Development and validation of the physical activity questionnaire for adults aged 65 and older (PAQ-EA): a comprehensive assessment tool

Desarrollo y validación del cuestionario de actividad física para adultos de 65 años y mayores (PAQ-EA): herramienta de evaluación integral

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Received: 10-06-25
Accepted: 10-10-25

How to cite in APA

Ferrer-Ramos, P., Serra-Payá, N., Garnacho-Castaño, M. V., Faundez-Zanuy, M., Serra-Prat, M., Palomera, E., & Girabent-Farrés, M. (2026). Development and validation of the physical activity questionnaire for adults aged 65 and older (PAQ-EA): a comprehensive assessment tool. *Retos, 74*, 96-108. https://doi.org/10.47197/retos.v74.116558

Abstract

Introduction: Physical activity is vital for healthy ageing, reducing risks of sarcopenia, frailty, and chronic diseases, while enhancing overall well-being. However, few validated tools comprehensively assess physical activity patterns in adults over 65, especially within social and familial contexts.
Objective: To develop and validate the Physical Activity Questionnaire for Elderly Adults (PAQ-EA).
Methodology: The PAQ-EA was developed using the Delphi method, involving a panel of 8 experts. The resulting 9-item questionnaire assesses physical activity across various intensities and domains, including sedentary behaviour. Reliability was evaluated in a sample of 140 participants (mean age 79.59 ± 5.60 years) using a one-week test–retest procedure. Intraclass correlation coefficients were used to determine reliability. Concurrent validity was assessed by comparing results with physical performance tests.
Results: The PAQ-EA demonstrated good to excellent reliability (ICC 0.560 to 0.985) and showed strong internal consistency (Cronbach's alpha = 0.875). Significant correlations were observed between PAQ-EA scores and physical performance measures, with sedentary behaviour associated with poorer functional outcomes.
Discussion: The PAQ-EA demonstrated good validity and reliability, distinguishing itself by assessing activity across social, familial, and solitary contexts. Although lower intensities were observed in familial and social activities, their relevance to overall wellbeing was highlighted. The inclusion of sedentary time and basic daily activities aligns with current evidence linking these factors to disease prevention and the mitigation of functional decline in older adults.
Conclusions: The PAQ-EA is a valid, reliable tool for assessing physical activity in older adults, incorporating crucial social and familial contexts.

Keywords

Active lifestyle; elderly people; healthy ageing; met; test-retest reliability.

Resumen

Introducción: La actividad física es fundamental para un envejecimiento saludable, ya que reduce riesgos como sarcopenia, fragilidad, enfermedades crónicas y mejora el bienestar. Sin embargo, existen pocas herramientas validadas que evalúen de manera integral los patrones de actividad física en adultos mayores de 65 años, especialmente en contextos sociales y familiares.
Objetivo: Desarrollar y validar el Cuestionario de Actividad Física para Adultos Mayores (PAQ-EA).
Metodología: El PAQ-EA se diseñó mediante el método Delphi, con un panel de 8 expertos. El cuestionario consta de 9 ítems que evalúan la actividad física en diferentes intensidades y dominios, incluyendo el comportamiento sedentario. La fiabilidad se analizó en una muestra de 140 participantes (edad media 79.59 ± 5.60 años) mediante un test-retest, utilizando coeficientes de correlación intraclase. Para evaluar la validez concurrente, se compararon las puntuaciones con pruebas de desempeño físico.
Resultados: El PAQ-EA presentó una fiabilidad de buena a excelente (ICC 0.560 a 0.985) y una consistencia interna considerada buena (α de Cronbach = 0.875). Se hallaron correlaciones significativas entre las puntuaciones del cuestionario y el rendimiento físico, observándose que mayor tiempo sedentario se relaciona con peor desempeño funcional.
Discusión: El PAQ-EA demostró una buena validez y fiabilidad, evaluando también la actividad en contextos sociales, familiares y solitarios. Se identificaron intensidades más bajas en actividades familiares y sociales, aunque relevantes para el bienestar. La inclusión del tiempo sedentario y de actividades básicas cotidianas refuerza su vínculo con la prevención del deterioro funcional en adultos mayores.
Conclusión: El PAQ-EA es una herramienta válida y fiable para la evaluación de la actividad física en adultos mayores, incorporando contextos clave.

Palabras clave

Estilo de vida activo; envejecimiento saludable; fiabilidad test-retest; met; personas mayores.

Introduction

Physical activity and exercise are closely related to healthy ageing and has a wide spectrum of health benefits, such as reducing all-cause mortality, reducing chronic diseases (both physical and mental), decreasing risk of premature death, as well as improving cardiovascular health, functional independence, and overall well-being (Mora & Valencia, 2018; Schuch & Vancampfort, 2021; Susanto et al., 2024). In addition, physical exercise is an effective and accessible strategy to support brain health in older adults with mild cognitive impairment or at risk of dementia, offering functional and biological benefits (Bustos Barahona et al., 2025).

As people age, physiological ageing occurs, which is associated with the loss of lean muscle mass and an increase in fat deposits, a process known as sarcopenia (Eckstrom et al., 2020). This process can lead to an increased obesity rate in older adults, negatively impacting people's health. A reduction in muscle mass not only alters strength and locomotion but also affects energy expenditure, insulin sensitivity, and metabolic health, while serving as the body's main protein reservoir (Colleluori & Villareal, 2021). Another consequence of ageing is the decline in physical activity and exercise levels, accompanied by an increase in inactivity and sedentary behaviour. This contributes to higher levels of sarcopenia and may lead to frailty. Frailty was defined by Fried et al. (2004) as a physiological state of increased vulnerability to stressors, resulting from a decrease in physiological reserves and even the deregulation of multiple physiological systems. Maintaining high levels of physical activity is associated with better mental health, reduced anxiety and depression, improved cognitive function in dementia, enhanced mobility, lower risk of sarcopenia, osteoporosis and falls, reduced chronic pain, increased VO_2max, and improved body composition, walking speed, and handgrip strength—factors linked to a lower risk of cardiovascular events (An et al., 2020; Chodzko-Zajko et al., 2009; de Oliveira et al., 2019; Eckstrom et al., 2020; Hsu et al., 2019; Jia et al., 2019; Laukkanen et al., 2021; Nuzum et al., 2020). Therefore, it is necessary to have measurement instruments for the levels of physical activity that older people carry out.

The measurement of physical activity and sedentary behaviour in older adults can be conducted using different instruments currently available, either directly or indirectly (Kowalski et al., 2012). Indirect instruments for measuring physical activity have proven to be useful and appropriate for the general population, as they are cost-effective, have short administration time, are easy to apply, and generally exhibit good reliability (Craig et al., 2003; Strath et al., 2013). However, when assessing physical activity in this population group, assessment scales and instruments should consider the age-related aspects and be specific to them. Existing tools like the IPAQ (International Physical Activity Questionnaire) and GPAQ (Global Physical Activity Questionnaire), which consider daily physical activities in a broad population group, including work-related activities (Bull et al., 2009), do not fully capture the unique social and familial activity contexts of older adults. While numerous physical activity questionnaires exist, few are specifically designed to capture the unique activity patterns and social contexts of adults aged 65 and over. This is largely due to changes in daily routines following retirement, which typically occurs around this age, and because physical activity habits have been observed to differ after retirement, particularly among women (Pulakka et al., 2020), highlighting the need for a dedicated assessment tool. The development of a new instrument suitable for the reality of this population profile is necessary, mainly because of the change in work habits, where many people retire, have more free time, but perform less physical activity, where it is known that just over 50% of the European population engages in physical activity (Clemente Remón et al., 2021). Among adults under 69 years old, one of the most widely used and easily translated validated questionnaires is the IPAQ. Therefore, the development and subsequent validation and reliability analysis of a questionnaire based on the IPAQ is proposed, with the aim of including habits commonly found among older adults. Physical activity is understood not as an isolated and individual practice, but as one that can also be carried out in the company of others, within both familial and social contexts. To this end, the new questionnaire will also encompass these spheres of interaction.

Thus, the main objective of this study was to develop a new physical activity questionnaire for the Spanish population aged over 65 years and to evaluate its validity and reliability. Specifically, concurrent validity was assessed, understood as the correlation with previously established measures of the same construct, as well as internal validity, referring to the control of potential confounding factors. Reliability

was examined through the intraclass correlation coefficient (ICC), which quantifies the stability of scores, and internal consistency, which reflects the coherence among the questionnaire items.

Method

This study was conducted in two stages: (i) the development of the PAQ-EA, which involved creating the PAQ-EA questionnaire using the Delphi method based on expert judgement; and (ii) the assessment of its validity and reliability, which focused on test-retest assessment to determine reliability, as well as comparing its results with physical performance parameters to assess construct validity. This study was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki. The Ethics Committee of Universitat TecnoCampus Mataró-Maresme and the Ethics Committee of Consorci Sanitari del Mareme approved the study protocol (CEI1/2022; CEIm CSdM 07/23, respectively). All participants were fully informed and provided written informed consent.

The present study was funded by two different projects: the PECT–Mataró Maresme project and the FIS22–Primary Care study. Thus, the sample was recruited from these projects.

Participants

Participants in the first stage were Spanish professionals with recognised expertise in geriatrics and healthcare, including physiotherapists, nurses, and specialists in sport and health sciences, all of whom had substantial experience with physical activity questionnaires and programmes targeting older adults. Following the identification of potential candidates, thirteen experts were invited via email to participate in the Delphi process, which included a detailed description of the project objectives and procedures.

Interested candidates were invited to complete a set of five items designed to assess their knowledge and experience with physical activity questionnaires, their familiarity with the target population, and their involvement in relevant research projects and published literature. This process allowed them to self-assess their level of expertise. Specifically, the items evaluated were: (1) knowledge of physical activity questionnaires; (2) experience in the use of physical activity questionnaires; (3) knowledge and experience of working in physical activity programmes with individuals aged 65 years and older; (4) participation in research related to the target population; and (5) having published research concerning the target population.

Expert competence was assessed using the expert competence coefficient (K), which comprises two components: the knowledge coefficient (Kc) and the argumentation coefficient (Ka) (Cabero Almenara & Infante Moro, 2014). The Kc corresponded to item (1), while the Ka was derived from the weighted median of items (2) to (5), with weights of 0.6, 0.3, 0.05 and 0.05, respectively, according to the relative importance of each item. Experts with a K value of ≥ 0.8 were selected for inclusion in the panel. In total, 13 experts were initially screened, from which a final panel of eight was constituted, comprising two men and six women.

The second stage was an observational study involving 140 participants (82 women and 58 men) aged 65 years or over (mean age 79.59 ± 5.60 years). The participants were recruited from various cities and villages within the Spanish region. A combination of convenience sampling—utilising audiovisual media and word-of-mouth—and random sampling based on the primary care census was employed to assemble the study sample. The sample size for the reliability analyses was calculated using the formulas proposed by Zou (2012). Drawing on the validation of the IPAQ in individuals aged 65 years and over (Tomioka et al., 2011), an expected concordance level of 0.800, not lower than 0.700, was set, with a 5% significance level and 80% power. This resulted in an estimated required sample size of 139 participants, assuming a 20% attrition rate.

Eligibility criteria included individuals aged over 65 years, without any physical limitations that would prevent them from engaging in physical activity, and who were living independently within the community. Exclusion criteria comprised the presence of cognitive impairment, a Global Deterioration Scale (GDS) score of 3 or higher, and a life expectancy of less than six months.

All participants were screened for cognitive impairment to ensure the reliability of self-reported data. Individuals exhibiting symptoms of cognitive impairment were excluded from the study. Socioeconomic and anthropometric variables were collected and are summarised in Table 1.

Table 1. Characteristics of the study participants. Values are expressed as mean (SD).

		All	Women	Men
Age (years)		79.59 (5.60)	80.57 (4.41)	78.89 (6.24)
Weight (kg)		71.34 (13.41)	64.91 (11.39)	80.43 (10.51)
Height (cm)		158.85 (9.84)	153.08 (7.00)	166.9 (7.16)
BMI ($kg \cdot m^{-2}$)		28.27 (6.36)	27.83 (5.30)	28.86 (3.54)
Educational level (%)	Without studies	27.93	38.09	14.58
	Primary school	40.54	36.51	45.83
	Secondary school	19.82	19.05	20.84
	University degree	11.71	6.35	18.75
Living arrangement (%)	Living alone	26.13	38.09	12.50
	Living with others	73.87	61.91	87.50

BMI: body mass index.

Procedure

The questionnaire was designed for adults aged 65 and above, aiming to gather information on time spent walking, engaging in vigorous and low-to-moderate intensity activities (across three domains: solitary, familial, and social), flights of stairs climbed, and sedentary behaviour, as evaluated by other questionnaires (Bull et al., 2009; Craig et al., 2003). Figure 1 depicts the two stages involved in the study procedure.

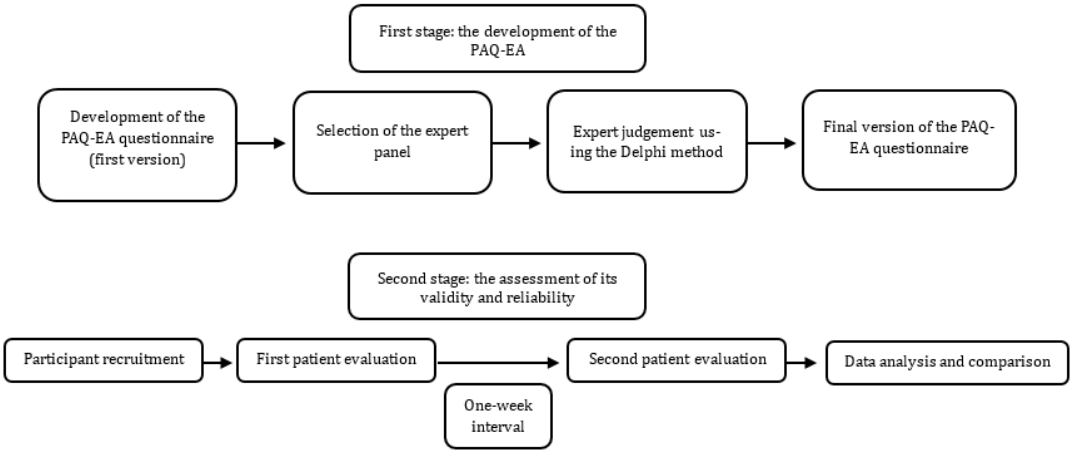
Survey process

After obtaining consent from the expert panel, the first online version of the PAQ-EA, comprising 16 multiple-choice items, was distributed. Experts were asked to complete the questionnaire within one week, with reminder emails sent to those who missed the deadline. They were asked to rate their level of agreement with proposed questions using a 5-point Likert scale, with responses ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Additionally, experts were encouraged to provide their opinions and suggestions for each question, if necessary. Following the first round, the data were summarised, and questions were revised based on expert feedback and suggestions. This process was repeated until consensus was achieved. Two rounds were required to reach a final consensus.

Calculation of Metabolic Equivalents

The PAQ-EA data were entered into an online platform to ensure data security and confidentiality. For data analysis and based on the 2024 Compendium of Physical Activities (Herrmann et al., 2024), metabolic equivalents (METs) were calculated using the average values of all activities selected for this population group. It is worth noting that one MET corresponds to the energy expended at rest and is defined as 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$ (Jetté et al., 1990). The total METs for each category were as follows: low-to-moderate intensity—defined as 4.31 METs in the social domain, 3.80 METs in individual settings, and 3.10 METs in the family domain; vigorous intensity—defined as 6.47 METs in the social domain, 8.08 METs in individual settings, and 5.40 METs in the family domain. Each floor climbed was assigned a value of 0.87 METs, according to Teh & Aziz (2002), based on an estimated energy cost of 9.60 METs for climbing eleven floors. Walking activity was assigned a value of 3.70 METs.

Figure 1. Overview of the study process, including its different phases.



Reliability and validity assessment

The reliability study was conducted by performing two assessments of each participant, separated by a seven-day interval. During the initial visit, demographic data were collected, and participants completed the new version of the PAQ-EA. They also reviewed and provided informed consent via an institutional online platform. Up to one week later, participants completed the same version of the PAQ-EA again, to assess test-retest reliability. On the second assessment day, participants were evaluated on the same day of the week and at the same time of day to minimise potential bias.

During the initial visit, participants were also invited to perform a series of physical performance assessments aimed at evaluating their functional capacity. They completed the Short Physical Performance Battery (SPPB), which consists of three components: a balance test—requiring participants to maintain side-by-side, semi-tandem, and tandem stances for up to 10 seconds each; a gait speed test—measuring the time taken to walk 4 meters at a usual pace; and a chair stand test—assessing the time needed to rise from a seated position five times consecutively without using their arms. Each component is scored from 0 to 4, resulting in a total SPPB score ranging from 0 to 12, with higher scores reflecting better physical performance and functional status.

In addition, participants completed the Timed Up and Go (TUG) test, which evaluates dynamic balance and mobility. This test involves standing up from a chair, walking three metres, turning around, going back, and sitting down again. The time taken to complete the task is recorded in seconds. Shorter completion times reflect better functional mobility, with values below 10 seconds considered normal for healthy older adults, while times exceeding 20 seconds suggest a need for assistance.

Finally, upper limb strength was assessed using the handgrip strength test with a JAMAR dynamometer. Participants were instructed to squeeze the device with maximum effort, and the best value from three attempts per hand was recorded in kilograms. Higher values indicate greater muscle strength. According to established cut-off points for sarcopenia, values below 27 kg in men and 16 kg in women are indicative of reduced muscle strength (Cruz-Jentoft et al., 2019).

Data from the physical performance tests were recorded to compare with the questionnaire outcomes, with a specific focus on examining the relationship between total METs, sitting time, and the physical performance results.

Calculation of Total Energy Expenditure and Activity Categorisation

Based on the questionnaire results, total energy expenditure (METs·min^{-1}·day^{-1}) was calculated by multiplying the time spent at each intensity level of physical activity by the corresponding METs value. Additionally, the data included daily minutes spent on vigorous and low-to-moderate intensity of physical activity across different domains. Time spent walking and sitting per day was also recorded and analysed.

Answers from the questionnaire were categorised in accordance with the methodology described in the Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ Research Committee, 2005), and aligned with WHO (2020) recommendations. This approach was adopted due to its shared aim of capturing physical activity throughout a typical week, considering all types of activities individuals may engage in.

Data analysis

Data were analysed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY, USA). The minimum and maximum values, mean, standard deviation, first quartile (Q1), median (Me), third quartile (Q3) and interquartile range (IQR) were computed. Consensus was defined as the convergence of Me, Q1 and Q3 for each question in each questionnaire round. The following parameters were used to define consensus: (a) interquartile range (IQR): Q3-Q1, which was expected to decrease when comparing the first and second rounds, with a zero trend; (b) relative interquartile range (RIR): ((Q3-Q1)/Me) x 100 ≤ 25%, an arbitrary determination (Garcia-Casanovas et al., 2022).

For intra-observer agreement assessment, the ICC and its 95% confidence interval (CI) were calculated to evaluate the consistency of individual responses across the two test administrations and the precision of the estimates. A two-way mixed-effects model for absolute agreement was applied, considering single measures to assess the correspondence between repeated assessments. Following Fleiss et al. (2003), reliability is classified as excellent if ICC > 0.8, good if 0.6 < ICC ≤ 0.8, moderate if 0.4 < ICC ≤ 0.6, and weak or poor if ICC ≤ 0.4. Internal consistency was assessed using Cronbach's alpha coefficient.

Physical performance data did not follow a normal distribution. Therefore, non-parametric statistical tests were employed. To examine the association between questionnaire outcomes and physical performance variables, Spearman's rank correlation coefficient was applied. A significance level of $p < 0.05$ was adopted for all analyses.

Results

The expertise of the panel was evaluated using the K, Kc, and Ka indices. Experts with a K value ≥ 0.8 were deemed eligible to participate in the questionnaire design process. The competence scores of the selected experts were as follows: K = 8.7 ± 1.2, Ka = 8.4 ± 1.5, and Kc = 9.0 ± 1.0. The final panel consisted of eight experts.

Once the expert panel had been selected, its members were invited to participate in the first round. The initial results revealed some variability among the experts, with certain questions exhibiting a RIR > 25%, indicating a lack of consensus. To address this, a second round was conducted, focusing exclusively on those items with discrepancies. During this round, all questions achieved a RIR ≤ 25%, reflecting a satisfactory level of agreement among the experts. Given this high level of consensus, no additional rounds were required. The revised questions from the second round were incorporated into the final version of the questionnaire. A summary of the results from the first and second rounds is presented in Table 2

Following the two rounds of Delphi process, the items in the final version of the PAQ-EA were consolidated from 16 to 9, as the number of days and the duration of each activity were considered to reflect the same underlying construct, in line with the overall aim of assessing weekly physical activity. Consequently, the following items were merged: items 1 and 2, representing vigorous physical activity performed in a social context; items 3 and 4, representing vigorous physical activity performed individually; items 5 and 6, representing low-to-moderate physical activity performed in a social context; items 7 and 8, representing low-to-moderate physical activity performed individually; items 9, 10, and 11, representing both low-to-moderate and vigorous physical activity performed in a familial context; items 12 and 13, representing flights of stairs climbed; and items 14 and 15, representing walking performed individually. This consolidation process resulted in a final version of the questionnaire comprising nine items. The final version of the questionnaire, together with its interpretation guide, is provided as supplementary material accompanying this paper.

Table 2. Degree of agreement for each item in the Delphi version of the PAQ-EA.

Item number and description	Round	Q1	Median	Q3	RIR
(1) Vigorous PA performed in a social context – days	R1	4.00	4.50	5.00	22.22
	R2	4.50	5.00	4.50	22.22
(2) Vigorous PA performed in a social context – duration	R1	4.00	4.50	5.00	22.22
	R2	4.50	5.00	4.50	22.22
(3) Vigorous PA performed individually – days	R1	3.00	4.00	4.25	31.25
	R2	3.75	4.00	4.00	6.25
(4) Vigorous PA performed individually – duration	R1	3.00	4.00	4.25	31.25
	R2	3.75	4.00	4.00	6.25
(5) Low-to-moderate PA performed in a social context – days	R1	4.00	4.50	5.00	22.22
	R2	4.50	5.00	4.50	22.22
(6) Low-to-moderate PA performed in a social context – duration	R1	4.00	4.50	5.00	22.22
	R2	4.50	5.00	4.50	22.22
(7) Low-to-moderate PA performed individually – days	R1	3,75	4.00	5.00	26.70
	R2	4.00	4.00	4.00	0.00
(8) Low-to-moderate PA performed individually – duration	R1	3.00	4.00	4.25	31.25
	R2	4.00	4.00	4.25	6.25
(9) PA performed in a familial context – days	R1	4.00	4.00	5.00	25.00
	R2	4.75	5.00	5.00	5.00
(10) PA performed in a familial context – duration	R1	4.00	4.00	5.00	25.00
	R2	4.75	5.00	5.00	5.00
(11) Intensity PA performed in a familial context – low-to-moderate or vigorous	R1	4.00	4.00	5.00	25.00
	R2	4.75	5.00	5.00	5.00
(12) Flights of stairs climbed – days	R1	3.75	5.00	5.00	25.00
	R2	5.00	5.00	5.00	0.00
(13) Flights of stairs climbed – flights	R1	3.75	5.00	5.00	25.00
	R2	5.00	5.00	5.00	0.00
(14) Walking performed individually – days	R1	3.75	4.50	5.00	27.78
	R2	4.00	5.00	5.00	16.80
(15) Walking performed individually – duration	R1	4.00	4.50	5.00	22.22
	R2	4.00	5.00	5.00	11.19
(16) Seated time - duration	R1	3.00	4.00	5.00	50.00
	R2	4.75	5.00	5.00	16.09

PA: physical activity.

After conducting the test–retest procedure with the participants using the final 9-item version of the PAQ-EA, the results of the ICC and confidence intervals are presented in Table 3. Excellent reliability was found for the items “flights of stairs climbed”, “vigorous PA performed in a familial context”, “walking performed individually”, and “seated time,” in that order; good reliability for the items “vigorous PA performed individually”, “low-to-moderate PA performed in a social context”, “vigorous PA performed in a social context”, “low-to-moderate PA performed individually”, in the specified order; and moderate reliability for the item “low-to-moderate PA performed in a familial context”. Figure 2 shows the difference between measurements for the item ‘flights of stairs climbed’, illustrating the agreement between both responses through a Bland–Altman plot.

Table 3. ICC and confidence intervals for items using the test-retest method of the final version of the PAQ-EA.

Item number and description	Intraclass Correlation (ICC)	95% Confidence Interval	
		Lower Bound	Upper Bound
(1) Vigorous PA performed in a social context	.743	.604	.817
(2) Vigorous PA performed individually	.800	.705	.864
(3) Low-to-moderate PA performed in a social context	.766	.657	.841
(4) Low-to-moderate PA performed individually	.728	.601	.815
(5) Low-to-moderate PA performed in a familial context	.560	.390	.719
(6) Vigorous PA performed in a familial context	.980	.970	.986
(7) Flights of stairs climbed	.985	.978	.990
(8) Walking performed individually	.976	.965	.984
(9) Seated time	.883	.827	.920

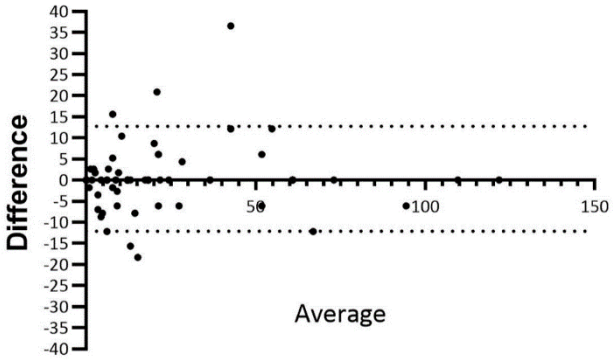
PA: physical activity.

The internal consistency of the questionnaire was found to be a Cronbach’s alpha of 0.875.

By converting the PAQ-EA scores obtained in both the first and second assessments into METs—using the questionnaire’s interpretation sheet provided as supplementary material—an average of 5181 ±

2954 METs·min/week was observed during the first evaluation, and 5284 ± 3460 METs·min/week during the second. The 95% confidence intervals for the mean were [4679, 5660] and [4642, 6608], respectively.

Figure 2. Bland-Altman plot of the differences between measurements for the "flights of stairs climbed" item.



Overall, the analysis identified statistically significant associations, presented in Table 4, between self-reported physical activity and specific indicators of physical performance. Greater weekly physical activity levels were linked to faster gait speed and shorter completion times in the TUG test. Conversely, sedentary behaviour was associated with reduced lower-limb strength and balance, as evidenced by poorer performance in the chair stand test, TUG, and overall SPPB score. No significant relationships were found between either physical activity or sedentary behaviour and upper limb strength, as assessed by the handgrip test.

Table 4. Associations between PAQ-EA outcomes and measures of physical performance.

Physical performance test	METS		Sedentary behaviour	
	r_s	p-value	r_s	p-value
TUG (seconds)	-.203	.016*	.315	< .001*
SPPB (score)	.102	.233	-.228	.007*
Handgrip (kg)	.091	.288	-.054	.526
Gait speed (m/s)	.167	.049*	-.126	.139
Chair stand test (score)	.143	.095	-.240	.005*

r_s: Spearman's correlation; *: Statistically significant.

Discussion

The aim of this study was to develop and validate a physical activity questionnaire specifically designed for adults aged over 65. The findings demonstrate that the PAQ-EA is a valid and reliable instrument, capable of accurately capturing the distinctive activity patterns of this population, including individual, social, and familial contexts.

The PAQ-EA has demonstrated efficacy as a tool for assessing physical activity in older adults, a population with specific needs related to functional capacity and activity patterns. Unlike existing questionnaires, the PAQ-EA captures physical activity across social, solitary, and familial domains, providing insights into how older adults' activity patterns are influenced by their social contexts. The original 16-item version was refined through expert judgement using the Delphi method, involving a panel of specialists in physical activity and healthcare. This process confirmed adequate content validity, as the items were deemed both relevant and comprehensive. As a result, the questionnaire was reduced to 9 items, since the number of days and the duration of each activity were considered to represent the same underlying construct. The Delphi method facilitated the integration of expert perspectives from diverse disciplines, an approach shown to be effective in achieving consensus in the development of health-related questionnaires (Garcia-Casanovas et al., 2022; McMillan et al., 2016). During this process, two rounds of consultation were required to refine the items and to ensure that the content of the PAQ-EA was both relevant and comprehensible for participants aged 65 years and above. Overall, the Delphi

methodology enhances the content validity of questionnaires, particularly in contexts where measurement criteria require the convergence of multiple professional perspectives (Hsu & Sandford, 2007).

The internal consistency of the PAQ-EA was high, with a Cronbach's alpha of 0.875, indicating strong homogeneity among the items and supporting the reliability of the instrument. According to Streiner (2003), alpha values above 0.80 reflect good internal consistency, whereas values above 0.90 may indicate redundancy among items. In this study, the observed alpha demonstrates that the questionnaire exhibits high internal consistency without any redundancy, confirming that questionnaire is a reliable tool for assessing habitual physical activity patterns.

One of the primary attributes of the PAQ-EA is its ability to assess physical activity across varying intensities—low-to-moderate and vigorous—within three specific domains of older adults' lives: social, solitary, and familial. This distinction is particularly relevant, since activity patterns in later life are often shaped by social interactions and family responsibilities, which are not adequately addressed by traditional instruments. In this context, the PAQ-EA enables the identification of not only the levels of physical activity but also its distribution in relation to the individual's social dynamics–a dimension identified as significant for the well-being and mental health of this population group (Kim et al., 2020).

Regarding intensity, the average energy cost for each activity domain was calculated based on the Compendium of Physical Activities for Adults (Herrmann et al., 2024). In the family and social domains at vigorous intensity, as well as in the family domain at low-to-moderate intensity, lower MET values were observed compared to the IPAQ. These variations may be attributed to the characteristics of the activities performed in these contexts, which, although generally less intense, hold considerable value in terms of emotional support and social interaction. Such benefits are equally important in promoting healthy ageing and sustained engagement in physical activity (Zimmer et al., 2021). Conversely, within the low-to-moderate intensity social domain, a higher MET value was observed, likely due to the nature of the selected activities, which were more physically demanding than those typically performed in isolation. Furthermore, in the PAQ-EA, activities were classified not only as moderate but also as low intensity, reflecting the intrinsic exertion capacity of this population group. The mean MET value for walking activities was found to be higher than that of the IPAQ, as it was derived from a variety of walking-related tasks that this group is capable of performing.

Another strength of the PAQ-EA is the inclusion of specific metrics, such as time spent walking, flights of stairs climbed, and sedentary time. These variables are particularly relevant for older adults, as increased sedentary time and a decline in basic physical activities may be associated with health deterioration and loss of independence (Daskalopoulou et al., 2017). The time allocated to walking and climbing stairs provides a detailed measurement of activities that significantly impact cardiovascular health and functional balance in older adults. These activities are crucial for the prevention of sedentary-related diseases, which may include all-cause and cardiovascular mortality, cognitive decline, dementia, Alzheimer's disease, depression, fractures, recurrent falls, disability in activities of daily living, and functional limitations (Cunningham et al., 2020).

The PAQ-EA prompts participants to reflect on the activities they have engaged in over the past seven days, a strategy that facilitates the collection of data more representative of individuals' recent behaviours. Seven-day recall periods have been widely utilised in physical activity questionnaires for individuals aged 64 years and older (Iona et al., 2022; Öhlin et al., 2022), considering that individuals' habits tend to remain consistent throughout the week. However, it is important to note that activities of vigorous intensity exhibit higher recall accuracy compared to low-to-moderate activities (Hagströmer et al., 2006). Additionally, previous research has suggested that the classification of intensity (low-to-moderate and vigorous) in older adults is dependent on the participant's fitness level, prior physical activity experience, and functional capacity, which may lead to misclassification of physical activity intensity (Slootmaker et al., 2009). Despite the aforementioned, our findings indicate a significant level of similarity in the responses provided through the test-retest method, except for the item "PA low-to-moderate", which pertains to a familial context. This item exhibits moderate reliability but is still considered acceptable. This result is expected due to the evolving circumstances that older adults experience in relation to their families, as this item attempts to analyse the physical activity they perform with family members, such as accompanying their grandchildren to school, where it is recognised that the weekly environment is subject to change.

In relation to the results of the PAQ-EA in comparison with physical performance, statistically significant, weak-to-moderate correlations were observed, suggesting that the questionnaire offers meaningful insight into the types of activities undertaken by individuals and their corresponding levels of physical performance. It is important to emphasise that this questionnaire is intended to serve as a screening tool to assess physical activity over a one-week period, offering an indication of individuals' habitual activity patterns. Accordingly, the results suggest a tendency whereby higher MET values obtained from the questionnaire are associated with slightly better levels of physical fitness, as reflected in the physical performance tests such as TUG and gait speed. In contrast, variables such as the SPPB score, chair stand test, and handgrip strength did not show significant correlations. This may be explained by the different constructs assessed by each instrument. The PAQ-EA evaluates self-reported physical activity levels over a given period, whereas the SPPB, chair stand, and handgrip tests provide objective measures of physical capacity. Therefore, a direct relationship is not necessarily expected, as these tools capture different dimensions: the PAQ-EA reflects habitual behaviour, while the aforementioned tests indicate current physical condition. This divergence in the nature of the constructs could account for the absence, or the very weak presence, of associations observed. Overall, further research is needed to assess the validity of this instrument in other populations and/or contexts, and to confirm the present findings with a larger sample size.

Our findings demonstrate the strong validity and reliability of a newly developed questionnaire designed to assess habitual physical activity levels in individuals aged 65 years and older. This questionnaire provides a valuable tool for gathering detailed information on physical activity patterns, which are crucial for promoting healthy lifestyles. Nevertheless, the PAQ-EA has certain limitations. The lower allocation of METs in the familial and social domains, compared with other questionnaires, may indicate a potential underestimation of physical activity within these contexts. This discrepancy may arise from older adults perceiving familial and social activities as less intense, or from these activities being less physically demanding than individual activities or those performed outside familial settings. Future studies are recommended to further explore these differences in the perception of physical activity according to social context, and to determine whether such differences could influence long-term health outcomes in this population.

Conclusions

The PAQ-EA provides a comprehensive tool for assessing habitual physical activity in older adults and may enhance intervention strategies aimed at increasing activity levels in this population. Its structured, domain-specific approach, combined with the high reliability observed through test–retest methods, makes the PAQ-EA a suitable instrument for both research and practical interventions. The questionnaire should be used to assess habitual physical activity rather than as a screening tool for low physical fitness. In practice, the PAQ-EA can assist physical activity and healthcare professionals in identifying low activity levels, tailoring interventions, and prescribing appropriate activity doses. Furthermore, it can be effectively integrated into public health frameworks and clinical settings to promote and support sustained engagement in physical activity among older adults.

Supplementary material

The questionnaire developed for this study is available in the supplementary materials accompanying the article (link). Making these resources publicly available enhances transparency and facilitates both replication and practical application in related research.

Acknowledgements

The authors gratefully acknowledge the valuable contributions and commitment of both the experts and participants involved in this study.

Financing

The present study was partially supported by the Research Group in Technology Applied to High Performance and Health (TAARS) at TecnoCampus, affiliated with Universitat Pompeu Fabra. It was also partially funded by a grant from the Spanish Ministry of Health–Instituto de Salud Carlos III (ISCIII), reference code PI22/00327, and co-financed by the European Union through FEDER funds.

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