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ORIGINAL ARTICLE

Short-Physical Performance Battery (SPPB) score is associated with falls in older outpatients

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Abstract

Background The capacity of Short-Physical Performance Battery (SPPB) test to discriminate between fallers and non-fallers is controversial, and has never been compared with fall risk assessment-specific tools, such as Performance-Oriented Mobility Assessment (POMA).

Aim To verify the association of SPPB and POMA scores with falls in older outpatients.

Methods 451 older subjects (150 males, mean age 82.1 ± 6.8) evaluated in a geriatric outpatient clinic for suspected frailty were enrolled in this cross-sectional study. Self-reported history of falls and medication history were carefully assessed. Each participant underwent comprehensive geriatric assessment, including SPPB, POMA, Geriatric Depression Scale (GDS), mini-mental state examination (MMSE) and mini-nutritional assessment-short form (MNA-SF). Multivariate logistic regression and receiver-operating characteristic (ROC) analyses were performed to determine the factors associated with the status of faller.

Results 245 (54.3%) subjects were identified as fallers. They were older and had lower SPPB and POMA test scores than non-fallers. At ROC analysis, SPPB (AUC 0.676, 95% CI 0.627–0.728, $p<0.001$) and POMA (AUC 0.677, 95% CI 0.627–0.726, $p<0.001$) scores were both associated with falls. At multivariate logistic regression models, SPPB total score (OR 0.83, 95% CI 0.76–0.92, $p<0.001$), POMA total score (OR 0.94, 95% CI 0.91–0.98, $p=0.002$) and SPPB balance score alteration (OR 2.88, 95% CI 1.42–5.85, $p=0.004$), but not POMA balance subscale score alteration, were independently associated with recorded falls, as also GDS, MMSE and MNA-SF scores.

Conclusions SPPB total score was independently associated with reported falls in older outpatients, resulting non-inferior to POMA scale. The use of SPPB for fall risk assessment should be implemented.

Keywords Comprehensive geriatric assessment · Falls · Frailty · Balance

Introduction

In older individuals, falls represent deleterious events predicting adverse health outcomes, including disability and death [1, 2]. The most detrimental consequences are fractures, namely of the hips, and cerebral damage, but even non-injurious falls are associated with increased anxiety, depression and reduced mobility, that significantly impact the quality of life and the trajectory of the aging process [3, 4].

A recent systematic review and meta-analysis has highlighted the importance of exercise, combined with multidimensional clinical and environmental interventions, for fall prevention [4]. However, the early identification of seniors at high risk of falling is fundamental for targeting the interventions to those who most need them.

At the current state of art, there is no gold-standard tool for assessing the fall risk profile in older patients referred to specialist geriatric clinics [5]. Several tests and scales have been described and validated in the literature. Some of these tools evaluating balance, such as Berg Balance scale, exhibit fairly good sensitivity and specificity in predicting

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falls [5], but a certain degree of inaccuracy is always present, depending on the setting of application [6]. Thus, a single gold-standard tool valid in all clinical settings is still lacking. The co-administration of at least two scales and the integration of balance performance with other clinical data collected during the comprehensive geriatric assessment (CGA) may improve accuracy [5, 7]. However, this approach is difficult, time-consuming and hardly feasible in everyday clinical practice.

Thus, in older subjects evaluated as outpatients, fall risk assessment generally relies on the administration of a single tool even in specialist geriatric clinics. Screening tools based on anamnestic records, such as the novel F3ALLS approach [8], are rapidly emerging, but objective measures still remain the best way to stratify fall risk. Tinetti Performance-Oriented Mobility Assessment (POMA) scale is one of the most known and used of the tools based on objective measures [9]. This is a 16-item scale, assessing balance and gait, significantly predicting the risk of falls and disability [10].

Interestingly, the domains of balance and gait are explored also by the Short-Physical Performance Battery (SPPB) [11]. This is a widely used scale exploring the reduction of physical performance in older persons, particularly muscle strength of lower extremities, 4-m walking speed at usual pace, and balance [11]. It has the ability of predicting mobility-disability, nursing home and hospital admission [12–14]. Poor physical performance and balance alterations are among the main causes of falls in older individuals [15].

As such, we hypothesize that SPPB, which is widely used and much quicker and simpler than the currently available fall risk screening tools, could represent a valid proxy of POMA scale in a group of older subjects evaluated in a geriatric clinic on an outpatient basis for memory or motoric complaints. Thus, in this cross-sectional study, we compared the accuracy of SPPB and POMA scales in discriminating between fallers and non-fallers in a large group of Italian older frail patients.

Materials and methods

Setting, participants, and ethical issues

We consecutively enrolled all outpatients evaluated for the first time at the Cognitive and Motoric Disorders Clinic of Geriatric-Rehabilitation Department of Parma University-Hospital from September to December 2017. Patients were referred to the clinic by their own general practitioners or specialist physicians of Parma University-Hospital, to undergo CGA for motoric or memory complaints.

Inclusion criteria were age ≥ 70 years old, the presence of perceived motoric or cognitive decline in the 6 months before the evaluation, presence of a caregiver, willingness to participate to the study and signed informed consent. Exclusion criteria were nursing home residence, active malignancy, presence of acute disease, certified diagnosis of severe dementia (mini-mental state examination—MMSE-test score ≤ 15) with significant impairment in functional performance, known disability referred by the patient as inability to walk for more than two blocks, hospitalization in the 2 weeks before the evaluation. According to the World Health Organization (WHO), falls were defined as unexpected events which result in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of the following: sustaining a violent blow, loss of consciousness, sudden onset of paralysis, as in a stroke, an epileptic seizure [16].

The present study is part of a larger project, called TRIP (Traumatic Risk Identikit Parma) Study, aimed at identifying the clinical correlates of falls in a large group of geriatric outpatients evaluated for suspected cognitive or motoric frailty. The protocol of the TRIP Study has been approved by the Ethics Committee of Parma province (ID 17262).

Outcomes

A history of falls, reported by the patient himself or by the caregiver in the 12 months before enrollment, was considered as the main outcome of this study. Clinical records of emergency department or specialist visits corroborating the self-reported history of falls were consulted whenever available. The number of reported falls and their clinical outcomes (i.e., fractures, hospital admission, organ damage) were also considered as secondary outcomes.

Clinical procedures

As part of the routine clinical assessment in our center, all enrolled patients underwent medical history collection, physical examination with particular emphasis on neurological examination, and CGA. Information on diseases and medications was accurately collected though medical records. The history of falls was thoroughly investigated with the patient and the caregiver. All the procedures were performed by an expert geriatrician and a skilled nurse.

The SPPB was calculated according to literature standards [11]. The patients were asked to perform three timed tasks: hierarchical assessment of standing balance, 4-m walking speed at usual pace, and standing five times from a seated position in a chair. The timed results of each sub-test were rescaled according to predefined cut-points for obtaining a score ranging from 0 (worst performance) to 4 (best performance). The total score of SPPB ranges from 0 to 12. For standing balance, participants were asked to remain standing with their feet as close together as possible, then in a semi-tandem position, and finally in a tandem position.

Each position had to be held for 10 s. We considered the presence of balance deficit as the inability to maintain tandem position for at least 10 s.

The POMA scale was assessed using a standard protocol composed by two sub-tests, exploring gait and balance, respectively. The possible score ranges from 0 to 28, and the highest risk of falling is present for scores < 19.

The number and type of chronic diseases and drugs, and the presence of visual or hearing deficits were also systematically assessed. Polypharmacy was defined as the presence of 5 or more medications in pharmacologic history. Cognitive function was evaluated with the MMSE-test as a screening procedure. Depressive symptoms were assessed with the 5-item Geriatric Depression Scale (GDS) test.

Functional performance was assessed with basic and instrumental activities of daily living (Katz's ADL and Lawton's IADL) questionnaires. Maximal grip strength was also measured, using a hand-held dynamometer (Jamar Plus, Patterson Company, Bolingbrook, IL, US). The dominant hand was tested three times and the average strength value was considered for the analysis.

Nutritional status was assessed through the administration of Mini-Nutritional Assessment-Short Form (MNA-SF) questionnaire, and through calculation of body mass index (BMI) as weight/height^2 (kg/m^2). Weight was measured using a high-precision mechanical scale. Standing height was measured to the nearest 0.1 cm.

Statistical analyses

Continuous variables were reported as mean ± standard deviation (SD) or as median and interquartile range (IQR), according to the normality of distribution of values. All characteristics of the population were stratified according to self-reported history of falls and were compared between groups using multivariate linear regression models, adjusted for age and sex whenever appropriate.

The capacity of SPPB scale, POMA scale, SPPB balance and POMA balance sub-tests to discriminate between fallers and non-fallers was tested with receiver operator characteristic (ROC) curve analysis. Then, the strength of the association between the two scales, or their balance sub-tests, and history of falls was also tested using multivariate logistic regression models, considering SPPB and POMA as both continuous and dichotomous variables. Age, sex, BMI, MMSE, GDS, grip strength, MNA-SF and number of drugs were considered as possible confounders, since cognitive impairment, depression, sarcopenia, malnutrition and polypharmacy could all have a role in defining the risk of falls in older people [4]. Covariates for the multivariate analysis were also selected considering the variables with a significant difference between fallers and non-fallers at preliminary comparisons.

All analyses were performed using SAS (v. 9.1, SAS Institute, Inc., Cary, NC) with a statistical significance level set at $P < 0.05$.

Results

The total number of patients included in the study was 451 (150 men and 301 women), aged in average 82.1 ± 6.8. The main characteristics of the study population are shown in Table 1. Namely, the median (IQR) of SPPB score was 6 (3–9), while the median (IQR) of POMA scale was 21 (12–25).

The number of fallers, i.e., subjects who reported a history of at least one fall in the year before the visit, was 245 (54.3%). Balance deficit was present in the majority of participants: 281 (62.0%) according to inability to maintain tandem position for at least 10 s in the balance-specific SPPB sub-test, and 274 (61.0%) according to the balance subscale of POMA score.

A comparison of the main considered variables between fallers and non-fallers is also depicted in Table 1. Fallers were significantly older than non-fallers (83.1 ± 6.5 vs 81.3 ± 6.9 years old, $p = 0.04$). The prevalence of balance deficit among fallers was 70.0% according to SPPB and 68.0% according to POMA, respectively. This prevalence was significantly higher than that detected in non-fallers, whatever the instrument of assessment used (Table 1). Fallers showed significantly lower levels of SPPB score, POMA scale, grip strength, ADL score, IADL score, MMSE and MNA-SF, and higher GDS scores than non-fallers. Visual deficits were more prevalent in fallers (Table 1).

The total SPPB score was significantly and positively correlated with the POMA score at Spearman correlation analysis ($R = 0.87$, $p < 0.001$) (Fig. 1). Both SPPB and POMA scores were associated with the status of faller in ROC analysis. The curves are shown in Fig. 2. The AUCs were 0.676 (95% CI 0.627–0.728, $p < 0.0001$) for total SPPB score, and 0.677 (95% CI 0.627–0.726, $p < 0.0001$) for POMA score, respectively.

ROC analysis was also used to test the ability of SPPB and POMA balance sub-tests to predict the faller status. Both sub-tests resulted significantly associated with falls (Fig. 3). The AUCs were 0.665 (95% CI 0.614–0.716, $p < 0.0001$) for the SPPB standing balance sub-scale, and 0.654 (95% CI 0.603–0.705, $p < 0.001$) for the POMA balance score, respectively.

In a multivariate logistic regression analysis model (Table 2, Model 1), considering a long list of possible covariates, SPPB total score was negatively associated with a history of falls (OR 0.83, 95% CI 0.76–0.92, $p < 0.001$). Among covariates, BMI exhibited a negative association with a history of falls, while a positive association was

Table 1 Overview of the main features of the studied population ($n = 451$) of patients evaluated for memory or motoric complaints on outpatient basis, stratified according to the presence ($n = 245$) or the absence ($n = 206$) of a self-reported history of falls in the year before the evaluation

Variable	Overall population ($n = 451$)	Fallers ($n = 245$)	Non-fallers ($n = 206$)	p* (fallers vs non-fallers)
Age (years)	82.1 ± 7	83.1 ± 6.5	81.3 ± 6.9	**0.04**
Males	150 (33)	63 (37)	87 (42)	0.16
SPPB total score	6 [3–9]	4.5 [1–7]	8 [4–12]	**< 0.001**
POMA total score	21 [12–25]	17 [6–23]	23 [17–25]	**< 0.001**
SPPB balance deficit	274 (61)	171 (70)	103 (50)	**< 0.001**
POMA balance deficit	281(62)	166 (68)	115 (56)	**0.002**
4-m gait speed (s)	4.99 [3.40–7.23]	5.05 [0–7.5]	4.98 [3.41–6.80]	0.28
Chair-standing test time (s)	11.24 [0-16.06]	9.97 [0–16.48]	11.36 [0.15.80]	0.86
Grip strength (kg)	18.28 [13.17–25.37]	16.25 [12.05–21.95]	19.93 [15.45–27.45]	**0.001**
MMSE score	21.4 ± 5.6	19.7 ± 5.6	22.8 ± 5.1	**< 0.001**
MNA-SF score	10.5 ± 2.6	10.1 ± 2.7	11.0 ± 2.4	**0.018**
GDS score	4.0 ± 3.8	4.6 ± 3.0	3.8 ± 2.6	**< 0.001**
Polypharmacy	202 (45)	102 (42.5)	100 (48.6)	0.28
Number of comorbidities	5.5 [1–9]	6 [1–10]	5 [1–9]	0.29
ADL, Katz scale	5 [2–6]	3 [1–5]	5 [3–6]	**< 0.001**
IADL, Lawton scale	2 [1–6]	1 [0–3]	4 [1–7]	**< 0.001**
Deficit of vision	118 (26.1)	83 (34)	35 (17)	**0.002**
Hearing deficit	168 (37.2)	100 (41)	68 (33)	**0.005**
BMI (kg/m^2)	26.9 ± 5.1	26.5 ± 5.3	27.2 ± 4.9	0.33

Significant p values (< 0.05) are indicated in bold

*p calculated with multivariate linear regression models comparing subjects with and without falls, adjusted for age and sex, when appropriate. Data expressed as mean ± standard deviation, median [interquartile range], or as number (percentage), as appropriate

SPPB Short-Physical Performance Battery, *POMA* Performance-Oriented Mobility Assessment, *MMSE* mini-mental state examination, *MNA-SF* mini-nutritional assessment-short form, *GDS* Geriatric Depression Scale, *ADL* activities of daily living, *IADL* instrumental activities of daily living, *BMI* body mass index

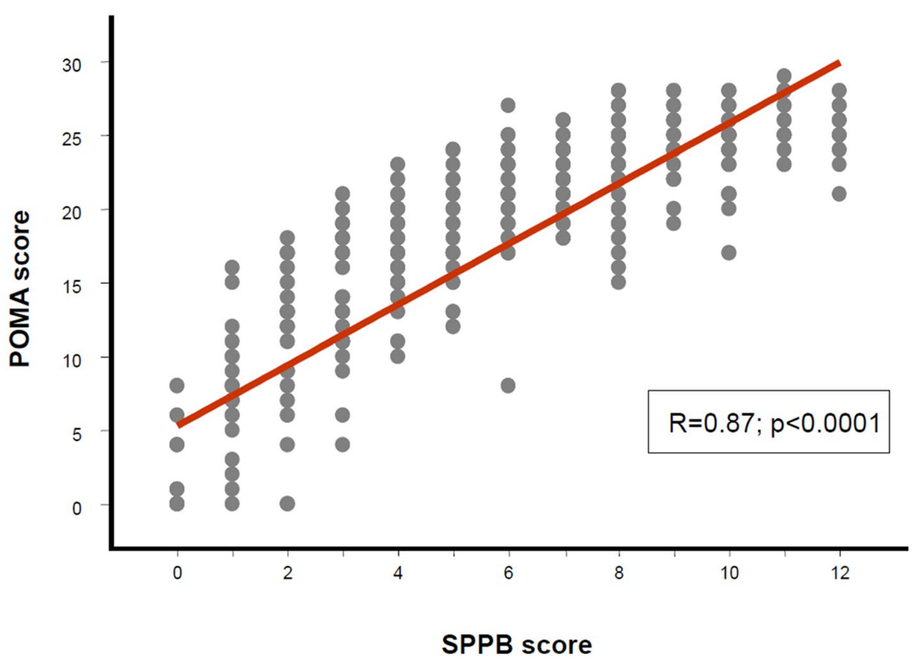

Fig. 1 Results of Spearman correlation analysis showing a strong positive correlation between Short-Physical Performance Battery (SPPB) score and Performance-Oriented Mobility Assessment (POMA) score in a group of 451 older patients

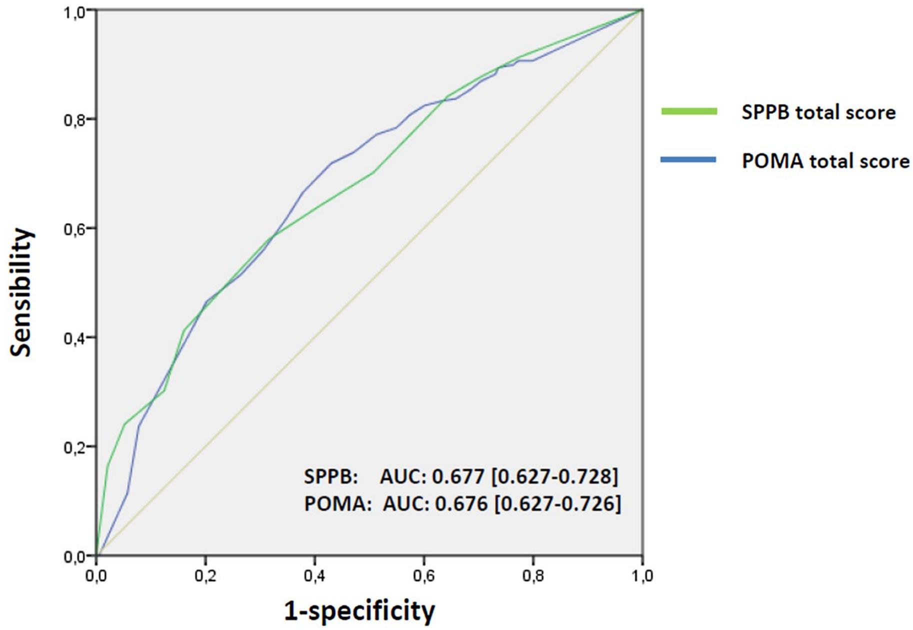

Fig. 2 Receiver-operating characteristic (ROC) curves showing the capacity of Short-Physical Performance Battery (SPPB) and Performance-Oriented Mobility Assessment (POMA) scores in discriminating between the status of faller and non-faller in a group of 451 older patients undergoing comprehensive geriatric assessment for memory or motoric complaints

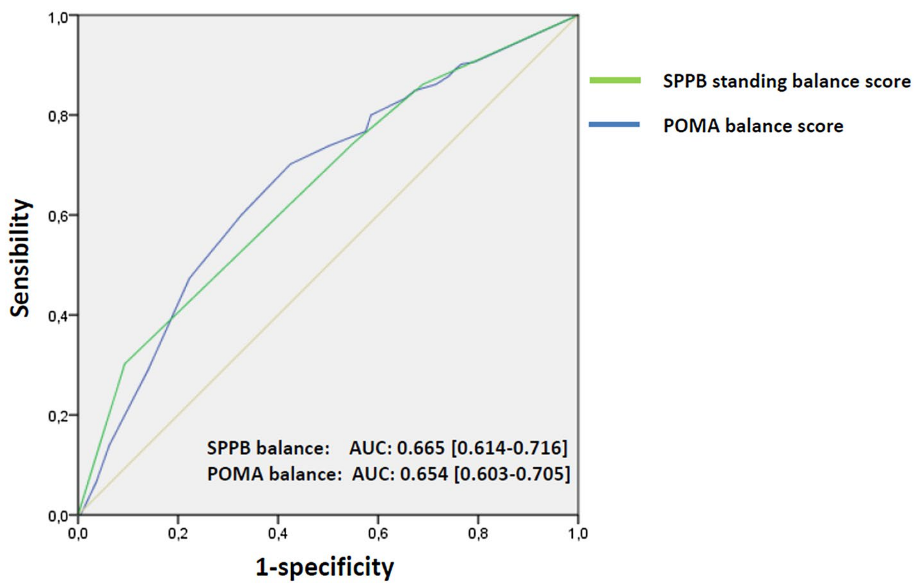

Fig. 3 Receiver-Operating Characteristic (ROC) curves showing the capacity of Short-Physical Performance Battery (SPPB) and Performance-Oriented Mobility Assessment (POMA) balance sub-test scores in discriminating between the status of faller and non-faller in a group of 451 older patients undergoing comprehensive geriatric assessment for memory or motoric complaints

shown for MMSE, GDS and MNA-SF scores. Multivariate logistic regression analysis also confirmed the inverse association between the POMA scale score and reported falls (OR 0.94, 95% CI 0.91–0.98, $p = 0.002$) (Table 2, Model 2).

Alterations in the SPPB standing balance test were significantly and independently associated with a history of falls (OR 2.88, 95% CI 1.42–5.85, $p = 0.004$) (Table 2 Model 3), while alterations in the POMA balance score test were not (OR 1.55, 95% CI 0.81–2.95, $p = 0.18$) (Table 2 Model 4).

The association between SPPB and a history of falls remained statistically significant even when the score was considered as a dichotomous variable. The presence of a total SPPB score < 10 was positively and independently associated with a history of falls (OR 2.16, 95% CI 1.16–4.20, $p = 0.02$). Similarly, also a POMA scale total score < 21 was significantly associated with reported falls (OR 2.28, 95% CI 1.50–4.80, $p < 0.001$).

Discussion

We have shown that, in a large group of older outpatients evaluated in a geriatric clinic for memory or motoric complaints, the SPPB total score and standing balance subscale were significantly associated with a history of falls. The performance of these tools, specifically designed to assess the

Table 2 Multivariate logistic regression models testing the association between Short-Physical Performance Battery (SPPB) score, Performance-Oriented Mobility Assessment (POMA) score, or their balance sub-tests with the status of fallers in a group of 451 older patients undergoing comprehensive geriatric assessment for memory or motoric complaints

Variable	Model 1		Model 2		Model 3		Model 4	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
SPPB total score	0.83 (0.76–0.92)	**< 0.001**	–	–	–	–	–	–
POMA total score	–	–	0.94 (0.91–0.98)	**0.002**	–	–	–	–
SPPB balance sub-test alterations	–	–	–	–	2.88 (1.42–5.85)	**0.004**	–	–
POMA balance sub-test alterations	–	–	–	–	–	–	1.55 (0.81–2.95)	0.18
MMSE score	0.89 (0.84–0.96)	**< 0.001**	0.89 (0.84–0.95)	**< 0.001**	0.88 (0.82–0.94)	**0.005**	0.88 (0.83–0.94)	**< 0.001**
Grip strength	1.02 (0.97–1.07)	0.29	1.01 (0.97–1.06)	0.59	1.02 (0.97–1.07)	0.51	0.99 (0.96–1.04)	0.96
BMI	0.94 (0.89–0.99)	**0.03**	0.96 (0.91–1.01)	0.08	0.96 (0.90–1.02)	0.19	0.96 (0.92–1.01)	0.12
GDS score	1.31 (1.08–1.59)	**0.005**	1.31 (1.08–1.58)	**0.006**	1.37 (1.09–1.72)	**0.006**	1.39 (1.16–1.67)	**< 0.001**
MNA-SF score	1.18 (1.04–1.34)	**0.01**	1.16 (1.02–1.32)	**0.02**	1.10 (0.96–1.26)	0.17	1.11 (0.98–1.25)	0.08
Number of drugs	1.10 (0.84–1.45)	0.48	1.14 (0.88–1.50)	0.32	1.25 (0.91–1.72)	0.12	1.20 (0.92–1.57)	0.17
Visual deficit	1.31 (0.64–2.68)	0.46	1.33 (0.64–2.73)	0.44	1.40 (0.69–2.84)	0.35	1.49 (0.73–3.06)	0.27
Age	0.98 (0.95–1.03)	0.61	0.99 (0.96–1.04)	0.82	0.99 (0.94–1.05)	0.79	1.00 (0.96–1.05)	0.85
Sex (male vs female)	1.16 (0.61–2.20)	0.66	1.09 (0.58–2.07)	0.78	1.55 (0.74–3.25)	0.24	1.02 (0.55–1.91)	0.94

Significant *p* values (< 0.05) are indicated in bold

SPPB Short-Physical Performance Battery, *POMA* Performance-Oriented Mobility Assessment, *MMSE* mini-mental state examination, *MNA-SF* mini-nutritional assessment-short form, *GDS* Geriatric Depression Scale, *ADL* activities of daily living, *IADL* instrumental activities of daily living, *BMI* body mass index

motoric performance and not the risk of falls, in discriminating between fallers and non-fallers were non-inferior than those of the POMA scale, a widely used tool for evaluating fall risk.

Our findings confirm those from the population-based study "Progetto Veneto Anziani" by Veronese and colleagues [17], who found that SPPB scores of 0–6 was significantly more associated with the status of recurrent faller than SPPB scores of 10–12 in a group of 2710 older persons. However, they did not find a significant association between the SPPB balance sub-test and recurrent falls. In fact, female fallers had lower gait speed and male fallers had longer times to complete the 5-timed chair-stand SPPB sub-test than non-fallers, as the main reasons for lower total scores [17]. SPPB total score was associated with falls also in a group of 307 older Korean volunteers [18] and in a group of 51 patients undergoing maintenance hemodialysis [19].

In a recent prospective study performed in a hospital general ward setting, baseline SPPB total score predicted serious injurious falls and fractures during the hospital stay, confirming SPPB as a valid tool to assess not only mobility, but also fall risk [20].

However, the results of two prospective cohort population-based studies carried out in Italy [21] and in the United States [22] showed no association between baseline SPPB score and incident falls at 3- and 4-year follow-up, respectively. The only parameters able to predict falls were age and GDS score in the Italian study [21], and fall history and a slow chair stand test in the American study [22]. Similarly, in another prospective cohort study, altered posture, but not total SPPB score, was associated with incident falls [23].

The discrepancy between the results of these studies and our data, showing that SPPB is equivalent to a specific fall risk assessment tool in discriminating between fallers and non-fallers, may depend on the characteristics of the population. In fact, the subjects who participated in our study were evaluated for cognitive or physical frailty, using an integrated approach considering the brain and the skeletal muscle pathology as two sides of the same clinical picture [24, 25]. The participants were recruited among outpatients evaluated at the Cognitive and Motoric Disorders Clinic, that represents a cohort of old people at higher risk of functional decline and adverse health outcomes in comparison with those living in the community. In fact, the overall sample result dependent in most instrumental activities of daily living and in one basic activity of daily living.

Falls represent an outcome of complex physio-pathological mechanisms influenced by sarcopenia, cognitive impairment, depression, malnutrition and chronic multimorbidity [26, 27]. The coexistence of these conditions, and particularly of severe cognitive impairment and physical limitations, defines the highest fall risk [28]. In fact, the Frailty Index was significantly associated with increased risk of falls in a large population-based study [29].

In this scenario, the execution of SPPB test during comprehensive geriatric assessment is mandatory, not only to screen physical frailty and sarcopenia [30], but also to objectively trace a fall risk profile, especially when time-consuming fall risk-specific scales are not feasible. SPPB, and particularly the balance sub-test, may also help to unveil the presence of subclinical chronic neurological diseases, such as parkinsonism or vascular dementia, which are often underdiagnosed in older people [31]. When performing comprehensive geriatric assessment, clinicians should be aware that SPPB test can give very important information not only on sarcopenia and mobility-disability, but also on the possible presence of balance alterations of neurological etiology, and representing the ideal tool for targeting the so-called “brain-muscle loop” [24]. Fall risk in fact may depend not only on muscle weakness and sarcopenia [32], but also on cognitive impairment [33], and clinical tools integrating both aspects of risk profile may be very useful in clinical practice.

Our data also show that the risk of falls is associated with clinically evident cognitive impairment, depression, and malnutrition, measured with MMSE, GDS and MNA-SF, respectively. Each one of these syndromes has already been associated with fall risk in large population-based studies [34–36]. Thus, fall risk assessment in older people can be very challenging for geriatricians, and should necessarily rely on multi-dimensional and multi-parametric evaluation [37]. Thus, the simplest and quickest assessment tools should be preferred in this setting. The non-inferiority of SPPB test with respect of POMA scale in defining the status of faller supports the integration of SPPB in algorithms of fall risk assessment, as a proxy of fall risk-specific assessment scales.

However, it is noteworthy that the performance of both studied tools, SPPB and POMA, in discriminating fallers and non-fallers, although statistically significant, was far from optimal. AUCs < 0.70 imply that a large number of fallers was misclassified as having a low-risk of falls by both tools. This is in line with several data from the literature showing that traditional tools for fall risk assessment have a limited capacity of correct stratification of fall risk in geriatric outpatients [5]. For example, in a study performed with a design similar to ours, the Berg Balance Scale proved able to discriminate fallers and non-fallers with an AUC of 0.69 [38]. Clinicians should be aware of the limitations of these tools when performing fall risk assessment in everyday practice, and further research is urgently needed to identify tools with better performances.

Our study has limitations, which should be considered in result interpretation. The cross-sectional design does not allow to infer the capacity of SPPB to predict falls in a long-term follow-up. Moreover, the association between SPPB score and faller status does not necessarily imply that falls were caused by poorer physical performance. The lower SPPB scores in fallers may have also been the consequence of injurious falls or the result of a more cautious attitude of patients towards movement because of the fear of falling. The methodology of faller status assessment, based on anamnestic record, may have led to underestimation of falls, especially the non-injurious ones. However, this methodology is widely applied in clinical practice. The participants already suffered from motoric or cognitive complaints, and so subjects with a low-risk of falling were not included in our study. Our findings should, therefore, be confirmed in population-based studies including also healthy-active individuals. Finally, some clinical elements, such as the specific types of medications and comorbidities, were not considered in the multivariate analysis.

In spite of these limitations, we have shown that, in older outpatients with suspected physical and/or cognitive frailty, SPPB test is non-inferior to POMA scale in discriminating between fallers and non-fallers. Clinicians who must perform fall risk assessment in frail older patients should be aware that SPPB test may represent a valid proxy of fall risk-specific scales, such as POMA, although both tests had a modest capacity of discriminating fallers vs non-fallers. More studies, especially with a longitudinal design, are needed to estimate the role of the SPPB test in the stratification of the “identikit” of older subjects at risk of falling.

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Author contributions FL and MM conceived and designed the study; FL, LG, AN and BP performed the investigation and collected data; FL and AT analyzed the data; AT wrote the paper; CT, TM and MM revised the manuscript for substantial content; TM and MM provided supervision.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

Ethical approval The protocol of the TRIP (Traumatic Risk Identikit Parma) Study, which the analyses reported in this paper are part of, has been approved by the Ethics Committee of Parma province (ID 17262).

Informed consent Written informed consent was obtained for all participants.

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