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Reliability Evaluation of the Physiological Profile Assessment to Assess Fall Risk in Older People

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Abstract

Background: The Physiological Profile Assessment (PPA) contains five tests: visual contrast sensitivity, hand reaction time, quadriceps strength, lower limb proprioception and postural sway. It has been widely used in research projects and is increasing used in clinical practice. However, reliability statistics for the composite PPA fall risk score for older people has not been previously reported.

Methods: Ten participants (80% female), average age 75.2 (SD=5.17) years participated in the study. The PPA tests were administered by two trained examiners with a time interval of five to seven days for intra-rater reliability assessments and twenty minutes for inter-rater reliability assessments. Intraclass Correlation Coefficients (ICC) (2,1) were computed to assess the reliability of the composite PPA and test component measures.

Results: These findings revealed good intra-rater reliability and very good inter-rater reliability for the PPA composite score. With respect to the individual PPA tests, contrast sensitivity and quadriceps strength demonstrated both excellent intra-rater and inter-rater reliability; proprioception demonstrated very good intra-rater reliability and excellent inter-rater reliability; reaction time demonstrated fair intra-rater reliability and good inter-rater reliability; and sway demonstrated fair intra-rater reliability and very good inter-rater reliability.

Conclusions: The study findings indicated the PPA composite score and most component parts had acceptable intra- rater and inter-rater reliability, and thus the PPA can be considered a reliable instrument for the assessment of fall risk in older people.

Keywords Physiological profile assessment; PPA; Reliability; Fall risk; Older people

Introduction

Brazil, like many countries around the world is experiencing population ageing. In 1970, older adults made up 4.9% of the population of Brazil. This figure increased to 8.5% in 1990 [1] and it is predicted that by 2050 older adults will make up 28.8% of the population and outnumber children and adolescents [2]. One of the major health care problems for older people is an increased risk of falls. In Brazil it has been reported that 27.6% of adults aged 60 or more fall at least once in a year, with falls associated with increased age, a sedentary lifestyle, the use of multiple medications and poor self-reported health [3]. Injuries due to falls in older people are common and likely to be serious. Studies indicate around 10% of fallers suffer a serious injury; such as a fracture, joint dislocation or severe head injury [4]; sequelae that often require hospital admission [5].

Assessment of fall risk in older people is complex due to the multifactorial nature of the underlying risk factors. Systematic reviews have shown that a multifactorial assessment of risk factors followed by targeted intervention is an efficient and effective strategy for preventing falls in this group [4]. For this approach to be effective, it is necessary to identify the population at risk, introduce standardised and reliable assessment measures and then put in place appropriate interventions [5,6].

The Physiological Profile Assessment (PPA) [7] is one externally validated fall risk assessment tool. It assesses vision, peripheral sensation, muscular force, reaction time and balance. It was deigned to be low-tech, portable and simple and quick to administer; be appropriate for older people to perform; and produce valid and reliable quantitative measures [8].

Previous studies have reported reliability data for PPA component tests [9], but no study has reported both intra- and inter-reliability statistics for these measures or for the composite PPA fall risk score. This is important as while intra-rater reliability may be acceptable for each individual test, small differences over a number of tests may combine to affect the composite fall risk score. Further, many studies require more than one examiner to perform physical measurements and it is important that each test is shown to be reliable between examiners. The objective of this study, therefore, was to verify whether both the PPA composite score and component parts have acceptable intra and inter-rater reliability in a sample of Brazilian community dwelling older adults.

Methods

Participants

This study was performed with a convenience sample of 10 community dwelling older adults with an average age of 75.2 (SD=5.17, range=67-87) years old, including eight women (80%) from Belo Horizonte, Minas Gerais, Brazil. The average years of education for the sample was 7.4 (SD=3.02) years; two participants completed high school and two had a major degree. All participants had at least one comorbidity and the most common was hypertension, reported by 70% of the sample. One participant reported a fall in the past year and four reported pain at the time of the interview with an average pain score of 5 (SD=2.94) on the Numeric Sale of Pain [10]. Most participants – 70% of the sample - reported health as being good.

Participants were excluded if they had a cognitive impairment (Mini Mental State Exam score < 24) [8], severe visual and/or hearing deficiencies, significant pain or severe motor deficiencies that precluded undertaking the PPA balance test. Participants were also excluded if they had medical conditions or were taking medications that could affect balance control.

All participants signed an informed consent and the study was approved by the Committee on Ethics in Research of Universidade Federal de Minas Gerais, protocol number ETIC 0100.0.203.000-11.

The sample size calculation was defined according to Portney and Watkins, 2008 [9]. This indicated that to obtain an Intraclass Correlation Coefficient (ICC) of 0.70 with a power of 0.80 and an alpha of 5%, 10 participants would be required.

Demographic and health-related measures

Participants completed a questionnaire on level of education, co-morbidities, history of falls and pain perception by the Numeric Scale of Pain [10].

The Physiological Profile Assessment (PPA)

The PPA has two versions: a comprehensive (or long) version for research settings and a short version for clinics and screening. The present study used the short version which contains five measures: tests of vision (edge contrast sensitivity), peripheral sensation (proprioception), lower-extremity force (knee extension force), reaction time using a finger press as the response, and body sway (sway when standing on the medium-density foam rubber mat). These five measures were found to be independent and significant risk factors for falls in large prospective studies [7]. The PPA composite score comprises weighted contributions from the above five test measures derived from discriminant function analysis [7]. The individual PPA tests are described below.

Edge contrast sensitivity

Edge contrast sensitivity is assessed using the Melbourne Edge Test [11]. The test has 20 circular patches with edges of reducing contrast of variable orientation. The test uses a 4-alternate forced choice method of presentation. The edges are presented in the following orientations: horizontal, vertical, 45 degrees to the left and 45 degrees to the right. A card with the possible choices is presented to the participant during instruction. The lowest contrast patch correctly identified is recorded as the participants contrast sensitivity in decibel units, where 1 dB =10log10 contrast.

Proprioception

Proprioception is defined as the discrimination of the positions and movements of body parts based on information other than visual, auditory, or verbal [11]. Proprioception is assessed in the PPA using an established and validated lower-limb matching task [12]. The participant is seated with their eyes closed and are asked to align their lower limbs simultaneously on each side of an acrylic panel. The panel–marked with a protractor–is positioned between the participant's legs. To prevent limited motion at the knee joint from confounding the results of this test, the examiner needs to ensure that participants match their limbs near the midrange of knee joint motion [12]. Each trial is performed relatively quickly, with a break between trials, to avoid weakness influencing results. Any difference in aligning the lower limbs (indicated by disparities in matching the great toes on either side of the acrylic sheet) is measured in degrees. After two practice trials, an average of five experimental trials is recorded [7].

Muscular strength

Maximum isometric muscular strength of the quadriceps for the PPA is measured using a digital dynamometer attached to the participant's leg with a strap placed 10 cm above the ankle joint. In 3 trials the participant attempts to push against the strap.

Reaction time

Reaction time in the PPA is assessed in milliseconds using a hand-held electronic timer and a light as a stimulus and depression of a switch by the finger as the response. The timer has a built-in variable delay of 1 to 5 seconds to remove any cues that could be gained from the test administrator commencing each trial by pressing the "start" button. A modified computer mouse is used as the response box for the finger press task. Five practice trials are undertaken, followed by 10 experimental trials.

Postural sway

Postural sway is measured using a swaymeter that measures displacements of the body at waist level. The device consists of a 40-cm-long rod with a vertically mounted pen at its end. The rod is attached to the participant by a firm belt and extends posteriorly. As the participant attempts to stand as still as possible for 30 seconds, the pen records the participant's sway on a sheet of millimetre graph paper fastened to the top of an adjustable-height table. Testing is performed, with eyes open on a medium-density foam rubber mat (15 cm thick). Total sway (number of square millimetre squares traversed by the pen) and anteroposterior and mediolateral sway are recorded.

Intra-rater reliability

The intra-rater reliability was performed by a trained examiner. The tests were performed with a time interval varying from 5 to 7 days of application. All the tests were performed in the Laboratory of Pain and Inflammation in Rehabilitation and Aging–LADIRE, following the established protocol.

Inter-rater reliability

The inter-rater reliability was performed by two trained examiners, with an interval of 20 minutes between tests. The order for which examiner would apply the tests first was randomly assigned. The tests were performed in LADIRE, following the established protocol.

Statistical analysis

Descriptive statistics were used to characterize the sample. The normality of the continuously scored PPA data was verified by the Shapiro-Wilk test. Intraclass Correlation Coefficients (2,1) were computed to assess the intra and inter-rater reliability of the PPA measures with values from 1.0 to 0.81 considered excellent; from 0.80 to 0.61, very good; from 0.60 to 0.41, good; from 0.40 to 0.21, fair; and from 0.20 to 0.00 poor [13]. All analyses were performed using SPSS 15.0.

Results and Discussion

Population aging is a global reality and identify the risk of falls in the elderly is a topic of interest to the health professionals, government and community. In 2020 Brazil will be the sixth elderly population in the world [14]. To check the reliability of equipment that aims to identify the risk of falls will enable preventive actions and to verify the success of therapeutic interventions in research and clinical practice.

Table 1 presents the mean and standard deviations for the composite PPA score and the PPA component tests as well as the intra-rater and inter-rater ICC values for each measure: these findings revealed good intra-rater reliability and very good inter-rater reliability for the PPA composite score. With respect to the individual tests, contrast sensitivity and quadriceps strength demonstrated both excellent intra-rater and inter-rater reliability; proprioception demonstrated very good intra-rater reliability and excellent inter-rater reliability; reaction time demonstrated fair intra-rater reliability and good inter-rater reliability; and sway demonstrated fair intra-rater reliability and very good inter-rater reliability.

	Mean (SD)	Intra-rater Reliability*	Inter-rater Reliability*
Composite fall risk	.53(1.01)	.55(.86– -.09)	.69 (.91–.19)
Contrast sensitivity (dB)	20.5 (1.51)	.94 (.99 –.78)	.93 (.98–.75)
Proprioception (degrees)	1.62 (1.31)	.74 (.93–.25)	.92 (.98–.62)
Muscular strength (kg)	23.95 (9.58)	.93 (.98–.76)	.95(.99–.84)
Reaction time (ms)	292.67 (62.34)	.25 (.7– -.42)	.54 (.86– -.01)
Sway (mm)	103.65 (64.32)	.24 (.74– -.42)	.62 (.89–.03)
High scores in the composite fall risk, proprioception, reaction time, and sway tests and low scores in the contrast sensitivity and quadriceps strength tests indicate impaired performances. * p<.005, ICC2.1 (Intraclass Correlation Coefficient)			

Table 1: Values for the intra and inter-rater reliabilities for the composite fall risk and of isolated tests

The PPA allows for multifactorial assessment of the main sensorimotor and balance factors involved in maintaining stability for the avoidance of falls [7]. The short form has been widely used in research projects and has limited use in clinical practice. The current study findings provide data on both the intra and inter-rater reliability of the composite fall risk score as well as its component tests. We found the ICC of the PPA composite score was good for intra-rater reliability and very good for inter-rater reliability. Thus, the PPA could be considered adequate in terms of psychometric measure for use in community dwelling older adults in Brazil. Other studies have been conducted using the fall risk given by the PPA as an outcome to assess the efficacy of interventions in the elderly [15-18] suggesting the instrument is appropriate for use in screening the elderly for falls risk and as a quantitative measure to assess the effectiveness of future interventions directed to this population in Brazil.

Intra-rater reliability data for individual PPA tests for an Australian population have been previously reported [7]. In comparison to these data, the ICCs found here were lower for the muscular strength, reaction time and sway tests (Australian ICCs: 0.97,0.69 and 0.57 respectively) and higher for the contrast sensitivity and proprioception tests (Australian ICCs: 0.81 and 0.50 respectively). These differences may relate to the differing sample sizes and sample make-up, test-retest time differences and subtle differences in test administration between the two reliability studies.

Additional factors can influence test performance and thus result in different scores on different occasions. These include initial unfamiliarity with novel tests and consequent learning effects at retest, medication and health-related factors affecting performance on one occasion more than another [19] especially when dealing with older people, who usually take more medication and have more comorbidities. It can also be related to differing test instructions/ administrator inconsistencies. Further, with the exception of the quadriceps strength test, PPA test performance requires comprehension of the task requirements and a degree of concentration. This may especially be the case for the sway on the unstable foam rubber surface test, as it has been reported this is a difficult task for older adults and demands complex and challenging body adjustments [20]. Thus if these factors varied over time, test performance would do also. Of note, the test that required a simple voluntary contraction (maximal quadriceps strength) had the highest reliability measures in both the current study and the previous report from the Australian sample.

When assessing an elderly population, one must have in mind that the individuals are more susceptible to clinical intercurrences and atypical manifestations of diverse health conditions, which may be associated with different performances in the assessments [19].

A strength of the study was the independent assessment of both inter and intra-reliability of the PPA composite score and component test measures. We acknowledge there are study limitations in that although the study was powered to determine an acceptable level of agreement, the sample size was small, and thus the reliability co-efficients reported may not be robust.

Conclusion

The causes of falls in older people are multifactorial and so for an adequate assessment of fall risk it is recommended that many different domains are assessed. The PPA aims to achieve this by testing the five important complementary sensorimotor and balance domains for

discriminating between fallers and non-fallers. The study findings indicated the PPA composite score and most component parts had acceptable intra and inter-rater reliability, and thus the PPA can be considered a reliable instrument for the assessment of fall risk in older people.

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