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Associations of Physical Activity and Built Environment in Older Adults: A Cross-Sectional Study in Six Countries as part of the FITOLD Project

Vânia Loureiro1, Adilson Marques2, Fortunata Ratinho1, Houshmand Masoumi3,4, Margarida Gomes1, Melika Mehriar3, Marija Rakovac5, Davor Šentija5, Andrzej Bahr6, Marta Tomczyk6, Wojciech Dynowski6, Roberto Solinas7, Maria Grazia Pirina7, Donatella Coradduzza8, Giannangelo Boccuzzi7, Birol Çağan9, Ahmet Dalcı10, Athanasios Papageorgiou11, Soultana Smaga11, Georgios Parisopoulos11, Georgios Patsakas11, Ioannis Meimaridis11, Nuno Loureiro1, João Martins2*

*** Correspondence: jmartins@fmh.ulisboa.pt (JM)**

1 Instituto Politécnico de Beja, 7800-295 Beja, Portugal; vloureiro@ipbeja.pt; margarida.gomes@ipbeja.pt ; fortunataratinhogdl@hotmail.com; nloureiro@ipbeja.pt;

2 Faculty of Human Kinetics, University of Lisbon, 1649-004, Lisboa, Portugal; amarques@fmh.ulisboa.pt; jmartins@fmh.ulisboa.pt

3 Technische Universität Berlin Germany - Center for Technology and Society, Kaiserin-Augusta-Alle, 104, Berlin, 10623, Germany; masoumi@ztg.tu-berlin.de; mehriar@ztg.tu-berlin.de

4 Department of Transport and Supply Chain Management, College of Business and Economics, University of Johannesburg, Kingsway Campus, Cnr Kingsway and University Road, Auckland Park, Johannesburg, South Africa.

5 University of Zagreb Faculty of Kinesiology, Horvaćanski zavoj 15, HR-10000 Zagreb, Croatia; marija.rakovac@kif.unizg.hr; davor.sentija@kif.unizg.hr

6 Cracow University of Technology, Sports and Recreation Centre, Ul. Kamienna 17, 30-001 Kraków, Poland; andrzej.bahr@pk.edu.pl; martatomczyk@pk.edu.pl; wojciech.dynowski@pk.edu.pl

7 Mine Vaganti NGO, Via del Vicolo del Fiore Bianco, 13/A, 07100, Sassari, Italy; president@minevaganti.org; mvngo.board@gmail.com; boccuzzi.giannangelo@gmail.com

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8 Department of Biomedical Sciences, University of Sassari, Viale San Pietro 43/B, 07100 Sassari, Italy. donatella.coradduzza0@gmail.com;
9 Spor Elcileri Dernegi (SPELL), Yakinca Mh. Kenan Işık Cad. No: 14 Yeşilyurt/Malatya, Turkiye; birolcagan@hotmail.com;
10 İnönü Univierstiy Hayriye Basdemir Middle school. Üzümlü, İnönü Ünv., 44000 Malatya Merkez/Malatya, Turkiye. dalciahmet@gmail.com
11 Northern Greece Physical Education Teachers' Association Northern Greece Physical Education Teachers' Association (EGVE). Proxenou Koromila 51, Thessaloniki, 546 22, Greece; apapageor1@gmail.com; soultanela@yahoo.gr; gipariso@outlook.com; geopat67@gmail.com; ihmeima@gmail.com

Abstract

Purpose: Physical activity (PA) is one of the key elements of healthy ageing. The present study aimed to explore the correlation between the time spent in different PA contexts and intensity levels and the dimensions of the Geographic Information Systems (GIS) among older adults living in six European countries. Methods: The sample consisted of 169 older adults living in Croatia, Greece, Italy, Portugal, Poland, and Turkey (mean age = 71.6±6.0, 61,3% female). PA measurements, level of intensity and context, were performed with the long form of the International Physical Activity Questionnaires (IPAQ). Based on the metabolic equivalent (MET) rates four domains of PA (Work, Transport, Domestic and Garden, and Leisure Time) were defined as continuous variables. Built environment variables were calculated by employing GIS to assess the relationship between street network configuration and PA. Results: Men spend more time doing PA at work and women more time in leisure-time (men: 875.2; 95% CI: 738.6, 1011.9; women: 1322.8; 95% CI: 1195.4, 1450.2; p<0.001). Higher levels of education were associated with more PA when commuting (1110.8, 95% CI: 1229.2, 1228.3), during leisure-time (1386.9, 95% CI: 1431.3, 1523.7) and total PA (4324.5, 95% CI: 3966.2, 4700.9). Total PA was related with GIS link node ratio (r=0.06, 95% CI: -0.03, 0.16) and transport PA with GIS length density (r=0.12, 95% CI: 0.02, 0.22). There was a negative and significant correlation between PA at work and GIS length density (r=-0.01, 95% CI: -0.10, 0.08). Conclusion: The PA promotion must be considered in healthy ageing programs and this study holds valuable implications for policymakers and urban planners, as it provides insights to enhance the BE and promote active living among older adults.

Key words: Exercise, MET, health, IPAQ, street connectivity

Introduction

The relationship between Physical activity (PA) and the built environment (BE) has acquired significant attention in recent years, particularly in the context of the older adult's population (Ding et al. 2014; Hawkesworth et al. 2018). Socioecological frameworks suggest that PA is influenced by complicated interactions between individual, social, and environmental factors (Sallis et al., 2006). The promotion of PA is dependent on the environment and the BE plays a crucial role in determining the opportunities and constraints for PA (Sallis et al., 1998).

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Engaging in regular PA has been associated with numerous health benefits for older adults, including improved cardiovascular fitness, reduced risk of chronic diseases, enhanced mental well-being, and increased longevity (Del Pozo Cruz et al., 2021; Lee et al., 2012; Mañas et al., 2019). On other hand, increasing PA is a public health priority mentioned in the "WHO Guidelines on Physical Activity and Sedentary Behaviour" and "WHO Package of Essential Noncommunicable (Pen) Disease Interventions for Primary Health Care" (WHO, 2020a, 2020b). Understanding the role of the BE in facilitating or obstruct PA among older adults is crucial for designing effective interventions and creating age-friendly communities that support active aging (Hawkesworth et al., 2018).
The WHO Age Friendly Cities distinguish the importance of the environment for improving health of older people (WHO, 2017). The BE is stated as the physical space of the environment which is human-made or modifiable and where people live and carry out their daily activities (Lenzi et al., 2013). The BE encompasses the physical features of neighborhoods, buildings (homes, workplaces), open spaces (parks, recreational facilities, and areas) and infrastructures (transportation systems, sidewalks) (Lenzi et al., 2013; WHO, 2017) that people interact with to undertake their daily activities. These elements can influence the opportunities and constraints for PA engagement among older adults. Research has shown that favorable BE characteristics, such as well-maintained sidewalks, accessible parks, and nearby recreational facilities, can promote PA among the elderly (Cerin et al., 2013; Van Cauwenberg et al., 2018). For example, having accessible walking paths and green spaces encourages walking, which is a popular and feasible form of PA among older adults (Cerin et al., 2013).
Contrarywise, unfavorable BE characteristics, such as inadequate pedestrian infrastructure, lack of recreational spaces, and unsafe neighborhoods, can impede PA engagement among older adults (Kerr et al., 2010; Salvo et al., 2018). Older adults may perceive their neighborhoods as unsafe, leading to reduced outdoor PA and increased sedentary behaviors (Bonaccorsi et al., 2020). Limited access to recreational facilities and transportation barriers can further limit opportunities for older adults to engage in physical activities (Ding et al., 2014).
Leisure-time PA refers to activities that individuals engage in during their free time for recreational purposes and health benefits. Research has consistently shown the positive effects of leisure-time PA on cardiovascular fitness, muscular strength, flexibility, and mental well-being in older adults (Garber et al., 2011; Reiner et al., 2013). Engaging in leisure activities such as walking, swimming, dancing, and participating in exercise classes not only promotes physical health but also provides opportunities for social interaction and enjoyment.
Occupational PA pertains to the physical activities performed as part of one's job or occupation. Many older adults continue to participate in the workforce, either through paid employment or volunteer work. Occupational PA can range from physically demanding tasks, such as manual labor or caregiving, to more sedentary occupations that require minimal physical effort. Understanding the impact of occupational PA on the health and well-being of aging workers is crucial for creating age-friendly work environments and promoting active aging in the workforce (Murphy et al., 2013; Proper et al., 2011).
Domestic PA encompasses the physical activities performed as part of daily household chores and responsibilities. Engaging in domestic tasks such as cleaning, cooking, gardening, and home maintenance can contribute to overall PA levels in older adults.

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Studies have shown that domestic PA can have positive effects on functional capacity, independence, and overall well-being in the elderly population (Prince et al., 2017).
Active transportation involves physical activities related to transportation, such as walking or cycling for commuting or running errands. Encouraging older adults to engage in active transportation can promote physical activity, reduce sedentary behavior, and improve cardiovascular health (Lachapelle et al., 2013; Sallis et al., 2012).
Research examining the associations between PA and the BE in the elderly population has yielded valuable insights. However, there is still a need for further exploration and understanding of the specific pathways through which the BE influences PA behaviors among older adults, particularly in less often studied countries and cities. In this study the focus will rely on the older adults living in a city in Croatia, Greece, Italy, Portugal, Poland Turkey. By unraveling these associations, policymakers, urban planners, and public health professionals can implement evidence-based strategies to create age-friendly environments that facilitate and promote PA among older adults. By adopting a similar methodology across less studies countries, this study will also add to the current body of exiting evidence on this topic.
The relationship between PA and the BE among older adults' population is a critical area of research and finding the associations between levels of PA in older adults´ and the attribute of the BE has the potential to advise interventions that support a healthy and active ageing. Therefore, this research aimed to study the correlation between the time spent in different PA contexts and levels of intensity and the dimensions of the Geographic Information Systems (GIS) among a sample of older adults living in six European countries.

Methods

Participants and study design

This cross-sectional study was conducted in 6 cities (Grândola, Krakow, Zagreb, Sassari, Thessaloniki, and Malatya) in 6 countries (Portugal, Poland, Croatia, Italy, Greece, and Turkey), within the scope of the "Interventions in the Elderly's Mobility Modes for Promotion of their Physical Activity and Fitness" (FITOLD) project. The FITOLD is an Erasmus+ Sport co-funded project by the European Union [Grant Agreement No 622623-EPP-1-2020-1-DESPO- SCP] that generally aims to provide up-to-date, inclusive, and geographically consistent resources for policy-making and awareness raising about the ways for enhancing PA of the elderly living on lower-income southern and Mediterranean countries, on which fewer studies have been conducted. The FITOLD project involves academic and non-governmental organization partners of the above-mentioned countries.
In each country, a convenience sample of people aged 60 or more years was considered to take part in the study and contacted through the network of the project members. For example, the respondents were randomly invited from the members of seniors' clubs, sports/fitness clubs, and/or health centres. The recruitment and selection processes were performed using the following eligibility criteria: (1) an age of 60 years old or older, (2) with stable and/or controlled health condition, (3) the ability to understand and execute instructions; (4) independent gait without the use of gait aid (e.g., walkers). The exclusion criteria were the following: (1) not having a controlled/stable health situation; (2) diminished physical/cognitive abilities that hampered participation; (3) visual or auditive impairments; (4) living in collective residences (e.g., nursing care

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homes; hospices); (5) potential risk of falls (1 or more falls during the last year); (6) not meeting inclusion criteria; and (7) declined to participate. In the first approach, participants were only included in the research if they state that they understand and consented by signing an informed consent and meeting the inclusion criteria. In a welcoming environment, seniors were provided sufficient time to analyse and decide whether to participate or not, in the study. Then, after understanding and accepting, a brief screening of health risks for exercise was performed. If the senior did not meet the criteria, was excluded from the study. All procedures were per the ethical standards of the 1964 Helsinki Declaration and its later amendments. The project had ethical approval from the FMH ethics committee (nº 22/21).

The data presented in this study were collected in the baseline phase of the project, via face-to-face interviews, with research team members of each country partner, with data being registered in a paper format questionnaire. The results were later translated into a computer form (excel file) and transferred into an SPSS file. The data collection phase of the data to be used in this study occurred between February and April of 2022.

Measures

marital status was collected by using the same questions of the European Social Survey Questionnaire. The European Social Survey is a biennial cross-national survey on behaviours and attitudes that started in 2001. Specifically, the education level of the participants was collected by using the question: "About how many years of education have you completed, whether full-time or part-time? Please report these in full-time equivalents and include compulsory years of schooling." The adapted answer options were: 1) up to 9 years, 2) 10-12 years, and 3) More than 12 years. Regarding marital status, the question used was: "What is your current marital status?". The answer options were as follows: single, divorced, married/living with my partner, or widow. Self-perceived health was measured with the questions: "How is your health in general?" options varied and were provided on a 5 point-Likert scale ranging from very good to very bad.

Physical activity. The International Physical Activity Questionnaire (IPAQ) Long Form was used to collect data on the PA levels of seniors (Craig et al., 2003). The questionnaire assesses four domains of PA (work-related, transport-related, domestic and gardening, and leisure-time PA) within the previous seven days. The 27 items provide domain-specific scores for walking, moderate-intensity, and vigorous-intensity activities in each of the four domains. The results are presented as continuous physical activity scores (IPAQ group. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ). 2005. Available from: https://sites.google.com/view/ipaq/score). The calculated scores were PA in the work domain, PA in the transportation domain, PA in the domestic domain, PA in the leisure-time domain, and overall total PA, all expressed in MET-min/week (metabolic equivalent-minutes per week). Total sitting in minutes/week was also presented.

Built environment-related variables. The BE variables were calculated by employing GIS to assess the relationship between street network configuration and active mobility (physical activity). For calculating BE variables, the nearest intersections to participants' homes were pinned by helping interviewers in Google Maps (kmz). The closest intersection to home was selected instead of the exacting place to respect the privacy of participants in the survey. Then, pinpoints were converted to shapefiles in ArcMap. The shapefiles of the street network of six European cities including Cracow, Zagreb,

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Grândola, Malatya, Thessaloniki, and Sassari were downloaded from OpenStreetMap. Then, disaggregated link-node ratio, link density, intersection density, and street-length density were calculated in ArcMap. All calculations were done in the 600-meter catchment area around homes based on the street network to have a higher quality of estimation in comparison with aggregated data and circular buffer around the living place of respondents. The 600-meter is considered according to transportation literature for the catchment area (Mehriar et al., 2021; Mehriar et al., 2020). In sum, the following GIS variables were obtained:

- Link-node ratio (continues) - The link-node ratio is the proportion of the number of streets to the number of intersections in the catchment area for each participant who pinned the home.
- Link density (continues) (link/m²) - Link density was calculated according to the proportion of the number of streets to the area of the catchment area for each pinpoint.
- Intersection density (continuous) (node/m²) - The total number of intersections was divided into the area of the catchment area for each home.
- Street-length density (continuous) (m/m²) - Street-length density was obtained from the division of the sum of street length into the area of the catchment area.

For calculating the above-motioned variables different analytical tools were used in ArcMap 10.4 including spatial analyst tools and network analyst extension (service area).

Data analysis

Descriptive statistics were calculated for all variables. Percentages for categorical variables and mean with a confidence interval for continuous variables.

The analysis of the relationship between the time spent in physical activities in different contexts and at different levels of intensity with sex, level of education and marital status was calculated with the T-test for independent samples and by ANOVA. The correlation between the time spent in physical activities in different contexts and at different levels of intensity and the dimensions of the GIS, was used Pearson's R correlation coefficient. A binary logistic regression model was used to analyse the relationship between GIS and high intensity PA. The regression model was adjusted for country, sex, and age. For data analysis, it was used SPSS 28. The p-value was set at 0.05.

Results

Table 1 presents the descriptive characteristics of the sample. The number of women (61.3%; 95% CI: 58.3, 64.3) is higher than that men (38.7; 95% CI: 35.7, 41.7). Most participants had a high level of education (50.6; 95% CI: 47.6, 53.7) and lived with a partner 63.4; 95% CI: 60.4, 66.3).

***** Table 1 *****

Table 2 presents the relationship between the time spent in PA in different contexts and at different levels of intensity and gender. Men spend significantly more time than women doing PA at work (men: 380.3, 95% CI: 214.7, 545.9; women: 131.7, 95% CI: 70.8, 192.5; p=0.003). On the other hand, women spend significantly more time than men in PA at leisure-time (men: 875.2; 95% CI: 738.6, 1011.9; women: 1322.8; 95% CI: 1195.4, 1450.2; p<0.001).

Participants with higher levels of education practised more PA when commuting (1110.8, 95% CI: 1229.2, 1228.3), during leisure time (1386.9, 95% CI: 1431.3, 1523.7) and

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total PA (4324.5, 95% CI: 3966.2, 4700.9) than those with lower level of education. Participants with intermediate level of education spend more time on sedentary behavior (sitting) than participants with high and low level (1855.9, 95% CI: 767.3, 1948.5).
Analysing the relationship between PA and marital status, the divorced group spent more time in PA during leisure time (1616.7, 95% CI: 1258.4, 1975.0). Regarding time spent sitting in sedentary behaviour, participants who lived with a partner spent more time (1820.9, 95% CI: 1758.4, 1883.3) than the other groups.

***** Tables 2a, 2b and 2c*****

The correlation between levels of PA in different contexts and at different levels of intensity and the GIS is shown in Table 3. A positive and significant relationship was verified between total PA and the GIS Link node ratio (r=0.06, 95% CI: -0.03, 0.16), and PA in transport and the GIS Length density (r=0.12, 95% CI: 0.02, 0.22). On the other hand, there was a negative and significant correlation between PA at work and GIS Length density (r=-0.01, 95% CI: -0.10, 0.08).

***** Table 3 *****

The relationship between intense PA and GIS is shown in Table 4. The GIS Link node ratio increased the likelihood of participants engaging in more intense PA (OR: 2.02, 95% CI: 1.25, 3.29).

***** Table 4 *****

Discussion

This study aimed to investigate the relationship between the amount of time that older adults spent in different PA contexts and intensity levels, along with the dimensions of the GIS, across six European countries. Our results indicated that women tend to spend more time in leisure PA; higher levels of education were associated with engagement in PA domains such as commuting, leisure-time and total PA; and PA was significant related with GIS variables (link node ratio and length density).
The findings indicate gender differences, with men spending significantly more time engaging in PA at work (380.3, 95% CI: 214.7, 545.9), whereas women tend to spend more time in leisure PA (1322.8; 95% CI: 1195.4, 1450.2). The identified gender differences in the study's findings highlight distinct patterns of PA engagement among men and women. These findings diverge from Stalling et al. (2020) studies in which women reported spending an average of 35.9 minutes per day in active leisure activities, while men reported spending 41.9 minutes per day.
Our study reveal a significant association between higher levels of education and increased engagement in PA across multiple domains such during their commute (1110.8, 95% CI: 1229.2, 1228.3), leisure time (1386.9, 95% CI: 1431.3, 1523.7), and overall total PA (4324.5, 95% CI: 3966.2, 4700.9). One study (Sousa et al., 2021) reveal that among 9896 elderly participants, those with higher educational levels had a higher prevalence of participation in PA. Individuals with higher levels of education often have greater knowledge and awareness of the benefits of PA, as well as the resources and opportunities to engage in such activities. Regarding the duration of sedentary

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behaviour, sitting time, our study identified that individuals with intermediate education level (1855.9, 95% CI: 767.3, 1948.5) tended to engage in such activities for a longer period compared to those with higher or lower levels of education. The systematic review conducted by do Carmo et al (2019) supports our findings, as it suggests an inverse association between the level of education and the amount of time spent in sedentary activities. Additionally, individuals with higher education levels may have access to more diverse and engaging opportunities for PA, reducing their dependence on sedentary activities.

The correlation between levels of PA in various contexts and at different intensity levels and the GIS indicate a positive and significant relationship between total PA and the GIS link node ratio (r = 0.06, 95% CI: -0.03, 0.16), and between transport PA and the GIS length density (r = 0.12, 95% CI: 0.02, 0.22). These findings suggest that there is a relation between the levels of PA and certain aspects of the BE. Specifically, a higher link node ratio is associated with increased total PA, indicating that the presence of more interconnected nodes in the environment may facilitate PA engagement. One study (Moogoor et al., 2022) showed that themes on everyday movements and destination nodes offer opportunities for both PA and social participation. Similarly, a higher length density is positively correlated with PA during transport, suggesting that areas with denser road networks or pathways may encourage individuals to engage in more active transportation modes.

In the same sense, our results show that a greater number of interconnected nodes is associated with a higher probability of individuals participate in higher intensity PA (OR: 2.02, 95% CI: 1.25, 3.29). This suggests that the presence of more interconnected nodes in the environment, provide convenient access to various destinations, and contributes to create opportunities for and facilitating participation in PA that require greater effort and intensity. The investigation conducted by Barnett et al. (2017) support the idea that access to overall and specific destinations and services has a positive influence on the participation of older adults in PA. The study highlights the importance of creating an environment that offers convenient access to various destinations and services, which in turn encourages and facilitates PA engagement among older adults.

The present study has some aspects that we consider relevant and should be stated. First, it can inform urban planning and design strategies to create age-friendly environments that promote PA among older adults. By identifying areas with low activity levels, interventions such as the development of accessible parks, walking paths, and community centres can be implemented to encourage active lifestyles. Secondly, the findings can contribute to the design of targeted interventions and programs that focus on increasing PA among older adults. Understanding the specific contexts and levels of intensity where older adults are active (more or less) can help design tailored interventions to their preferences and needs, and ultimately improve their overall health and well-being. Moreover, this research can contribute to the existing literature on PA and healthy aging, providing valuable insights into cross-national variations in older adults' activity patterns.

This study also has limitations. First, cross-sectional data did not consent us to draw conclusions about the causality of the observed relationship. Second, PA contexts and intensity levels were assessed using a self-reported questionnaire. A significant amount of random error in self-reports of PA might have affected our results. Despite that, IPAQ-

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long form is an internationally comparable measure that has been widely used in epidemiological research.

Conclusion

This study holds valuable implications for policymakers and urban planners, as it provides insights to enhance the BE and promote active living among older adults. By understanding the correlations between PA, GIS variables, and different contexts, policymakers and urban planners can make informed decisions to create environments that support and encourage PA engagement among older adults, resulting in a heathy ageing.

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Conflict of Interest

The authors declare no financial or other conflicts of interests.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Faculty of Human Kinetics (nº22/2021) for studies involving humans.

Informed Consent Statement

Any research article describing a study involving humans should contain this statement. Please add "Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

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Tables

Table 1 Sociodemographic, Physical activity and GIS characteristics.

Variable / category	% or mean (95% CI)
Sex (%)	
Men	38.7 (35.7, 41.7)
Women	61.3 (58.3, 64.3)
Age	71.6 (80.0, 72.1)
Country (%)	
Croatia	20.5 (18.0, 23.0)
Greece	19.9 (17.5, 22.4)
Italy	20.0 (17.5, 22.5)
Portugal	9.2 (7.4, 11.0)
Poland	16.7 (14.4, 19.0)
Turkey	13.7 (11.6, 15.8)
Education (%)	
Upt to 9 years	21.0 (18.5, 23.5)
10-12 years	28.3 (25.5, 31.1)
Higher education	50.6 (47.6, 53.7)
Marital status (%)	
Single	4.1 (2.9, 5.3)
Divorced	9.2 (7.5, 11.0)
Living with my partner	63.4 (60.4, 66.3)
Widow	23.3 (20.7, 25.9)
Self-rated health	2.3 (2.2, 2.3)
IPAQ	
Work Domain (MET-min/week)	300.1 (173.6, 456.5)
Transportation _Domain (MET-min/week)	1113.9 (987.6, 1240.2)
Domestic Domain (MET-min/week)	2129.9 (1774.3, 2485.6)
Leisure (MET-min/week)	1271.1 (1126.2, 1415.9)
Total PA (MET-min/week)	4814.9 (4331.9, 5298.0)
Total Sitting (min/week)	1696.4 (1626.0, 1766.9)
IPAQ categories	
Low	10.9 (8.7, 13.1)
Moderate	12.2 (9.9, 14.5)
High	76.9 (73.9, 79.8)
BE variables - GIS	
Length density	2.6 (2.3, 2.8)
Link density	3.0 (2.8, 3.2)
Intersection density	2.6 (2.4, 2.9)
Link node ratio	2.0 (1.9, 2.0)

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Table 2a. Relationship between the time spent in physical activity in different contexts and levels of intensity and gender.

IPAQ	Sex Mean (95% CI)		
	Men	Women	*p*
Work (MET-min week^{-1})	380.3 (214.7, 545.9)	131.7 (70.8, 192.5)	0,003
Transport (MET-min week^{-1})	947.2 (800.9, 1093.5)	1016.5 (921.1, 1111.9)	0,218
Domestic and Garden (MET-min week^{-1})	1895.8 (1505.2, 2286.3)	1581.1 (1376.4, 1785.8)	0,080
Leisure (MET-min week^{-1})	875.2 (738.6, 1011.9)	1322.8 (1195.4, 1450.2)	<0.001
Total PA (MET-min week^{-1})	3950.5 (3405.3, 4495.8)	4013.8 (3701.4, 4326.3)	0,843
Total Sitting (min/week)	1773.0 (1695.7, 1850.3)	1758.5 (1696.2, 1820.7)	0,775

1 Tested by independent sample T-test

Table 2b. Relationship between the time spent in physical activity in different contexts and levels of intensity and education.

IPAQ	Education % (95% CI)			
	Up to 9 years	10-12 years	Higher education	p
Work (MET-min week^{-1})	274.3 (1056.8, 440.9)	161.8 (955.4, 280.1)	233.5 (1123.5, 336.8)	0,539
Transport (MET-min week^{-1})	718.7 (1006.9, 899.9)	917.0 (996.3, 1046.5)	1110.8 (1229.2, 1228.3)	0,002
Domestic and Garden (MET-min week^{-1})	2080.0 (3540.2, 2717.2)	1569.5 (2445.1, 1887.1)	1649.2 (2568.8, 1894.7)	0,217
Leisure (MET-min week^{-1})	647.7 (1015.5, 830.5)	1024.8 (1316.7, 1195.9)	1386.9 (1431.3, 1523.7)	<0.001
Total PA (MET-min week^{-1})	3611.7 (4586.4, 4430.3)	3580.3 (3680.3, 4053.3)	4324.5 (3966.2, 4700.9)	0,037
Total Sitting (min/week)	1574.4 (808.4, 1689.4)	1855.9 (767.3, 1948.5)	1788.3 (722.8, 1852.8)	<0.001

Tested by ANOVA

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Table 2c. Table 2b. Relationship between the time spent in physical activity in different contexts and levels of intensity and marital status

IPAQ	Marital status % (95% CI)				
	Single	**Divorced**	**Living with my partner**	**Widow**	***p***
Work (MET-min $week^{-1}$)	162.8, (-101.7, 427.3)	289.8, (85.4, 494.2)	224.7, (143.3, 306.1)	189.7, (1.8, 377.5)	0,884
Transport (MET-min $week^{-1}$)	864.3, (540.2, 1188.4)	1245.9, (998.1, 1493.7)	937.3, (833.6, 1041.0)	1051.8, (886.8, 1216.8)	0,129
Domestic and Garden (MET-min $week^{-1}$)	1187.2, (556.7, 1817.7)	1919.9, (1351.3, 2488.4)	1753.0, (1505.4, 2000.5)	1542.6, (1139.1, 1946.2)	0,485
Leisure (MET-min $week^{-1}$)	1495.2, (1020.2, 1970.3)	1616.7, (1258.4, 1975.0)	1000.5, (890.1, 1110.9)	1340.2 (1118.3, 1562.0)	<0.001
Total PA (MET-min $week^{-1}$)	3590.0, (2584.5, 4595.5)	5018.2, (4080.6, 5955.9)	3821.3, (3479.6, 4163.1)	4089.4, (3455.6, 4723.2)	0,102
Total Sitting (min/week)	1689.0, (1422.2, 1955.9)	1627.1, (1473.1, 1781.1)	1820.9, (1758.4, 1883.3)	1682.3, (1590.3, 1774.4)	0,026

Tested by ANOVA

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Table 3. The correlation between IPAQ dimensions and GIS related variables.

IPAQ	BE variables (GIS)	Correlation (95% CI)	*p*
Domestic and Garden (MET-min week^{-1})	Length density	0.09, (-0.01, 0.18)	0,859
	Link density	-0.06, (-0.16, 0.04)	0,112
	Intersection density	-0.04, (-0.14, 0.06)	0,478
	Link node ratio	-0.06, (-0.16, 0.04)	0,737
Leisure (MET-min week^{-1})	Length density	0.09, (-0.01, 0.19)	0,018
	Link density	0.07, (-0.03, 0.16)	0,580
	Intersection density	0.00, (-0.10, 0.10)	0,084
	Link node ratio	0.25, (0.16, 0.34)	0,182
Total Sitting Time (min/week)	Length density	-0.13, (-0.22, -0.05)	0,086
	Link density	0.01, (-0.08, 0.09)	0,221
	Intersection density	0.01, (-0.07, 0.10)	0,387
	Link node ratio	0.05, (-0.03, 0.14)	0,259
Total PA (MET-min week^{-1})	Length density	0.11, (0.02, 0.21)	0,079
	Link density	-0.02, (-0.12, 0.08)	0,190
	Intersection density	0.02, (-0.08, 0.12)	0,985
	Link node ratio	0.06, (-0.03, 0.16)	<0.001
Transport (MET-min week^{-1})	Length density	0.12, (0.02, 0.22)	0,023
	Link density	0.03, (-0.07, 0.13)	0,686
	Intersection density	0.09, (-0.01, 0.18)	0,669
	Link node ratio	0.07, (-0.03, 0.17)	0,208
Work (MET-min week^{-1})	Length density	-0.01, (-0.10, 0.08)	0,003
	Link density	-0.08, (-0.17, 0.02)	0,853
	Intersection density	0.03, (-0.06, 0.13)	0,763
	Link node ratio	-0.02, (-0.11, 0.08)	0,223

Tested by Pearson correlation coefficient

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Table 4. Binary logistic regression to explain the "high" category of IPAQ.

BE variables - GIS	**OR (95% CI)**	***p***
Length density	1.04 (0.92, 1.18)	0,493
Link density	0.89 (0.78, 1.02)	0,092
Intersection density	1.05 (0.91, 1.20)	0,510
Link node ratio	2.02 (1.25, 3.29)	0,004

Abbreviation: CI, confidence interval; OR, odds ratio
Analysis adjusted for country, gender and age.

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