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Original Research

How Europeans move: a moderate-to-vigorous physical activity and sitting time paradox in the European Union

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ABSTRACT

Objectives: This study aimed to assess the interactions between physical activity (PA) and sedentary behaviour in a large population taking account of major sociodemographic characteristics.
Study design: Cross-sectional population-based study.
Methods: Data from 28,031 individuals living in the European Union who were aged ≥15 years were retrieved from a cross-sectional survey, the Eurobarometer 2017. Interactions among the four mobility components (vigorous, moderate, walking activity and sitting time) were assessed at the individual level across age, gender and place of residence, and at the country level by compositional data analysis, hierarchical linear regressions and principal component analysis.
Results: The most frequently reported PA was walking; however, sitting time represented >95% of the reported weekly times, whereas moderate-to-vigorous PA (MVPA) represented <1%. Women reported less PA and sitting time, age decreased total PA and increased sitting time, and individuals living in large urban areas reported lower PA and higher sitting times. MVPA decreased with age ($\beta = -0.047$, $P < 0.001$) and was lower in women ($\beta = -0.760$, $P < 0.001$) and those living in large urban areas ($\beta = -0.581$, $P < 0.001$), while walking and sitting times increased with age, being higher in women and lower in those living in rural areas. At the country level, sitting time was positively associated with moderate activity ($\beta = 0.389$, $P = 0.041$) and marginally non-significant with MVPA ($\beta = 0.330$, $P = 0.087$).
Conclusions: Walking was the highest contributor to weekly PA, whereas sitting time was paradoxically associated with higher MVPA. Specific measures to reduce sitting time are required to achieve an active lifestyle.

Introduction

Promoting active lifestyles in the population has important benefits, such as improving health status and preventing premature deaths.[1–4] The World Health Organisation (WHO) physical activity (PA) guidelines, established to improve population health, recommend 75 min of vigorous activity per week, 150 min of moderate activity per week or any equivalent combination of both.[5] However, lower volumes of PA have also been shown to increase life expectancy and quality of life (e.g. only 92 min per week or 15 min per day in a non-linear relationship), while increasing intensity may result in additional benefits.[6] As such, the study of PA patterns and their dissemination into different volumes and intensities (vigorous, moderate, light and very light) leads to a better understanding of their health-related impacts, interactions and the conditions that promote or limit PA.

Global health programmes to promote active lifestyles should include strategies to reduce sedentary behaviour. Many authors have described sedentary behaviour as an independent health risk factor.[7–10] Higher total PA levels seem to slightly decrease the detrimental effects of sitting time on health, although these are not eliminated completely.[7–9,11,12] Despite the rising role of sedentary behaviour in public health research, the available evidence linking sitting time with PA is scarce, and further research is required across different population groups. Increasing PA and reducing sedentary behaviours could play a critical role in health status by improving physical fitness and increasing energy expenditure.[13–16] Nonetheless, it remains debatable whether reducing sitting time results in a substantive increase in health status.[17] One perspective is that decreasing sitting time may improve health status by

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replacing it for light or very-light PA, increasing overall energy expenditure through muscle activity and energy costs.[10,18]

However, the interaction between PA and sedentary behaviour has not been rigorously investigated in large populations or taking into account sociodemographic factors, such as age, gender or place of residence. For example, age groups may interact with each other to modulate health-related lifestyle behaviours (e.g. parents' PA and sitting time could influence their children's PA),[19,20] and the relationship between activity patterns may differ across age and gender. Thus, this study aimed to identify the relationship between vigorous PA, moderate PA, walking PA and sitting time to gain a better understanding of how these behaviours are distributed and interact.

A representative sample of the European population was used in this study from the Eurobarometer 88.4, a cross-sectional survey conducted in the 28 European Union country members in 2017.[21] Reference values for total weekly energy expenditure and daily sitting time across age and gender for the European population are provided. A detailed analysis was subsequently performed of the relationship of PA pattern and sitting time, using both individual- and country-level approaches by age, gender and place of residence.

Methods

The present study was conducted according to the STROBE Statement for cross-sectional studies.[22]

Data

This study used data retrieved from the cross-sectional survey of Eurobarometer 88.4.[21] The survey was conducted between 2 December and 11 December 2017 and involved participants aged ≥15 years from the 28 European Union Member States, with approximately 1000 participants per country and a total sample size of 28,031 (54.77% women). By using a multistage random sampling method, in an iterative process, the sampling points were systematically drawn in each country according to population size and density by individual unit and type of area stratification, as well as age, gender, region and size of the locality. Finally, one participant (aged ≥15 years) in each household was randomly selected to complete a face-to-face survey by trained interviewers.

Physical activity and sedentary behaviour assessment

The International Physical Activity Questionnaire (IPAQ) was employed to assess the PA level of the population.[23] The IPAQ measures PA in a typical week according to its frequency (in days) and duration (the average minutes per day) at three different intensities (vigorous, moderate and walking). The Eurobarometer categorised the duration of PA into the following intervals: 'Never do any vigorous (or moderate) physical activity or never walk for 10 min at a time'; '30 min or less'; '31–60 min'; '61–90 min'; '91–120 min'; and 'More than 120 min'. Therefore, we applied the median values of each interval to obtain a continuous value to compute PA weekly time (note: for participants who responded 'Never do any physical activity or walk for 10 min' or 'More than 120 min', the values of 0 and 135 min were used, respectively).

In addition, we computed weekly moderate-to-vigorous physical activity (MVPA) as the sum between vigorous and moderate activity, excluding walking (despite that it is also considered a moderate activity), and total health-enhancing physical activity (HEPA, also as total PA) as the sum of the three intensities. HEPA was also expressed in metabolic equivalent of tasks (METs) per week as a relative measure of energy expenditure from resting values for percentile quantification across age groups, as detailed in the 'Statistical analyses' subsection. Each minute of vigorous, moderate and walking activity corresponds to 8, 4, and 3.3 METs, respectively. Further information related to METs for different activities is provided elsewhere.[24,25]

Last, individuals were classified into active or inactive categories according to the WHO PA recommendations.[5] To be active, individuals must accomplish at least one of the following criteria: 150 min of moderate PA per week; 75 min of vigorous PA per week; or any equivalent combination of vigorous and moderate PA.

Sedentary behaviour was assessed as sitting time in minutes per day, using the IPAQ. Sitting time was categorised into intervals ranging from '1 h or less', '1 h and 1 min to 1 h and 30 min', with subsequent increments of 1 h until 'more than 8 h and 30 min'. The median sitting time in minutes per day was computed, using 540 min (9 h) as the upper limit.

Statistical analyses

First, descriptive statistics (mean ± standard deviation [SD]) were calculated for weekly vigorous PA, moderate PA, walking PA, MVPA and HEPA, as well as daily sitting time across sociodemographic factors (i.e. gender, six age groups, place of residence, compliance with PA guidelines and country). HEPA expressed in MET-min/week were also reported by gender and age groups as mean, SD and percentiles (5th, 10th, 25th, 50th, 75th, 90th and 95th).

Second, two different approaches were carried out at the individual- and country-level to assess PA patterns. In the individual approach, compositional data analysis was executed among MVPA, walking and sitting time to analyse absolute and relative contributions to weekly IPAQ-reported activity, as well as interactions among the different and exclusive behaviours.[26] We transformed daily sitting time to weekly time to unify all variables in a weekly scale. Thus, we computed the absolute contribution means of the three components by using the geometric means. Subsequently, we obtained isometric log ratios, also called pivot coordinates, which represent the contribution of a given behaviour with respect to the overall PA pattern. Because many individuals do not perform MVPA, 0 values were imputed by pseudo-zeros of 0.01 min per week to allow these calculations. Hierarchical linear regressions were then modelled using the isometric log ratios to examine how the contributions differ by age, gender and place of residence. The models included a random intercept for the country and a random slope to age (level 1) for countries (level 2), as individuals are nested in countries. These models were also used to address the variability between countries.

Furthermore, at the country level, multiple linear regression models were carried out using vigorous PA, moderate PA, walking PA and sitting time as outcomes, using the others as predictors and adjusting for mean age per country. MVPA was also modelled against walking and sitting time, as well as HEPA against sitting time. Robust linear regression was applied using an 'M' estimation when any assumption was violated. Moreover, to assess multivariate interactions, two principal component analyses were performed scaling to unit variance: first with three weekly PA components (vigorous, moderate and walking) and second, using MVPA, walking and daily sitting time.

Individuals with missing data in any of IPAQ's questions or illogical answers were removed (n = 8269; 29.50%). Illogical answers included participants who selected multiple categories; for example, participants who reported that they perform PA '1 or more days per week' and 'Never do physical activity' in the intensity component, or 'zero days per week' and 'more than zero minutes' in the duration questions. The statistical significance level was set at

5%, and all statistical analyses were run employing Rstudio version 3.6.1.

Results

Population levels of physical activity and sitting time

Table 1 shows descriptive statistics of the different PA intensities and daily sitting times by sociodemographic factors.

For the total study population, an increase in the frequency of volume of PA was associated with a reduction in intensity, with an MVPA of 247.13 ± 367.16 min/week and a HEPA of 447.40 ± 488.59 min/week, whereas sitting time was 302.74 ± 147.22 min/day.

In terms of gender, men reported more PA and sitting time than women, excluding days of walking, which were higher in women than men (4.44 ± 2.56 vs 4.34 ± 2.56 days).

Vigorous PA decreased as age increased. There was a small increase in moderate activity levels and walking activity with age, but these decreased considerably in those aged ≥65 years. MVPA and HEPA also decreased with age, whereas sitting time slowly increased from the age of 25 years (285.13 ± 151. min/day) to those aged ≥65 years (321.99 ± 141.46 min/day). Further descriptive results of physical activity and sitting time levels across age and gender are provided in the supplementary material (Fig. S1).

Regarding the place of residence, participants living in large urban environments showed the lowest vigorous and moderate PA patterns but more walking frequency compared with those living in small urban environments. Moreover, MVPA was slightly higher in rural areas, while HEPA was higher in small urban areas. Sitting time was higher in large urban environments, but this study found no differences in sitting time between rural and small urban places.

It is interesting to note that the difference in daily sitting time between participants with an active lifestyle and those with an inactive lifestyle is smaller than the differences observed between these two lifestyle groups in all other categories of physical activity type (see Table 1).

Descriptive results of physical activity and sitting time across the 28 European Union country members are presented in the supplementary material (Table S1).

The asymmetric distribution of HEPA energy expenditure percentiles showed that, regardless of age and gender, most European individuals reported a low level of total PA (Fig. 1, Tables S2 and S3). With increasing age, HEPA percentiles decrease in both genders. Furthermore, the percentiles for women in all age groups were lower than for men; that is, women are more inactive and perform less PA.

Interactions between physical activity, walking and sitting time

In a typical week, the absolute and relative mean contributions to the analysed activity pattern were 4.584 min (0.25%) of MVPA, 43.276 min (2.37%) of walking and 1782.15 min (97.38%) of sitting. Ternary plots showed a high proportion of sitting time (>90%) for all age groups. MVPA decreases with age in men, and there is a corresponding increase in sitting time (Fig. 2a). In contrast, MVPA levels are low for women in all age groups. However, women reported more walking activity than men. For women of all ages, increases in sitting time were associated with reductions in levels of walking. In terms of place of residence, rural areas showed lower walking and higher sitting times (Fig. 2b).

Hierarchical linear regression models at the individual level (Table 2) revealed that MVPA decreased with age and was lower in women and individuals living in large urban areas. Walking

Table 1
Descriptive results at the individual level of physical activity and sitting time by sociodemographic factors and active/inactive status in the European Union-28, 2017.

Sociodemographic factors and active/inactive status	n (%)	Vigorous PA		Moderate PA		Walking		MVPA	HEPA	Sitting
		Days	Weekly time	Days	Weekly time	Days	Weekly time	Weekly time	Total weekly time	Daily time
Overall	19,762 (100)	1.52 ± 2.04	110.87 ± 196.99	2.11 ± 2.40	136.27 ± 215.18	4.40 ± 2.56	200.26 ± 220.42	247.13 ± 367.16	447.40 ± 488.59	302.74 ± 147.22
Gender										
Men	9047 (45.78)	1.79 ± 2.13	139.47 ± 218.31	2.27 ± 2.39	152.74 ± 224.51	4.34 ± 2.56	203.03 ± 229.53	292.22 ± 397.90	495.25 ± 525.17	308.05 ± 146.17
Women	10,715 (54.22)	1.30 ± 1.95	87.71 ± 173.37	1.98 ± 2.40	122.35 ± 205.97	4.44 ± 2.56	197.93 ± 212.42	209.07 ± 334.36	407.00 ± 451.51	298.26 ± 147.96
Age group (years)										
15–24	1653 (8.36)	2.20 ± 2.05	154.19 ± 196.92	2.57 ± 2.24	150.23 ± 189.36	5.02 ± 2.26	220.53 ± 223.36	304.42 ± 339.43	524.95 ± 454.58	318.16 ± 148.04
25–34	2541 (12.86)	2.00 ± 2.13	146.89 ± 218.21	2.43 ± 2.38	162.77 ± 231.50	4.71 ± 2.43	216.89 ± 225.19	309.66 ± 400.25	526.55 ± 514.96	285.13 ± 151.47
35–44	3021 (15.29)	1.76 ± 2.08	132.31 ± 215.59	2.21 ± 2.35	149.39 ± 229.50	4.36 ± 2.51	199.09 ± 223.41	281.70 ± 402.50	480.79 ± 527.74	284.70 ± 149.12
45–54	3272 (16.56)	1.62 ± 2.09	120.58 ± 207.41	2.13 ± 2.38	139.64 ± 221.44	4.35 ± 2.56	202.23 ± 227.85	260.23 ± 379.90	462.46 ± 503.53	295.06 ± 150.06
55–64	3568 (18.05)	1.41 ± 2.03	104.55 ± 197.17	2.13 ± 2.44	142.12 ± 223.08	4.40 ± 2.54	208.34 ± 228.19	246.67 ± 376.02	455.01 ± 503.57	299.70 ± 144.37
≥65	5707 (28.88)	1.00 ± 1.83	69.31 ± 158.84	1.78 ± 2.41	107.88 ± 194.25	4.11 ± 2.69	181.42 ± 204.64	177.20 ± 311.46	358.61 ± 429.43	321.99 ± 141.46
Place of residence[a]										
Rural	5708 (28.88)	1.61 ± 2.15	121.12 ± 213.63	2.19 ± 2.46	146.95 ± 229.67	4.14 ± 2.66	189.60 ± 218.08	268.07 ± 397.16	457.67 ± 521.71	292.88 ± 146.96
Small urban	6525 (33.02)	1.56 ± 2.04	112.95 ± 196.63	2.20 ± 2.41	144.85 ± 223.20	4.32 ± 2.59	207.02 ± 231.67	257.80 ± 372.19	464.82 ± 502.22	295.59 ± 147.03
Large urban	7529 (38.10)	1.42 ± 1.96	101.29 ± 183.25	1.98 ± 2.33	120.73 ± 194.92	4.66 ± 2.44	202.49 ± 211.76	222.02 ± 336.41	424.51 ± 448.15	316.43 ± 146.57
Physical Activity status[b]										
Active	13,460 (68.11)	2.20 ± 2.15	162.17 ± 220.69	2.98 ± 2.40	197.53 ± 236.80	5.19 ± 2.10	272.59 ± 232.49	359.70 ± 397.51	632.29 ± 492.27	288.36 ± 139.32
Inactive	6302 (31.89)	0.07 ± 0.33	1.30 ± 5.93	0.28 ± 0.88	5.41 ± 17.08	2.69 ± 2.63	45.78 ± 43.38	6.71 ± 19.20	52.49 ± 45.23	333.48 ± 158.53

PA, physical activity; MVPA, moderate-to-vigorous physical activity; HEPA, health-enhancing physical activity.
[a] Residence place was classified according to European Commission.
[b] Physical status active or inactive was determined according to the WHO guidelines.

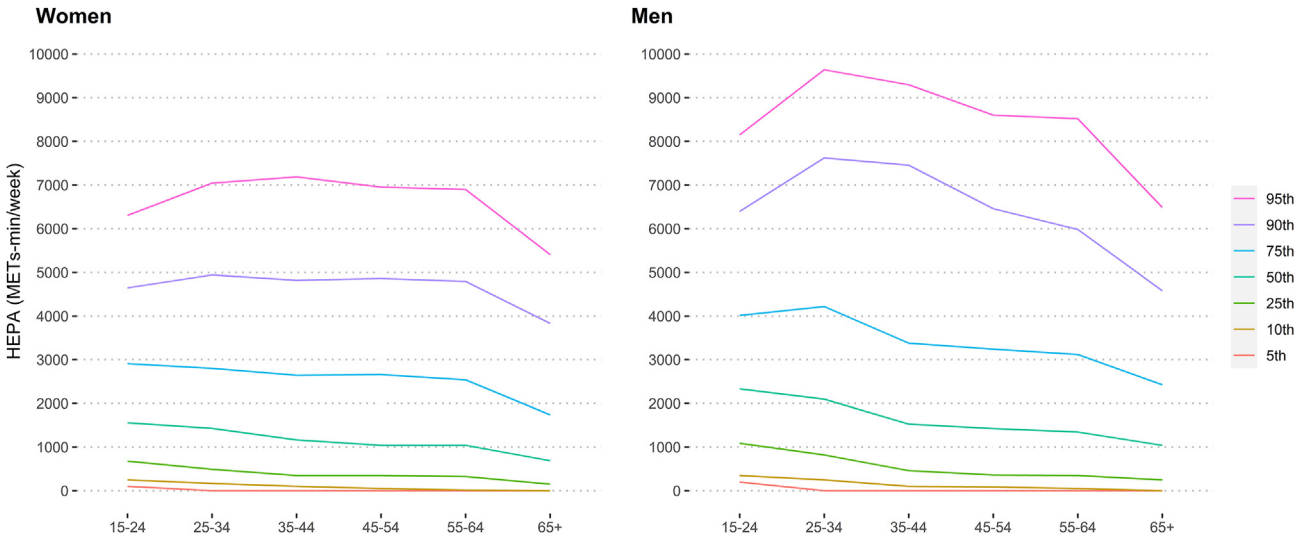

Fig. 1. Percentiles of Health-Enhancing Physical Activity (HEPA) across age groups and gender expressed as Weekly Metabolic Equivalents of Task (METs) in minutes. HEPA is the sum of vigorous, moderate and walking activity's METs. European Union-28, 2017.

increased with age and was higher in women and those living in small and large urban areas. Finally, sitting time also increased with age and was higher in women but lower in participants living in small urban areas.

At the country level (Table 3), the association between physical activity type and sitting time was analysed. Vigorous PA and moderate PA were associated, and walking was only associated with MVPA. Daily sitting time was not associated with total PA (HEPA) in the European population.

The principal component analysis among PA components (i.e. vigorous, moderate and walking activity) showed that all variables are towards the same direction (i.e. right, indicating higher activity), and moderate and vigorous PA are closely aligned (Fig. S2a). The second principal component analysis (Fig. S2b) showed that MVPA and walking activity behaviour are not inversely related with mean daily sitting time.

Discussion

We found that daily sitting time was paradoxically associated with HEPA as there are countries with high PA and sedentary behaviour, such as the Netherlands. In this study, sitting time is shown to be a persistent behaviour, whereas walking is the predominant PA type at the individual level, with higher volume and frequency compared with other types of PA. Consistent with other studies, walking contributes significantly to HEPA level.[27,28] This study also established that, at the country level, vigorous PA and moderate PA are strongly associated. However, the results of the compositional analysis showed that, on average, 97.38% of the reported weekly activity patterns were sitting time, and MVPA did not reach 1%. The current analyses revealed that sitting time could not be explained by changes in the amount of weekly PA pattern. This noteworthy finding indicates that sitting time is a very widespread behaviour and is not influenced by an increase in weekly PA.

The unexpected lack of association between sitting time and overall PA contradicts previous studies that have shown increased walking and MVPA levels to be associated with reduced sitting times.[29] As such, this study has observed an activity-sedentary paradox among European countries and populations. Furthermore, we must consider that there is little evidence of the combined impact of PA and sedentary behaviour on health. Some researchers have found that the harmful effects of sitting time can be offset by a high PA level (>35.5 MET-h/week);[30] although other authors have found that it can be only partially offset.[8,9,11] Therefore, future studies of PA should also include sedentary behaviours as an independent risk factor.

Moreover, age, gender and other sociodemographic factors impact daily PA,[31–33] but little is known about their influence on sitting time. This study has found that all types of PA decrease with age, whereas sitting time increases. In addition, being a woman or living in large urban areas are associated with a lower HEPA and higher sitting time. Rural areas also reported a higher proportion of sitting and a lower proportion of walking, showing a gradient from rural to large urban areas. Previous reports have described lower PA and higher sitting time in older adults, women and rural settings.[34–39] Place of residence and environmental factors that impact sitting time and light-intensity PA may become more relevant because leisure-time PA is socially biased, and it is not the main source of daily energy expenditure for the whole population.[40,41] Some studies have reported that changes in moderate-to-vigorous leisure-time PA levels do not always reduce obesity nor increase energy expenditure.[42] Also, most populations describe only modest contributions by these MVPAs to daily energy expenditure[41] and, according to the results of the current study, increased walking could improve PA in the European population.

These PA levels and differences among population groups may correspond to individual particularities, such as lack of motivation, lack of time, or work and family barriers and their characteristics (e.g. time of the day, venue, the social condition of the activity, among others).[43] However, social determinants and better living conditions (e.g. educational level, social class, income or gender equality), in particular, may help achieve the goal of increasing walking by means of daily commuting and other non-leisure PA.[27,44–49] Light PA may also contribute significantly to total daily PA because, at these intensities, the population can maintain large volumes of PA and, more importantly, can replace sitting time. Several experimental studies indicate that under prolonged and continuous sitting time, brief breaks to a standing position may counter adverse effects to the metabolism and breaks, including light PA, could even improve health status.[16,50,51]

Future research should analyse the combination of sedentary behaviour with PA using both experimental and epidemiological approaches. Current experimental research conducted on breaks

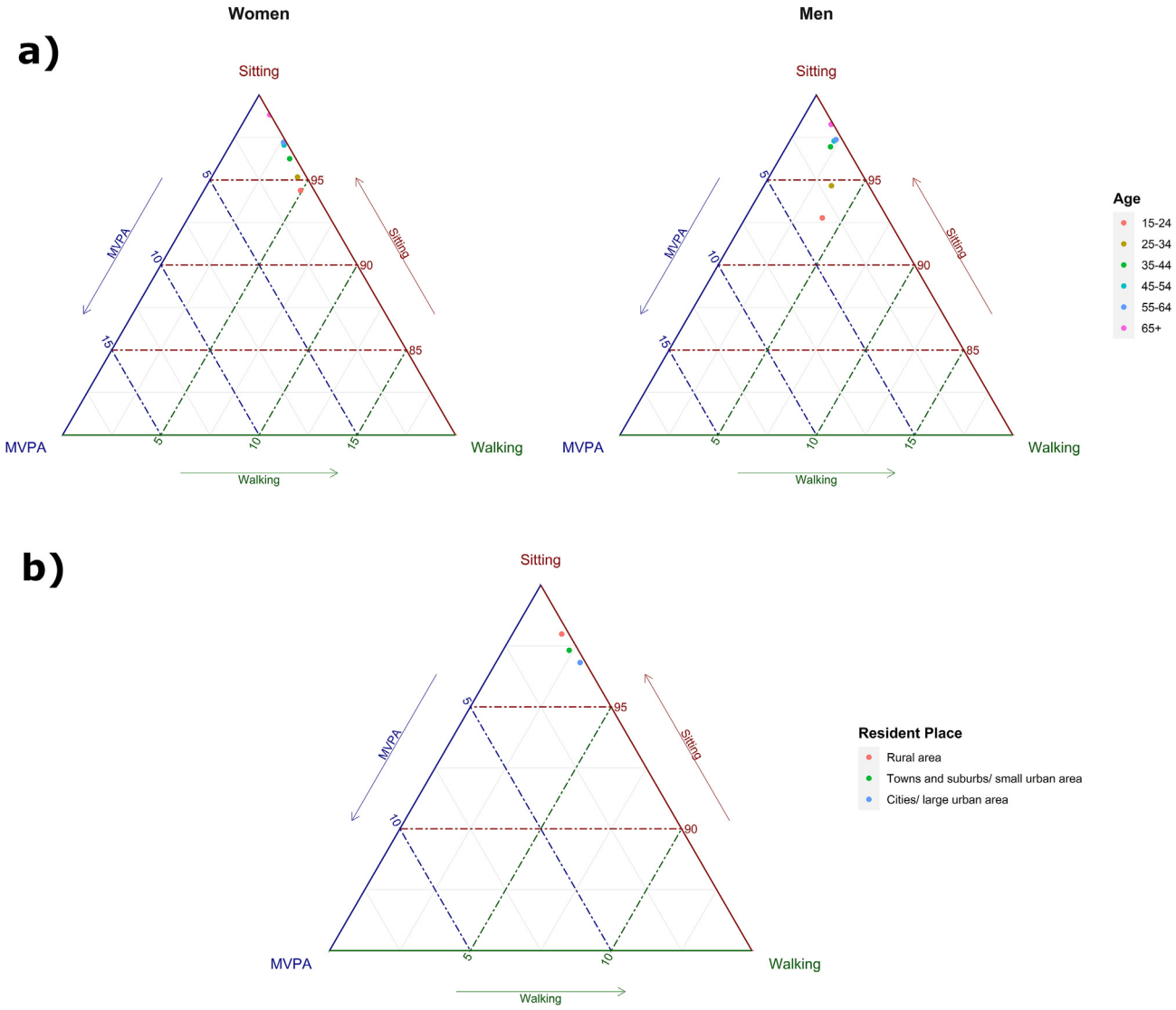

Fig. 2. Ternary plots of weekly compositional data analysis among moderate-to-vigorous physical activity (MVPA), walking and sitting total time in minutes across (a) age groups and gender, and (b) different places of residence. The residence place was classified according to European Commission. Points represent the centre using geometric means from each pattern component. European Union-28, 2017.

Table 2
Contributions to weekly activity and sociodemographic factors by age-adjusted hierarchical linear regression's unstandardised beta coefficients in the European Union-28, 2017.

Sociodemographic factor[a]	MVPA		Walking		Sitting	
	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value
Age	−0.047 (−0.053, −0.042)	<0.001	0.007 (0.003, 0.011)	0.002	0.041 (0.036, 0.045)	<0.001
Gender						
Women	−0.760 (−0.861, −0.658)	<0.001	0.431 (0.353, 0.508)	<0.001	0.329 (0.255, 0.404)	<0.001
Place of residence[b]						
Small urban	−0.089 (−0.223, 0.045)	0.192	0.291 (0.189, 0.393)	<0.001	−0.204 (−0.302, −0.106)	<0.001
Large urban	−0.581 (−0.711, −0.452)	<0.001	0.673 (0.574, 0.771)	<0.001	−0.094 (−0.189, 0.001)	0.053

CI, confidence interval; MVPA, moderate-to-vigorous physical activity.
[a] Reference groups were men and rural residence place.
[b] Residence place was classified according to European Commission.

during the sitting time are providing evidence about those 'sedentary' physiological pathways that can have harmful effects on health.[7,16,52] In addition, new epidemiological studies are showing how and why PA and sedentary behaviours are formed, their factors, determinants and correlates.[53]

The current study has some limitations. First, the cross-sectional study design excludes cause-effect implications. Second, the use of the IPAQ implies a subjective assessment based on memory and recall. The IPAQ was validated to evaluate PA in large samples, but its application tends to overestimate PA and underestimate sitting

Table 3
Associations between physical activity types and sitting time at the country level by age-adjusted multiple linear regression's unstandardised beta coefficients in the European Union-28, 2017.

Physical activity type	Vigorous PA		Moderate PA		Walking		Sitting		MVPA		HEPA	
	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value	β (95% CI)	*P*-Value
Vigorous PA			1.052 (0.748, 1.355)	<0.001	0.316 (−0.447, 1.079)	0.402	−0.359 (−1.139, 0.359)	0.316				
Moderate PA	0.646 (0.484, 0.808)	<0.001			0.586 (−0.003, 1.174)	0.050	0.538 (−0.016, 1.092)	0.072				
Walking	0.077 (−0.071, 0.225)	0.309	0.139 (−0.075, 0.353)	0.191			−0.135 (−0.440, 0.171)	0.400	1.183 (0.738, 1.627)	<0.001		
Sitting	−0.076 (−0.274, 0.122)	0.461	0.286 (0.011, 0.561)	0.042	−0.229 (−0646, 0.187)	0.300			0.708 (−0.097, 1.513)	0.082	0.951 (−0.855, 2.756)	0.289

CI, confidence interval; PA, physical activity; MVPA, moderate-to-vigorous physical activity; HEPA, health-enhancing physical activity.

time.[23] Additionally, self-reported PA assessments may undervalue the actual amount of activity energy expenditure on ill and old-aged populations, leading to profile misclassification (active/inactive).[54] The IPAQ's estimations also vary between countries[55] according to residence location, with lower validity results in rural populations.[56] Third, light PA (<3 METs) could not be measured by the IPAQ; hence, we used walking activity as a proxy. Therefore, compositional analysis of mobility patterns consisted of an incomplete spectrum of total weekly activity data, in addition to previous biases, such as duration interval. Last, other social determinants may alter activity and sedentary patterns as active prevalence and total PA. Education attainment, occupational social class, subjective social class and household incomes are strong social determinants, showing a descending social gradient of health and PA from high to low social status.[33,47,57,58] Nonetheless, the objective of this study was to provide an initial overview of PA patterns in Europe.

In summary, higher daily PA is not necessarily associated with lower sitting time. In fact, countries could present both high PA and sitting time. Sitting time appears to be a consistent behaviour across sociodemographic characteristics in European countries. The relationship between MVPA and sitting time differs across sociodemographic characteristics, such as age, gender and place of residence. Moreover, walking behaviour was the highest contributor to weekly PA, showing narrower sociodemographic differences among population groups. Public health policies should consider not only promoting PA, but also reducing sitting time because sitting time could not be explained by changes in PA patterns.

Author statements

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Ethical approval

Not applicable.

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Competing interests

The authors have no conflict of interest to declare.

Availability of data and materials

Data are from the GESIS Leibniz Institute for the Social Sciences.

Authors' contributors

A.M.L contributed to performing the study and data analysis. J.G.M contributed to performing the study. E.D.C.S participated in the design of the study and contributed to performing the study and data analysis. All authors contributed to the writing of the manuscript. All authors have read and approved the final version of the manuscript and agree with the order of the presentation of the authors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2021.11.016.

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