

Physical activity buffers the negative relationship between multimorbidity, self-rated health and life satisfaction

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ABSTRACT

Background This study aimed to examine the relationship between multimorbidity, self-rated health and life satisfaction, and to test the moderating effect of physical activity on the relationship between multimorbidity, self-rated health and life satisfaction.

Methods This is a cross-sectional study based on data from the European Social Survey 2014. Participants were 25 713 adults (12 830 men), aged 18–64 years old, from 18 European countries and Israel. Self-reported information regarding chronic diseases, health perception, life satisfaction and physical activity was collected through interview. Multimorbidity was defined as the co-occurrence of ≥ 2 chronic diseases. Linear regression models were used to estimate the effects of multimorbidity, physical activity and the interaction effect of multimorbidity \times physical activity on self-rated health and life satisfaction.

Results Multimorbidity was negatively related to self-rated health ($d = 0.03$) and life satisfaction ($d = 0.03$). Physical activity was positively related to self-rated health and life satisfaction. There was a significant interaction effect between multimorbidity and physical activity with regard to self-rated health ($\beta = 0.01$, $P < 0.001$) and life satisfaction ($\beta = 0.04$, $P < 0.001$).

Conclusions Physical activity buffered the negative relationship between multimorbidity, self-rated health and life satisfaction; contributing to better self-rated health and life satisfaction.

Keywords chronic diseases, European, exercise

Introduction

Self-rated health reproduces the subjective experience of health, and it has been shown to be a significant predictor of morbidity and mortality,^{1,2} related to several biomarkers such as blood pressure, blood levels of albumin, white blood cell count, haemoglobin, HDL cholesterol, serum creatinine and a barometer of physiological states.^{1,3,4} Life satisfaction can be defined as a general evaluation of an individual's personal life, and has been related to several mental adverse health outcomes such as depression and psychiatric problems,⁵ along with somatic disability and mortality.⁶ The association between self-rated health and life satisfaction with health outcomes enables a conceptual understanding of the health from people's perspective.

Multimorbidity, defined as the co-occurrence of two or more chronic diseases⁷ is a consequence of the aging of the population; it results from both an increase in the prevalence of chronic diseases,⁸ and the number of diseases from which a patient suffers.⁹ Multimorbidity influences health perception and subjective wellbeing perhaps because of its physical and psychological consequences.¹⁰ Chronic diseases affect people ability to manage their daily functioning, and those

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people usually experienced a decline on their quality of life.¹¹ Thus, the presence of multimorbidity is negatively associated with both self-rated health^{2,12,13} and life satisfaction.¹⁴ Most studies relating self-rated health or life satisfaction to chronic diseases focus on specific populations or specific diseases or group of diseases. For example, among middle-aged and older adults, poorer self-rated health is strongly associated with single chronic diseases, particularly cardiovascular diseases, multimorbidity and poor psychosocial function,^{2,13,15} while life satisfaction is inversely associated with multimorbidity.^{14,15} Similarly, cardiovascular mortality in the general populations with and without prior cardiovascular disease is associated with poor self-rated health.¹⁶ Also, increased risk of specific diseases, such as cancer, stroke and type 2 diabetes mellitus are associated with lower life satisfaction.¹⁷

In opposition to multimorbidity, physical activity has been shown to have a significant and positive association with self-rated health and life satisfaction.^{18,19} Furthermore, physical activity can reduce chronic diseases and the risk of disease progression,^{20–22} and it is inversely associated with multimorbidity.¹² However, the possibility for physical activity moderating the relationship between multimorbidity and self-rated health and life satisfaction has yet to be explored. It is thus expected that, by having a positive effect on self-rated health and life satisfaction, and by having a protective health effect against chronic diseases, physical activity might moderate the relationship between multimorbidity and self-rated health and life satisfaction. Therefore, the purpose of this study was two-pronged: (i) to examine the relationship between multimorbidity, self-rated health and life satisfaction; and (ii) to test the moderating effect of physical activity

on the relationship between multimorbidity, self-rated health and life satisfaction.

Methods

Study design and participants

The present study was based on the seventh wave of the European Social Survey, 2014, which included 20 European countries (Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Hungary, Ireland, Lithuania, Netherlands, Norway, Poland, Portugal, Sweden, Slovenia, UK) and Israel. The European Social Survey is a survey that has been conducted every two years to measure the attitudes, beliefs, and behaviours of European adults. The survey uses representative samples among countries. Participants were sampled by postal code, address files, social security registry data, population registers and/or telephone books. The information was collected in each country, using a questionnaire filled-in through an hour-long face-to-face interview. The questionnaire was translated, by language experts, into the language spoken in each of the participating countries. Further details about the European Social Survey are available elsewhere.²³ The study protocol subscribes to the Declaration on Professional Ethics of the International Statistical Institute.

Probability sampling from residents aged 15 years and older was applied (excluding the homeless, and institutionalized people), comprising 40 185 participants. For the present study participants under 18 years and above 64 years of age were excluded ($n = 9851$), because the focus was on the adult population. Participants from Czech Republic and Estonia, and others that also did not report information on chronic diseases and were therefore excluded ($n = 4255$). Respondents without information in more than two socio-demographic variables were also excluded ($n = 366$). These restrictions resulted in a sample of 25 713 participants (12 830 men and 12 883 women) (Fig. 1).

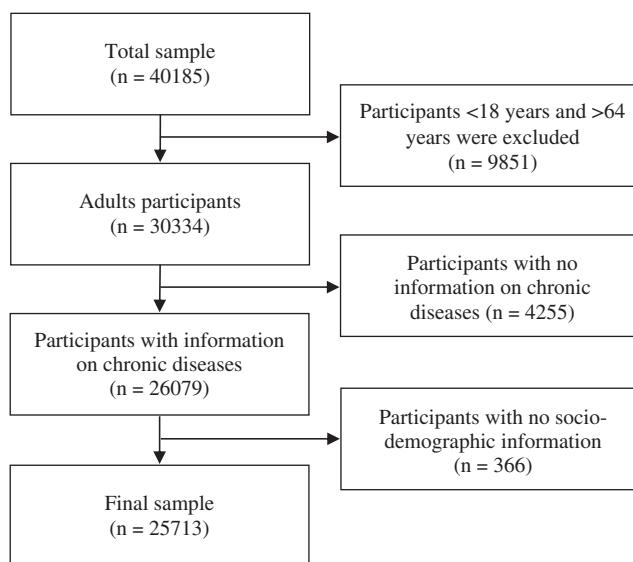


Fig. 1 Flow chart diagram of participants.

Measures

Chronic diseases

Most of the chronic diseases (heart or circulation problems, high blood pressure, diabetes, stomach or digestion problems, breathing problems, allergies, headaches and cancer) were assessed by asking participants to indicate whether they currently have, or had, chronic diseases (yes/no) in the last 12 months. For obesity, body mass index (BMI) was calculated from self-reported height and weight (kg/m^2). Body mass index categories were calculated in accordance with the WHO guidelines²⁴ and dichotomized into non-obese ($<30.0 \text{ kg}/\text{m}^2$)

and obese ($\geq 30 \text{ kg/m}^2$). Multimorbidity was defined as the co-occurrence of two or more of the nine aforementioned diseases.⁷

Physical activity

Physical activity was assessed with a single item asking, 'On how many of the last 7 days did you walk quickly, do sports or other physical activity for 30 min or longer?' Although physical activity was assessed with a single item, there is evidence in previous studies that a single question is an acceptable alternative;²⁵ this approach was used previously with European Social Survey data.^{26,27}

Self-rated health

Self-rated health was assessed with a single item question. Participants were asked, 'How is your health in general?' The response options were very bad, bad, fair, good or very good. This single item question has been widely validated in epidemiological studies.^{26–28} Previous studies have found a relationship between levels of self-rated health and adverse health outcomes, indicating its validity.^{1,29}

Life satisfaction

Life satisfaction was assessed with the item, 'How satisfied are you with your life as a whole nowadays?' Responses were indicated using a scale ranging from 0 'extremely dissatisfied' to 10 'extremely satisfied'. Studies have shown that life satisfaction is associated to mental health outcomes,⁵ can predict mortality,³⁰ and that one single item is a robust measure capable of reliably estimating life satisfaction.³¹

Covariates

Participants reported sex, age and years of full-time education. Respondents were asked to describe whether they live with or without a husband/wife/partner, and the legal situation. Response options were dichotomized into live with, or without, a partner. Household income was determined based on decile. It is a socioeconomic indicator as important as or more important than education and occupation, because is indicative of a standard of living.³² Household income also shows relationship with health status.³³ Using household income decile information, first to third decile, fourth to seventh decile and 8th to 10th were grouped to create three groups. Participants were asked to report their occupation. To determine the living place, those who indicated that they lived in a big city, the suburbs or the outskirts of big city were grouped into a new category named urban areas; those who responded that they lived in the country, a village or a

home in countryside were grouped into rural areas. Participants answered if they lived with or without children at home, along with the number of people living regularly as a member of the household.

Data analysis

Descriptive statistics were calculated for the entire sample (means, standard deviation and percentages). The relationship between the presence or absence of chronic diseases and multimorbidity, according self-rated health and life satisfaction, was tested by ANCOVA. Linear regression models were used to estimate the principal effects of multimorbidity, physical activity, and the interaction effect of multimorbidity \times physical activity on self-rated health and life satisfaction. Multimorbidity enters the models as a dummy variable, and physical activity as a continuous variable. To calculate the variable that expresses the interaction effect (multimorbidity \times physical activity), physical activity was transformed using grand mean centring. The grand mean centring was calculated by taking each value of physical activity (times/week) and subtracting from it the mean of the total sample. Physical activity grand mean centring was then multiplied by multimorbidity to have a variable to test the moderation effect (multimorbidity \times physical activity). Analyses were not stratified by sex or age because an interaction effect between sex and age on multimorbidity was not verified. For ANCOVA and linear regression, the analysis were adjusted for sex, age, education, marital status, household income, occupation, living place, having children and household members. Statistical analysis was performed using IBM SPSS Statistics v.24.0. The significance level was set at $P < 0.05$.

Results

Table 1 presents the characteristics of the study sample. The most prevalent chronic diseases were: high blood pressure (17.5%), stomach or digestion problems (16.2%) and obesity (15.5%). Almost 30% of the participants had multimorbidity (≥ 2 chronic diseases). From 1 to 5, the mean value for self-rated health was 3.8 ± 0.9 , and from 0 to 10, the mean of life satisfaction was 7.2 ± 2.2 . Physical activity was practiced, on average, 3.2 ± 2.6 times/week.

Results of the relationship between the presence or absence of chronic diseases and multimorbidity, according to self-rated health and life satisfaction, are presented in Table 2. For each chronic disease, participants who did not report having the disease had significantly better self-rated health than those who reported having the disease. Similar

Table 1 Participants' characteristics for total sample and stratified by sex in 2014

	Total (n = 25713) % or M ± SD
Sex	
Male	48.7
Female	51.3
Age	47.4 ± 18.3
Education (years)	12.5 ± 3.9
Marital status	
Live with partner	62.0
Live without partner	38.0
Household income	
Low (first to third decile)	30.1
Middle (fourth to seventh decile)	43.1
High (8th to 10th decile)	26.8
Occupation	
Employed	61.9
Unemployed	6.8
Student	8.7
Retired	22.5
Living place	
Urban area	61.1
Rural area	38.9
Children	
Do not have children	60.8
Have children	39.2
Household members	2.8 ± 1.4
Chronic diseases (last 12 month)	
Heart or circulation problems	9.8
High blood pressure	17.5
Diabetes	4.9
Obesity	15.5
Stomach/digestion problems	16.2
Breathing problems	8.8
Allergies	12.4
Headaches	14.4
Cancer	10.3
Multimorbidity	
No	70.3
Yes	29.7
Self-rated health	3.8 ± 0.9
Life satisfaction	7.2 ± 2.2
Physical activity (times/week)	3.2 ± 2.6

results were observed for life satisfaction. Those who did not report the presence of the disease had better life satisfaction, with the exception of allergies. Although the effect size was small, multimorbidity was also significantly related to self-rated health and life satisfaction. Those without

multimorbidity had better self-rated health (4.08 ± 0.77 versus 3.40 ± 0.89 , $F(1) = 2399.93$, $P < 0.001$) and better life satisfaction (7.37 ± 2.00 versus 6.86 ± 2.30 , $F(1) = 243.35$, $P < 0.001$).

Table 3 depicts the results for linear regression analysis. Unadjusted analysis demonstrated that multimorbidity was negatively related to self-rated health and life satisfaction. When accounting for other social-demographic confounders, multimorbidity remained negatively related with self-rated health ($\beta = -0.52$, 95% CI: -0.054 to -0.50 , $P < 0.001$) and life satisfaction ($\beta = -0.43$, 95% CI: -0.49 to -0.37 , $P < 0.001$). In turn, in the unadjusted and adjusted model, physical activity was positively related to self-rated health ($\beta = 0.04$, 95% CI: 0.04 – 0.05 , $P < 0.001$) and life satisfaction ($\beta = 0.07$, 95% CI: 0.05 – 0.08 , $P < 0.001$). There was a significant interaction effect between multimorbidity and physical activity with regard to self-rated health ($\beta = 0.01$, 95% CI: 0.01 – 0.02 , $P < 0.001$) and life satisfaction ($\beta = 0.04$, 95% CI: 0.02 – 0.06 , $P < 0.001$), portraying physical activity as a moderator of the relationship between multimorbidity and these variables.

Discussion

Main finding of this study

This study investigated the relationship between multimorbidity, self-rated health and life satisfaction, as well as the moderating effect of physical activity on the relationship between multimorbidity, self-rated health and life satisfaction. Multimorbidity was negatively related to self-rated health and life satisfaction. On the other hand, physical activity was positively related to self-rated health and life satisfaction, thereby buffering the effect of multimorbidity on self-rated health and life satisfaction. In sum, physical activity moderates the effect of multimorbidity on self-rated health and life satisfaction.

What is already known on this topic

Subjective health expressed, as self-rated health, is associated with single chronic diseases and with multimorbidity. Those with chronic diseases and multimorbidity had lower self-rated health. Results from this study are in line with previous findings in literature.^{2,12,13} These results corroborate that self-rated health is a proxy of health biomarkers,¹ and a barometer of physiologic states,³ because it is sensitive to the presence of chronic diseases or multimorbidity. Self-rated health is correlated with socio-demographic factors.^{2,13} However, adjusting the analysis of the relationship between multimorbidity and self-rated health, for socio-demographic

Tables 2 Relationship between, chronic diseases and the presence of multimorbidity and self-rated health of European adults in 2014

<i>Chronic diseases and multimorbidity</i>	<i>Self-rated health</i>		<i>Life satisfaction</i>	
	<i>Mean ± SD</i>	<i>P</i>	<i>Mean ± SD</i>	<i>P</i>
Heart or circulation problems		<0.001		<0.001
No	3.96 ± 0.81		7.28 ± 2.07	
Yes	3.08 ± 0.90		6.62 ± 2.39	
High blood pressure		<0.001		<0.001
No	3.99 ± 0.82		7.29 ± 2.05	
Yes	3.35 ± 0.87		6.89 ± 2.33	
Diabetes		<0.001		<0.001
No	3.92 ± 0.84		7.24 ± 2.09	
Yes	3.09 ± 0.89		6.82 ± 2.38	
Obesity		<0.001		<0.001
No	3.95 ± 0.84		7.28 ± 2.07	
Yes	3.49 ± 0.87		6.90 ± 2.29	
Stomach/digestion problems		<0.001		<0.001
No	3.94 ± 0.84		7.27 ± 2.08	
Yes	3.59 ± 0.91		6.97 ± 2.21	
Breathing problems		<0.001		<0.001
No	3.93 ± 0.84		7.25 ± 2.08	
Yes	3.34 ± 0.96		6.88 ± 2.33	
Allergies		<0.001		0.964
No	3.89 ± 0.86		7.21 ± 2.11	
Yes	3.81 ± 0.87		7.27 ± 2.09	
Headaches		<0.001		<0.001
No	3.92 ± 0.84		7.30 ± 2.05	
Yes	3.64 ± 0.93		6.77 ± 2.37	
Cancer		<0.001		<0.001
No	3.93 ± 0.84		7.25 ± 2.08	
Yes	3.43 ± 0.95		6.93 ± 2.33	
Multimorbidity		<0.001		<0.001
No	4.08 ± 0.77		7.37 ± 2.00	
Yes	3.40 ± 0.89		6.86 ± 2.30	

Tested by ANCOVA.

SD, standard deviation.

Analysis were adjusted for sex, age, education, marital status, household income, occupation, living place, having children and household members.

factors, did not significantly modify the association. This reinforces the strong relationship between the two variables, independently of socio-demographic factors.

Literature shows that chronic diseases and multimorbidity are associated with lower life satisfaction.^{14,34} This was observed, in the present study, for all particular chronic diseases (except for allergies) and for multimorbidity, confirming that the presence of these diseases, or a cluster of these diseases, has a negative effect on subjective wellbeing. The observed negative relationship supports the fact that life satisfaction depends on the individual's health status.³⁵ This finding

depicts life satisfaction as an important health outcome used to characterize the population's health and wellbeing.^{5,36}

Regarding the relationship between physical activity, self-rated health and life satisfaction, this study's results provide evidence that regular physical activity is associated with better self-rated health and life satisfaction among adults. Previous studies have also demonstrated the positive relationship between these variables.^{18,19} The impact of physical activity on self-rated health and life satisfaction is observed even among people with chronic diseases,^{37,38} and exists across the spectra of both age and socioeconomic status.^{19,39}

Table 3 Main and interaction effect of multimorbidity and physical activity on self-rated health and life satisfaction of European adults in 2014

	<i>Self-rated health</i>		<i>Life satisfaction</i>	
	<i>Model 1</i> β (95% CI)	<i>Model 2</i> β (95% CI)	<i>Model 1</i> β (95% CI)	<i>Model 2</i> β (95% CI)
Multimorbidity ^a	-0.60 (-0.68, -0.64)*	-0.52 (-0.54, -0.50)*	-0.48 (-0.54, -0.42)*	-0.43 (-0.49, -0.37)*
Physical activity	0.05 (0.04, 0.05)*	0.04 (0.04, 0.05)*	0.07 (0.06, 0.09)*	0.07 (0.05, 0.08)*
Multimorbidity \times physical activity ^b	0.02 (0.02, 0.03)*	0.01 (0.00, 0.02)*	0.04 (0.02, 0.06)*	0.04 (0.02, 0.06)*

CI, confidence interval.

Model 1: Unadjusted analyses.

Model 2: Analyses were adjusted for sex, age, education, marital status, household income, occupation, living place, having children and household members.

* $P < 0.001$.

^aMultimorbidity enter into the model as a dummy variable.

^bPhysical activity was transformed using grand mean centring. The grand mean centring was achieved by taking each value of physical activity (times/week) and subtracting from it the mean of the total sample.

What this study adds

The identification of physical activity as a mediator between multimorbidity, self-rated health and life satisfaction is of importance because this moderation effect changes the slope of the negative relationship (i.e. physically active people with multimorbidity can have better self-rated health and life satisfaction than their non-active peers). Considering that self-rated health and life satisfaction are directly linked to mortality, health biomarkers and mental health outcomes,^{1,2,5} improving self-rated health and life satisfaction can result in improving general health status. This study's results offer potential targets for future public health interventions. In order to enhance overall physical and mental health status, both of which are strongly linked to self-rated health and life satisfaction, physical activity should be promoted. For those who are not physically active, even a minimum amount of physical activity has a protective health effect against chronic diseases and mortality.^{20–22}

Limitations of this study

A number of strengths and limitations should be kept in mind. The main strength of this study was the European Social Survey database, which includes a large and representative sample of adults from several European countries, as well as socio-demographic characteristics and numerous chronic diseases of the study sample. In view of the large sample and the heterogeneity of the participants, the generality of these results should be considered strengths of the study. The use of multimorbidity as a predictor variable is of importance, because multimorbidity is becoming progressively common,⁴⁰ and is an increasing burden for public health.⁴¹ On the other hand, there are some limitations that

should be acknowledged. The cross-sectional design implies that no causal inferences can be made. The current study cannot answer the question whether multimorbidity changes self-rated health and life satisfaction, or vice versa. Although the large and representative sample of adults contributes to the generalization of the results, when doing so and when designing public health interventions the cultural and socio-demographic differences across European countries should be taken into account. Notwithstanding, all the analyses were adjusted to socio-demographic characteristics. Multimorbidity was based on self-reports, and only nine chronic diseases were considered, albeit the major ones.⁴² However, studies have suggested that self-reported chronic disease is fairly to largely accurate for most diseases.⁴³ Physical activity was self-reported which could be subject to bias in terms of over- and under-estimation.⁴⁴ Nonetheless, self-reported physical activity is a reliable method for epidemiologic studies, and is still the mainstay of surveillance studies.⁴⁵ Considering that only nine chronic diseases were used to calculate multimorbidity, perhaps some participants classified as not suffering from multimorbidity could be included in this group if more diseases had been asked for. Nevertheless, the chronic diseases included in the study were the most prevalent ones. Finally, the European Social Survey had no data on whether individuals had mobility limitations or not. Therefore the analyses were not adjusted for mobility limitations.

Conclusion

Multimorbidity was negatively related to self-rated health and life satisfaction. Physical activity buffered these relationships, contributing to better self-rated health and life satisfaction,

even among European adults with multimorbidity. These findings offer potential targets for future public health interventions. Promoting physical activity, and thus improving self-rated health and life satisfaction in order to enhance overall physical and mental health status, is suggested to be an important intervention strategy.

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Conflicts of interest

The authors declare none conflict of interests.

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