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RESEARCH

COMPARATIVE VALIDITY OF PHYSICAL ACTIVITY SCALE FOR ELDERLY WITH AN ACCELEROMETER IN PATIENTS WITH STROKE

Abstract

Introduction: This study aimed to evaluate the validity of the Physical Activity Scale for the Elderly in stroke patients by comparing its scores with activity data derived from an accelerometer.

Materials and Method: Twenty-five patients with stroke who walked independently or with an assistive device were included in the study. An accelerometer was held on participants' non-paretic hips on Monday–Friday, and data were collected during three valid weekdays: Tuesday, Wednesday and Thursday. To evaluate validity, accelerometer-derived physical activity data and the Stroke Impact Scale were used.

Results: A statistically significant moderate correlation was found between the Physical Activity Scale for Elderly and activity counts during moderate physical activity (Spearman correlation rho = 0.43, p = 0.03), energy expenditure during moderate activity, and total step count (rho = 0.41, p = 0.04; rho = 0.45, p = 0.03; rho = 0.45, p = 0.03; consecutively), while no significant correlations were found between Physical Activity Scale for Elderly score and total activity counts and activity counts during sedentary, light activity, or total energy expenditure (p >0.05). There was a moderately positive, statistically significant correlation between PASE and Stroke Impact Scale scores (rho = 0.49, p = 0.01) showing convergent validity.

Conclusions: There is uncertainty about the validity of the Physical Activity Scale for Elderly for specifically reflecting total, light, and sedentary activity. Physical Activity Scale for Elderly was not designed to be used to measure and evaluate different physical activity levels. Accelerometers enabled an assessment of the amount and intensity of physical activity. The findings of this study support the use of accelerometers for assessing physical activity in patients with stroke rather than Physical Activity Scale if these factors are importantly considered.

Clinical trial registration: NCT04092322

Keywords: Exercise; Stroke; Weights and Measures

INTRODUCTION

Physical activity is defined by the World Health Organization (WHO) as any bodily movement produced by skeletal muscles that requires energy expenditure-including activities undertaken while working, playing, carrying out household chores, traveling, and engaging in recreational pursuits (1). It is well known that regular physical activity provides important health benefits (2). Stroke survivors often present with functional limitations that result in decreased physical activity (3). Thirty percent of patients with stroke are at increased risk of recurrent stroke (1). Physical activity has been shown to decrease the risk for first-ever stroke as well as recurrent stroke, and has a positive effect on almost all known modifiable risk factors for stroke, such as high blood pressure, blood glucose, and cholesterol levels (3). The American Heart Association recommends physical activity for stroke survivors (4). Thus, it is crucial to assess the physical activity levels of patients with stroke using reliable and valid tools. Physical activity can be measured via objective methods, including the doubly labeled water method, heart rate monitors, calorimeters, and accelerometers, and subjective methods, including self-report questionnaires and self-report activity diaries (2, 5, 6). Subjective measurements enable a large number of patients to be evaluated at a low cost (6). Doubly labeled water technique is viewed as the gold standard, but sophisticated laboratory equipment are needed (6). Accelerometers detect accelerations of the body via piezoelectric transmitters, which are stressed by acceleration forces, generating electrical signals that are converted by processing units to produce indications of movement. Accelerometers provide outputs concerning body movement in counts per unit time (called an epoch) (6). They record data continuously over a period of time and they have the ability to give detailed parameters of physical activity, such as frequency, intensity, and duration, and this makes them superior to other tools such as pedometers (6). Therefore, accelerometer is an objective tool that allows assessors to examine physical activity levels as close and as compatible to WHO global recommendations on physical activity for health. Previously, the Physical Activity Scale for the Elderly (PASE), the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD), and the International Physical Activity Questionnaire Short Form (IPAQ-SF) were used to examine the physical activity levels of patients with stroke. PASIPD has been validated in a heterogeneous group of patients with physical disabilities, including stroke, spinal cord injury, whiplash, neurological, and orthopedic back disorders, by comparing it with an accelerometer (7). IPAQ-SF has been developed for the general population and has not been validated in stroke. PASE is the questionnaire that has been mostly used for the assessment of the physical activity of stroke patients (8). Validation of PASE has been investigated by comparing PASE scores with physical activity assessed by a portable accelerometer among healthy adults (9). PASE has also been validated based on energy expenditure evaluated by the doubly labeled water method, which is the gold standard method measuring energy expenditure (10). However, the correlation between PASE scores and accelerometer-derived physical activity levels among patients with stroke has not been examined. Further, PASE is the only patient-reported outcome measure, a self-report questionnaire that has been validated in Turkish to measure physical activity levels (11). Thus, there is a need to evaluate its validity against an objective measurement method, accelerometer. Therefore, the aim of this study was to evaluate the validity of PASE in stroke patients by comparing PASE scores with activity derived from an accelerometer.

MATERIALS AND METHODS

Study design

The study was designed as a prospective longitudinal study. Ethical approval was obtained from the Institutional Review Board of the Marmara University (approval number: 09.2019.205).

Subjects and settings

The study protocol was registered at https://clinicaltrials.gov/, under the number of NCT04092322. Subjects of this study were recruited from the participants of a descriptive study. (Eren, N (2019). Evaluation of Physical Activity and Related Factors in a Sample of Turkish Patients with Stroke. (Master of Science dissertation in Physiotherapy, Marmara University, Turkey) Retrieved from ProQuest Digital Dissertations (28243563). Both oral and written informed consents were obtained from the participants. The study was performed in accordance with the principles of the Declaration of Helsinki. Twenty-five patients with stroke who were able to walk independently or with an assistive device were included. Inclusion criteria were (1) patients with first-ever unilateral stroke and (2) being between the ages of 40-80 years. Exclusion criteria were (1) acute stroke, (2) having severely impaired mental function and being unable to complete questionnaires, (3) uncontrolled hypertension, cardiopulmonary disease, and severe heart disease, and (4) gait impairment that was not associated with stroke.

Sample size

Sample size analysis was based on the correlation coefficient of 0.6 between PASE and Computer Science and Applications, Inc. (CSA) portable accelerometer data findings of a previous study by Washburn et al (9). The estimated lowest minimum sample size of 25 is needed to detect a correlation coefficient of 0.6 with an alpha of 0.05 and power of 80.0% (12).

Outcome assessments

Patient characteristics

Demographic data obtained included age, sex, stroke type, time since stroke, Brunnstorm motor recovery level, and Functional Ambulation Category. To evaluate validity, we used physical activity data obtained from an accelerometer and the Stroke Impact Scale.

Physical Activity Scale for the Elderly (PASE)

The PASE is a self-reported questionnaire that consists of 12 questions on physical activity performed during the previous week. Physical activities include walking; light, moderate, and strenuous sports; strength training; light and heavy household work; home repair; lawn work; gardening; caring for another person; and paid or voluntary work involving standing or walking. The respondents were also asked about the activity frequency in hours per day and how many days during the last week the activity was performed. Household activities and work were responded to as "yes" or "no". Work is described by the number of hours spent standing and walking. The PASE score was calculated by multiplying the activity's weight by the time spent to obtain a total score of physical activity during the past 7 days. A high score indicates a higher level of physical activity. The total score ranges from 0 to more than 400. The PASE manual was used to calculate PASE scores (13, 14). PASE was validated in Turkish by Ayvat et al. (11).

The PASE is the most commonly used self-reported physical activity measurement tool in previous studies investigating the physical activity levels of stroke survivors (13, 15-17). These studies included adult patients (patients > 18 years). PASE has been used to assess the physical activity levels of the elderly, as well as the physical activity of younger stroke patients (13, 15-17).

Accelerometer-derived physical activity

Actical accelerometer monitoring devices (Actical®, Philips Respironics) were worn over the non-paretic anterior-superior iliac spine with elastic belts because the hip has been known to be more reliable than the wrist and ankle, as previously described by Serra et al (18). According to a systematic review by Tinlin et al.(19), a minimum 3-day measurement period was found to be sufficient for estimating habitual physical activity. To ensure data collection during three valid weekdays, including Tuesday, Wednesday, and Thursday, all participants were instructed to wear the monitors for five consecutive days (Monday–Friday), except during water-based activities. They were also asked to press the marker button to mark the start and end of the wear time (19). Accelerometers provide outputs regarding body movement in counts per unit time (epoch counts per unit time). Each accelerometer was set with 15 secs epochs. Data including total activity counts and energy expenditure during sedentary, light, moderate, vigorous activity, and step count were collected from the accelerometer.

Stroke Impact Scale 3.0

The Stroke Impact Scale 3.0 is a quality-of-life scale specific to stroke; it evaluates multiple domains of health, including strength, memory and thinking, emotion, communication, activities of daily living, mobility, hand, and participation. Patients were invited to respond to each item based on a 5-point Likert scale that asked them to score their level of difficulty with a task over the previous two weeks (20). The reliability and validity of the Turkish version of the Stroke Impact Scale 3.0 was demonstrated by Hantal et al. (21). Higher scores indicate a higher quality of life.

Statistical analysis

The SPSS version 20.0 statistical software package was used for statistical analyses. The Histogram and normality plots and Shapiro-Wilk normality test were used to evaluate the distribution of data. Descriptive analyses were performed to examine demographic data. The Spearman's rank correlation coefficient (Spearman correlation rho) was used for construct validity analysis. A correlation coefficient, rho, of ≤ 0.35 was defined as a weak correlation, 0.36 to 0.50 as a moderate correlation, and 0.5 to 1.0 as a strong correlation (14). A p-value <0.05 was considered statistically significant.

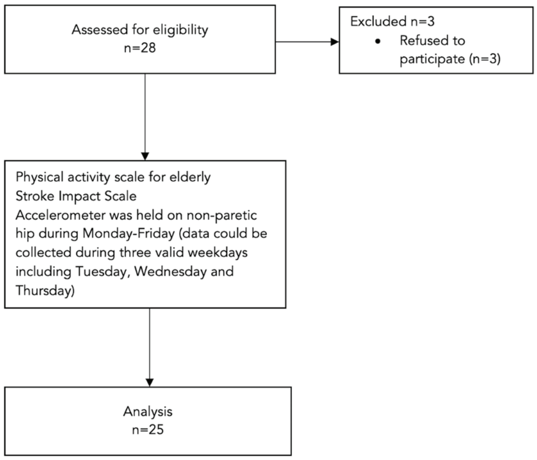
RESULTS

The flow chart of the study is depicted in **Figure 1**. Patient characteristics are presented in **Table 1**. Mean PASE score of the patients was 54.38±40.25, while mean total activity count was 30106.53±26403.05. Accelerometer-derived physical activity data of the patients is depicted in Table 2. The Spearman's rank correlation coefficients between the PASE score, the Actical, and the Stroke

Table 1. Patient characteristics

Age (year)	54.96±10.79
BMI (kg/m^2)	28.51±4.43
Gender (Famale/Male)	8/17
Type of stroke (Hemorrhagic/ Ischemic)	11/14
Duration of stroke (months)	48.32±43.99
Brunnstrom motor recovery level of lower extremity n (%)	
1	0(%0)
2	1(%4)
3	10(%40)
4	9(%36)
5	2(%8)
6	3(%12)
Functional ambulation level category n (%)	
1	0(%0)
2	1(%4)
3	10(%40)
4	12(%48)
5	2(%8)

Figure 1. Flow chart of the study



Impact Scale are shown in **Table 3.** A statistically significant moderate correlation was detected between PASE and activity counts during moderate physical activity (Spearman correlation rho = 0.43, p = 0.03), energy expenditure during moderate activity, and total step count (rho = 0.41, p = 0.04; rho = 0.45, p = 0.03; rho = 0.45, p = 0.03; consecutively), whereas no significant correlations were detected between PASE score and total activity counts, activity counts during sedentary, light activity, and total energy expenditure (p >0.05). The three-day accelerometer recordings showed zero activity counts and energy expenditure during vigorous activity and zero energy expenditure during sedentary activity. There was a moderately positive, statistically significant correlation between PASE and Stroke Impact Scale scores (rho = 0.49, p = 0.01).

Table 2. Accelerometer-derived physical activity data of the patients with stroke (n=25)

PASE	39,60(0,00-162,33)
AC_{total}	19818,33(1410,0-102647,66)
$AC_{sedentary}$	4132,33(1269,66- 6949,33)
AC_{light}	7969,66(140,33-32043,0)
$AC_{moderate}$	5058,66(0,00-67094,33)
$AC_{vigorous}$	0
EE_{total}	123,91(1,99-526,10)
$EE_{sedentary}$	0
EE_{light}	83,58(1,99-257,15)
$EE_{moderate}$	38,43(0,00-268,95)
$EE_{vigorous}$	0
Step count/day	1258,16 (96-7028,33)

Values are presented as median (minimum-maximum)
PASE: Physical Activity Scale for Elderly
AC: activity counts; EE: Energy expenditure
AC_{total}: Total activity counts a day
$AC_{sedentary}$: Total activity counts a day obtained during sedentary activity
AC_{light}: Total activity counts a day obtained during light activity
$AC_{moderate}$: Total activity counts a day obtained during moderate activity
$AC_{vigorous}$: Total activity counts a day obtained during vigorous activity
EE_{total}: Total energy expenditure a day
$EE_{sedentary}$: Energy expenditure a day during sedentary activity
EE_{light}: Energy expenditure a day during light activity
$EE_{moderate}$: Energy expenditure a day during moderate activity
$EE_{vigorous}$: Energy expenditure a day during vigorous activity

DISCUSSION

The present study aimed to explore the validity of PASE among patients with stroke based on accelerometer data. The results of the present study showed a moderate association between activity counts and energy expenditure obtained during moderate activity and total step count. No significant correlation was noted between total activity counts and PASE. Our results revealed a strong association between PASE and the Stroke Impact Scale, showing convergent validity. In line with the results of the remaining study, Ayvat et al. found a significant relationship with PASE and SF-36 (11). Previous findings regarding PASE total score and accelerometer-derived physical activity findings have been controversial, and results vary in different diseases (9, 10, 22, 23). Washburn et al. demonstrated a positive significant correlation between PASE total scores and accelerometer readings in healthy volunteers (9). Correlation between accelerometer total counts per minute and the PASE total score

Table 3. Validity of the total PASE score, and the scores for light, moderate and vigorous physical activity intensity and Stroke Impact Scale.

		PASE	AC total	AC sedentary	AC light	AC moderate	EE total	EE light	EE moderate	Step count
PASE	rho	1.00	0.37	0.01	0.21	0.43	0.32	0.19	0.41	0.45
	p		0.06	0.95	0.31	**0.03**	0.12	0.35	**0.04**	**0.03**
Stroke Impact Scale	rho	0.5	0.25	0.34	0.2	0.2	0.29	0.25	0.25	0.29
	p	**0.01**	0.24	0.1	0.35	0.33	0.17	0.22	0.23	0.18
AC total	rho	0.373	1.00	0.38	0.91	0.95	0.98	0.93	0.93	0.81
	p	0.07		0.06	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**
AC sedentary	rho	0.01	0.38	1.00	0.54	0.19	0.38	0.49	0.18	0.15
	p	0.95	0.06		**0.005**	0.38	0.06	**0.014**	0.38	0.48
AC light	rho	0.21	0.91	0.54	1.00	0.79	0.93	0.97	0.78	0.69
	p	0.31	**0.0001**	**0.005**		**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**
AC moderate	rho	0.43	0.95	0.19	0.79	1.00	0.92	0.82	0.96	0.81
	P	**0.033**	**0.0001**	0.38	**0.0001**		**0.0001**	**0.0001**	**0.0001**	**0.0001**
EE total	rho	0.32	0.98	0.38	0.93	0.92	1.00	0.97	0.93	0.79
	p	0.12	**0.0001**	0.06	**0.0001**	0.0001		**0.0001**	**0.0001**	**0.0001**
EE light	rho	0.19	0.93	0.49	0.97	0.82	0.97	1.00	0.85	0.74
	p	0.35	**0.0001**	**0.01**	**0.0001**	**0.0001**	**0.0001**		**0.0001**	**0.0001**
EE moderate	rho	0.41	0.93	0.18	0.78	0.97	0.92	0.85	1.00	0.83
	p	**0.04**	**0.0001**	0.38	**0.0001**	**0.0001**	**0.0001**	**0.0001**		**0.0001**
Step count	rho	0.45	0.81	0.15	0.69	0.81	0.79	0.74	0.83	1.00
	p	**0.03**	**0.0001**	0.48	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	

PASE; Physical activity scale for elderly, AC; activity count, EE; energy expenditure, rho: Spearman's rank correlation coefficient

was found to be statistically nonsignificant by Svege et al. in patients with hip osteoarthritis (22). The correlation coefficient between the PASE total score and the total activity level was found to be weak but statistically significant by Casartellli et al. in patients after total hip arthroplasty (23). Schuit et al. investigated the correlation between PASE score energy expenditure measured by doubly labeled water and found a strong positive correlation (10).

In the present study, the criterion validity correlation for PASE among patients with stroke was similar to those reported for patients with other conditions. In the aforementioned studies, the correlation coefficients were low to moderate, varying between 0.27 and 0.49. In contrast to these studies, the Spearman correlation coefficient between PASE and physical activity ratio obtained from the doubly labeled water method was found to be high (r = 0.68) among the elderly. According to the recommendations for physical activity questionnaires, a correlation coefficient of ^{3}0.5 for comparisons between questionnaires and accelerometer-derived physical activity outcomes should be considered as adequate (24). In the present study, none of the correlation coefficients between PASE and accelerometer-derived physical activity outcomes were as high as recommended.

Comparing the total score with the total counts per day of an accelerometer is suggested as the most optimal design for examining the validity of a physical activity questionnaire by comparing it with physical activity outputs obtained from accelerometer (24). In the current study, the correlation between PASE and total activity counts was close to significance. This discrepancy may be explained to some extent by the smaller sample size (25). Controversially, the present study found an association between PASE and total activity counts during moderate activity; we suppose that this was because PASE was specifically developed to assess the physical activity levels of elderly individuals focusing on light to moderate intensity recreational, household, and work-related activities (23).

The relatively small sample size can be considered a limitation of this study. Nevertheless, this study is the first to address the validity of PASE in patients with stroke by comparing it to an accelerometer, which is its strength.

CONCLUSION

The PASE total score was only correlated with activity counts and energy expenditure obtained during moderate activity and total step count but not correlated with total activity counts. Based on the results of the present study, there is uncertainty about the validity of the Physical Activity Scale for Elderly for specifically reflecting total, light, and sedentary activity. PASE was not designed to specifically measure or evaluate different physical activity levels. Accelerometers are more accurate tools enabling the measurement of the amount and intensity of physical activity. The findings of this study support the use of accelerometers if the exact measurement of the amount and intensity of physical activity are importantly considered. Further study with a larger sample size should be conducted to establish the precise validity of PASE among patients with stroke. Since questionnaires are cheap, easy, and useful methods of data collection, if valid, they could be useful in screening and assessing a large population. Thus, a stroke-specific physical activity measurement scale should be developed and then validated against physical activity outputs obtained from accelerometers.

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Conflict of interest: The authors report no conflict of interest regarding this work.

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