 0.001
Education level				
Low	54.1	47.1	58.5	< 0.001
Middle	31.8	35.2	29.6	
High	14.1	17.7	11.9	
Living place				
Big city	15.6	14.5	16.2	0.653
Suburb of a big city	8.5	8.9	8.3	
Large town	17.8	18.4	17.5	
Small town	28.2	28.3	28.1	
Rural area	29.9	29.9	29.9	
CASP score	34.0 \pm 6.7	34.7 \pm 6.6	33.6 \pm 6.8	< 0.001
EURO-D score	3.4 \pm 2.6	2.9 \pm 2.5	3.8 \pm 2.7	< 0.001

All participants at baseline had low levels of PA.

CASP – Control, Autonomy, Self-Realization and Pleasure (index for quality of life and well-being)

Differences between genders were tested by Student *t*-test and Chi-Square test.

Table 2. CASP index for each physical activity intensity and frequency by gender at follow-up (2015)

	CASP score			
	Men (mean \pm SD)	<i>p</i>	Women (mean \pm SD)	<i>p</i>
Moderate PA				
Less than once a week	33.1 \pm 6.8		31.6 \pm 6.6	
Once a week	35.9 \pm 6.2	< 0.001	34.7 \pm 6.5	< 0.001
More than once a week	36.3 \pm 6.1		35.4 \pm 6.5	
Vigorous PA				
Less than once a week	34.1 \pm 6.7		32.8 \pm 6.7	
Once a week	36.7 \pm 5.4	< 0.001	36.1 \pm 6.0	< 0.001
More than once a week	37.6 \pm 6.3		36.5 \pm 6.3	

CASP – Control, Autonomy, Self-Realization and Pleasure (index for quality of life and well-being)
PA – physical activity

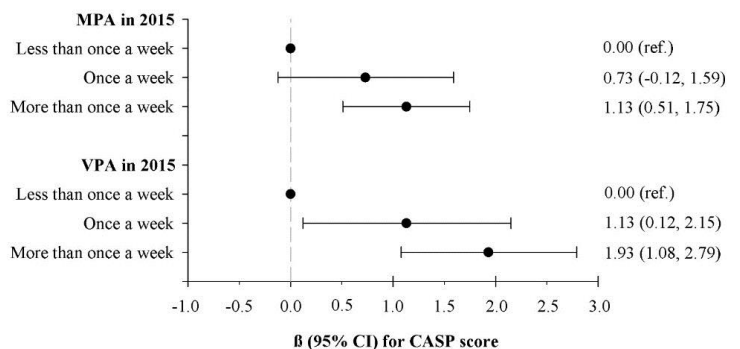
Table 2 presents the quality of life scores according to PA intensity and frequency at follow-up (2015), stratified by gender. Both men and women who engaged once a week and more than once a week in moderate and vigorous PA had a significantly greater quality of life scores than those engaging in PA less than once a week ($p < 0.001$).

The association between PA trajectories and quality of life (estimated parameters of quality of life according to the frequency and intensity of PA) by gender are presented in Figure 1. Among men (panel A), increasing moderate PA levels (to more than once a week in 2015; $\beta = 1.13$, 95% CI: 0.51, 1.75) and slightly increasing (to once a week in 2015; $\beta = 1.13$, 95% CI: 0.12, 2.15) or increasing (to more than once a week in 2015; $\beta = 1.93$, 95% CI: 1.08, 2.79) vigorous PA levels were associated with a greater quality of life score, compared to maintaining low PA levels. For women (panel B), slightly increasing PA levels to once a week in 2015 (moderate: $\beta = 1.43$, 95% CI: 0.83, 2.02; vigorous: $\beta = 1.77$, 95% CI: 1.32, 2.22) and increasing PA levels to more than once a week in 2015 (moderate: $\beta = 1.10$, 95% CI: 0.39, 1.83; vigorous: $\beta = 1.72$, 95% CI: 1.04, 2.40) were related to a better quality of life when compared to maintaining low PA levels.

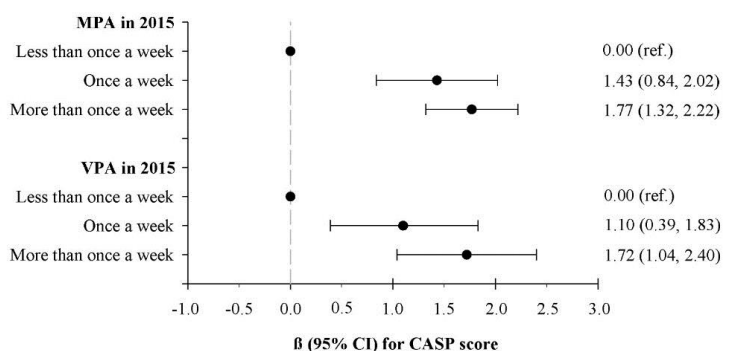
Discussion

The present study analysed the longitudinal association between 2-year PA trajectories and quality of

Panel A. All men engaged in MPA and VPA less than once a week in 2013



Panel B. All women engaged in MPA and VPA less than once a week in 2013



Panel A is for men and Panel B is for women.

CASP – Control, Autonomy, Self-Realization and Pleasure (index for quality of life and well-being), CI – confidence interval, MPA – moderate physical activity, VPA – vigorous physical activity. Adjusted for age, education level, living place and depressive symptomatology.

Figure 1. Association between physical activity trajectories and quality of life by gender

life in a large sample of older adults (aged 50 and older) from 13 European countries. The findings indicate a positive association between increasing PA trajectories, for moderate and vigorous intensity PA, and quality of life among older men and women. These findings are corroborated by previous cross-sectional and longitudinal evidence supporting the role of PA in increasing people's quality of life [6, 12, 15, 32]. The potential mechanisms underlying PA's association with quality of life are diverse. Some studies attribute the positive association to PA's role in maintaining physical capacity and attenuating functional decline during the ageing process, which, consequently, lead to better aptitude for performing daily activities [4, 6, 19, 33]; while others attribute it to improved self-esteem and self-efficacy, directly influencing life satisfaction [4].

Despite the overall effect of PA, some gender differences were found. According to previous studies, women reported a lower quality of life score than men, regardless of PA frequency and intensity level [4, 8]. Several factors may explain this difference, with one being their

mental health. Mental health, specifically depressive symptomatology, greatly affects the quality of life [8]. Women are known to have greater depressive symptomatology than men. Furthermore, women with lower PA levels are at a higher risk of depression than women with higher PA levels [34]. Thus, greater depressive symptomatology and lower PA levels may be two factors that partly explain why women have worse quality of life scores.

Within the ageing process, it is not only important to maximise longevity by reducing the risk of disease and disability, but also to improve quality of life and understanding how PA can help promote it [32]. Similar to previous research, greater PA frequency at moderate and vigorous intensity was linked to a better quality of life [15, 19]. Improvements in the quality of life score were observed in older adults with increasing PA trajectories (low PA levels in 2013 to slightly higher and higher PA levels in 2015). Slight gender differences were also observed in the association between PA trajectories and quality of life. Women presented greater effect sizes and a lower frequency threshold (only once a week, while for men, it was more than once a week) in the association between moderate PA and quality of life. As women are more susceptible to depression, lower PA doses (intensity and frequency) may be associated with a greater effect than in men and, consequently, to improving quality of life with moderate PA once a week. These are relevant findings from a public health standpoint, meaning that for those of older ages, promoting PA, even if only once a week, is still a significant strategy to improve people's lives as the quality of life predicts longevity and morbidity [18, 35].

This study has a set of strengths and limitations that must be acknowledged when interpreting its findings. The prospective design and analysis of PA trajectories should be highlighted. It provides an understanding of what happens when there is a longitudinal change in PA behaviour and projects different scenarios. Also, studying intensity and frequency makes it possible to mimic dose-response relationships and interpret them [15, 19, 21, 32]. Furthermore, using a European multi-country sample from the SHARE project better reflected the diversity of the population in the study [36]. Despite these strengths, several limitations must be recognised. There is a bias associated with the subjective measure of PA, as an alternative to objective ones (e.g. accelerometers). Previous analyses have shown that there is a tendency for participants to overestimate their reports of PA [21] and to underestimate time [37]. Although the limitations of self-report measures are known, they remain the most viable and frequently used solution

for studying large samples [1, 21]. Quality of life was also self-reported using the CASP-12 questionnaire. However, this questionnaire has been validated and is frequently used internationally, increasing comparability [24]. In addition, the CASP-12 reveals high reliability among the older population [38].

Conclusions

As the older adult population increases, it has become a key priority for public health policies to support the ageing process, emphasising maintaining the quality of life. This study showed that increasing the frequency of moderate- and vigorous-intensity PA is associated with a better quality of life in adults aged 50 and older from 13 European countries. This is an important finding from a public health perspective, meaning that for those of older ages, promoting PA, even if only once a week, is still a significant strategy to improve people's lives. Even in later life, changes in lifestyle components, such as PA, can significantly increase the quality of life. Thus, public health should encourage promoting PA as an effective strategy to improve healthy ageing and hinder vulnerability in older ages.

Disclosure statement

No author had 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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