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Runnig head: monofilament test and falls in the elderly

The Semmes-Weinstein Monofilament Examination for predicting physical performance and the risk of falls in older people: results from the Pro.V.A. longitudinal study

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The Semmes-Weinstein Monofilament Examination for predicting physical performance and the risk of falls in older people: results from the Pro.V.A. longitudinal study

Objectives: to investigate whether Semmes Weinstein Monofilament Examination (SWME) was associated with, and could predict measures of physical performance and the risk of fall in elderly subjects. **Design:** prospective study (mean follow-up 4.4-years). **Setting:** community. **Subjects:** 2826 older subjects enrolled in the *Progetto Veneto Anziani* (Pro.V.A.), an Italian population-based cohort study. For longitudinal analyses, we considered a subsample of 1885 persons who did not report falls at baseline. **Interventions:** not applicable. **Main outcome measures:** falls reported in the year preceding the assessment and Short Physical Performance Battery (SPPB) were recorded at baseline and again after 4.4 years. **Results:** At baseline, 830 (29.4%) subjects had experienced falls in the previous year, with a higher prevalence of falls in those positive at SWME (SWME+) than in those negative at SWME (SWME-) (35.8% vs 28.0%, p=0.001). Using logistic regression, SWME+ subjects had a significant 66% higher risk of presenting worse SPPB score (95%CI: 1.51-1.83), and between 25% and 32% higher risks of having experienced at least one or recurrent falls, than those SWME-. The incidence of falls at follow-up was higher in the SWME+ compared with the SWME- group (42.2% vs 30.7%, p=0.001), and multinomial logistic regression showed that the former had a 13% higher risk of decline in SPPB scores (95%CI: 1.03-1.25), particularly for gait and balance, 48% higher risk of having had at least one fall and 77% higher risk of recurrent falls. At both baseline and follow-up, the larger the extension of neuropathy (SWME- vs unilateral vs bilateral SWME+), the greater its negative impact on falls and physical performance. **Conclusion:** SMWE was associated with, and could predict lower-extremity physical performance and falls in older people.

Keywords: aged, peripheral nervous system diseases, lower extremity.

Abbreviations:

ADL, Activities of Daily Living

ANOVA, Analysis of Variance

BMI, Body Mass Index

COPD, Chronic Obstructive Pulmonary Disease

CVD, Cardiovascular Diseases

GDS, Geriatric Depression Scale

IADL, Instrumental Activities of Daily Living

ICDF, International Consensus on the Diabetic Foot

MMSE, Mini Mental State Examination

OA, Osteoarthritis;

SPPB, Short Physical Performance Battery

SWME, Semmes Weinstein Monofilament Examination

The burden of falls in the elderly population is documented worldwide and leads to an increase in morbidity and mortality [1]. This is the result of an interaction of risk factors, one of which is peripheral neuropathy, that affects around 15% of older people [2], and presents with a variable etiology [3]. Involving both sensory and motor fibers, age-related peripheral nerve dysfunction may be associated with gradual loss of strength, impaired position sense, ataxia, and muscle atrophy [4], all of which can negatively affect lower-extremity physical performance, and increase the risk of falls.

Nerve conduction studies are the validated methods for diagnosing peripheral neuropathy, but they are costly and time-consuming, and require trained physicians and technicians [5]. These tests may also be unable to detect early nerve conduction impairment, so symptoms of peripheral neuropathy often precede its instrumental diagnosis [6]. Among other clinical tests developed to identify the first signs of peripheral neuropathy, the Semmes-Weinstein Monofilament Examination (SWME) is a noninvasive, low-cost, quickly-implemented method that can be used as a first step [7]. The value of SWME in the early detection of peripheral neurological disorders in the elderly general population has yet to be fully investigated. Few studies have examined how neuropathy detected on SWME is associated with physical performance impairments and falls [8-10], and how much the risk of falls is mediated by physical impairments [11,12].

We hypothesized that SWME could be useful for the early detection of older individuals at high risk of falls due to motor and sensory nerve conduction impairments. The aims of our study were thus to investigate the association between SWME findings and lower-extremity physical performance and falls in a sample of elderly individuals, and to establish how much the association between SWME results and falls was mediated by any neuropathy-related impairment in these subjects' physical performance.

METHODS

Data source and subjects

Our study sample involved subjects enrolled in the *Progetto Veneto Anziani* (Pro.V.A.), an observational cohort study on the Italian elderly population. This project initially enrolled 3099 age- and sex-stratified community-dwelling Caucasian adults (1245M, 1854F), aged ≥65, randomly selected between 1995 and 1997 [13]. Of these 3099 individuals, the following were excluded for the purposes of our analyses: 222 subjects without data on SWME, falls, or baseline physical performance; 5 who reported toe amputations; and 46 who had lower limb ulcers. The final sample thus included 2826 subjects. For longitudinal analyses, we excluded another 830 subjects with a history of falls at the baseline, and 111 who were lost to follow-up, thus remained with 1885 subjects.

The ethical committees of Padua University and the Local Health Units No.15 and No.18 of the Veneto Region approved the protocol, and participants gave written informed consent.

Demographic characteristics, health and functional status

For each participant, we collected data regarding educational level, monthly income, smoking habits, and alcohol drinking (yes/no). Body mass index (BMI) was calculated as weight over height in meters squared (kg/m^2). Comorbidities were assessed by board-certified physicians based on a physical examination, medical history, questionnaires, and biochemical analyses. The number of drugs taken per day was categorized as $\leq$ or >3 drugs/day. For the purposes of our study, we considered the presence of cardiovascular diseases (CVD), orthostatic hypotension, diabetes [14,15], fractures, lower limb osteoarthritis (OA), chronic obstructive pulmonary disease (COPD), cancer, altered vision, and the Romberg test. CVD was defined on the grounds of: a history of congestive heart failure, coronary ischemic diseases, stroke, or peripheral artery disease. Orthostatic hypotension was tested by trained nurses who first measured clinostatic blood pressure in both arms three times, using a mercury sphygmomanometer and taking the mean value for reference; then orthostatic blood pressure was measured after 1 and 3 minutes of standing. In accordance with

current guidelines, orthostatic hypotension was defined as a drop of ≥20 mm Hg in systolic or ≥10 mm Hg in diastolic blood pressure within 3 minutes of standing up [16].

Semmes-Weinstein monofilament examination (SWME)

At the baseline we performed the 10 g SWME test [17,18] according to the protocol of the International Consensus on the Diabetic Foot (ICDF) [19], assessing the three originally-recommended sites in the hallux, 1st metatarsal and 5th metatarsal areas. The test was considered positive (SWME+) if a subject failed to perceive the monofilament in at least one of the three points stimulated on the right or left foot; otherwise it was considered negative (SWME-). We classified the test results according to whether an impaired monofilament perception was reported in only one foot (unilateral SWME+), or in both feet (bilateral SWME+).

Definition of outcome

Lower-extremity physical performance was assessed with the Short Physical Performance Battery (SPPB), evaluating gait speed, static balance, and time to rise from a chair, scoring performance from 0 (worse) to 4 (best) for each item, and from 0 (worse) to 12 (best) as a total score [20]. A baseline poor performance in single SPPB items was defined as a score of ≤2 for gait and chair stands, and ≤3 for balance, in the light of the lowest tertiles identified for these items. Similarly, and consistently with previous studies and the lowest tertile, physical performance was defined as poor if the total SPPB score was ≤8 [21]. At the follow-up, a decline in physical performance was defined as the loss ≥1 point in any of the single items or in the total SPPB score [22].

The number of falls reported in the year preceding the baseline and follow-up assessments was recorded by trained nurses during face-to-face interviews with participants, or with their caregivers in the case of cognitively impaired subjects. In accordance with the WHO guidelines, a fall was defined as “an unexpected event where a person falls to the ground from an upper level or the same level” [23]. For the purposes of our study, reports of at least one, or of ≥2 (recurrent) falls were considered as separate outcomes.

Statistical analyses

To generalize the Pro.V.A. sample to the population in the two areas of the participants' provenance, we used a set of weights based on the gender and age distribution of the reference population (Italy, Census 1991), and the sample fraction. After dividing the sample into two groups by SWME results, we compared the means of the continuous covariates using Student's t-test, and categorical covariates using the chi-squared test. Levene's test was used to test the homoscedasticity of the variances and, if its assumption was violated, then Welch's ANOVA was used. Multivariate logistic regression analyses were run to explore the association between SWME, physical performance and reported falls at the baseline. The analyses were adjusted first only for age and sex (Model 1), then also for additional variables revealing significant differences between SWME- and SWME+ subjects, or that could directly or indirectly influence physical performance or the occurrence of falls (Model 2) [24]. The association between the number of points where perception was impaired in the SWME and the number of falls reported at the baseline was examined using multiple linear regression. Longitudinal analyses were performed using multinomial logistic regression, including mortality as an outcome to consider the competing risk of death. For the risk of falls, the analyses were run considering subjects who reached the follow-up assessment without experiencing any falls as the reference category, and the occurrence of one fall, recurrent falls, or death before the follow-up assessment as alternative outcomes. All statistical tests were two-tailed and statistical significance was assumed for a p-value <0.05. All analyses were performed using the SPSS 23.0 for Windows (SPSS Inc., Chicago, Illinois).

RESULTS

Our study sample included 2826 subjects (1149M, 1677F) with a mean age of 75.7±7.5 years, and a mean BMI of 27.63±4.58 kg/m^2. Table 1 shows the baseline characteristics of our participants, grouped by SWME result.

At the baseline, 830 (29.4%) subjects reported falls in the previous year, with a higher prevalence of falls in the SWME+ than in the SWME- group (35.8% vs. 28.0%, p=0.001). Using multiple linear

regression, a significant association emerged between the number of points where perception of the monofilament was impaired and the number of falls reported (β=0.14, $p<0.0001$). The logistic regression on the association between SWME findings, SPPB scores, and falls reported at the baseline (Table 2) showed that the SWME+ group had a significant, 66% higher risk of a poor lower-extremity physical performance (particularly as concerns gait), a 25% higher risk of having experienced ≥1 fall, and a 32% higher risk of having had recurrent falls, than the SWME- group. As for the impairments identified with the SWME, the greater the extent of the neuropathy, the higher the likelihood of falls being reported. This was reflected in the findings regarding physical performance, with the exception of gait speed, which was more likely to be slower in unilaterally than in bilaterally SWME+ subjects (Table 2).

At the follow-up, only the subjects who had reported at the baseline having experienced no falls were considered (n=1885). When compared with the subjects excluded from this longitudinal analysis (Table 3), the follow-up subgroup was younger (mean age 75.1±7.4 vs 76.8±7.2 years, $p<0.0001$), and included fewer women (55.7% vs 66.6%, $p<0.0001$). At the follow-up assessment, 489 subjects (25.9%) reported having experienced at least one fall in the previous year, 156 (8.3%) had experienced recurrent falls, and 370 (19.6%) had died before attending the interview. The incidence of falls reported at the follow-up was higher in the SWME+ group than in the SWME- group (42.2% vs 30.7%, $p=0.001$). Using multinomial logistic regression, our analyses confirmed that the SWME+ group had a 13% higher risk of a decline in their SPPB scores (particularly for gait and balance), a 48% higher risk of having had at least one fall, and a 77% higher risk of having experienced recurrent falls, than the SWME- group (Table 4; ORs for mortality are given in Supplementary Table 1). Here again, the greater the extent of the neuropathy, the higher the likelihood of a decline in physical performance and falls (Table 4). When we considered how physical performance influenced the association between SWME findings and falls, at both the baseline and the follow-up, we found that impaired performance, particularly in gait, could only mediate up to 6% of this association (Table 5).

DISCUSSION

Our study demonstrated that SWME findings were associated with, and could predict lower-extremity physical performance and falls in a sample of community-dwelling older persons. Although SWME is not enough for a definitive diagnosis of peripheral neuropathy, it may be useful for identifying nerve dysfunction in the peripheral sensory fibers, which may negatively affect lower limb function and raise the risk of falls [3,5,25]. In addition to being complications of chronic conditions like diabetes mellitus, alcohol abuse, and vitamin deficiencies, symptoms such as poor distal sensitivity or muscle strength, or loss of tendon reflexes may occur in healthy elderly people too, so aging *per se* may cause a gradual neurological degeneration [26].

To the best of our knowledge, other Authors have conducted studies with SWME in particular categories of patients [8,27,28], but there is still little evidence regarding the elderly general population. The low prevalence of diabetes (14.1%) in our sample, which was similar in our SWME+ and SWME- groups, and having adjusted our analysis for other potential causes of neuropathy, together reinforce the usefulness of SWME for detecting neuropathy in the general older population, not only in patients with specific diseases.

Our results confirm the relationship between age-related neuropathy and physical performance previously reported in diabetic patients and elderly general populations [4,5,10,29–32]. In our sample, as in Strotmeyer´s study [29], SWME+ was associated with all lower-extremity functions at the baseline, and could predict a decline during the follow-up, especially in gait and balance. The weaker impact of neuropathy over time on the chair stands test compared with other physical performance measures, suggests that it may affect the motor fibers involved in maintaining limb muscle strength and endurance more slowly than other motor and neurosensory components. We also noted that the greater the extent of neuropathy (in terms of bilateral vs unilateral SWME+), the greater its impact on physical performance. The only exception concerned gait speed at the baseline assessment, which was more likely to be slower in unilaterally than in bilaterally SWME+ subjects. This could be due to subjects with unilateral SWME+ having certain characteristics not thoroughly

accounted for in our fully-adjusted analyses, or to possible compensatory mechanisms at work during walking (that might be more likely in the case of bilateral impairments). Further investigations are needed to clarify this issue.

Our study revealed also a significant association between neuropathy detected by SWME and a recent history of falls, suggesting that nerve conduction impairments, however mild and undiagnosed, have already had negative consequences. A peripheral nerve dysfunction identified on SWME was also associated with a 55% higher risk of falls during the follow-up, corroborating the findings of Riskowsky *et al.* [8]. The association between SWME findings and the risk of falls was further strengthened when we considered the reports of recurrent falls, demonstrating even more consistent results, at both baseline and follow-up. The neuropathy-related impairments in gait, balance and chair stands seemed to only partially contribute to higher odds of falling in our sample, however, although lower-extremity physical performance is strongly associated with this risk. This means that peripheral neuropathy may influence the risk of falls via other mechanisms not considered here, such as impaired position sense, ataxia, or loss of sensorimotor reflexes [4,10]. Alternatively, peripheral neuropathy could be a sign of a more complex state of multimorbidity that would gradually raise the risk of falls in older people [33]. As for physical performance, the risk of falls increased more for bilateral than for unilateral impairment in SWME, which means that the extent of any neuropathy is another factor to consider when assessing the risk of falls in older people.

Study limitations

Our study has some limitations. First, the effects of repeated trials, and of the operator's hand movements may represent a potential bias in SWME results. Second, having ignored the dynamics of reported falls (e.g. syncope, vertigo) may bias our analyses because not all falls are caused by somatosensory system impairments, as detected by SWME. Finally, at the follow-up assessment only falls occurring in the previous year were considered (not during the whole follow-up), so the rate of new fallers may have been underestimated.

On the other hand, the strengths of this study lie in the size of our sample and its prospective design. The considerable number of adjusting covariates used in the model also enabled us to minimize their confounding effect on the association between SWME and falls.

CONCLUSIONS

In conclusion, our study demonstrates that SWME was associated with, and could predict lower-extremity physical performance and falls in a sample of community-dwelling older persons.

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TABLE LEGENDS

Table 1. The baseline characteristics of the 2826 participants of the PRO.V.A. Study, classified according to the result at Semmes Weinstein monofilament examination (SWME). Numbers are mean values (and standard deviations) or n (%), as appropriate.

Table 2. Associations between the baseline Semmes Weinstein Monofilament Examination with physical performance and the history of at least one fall or recurrent falls in the year preceding the baseline evaluation (n=2826) (weighted data).

Table 3. The baseline characteristics of the 1885 participants included in the follow-up analysis, compared with those excluded (n=941) because reporting at least one fall at baseline or missing data (unweighted data). Numbers are mean values (and standard deviations) or percentages (%), as appropriate.

Table 4. Multinomial regression analyses on the association between the baseline results at SWME with physical performance decline and falls in the year preceding the follow-up evaluation (n=1885) (weighted data).

Table 5. Comparison between age- and gender-adjusted with age-, gender- and impairment-adjusted models relating SWME and falls at the baseline and follow-up evaluation.

Table 1. The baseline characteristics of the 2826 participants of the PRO.V.A. Study, classified according to the result at Semmes Weinstein monofilament examination (SWME). Numbers are mean values (and standard deviations) or n (%), as appropriate.

Variable	SWME – (n=2334)	SWME + (n=492)	*p* value*
Age (years)	75.1±7.4	78.1±7.7	<0.0001
Gender (female, %)	60.0	56.1	0.11
Anthropometric and demographic data			
BMI (kg/m^2)	27.56±4.54	27.96±4.76	0.09
Education > 5 ys (%)	15.8	11.3	0.013
Monthly income >500 euro (%)	39.6	33.7	0.15
Living alone (%)	17.1	21.2	0.03
Current smokers (%)	9.3	8.3	0.52
Heavy drinkers (%)	12.7	10.4	0.15
ADL score	5.26±1.26	4.59±1.75	<0.0001
IADL score	6.21±1.89	5.26±2.24	<0.0001
GDS score	9.29±5.30	10.09±5.90	0.006
MMSE score	23.94±5.39	22.47±5.44	<0.0001
Physical performance items			
SPPB total score (points)	8.28±3.41	6.68±3.70	<0.0001
Medical conditions			
Diabetes (%)	14.8	20.7	0.01
Orthostatic hypotension (%)	30.9	34.5	0.13
Romberg test (positive, %)	3.6	6.6	0.003
CVD (%)	20.7	28.7	<0.0001

Variable	SWME – (n=2334)	SWME + (n=492)	*p* value*
Fractures (%)	9.2	13.0	0.010
Lower limb osteoarthritis (%)	23.5	36.4	<0.0001
COPD (%)	9.1	12.2	0.03
Cancer (%)	7.5	7.9	0.77
Vision deficits (%)	37.2	44.0	0.004
Number of drugs >3 (%)	60.8	68.0	0.007
History of fall in the last year (%)	28.0	35.8	0.001

*Unless otherwise specified, p values are adjusted for age using a general linear model or logistic regression, as appropriate.

Table 2. Associations between the baseline Semmes Weinstein Monofilament Examination with physical performance and the history of at least one fall or recurrent falls in the year preceding the baseline evaluation (n=2826) (weighted data)

				Baseline SWME categories		
		SWME-	SWME+	SWME-	Unilateral SWME+	Bilateral SWME+
SPPB balance ≤3	**Model 1**	[ref]	1.71 (1.59-1.84)***	[ref]	1.49 (1.34-1.65)***	1.92 (1.74-2.10)***
	Model 2	[ref]	1.28 (1.17-1.41)***	[ref]	1.33 (1.19-1.48)**	1.75 (1.58-1.93)***
SPPB gait ≤2	**Model 1**	[ref]	2.19 (2.04-2.36)***	[ref]	2.16 (1.95-2.39)***	2.22 (2.03-2.44)***
	Model 2	[ref]	1.72 (1.57-1.89)***	[ref]	1.93 (1.73-2.16)***	1.79 (1.62-1.98)***
SPPB chair ≤2	**Model 1**	[ref]	1.78 (1.67-1.91)***	[ref]	1.57 (1.43-1.73)***	1.98 (1.81-2.16)***
	Model 2	[ref]	1.54 (1.40-1.68)***	[ref]	1.39 (1.25-1.54)***	1.79 (1.62-1.96)***
SPPB tot ≤8	**Model 1**	[ref]	2.12 (1.97-2.28)***	[ref]	1.84 (1.66-2.03)***	2.39 (2.18-2.62)***
	Model 2	[ref]	1.66 (1.51-1.83)***	[ref]	1.62 (1.45-1.81)***	2.07 (1.87-2.29)***
≥ 1 fall	**Model 1**	[ref]	1.41 (1.30-1.53)***	[ref]	1.11 (1.004-1.22)*	1.53 (1.40-1.67)***
	Model 2[†]	[ref]	1.25 (1.15-2.36)***	[ref]	0.95 (0.86-1.05)	1.30 (1.19-1.43)***
≥ 2 falls	**Model 1**	[ref]	1.60 (1.47-1.75)***	[ref]	1.39 (1.22-1.57)***	1.79 (1.61-1.99)***
	Model 2[†]	[ref]	1.32 (1.21-1.45)***	[ref]	1.16 (1.02-1.32)*	1.44 (1.28-1.61)***

Unless otherwise specified, data are presented as odds ratios and 95% confidence intervals with corresponding p-values: *p<0.05; **p<0.01; ***p<0.001.

Notes: SWME-, negative Semmes Weinstein Monofilament Examination; SWME+, positive Semmes Weinstein Monofilament Examination.

Model 1 includes: age (as a continuous variable) and sex (male/female).

Model 2 includes: sex (male/female); age, Geriatric Depression Scale (as continuous variables); Body Mass Index (<25 vs 25-29.9/>30); Mini-Mental State Examination (≥ vs <24), educational level (education ≥5 vs <5 years); monthly income (>500 vs ≤500 euro); living alone, diabetes, orthostatic hypotension, cardiovascular diseases, vision deficit, chronic obstructive pulmonary disease, fracture, lower limb osteoarthritis (all yes/no); Romberg test (positive vs negative), number of drugs taken per day (≥3 vs <3). [†]Model 2 includes also: baseline total SPPB score (as continuous variable).

Table 3. The baseline characteristics of the 1885 participants included in the follow-up analysis, compared with those excluded (n=941) because reporting at least one fall at baseline or missing data (unweighted data). Numbers are mean values (and standard deviations) or percentages (%), as appropriate.

Variable	Follow-up sample (n=1885)	Excluded subjects (n=941)	*p* value*
Age (years)	75.09±7.36	76.79±7.73	<0.0001
Sex (Female, %)	55.7	66.6	<0.0001
Anthropometric and demographic data			
BMI (kg/m^2)	27.66±4.60	27.57±4.54	0.65
Education ≥ 5 ys (%)	15.8	13.4	0.097
Monthly income >500 euro (%)	41.5	32.6	<0.0001
Living alone (%)	16.2	21.2	0.001
Current smokers (%)	9.5	8.3	0.29
Heavy drinkers (%)	14.0	9.0	<0.0001
ADL score	5.31±1.24	4.81±1.58	<0.0001
IADL score	6.54±1.61	5.9±2.16	<0.0001
GDS score	9.13±5.21	10.03±5.77	<0.0001
MMSE score	24.14±5.18	22.77±5.78	<0.0001
Physical performance items			
SPPB total score (points)	8.45±3.35	7.11±3.65	<0.0001
Medical conditions			
Diabetes (%)	15.2	17.1	0.18
Orthostatic hypotension (%)	29.9	34.9	0.008
CVD (%)	24.9	20.6	0.01

Variable	Follow-up sample (n=1885)	Excluded subjects (n=941)	*p* value*
Romberg test (positive, %)	6.3	3.0	<0.0001
Fractures (%)	9.1	11.5	0.04
Lower limb osteoarthritis (%)	22.6	32.1	<0.0001
COPD (%)	9.5	9.8	0.85
Cancer (%)	8.0	6.8	0.25
Vision deficits (%)	39.4	48.5	<0.0001
Number of drugs >3 (%)	59.9	66.2	0.003

*Unless otherwise specified, p values are adjusted for age and gender using a general linear model or logistic regression, as appropriate.

Table 4. Multinomial regression analyses on the association between the baseline results at SWME with physical performance decline and falls in the year preceding the follow-up evaluation (n=1885) (weighted data).

		Baseline SWME categories				
		SWME-	**SWME+**	**SWME-**	**Unilateral SWME+**	**Bilateral SWME+**
Balance decline	**Model 1**	[ref]	1.26 (1.14-1.38)***	[ref]	1.27 (1.11-1.45)***	1.24 (1.09-1.41)***
	Model 2	[ref]	1.28 (1.16-1.41)***	[ref]	1.25 (1.09-1.44)**	1.30 (1.14-1.48)***
Gait decline	**Model 1**	[ref]	1.25 (1.14-1.37)***	[ref]	1.21 (1.07-1.38)***	1.28 (1.13-1.45)***
	Model 2	[ref]	1.31 (1.19-1.44)***	[ref]	1.27 (1.11-1.44)***	1.35 (1.19-1.53)***
Chair stand decline	**Model 1**	[ref]	0.96 (0.88-1.05)	[ref]	0.95 (0.84-1.08)	0.97 (0.86-1.10)
	Model 2	[ref]	0.96 (0.88-1.05)	[ref]	0.94 (0.83-1.07)	0.98 (0.87-1.11)
Total SPPB decline	**Model 1**	[ref]	1.13 (1.02-1.24)*	[ref]	1.03 (0.91-1.18)	1.23 (1.08-1.41)**
	Model 2	[ref]	1.13 (1.03-1.25)*	[ref]	1.02 (0.89-1.16)	1.26 (1.10-1.45)**
1 fall	**Model 1**	[ref]	1.52 (1.37-1.69)***	[ref]	1.04 (0.88-1.22)	2.10 (1.83-2.41)***
	Model 2	[ref]	1.48 (1.33-1.65)***	[ref]	1.02 (0.87-1.20)	2.04 (1.77-2.34)***
≥ 2 falls	**Model 1**	[ref]	1.84 (1.60-2.11)***	[ref]	1.66 (1.37-2.00)***	2.05 (1.70-2.46)***
	Model 2†	[ref]	1.77 (1.54-2.04)***	[ref]	1.70 (1.40-2.06)***	1.85 (1.53-2.24)***

Unless otherwise specified, data are presented as odds ratios and 95% confidence intervals with corresponding p-values: *p<0.05; **p<0.01; ***p<0.001.

Notes: SWME-, negative Semmes Weinstein Monofilament Examination; SWME+, positive Semmes Weinstein Monofilament Examination.

Model 1 includes: age (as a continuous variable) and sex (male/female).

Model 2 includes: sex (male/female); age, Geriatric Depression Scale (as continuous variables); Body Mass Index (<25 vs 25-29.9/>30); Mini-Mental State Examination (≥ vs <24), educational level (education ≥5 vs <5 years); monthly income (>500 vs ≤500 euro); living alone, diabetes, orthostatic hypotension, cardiovascular diseases, vision deficit, chronic obstructive pulmonary disease, fracture, lower limb osteoarthritis (all yes/no); Romberg test (positive vs negative), number of drugs taken per day (≥3 vs <3). †Model 2 includes also: baseline total SPPB score (as continuous variable).

Table 5. Comparison between age- and gender-adjusted with age-, gender- and impairment-adjusted models relating SWME and falls at the baseline and follow-up evaluation

	% OR change attributable to physical impairment at baseline	% OR change attributable to physical impairment at follow-up*
Balance	-3.0	-1.0
Gait	-6.0	-3.7
Chair stand	-4.5	-3.1
Total SPPB	-5.3	-3.7

*Impairment-adjustment includes: baseline impairment (as yes/not) and decline in the correspondent item over the follow-up period (as a continuous variable).

Supplementary Table 1. Association between the baseline Semmes Weinstein Monofilament Examination and mortality at the multinomial regression analyses considering as alternative outcomes physical performance decline and falls in the year preceding the follow-up evaluation (n=1885) (weighted data).

Mortality (SWME and main outcome)				Baseline SWME categories		
		SWME-	SWME+	SWME-	Unilateral SWME+	Bilateral SWME+
Mortality (SWME and Balance decline)	**Model 1**	[ref]	1.57 (1.41-1.75)***	[ref]	1.77 (1.52-2.05)***	1.42 (1.23-1.64)***
	Model 2	[ref]	1.44 (1.28-1.62)***	[ref]	1.57 (1.34-1.84)***	1.34 (1.15-1.56)***
Mortality (SWME and Gait decline)	**Model 1**	[ref]	1.57 (1.41-1.75)***	[ref]	1.73 (1.50-2.01)***	1.44 (1.24-1.66)***
	Model 2	[ref]	1.45 (1.30-1.63)***	[ref]	1.57 (1.35-1.84)***	1.36 (1.17-1.58)***
Mortality (SWME and Chair stand decline)	**Model 1**	[ref]	1.40 (1.25-1.56)***	[ref]	1.56 (1.34-1.81)***	1.27 (1.09-1.47)**
	Model 2	[ref]	1.27 (1.13-1.43)***	[ref]	1.38 (1.18-1.62)***	1.19 (1.02-1.39)*
Mortality (SWME and Total SPPB decline)	**Model 1**	[ref]	1.55 (1.37-1.75)***	[ref]	1.64 (1.39-1.93)***	1.49 (1.27-1.76)***
	Model 2	[ref]	1.42 (1.25-1.61)***	[ref]	1.44 (1.22-1.71)***	1.41 (1.19-1.67)***
Mortality (SWME and Falls)	**Model 1**	[ref]	1.70 (1.52-1.89)***	[ref]	1.72 (1.49-1.99)***	1.70 (1.47-1.96)***
	Model 2†	[ref]	1.41 (1.26-1.59)***	[ref]	1.50 (1.28-1.75)***	1.35 (1.16-1.58)***

Unless otherwise specified, data are presented as odds ratios and 95% confidence intervals with corresponding p-values: *p<0.05; **p<0.01; ***p<0.001

Notes: SWME-, negative Semmes Weinstein Monofilament Examination; SWME+, positive Semmes Weinstein Monofilament Examination.

Model 1 includes: age (as a continuous variable) and sex (male/female).

Model 2 includes: sex (male/female); age, Geriatric Depression Scale (as continuous variables); Body Mass Index (<25 vs 25-29.9/>30); Mini-Mental State Examination (≥ vs <24), educational level (education ≥5 vs <5 years); monthly income (>500 vs ≤500 euro); living alone, diabetes, orthostatic hypotension, cardiovascular diseases, vision deficit, chronic obstructive pulmonary disease, fracture, lower limb osteoarthritis (all yes/no); Romberg test (positive vs negative), number of drugs taken per day (≥3 vs <3). †Model 2 includes also: baseline total SPPB score (as continuous variable).