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ABSTRACT

Purpose: Habitual strength and power-demanding activities of daily life may support the maintenance of adequate lower-extremity functioning with ageing, but this has been sparingly explored. Hence, we examined whether the characteristics of free-living sit-to-stand (STS) transitions predict a decline in lower-extremity functioning over a 4-year follow-up. **Methods:** 340 community-dwelling older adults (60% women, age 75, 80 or 85 years) participated in this prospective cohort study. At baseline, a thigh-worn accelerometer was used continuously (3-7 days) to monitor the number and intensity of free-living STS transitions. A decline in lower-extremity functioning was defined as a drop of ≥ 2 points in the Short Physical Performance Battery (SPPB) from baseline to follow-up. Maximal isometric knee-extension strength was measured in the laboratory. **Results:** 85 participants (75% women) declined in SPPB over 4 years. After adjusting for age, sex, and baseline SPPB points, higher free-living peak STS angular velocity (odds ratio [OR] = 0.70; 95% confidence interval [CI] = 0.52-0.92, per 20 deg/s increase) protected against a future decline. When adjusting the model for maximal isometric knee-extension strength, the statistical significance was attenuated (OR = 0.72; 95% CI = 0.54-0.96, per 20 deg/s increase). **Conclusions:** Performing STS transitions at higher velocities in the free-living environment can prevent a future decline in lower-extremity function. This indicates that changes in daily STS behavior may be useful in the early identification of functional loss. Free-living peak STS angular velocity may be a factor underlying the longitudinal association of lower-extremity strength and performance.

Key Words: ACCELEROMETER, OLDER ADULTS, CHAIR RISE, DAILY LIFE

INTRODUCTION

High levels of muscle strength and power in old age can protect against future declines in physical functioning (1, 2). One might thus hypothesize that daily engagement in a substantial volume of strength- and power-demanding activities at high intensities, such as sit-to-stand (STS) transitions or stair negotiation, yields positive outcomes. However, these specific activities have previously been beyond the reach of conventional device-based physical activity measurements in the free-living environment (3, 4). While engaging in physical activity at moderate-to-vigorous intensity is important to maintain physical functioning (5–8), the role of daily strength- and power-demanding activities remains to be investigated.

Recently, we have developed a methodology to quantify free-living STS transitions based on thigh-worn accelerometry (9–11). We reported that individuals with a higher number and intensity of free-living STS also had higher physical functioning and knee-extension strength, and a faster lab-based 5xSTS time (9, 10). As older adults perform multiple (on average 45) STS transitions per day (12) and approach their maximal strength capabilities while doing so (10), free-living STS transitions may produce the necessary momentary overload needed to maintain the ability to function. Whether or not free-living STS performance can actually prevent declines in physical functioning among older adults remains scarcely explored. Therefore, the aim of the present study was to examine whether free-living baseline STS characteristics predict a decline in lower-extremity physical functioning over a 4-year follow-up among community-dwelling older adults.

METHODS

Participants and design

We present longitudinal analyses from the population-based *'Active aging - resilience and external support as modifiers of the disability outcome'* (AGNES) study. The AGNES study comprises three age cohorts (Baseline: 75, 80, and 85 years) of older people living independently in the city of Jyväskylä, in Central Finland (13). The baseline data were collected in 2017-2018 and the 4-year follow-up measurements were carried out in 2021-2022. The Ethical Committee of the Central Finland Health Care District provided an ethical statement on the research plan and protocol of the AGNES baseline (August 23, 2017) and follow-up study (September 8, 2021). The study was executed in accordance with the principles of the Declaration of Helsinki. All participants provided written informed consent.

Baseline recruitment was drawn as a random sample from postal code areas in Jyväskylä (Finland) using the Digital and Population Data Services Agency in Finland registers. After this, a preliminary information letter was sent and the willingness to participate in the study was inquired by phone. Baseline inclusion criteria were age and residence in the study area, willingness to participate and the ability to communicate (13). After exclusions, 1021 individuals participated in the study and of these, 479 wore a tri-axial accelerometer for 3 to 7 consecutive days. From the 479 older adults included in the baseline accelerometer study, 73 were not interested, 32 were deceased, 34 were excluded (not reached, missing data) at the time of the follow-up and hence, the final follow-up sample consisted of 340 participants (Figure 1). All these participants had at least 3 days of successful accelerometer recordings at baseline and took part in follow-up measurements. Variables are described below as follows: predictor variables (baseline tests) and outcome variable (change from baseline to follow-up).

Baseline predictors and covariates

Age and sex were extracted from the population register, body mass (digital scale Seca, Hamburg, Germany), height, cognitive function (mini-mental state examination, MMSE) (14), and the number of self-reported diseases (as part of the home interview) were assessed using standardized procedures. The maximal isometric knee-extension strength of the dominant lower limb with the knee at 60 (0° is a full extension) was measured in a sitting position using an adjustable dynamometer chair (Metitur LTD, Jyväskylä, Finland) in the research center. The ankle was attached to a strain-gauge system, and after a practice trial, the test was performed at least three times until no further improvement occurred, with an inter-trial rest period of 1 min. During each maximal contraction of 2 to 3 seconds, participants were strongly encouraged to exhibit the best possible force. At least 3 attempts were required, and the highest strength was chosen to represent maximal strength (15). Knee extension strength test has been demonstrated to have good test-retest reliability within a 2-week interval in our research center (15).

At baseline, participants wore a thigh-mounted accelerometer (UKK RM42 tri-axial accelerometer, sampling continuously at 100 Hz, 13-bit analog-to-digital conversion, acceleration range ±16 g, UKK Terveyspalvelut Oy, Tampere, Finland) continuously (24h) for 3 to 7 consecutive days. Daily STS transitions were assessed using our open-access algorithm, which detects STS transitions and measures the angular velocity during the sit-to-stand phase of the movement based on accelerometer data. The structure, code and properties of the algorithm are described elsewhere (9, 11). The thigh angular velocity quantification of the algorithm corresponds to the results of the 2-D motion analysis, and the algorithm's detection accuracy for STS transitions was over 93% (9).

For daily continuous accelerometry recording, the number of STS were determined as the mean number of transitions per monitoring day. The free-living mean STS angular velocity [°/s] of the STS transitions was determined as the mean of free-living median transitions from sitting to standing, and the free-living peak STS angular velocity [°/s] was defined as the median of the ten fastest STS transitions over the full monitoring period. Free-living mean STS angular velocity thus describes the average velocity of STS transitions in everyday life, while peak angular velocity describes the fastest STS transition velocity during the measurement period, which we have reported to have a better association with a laboratory-based capacity (10) compared to mean angular velocity.

Outcome variable measured as change from baseline to follow-up

Lower-extremity functioning was assessed in the participant’s home using the Short Physical Performance Battery (SPPB) at baseline and at follow-up. The SPPB comprised tests on standing balance, walking speed over a 3-m distance, and the 5×STS (16, 17). From the test results, we calculated the SPPB total score with a maximum of 12 points, where higher scores indicate better performance (16). Participants whose decline in SPPB total score was at least two points (substantial meaningful change) (18–20) were classified into the group with a *“decline in lower-extremity functioning”* over 4 years of follow-up, and those with a decline of 1 or no change or improvement into the group, *“no decline in lower-extremity functioning”*. In the *“decline in lower-extremity functioning”* group, there was an average decline in all components (subtests) of the SPPB test during the four-year follow-up (Supplemental Table 1, Supplemental Digital Content 1, Comparison of Short Physical Performance Battery components between physical functioning decline and non-decline groups).

Statistical analyses

Descriptive data are reported as mean and standard deviation (SD). Shapiro-Wilk normality test indicated that variables were not normally distributed, and nonparametric statistical tests were therefore chosen. Baseline differences between both groups (i.e., decline or no decline in lower-extremity function) were evaluated using the independent-samples Mann-Whitney U test.

Logistic regression analysis was the main statistical method, and the likelihood of a decline in lower-extremity functioning over the 4-year follow-up was examined using odds ratios (OR) with 95% confidence intervals (95% CI). The outcome variable was the dichotomous variable on decline in lower-extremity functioning (0 = ‘no decline’; 1 = ‘decline’) and the predictor variables were free-living STS peak angular velocity, free-living STS mean angular velocity and the number of free-living STS. Models were first adjusted for age, sex and lower-extremity functioning at the baseline (baseline SPPB total score). Finally, maximal isometric knee-extension strength was added to the models to assess whether STS characteristics mediate its association with future decline in lower-extremity physical functioning. To evaluate potential bias, we conducted sensitivity analysis by adding body weight, body height and self-reported number of chronic diseases in the model.

Odds rations were expressed per 20 deg/second for peak STS angular velocity, 10 deg/second for mean STS angular velocity, 10 repetitions/24 hour for number of STS transitions and 50 N for maximal isometric knee-extension strength. These units were chosen because they correspond the standardized values calculated using the formula $z = (x - \mu) / \sigma$, where z = Z-score, x = the value being evaluated, μ = the mean and σ = the standard deviation. The possibility of multicollinearity was excluded with the correlation matrix (Supplemental Table 2, Supplemental Digital Content 1, Spearman's rank correlation coefficient between variables) (21). Statistical significance was set at $p < .05$ and analyses were performed in the "R" statistical environment (version 4.2.1) (22) and using SPSS statistical software package (IBM SPSS Statistics Version 28.0.1.1, SPSS Inc., Chicago, IL, USA) (23).

RESULTS

The sample included a total of 340 participants, comprising 60.3% females, with a mean age of 78.0 years (SD 3.2). Other baseline characteristics can be found in Table 1. A total of 85 participants of the final sample (25%, of whom 75 % were women) experienced a decline of at least two points in lower-extremity function at 4-year follow-up compared to baseline. At baseline, body height, number of diseases, maximal isometric knee-extension strength and free-living peak STS angular velocity were lower among groups that experienced a decline in lower-extremity function over the 4-year follow-up period compared to those who did not ($p < .05$) (Table 1) (Supplemental Figure 1, Supplemental Digital Content 2).

We observed that free-living peak STS angular velocity protected from lower-extremity physical functioning decline by almost 40% per 20 deg/s increase (Table 2). After adjusting for sex, baseline age, baseline SPPB points (Model 2) free-living peak STS angular velocity odds ratios were slightly attenuated (Table 2). When maximal isometric knee-extension strength was added to the model (Model 3), odds ratios were further attenuated but remained significant (Table 2). The number of STS transitions and mean STS angular velocity did not predict the future decline in lower-extremity physical functioning (Table 2).

Sensitivity analysis

Further adjustments for body weight, body height and number of chronic diseases did not materially change the risk estimates but widened the 95% confidence intervals because of the reduced statistical power of the models. The participants not available at follow-up (dropouts; n = 139) were older, had lower SPPB scores, lower body weight, lower maximal isometric knee-extension strength and took longer to complete the 5xSTS test ($p < .05$) at baseline compared to the final sample (Supplemental Table 3, Supplemental Digital Content 1, Comparison between included and lost to follow-up participants in this follow-up study).

DISCUSSION

The novel finding of this study was that a higher peak angular velocity of free-living STS transitions at baseline increased the odds of maintaining lower-extremity function over a 4-year follow-up. More specifically, community-dwelling older adults with 20 degrees/seconds increase in peak STS angular velocity were almost 40% less likely to demonstrate a two point decline in SPPB compared to those with lower values. We suggest that free-living STS characteristics, especially the peak intensity, may underlie the association of muscle strength with future functional decline and disability. The present study also showed that maximal isometric knee-extension strength at baseline was associated with changes in lower-extremity functioning. This is in line with earlier studies, thus supporting the validity of our findings (2, 24, 25).

We developed a new methodology to analyse wearable technology data (i.e., accelerometry) to identify habitual strength and powerdemanding activities (STS transitions) (9–11). This enabled extending device-based physical measurement into strength and power-demanding free-living activities. A similar approach of tailoring numerical treatment of the free-living acceleration records to the physiological underpinnings has been applied successfully for bone-specific activities (26) and interverbal discs in the past (27). Accordingly in the present study targeting sit-to-stand transitions as a proxy of strength demands on the lower extremity locomotory system was found to be associated with physical functioning by hypothesizing that the transient overload and supercompensation discovered in resistance training literature might manifest in this way. Considering how to analyse the recorded signals for a particular outcome or physiological underpinning may be a valuable exercise. For example, in our study over the 4-year follow-up period, 25% demonstrated a substantial meaningful decline in lower-extremity function. If we were able to identify the ones at risk of developing a decline in function at an early phase, these individuals could be targeted with specific countermeasures. The growth of telerehabilitation and daily behaviour monitoring (28, 29) will enable long-term continual monitoring to target early interventions without the need for frequent supervised laboratory visits. In addition, free-living assessments allow the collection of unique information regarding behaviour in the real-life environment that cannot be observed in the laboratory. Future research should therefore identify relevant assessments for specific outcomes with the help of more modern and easier-to-use wearable sensor technology, and the practical application of such assessments.

In this study, only peak angular velocity of sit-to-stand movements predicted decline in physical functioning. Neither the number of sit-to-stand transitions nor their mean angular velocity showed any predictive value. These findings are in line with our previous cross-sectional findings (9, 10), where we reported that peak STS angular velocity was more strongly related to fear of falling, difficulties negotiating stairs, and physical functioning, compared to mean STS angular velocity and the number of STS transitions. This indicates that the mean angular velocity of STS transitions is a submaximal performance indicator, providing a less accurate view of an individual's potential capacity than peak angular velocity or isometric knee extension strength.

The definition of decline in physical functioning was based on a ≥ 2-points decline in SPPB. Importantly, all three components of the SPPB showed a significant decline, and not only the 5xSTS test (Supplemental Table 1, Supplemental Digital Content 1). Neither the 5xSTS time nor the 5xSTS points at baseline were predictors of the decline in total SPPB points (OR = 1.00, 1.05; $p > 0.05$, respectively, data not shown in the results section). This rules out that the predictive value of free-living STS transitions is caused by their association with lab-based 5xSTS test. In fact, maximum capacity measured in the laboratory (such as maximal strength or maximal walking speed) and body movements measured in a free-living environment (for example, STS free-living angular velocity, customary walking speed) are different constructs

(10, 30). As people get older, their reduced maximum capacity becomes more of a limiting factor for performing everyday activities such as STS. Previous observations indicate that older adults perform habitual activities at an intensity that is close to their full capacity (10, 31). It is reasonable that maximum capacity underlies daily movement behaviour, even though it does not determine it completely. Therefore, in the future it should be investigated whether reserve capacity could result in a better prediction of future functional declines.

Some limitations of the present approach should be considered. First, the study focused on STS transitions only, which do not capture the total volume of free-living strength and power-demanding activities. Second, the study period is limited to two measurement points (i.e., baseline and 4-year follow-up), which may hinder a comprehensive understanding of the temporal dynamics and fluctuations in the variables of interest. Third, we cannot rule out some miss-classifications of free-living movements, even though the algorithm's accuracy of detecting STS transitions was greater than 93% and the angular velocity determination was accurate (9, 11). Fourth, using the arms during STS transitions cannot be controlled in the free-living environment, which can lead to misinterpretations in determining the intensity of STS transitions. An underestimation of the studied associations might have occurred, as our sample consisted of community-dwelling, rather well-functioning older adults aged 75, 80, and 85. Inclusion of more individuals with lower-extremity limitations would have resulted in stronger associations. However, from a preventative perspective, it is crucial to detect potential problems in lower-extremity functioning in time, so that interventions can be initiated before major impairments occur.

The main strengths of this study include the comprehensive monitoring of free-living movement behaviour over a moderately long 4-year follow-up time period using wearable accelerometers (32). Secondly, we created a novel approach to analysing strength and power-demanding movements from accelerometer data. Third, we linked free-living data with data on maximum muscle strength using a prospective design among a large sample of older people. Finally, we used an objectively assessed meaningful decline in SPPB as the outcome of the analyses (18–20).

CONCLUSIONS

The novel finding of this study is that performing faster STS transitions in the free-living environment is associated with a future decline in lower-extremity function. Monitoring of free-living STS behavior allows frequent remote assessments of function, which can potentially enable early detection of functional declines, so that preventive strategies can be initiated in time.

Conflict of interest statement

None declared.

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Author Contributions

Conceptualization, A.L., L.K., L.P., E.P., T.R., T.F., C.D., E.V.R. and Ti.R.; methodology, A.L., L.K., L.P., E.P., T.R and Ti.R.; formal analysis, A.L. and Ti.R.; writing—original draft preparation, A.L.; writing—review and editing, A.L., L.K., L.P., E.P., T.R., T.F., C.D., E.V.R. and Ti.R.; supervision, T.F., C.D., E.V.R. and Ti.R.; All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

After completion of the study, data will be stored at the Finnish Social Science Data Archive without potential identifiers (open access). Until then, pseudonymized datasets are available to external collaborators subject to agreement on the terms of data use and publication of results. To request the data, please contact Professor Taina Rantanen (taina.rantanen@jyu.fi).

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FIGURE LEGEND

Figure 1. Flow chart of the study. *Note*. Decline over 4 years FU = decline in SPPB total score was at least two points (=> 2) over 4-year follow- up (BL to FU). No decline over 4 years FU = decline in SPPB total score was at less than 1 point (<= 1) over 4-year follow-up (BL to FU). STS = Sit-To-Stand, BL = Baseline, FU = Follow-Up, SPPB = Short Physical Performance Battery.

SUPPLEMENTARY DIGITAL CONTENT

SDC 1: Supplemental Digital Content 1.docx

SDC 2: STSFollowup_Alopponen_SupplementaryFigure4.pdf

Figure 1

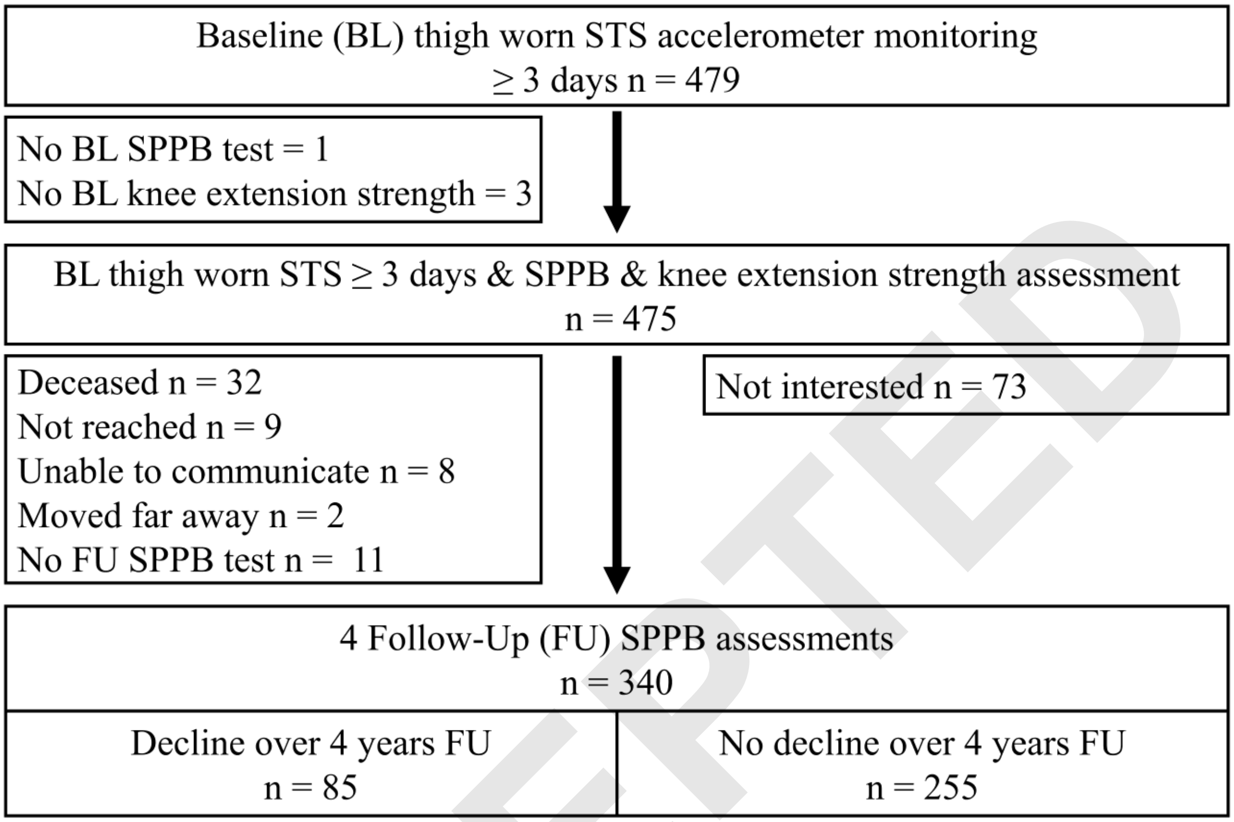
Baseline (BL) thigh worn STS accelerometer monitoring
≥ 3 days n = 479
No BL SPPB test = 1
No BL knee extension strength = 3
BL thigh worn STS ≥ 3 days & SPPB & knee extension strength assessment
n = 475
Deceased n = 32
Not reached n = 9
Unable to communicate n = 8
Moved far away n = 2
No FU SPPB test n = 11
Not interested n = 73
4 Follow-Up (FU) SPPB assessments
n = 340
Decline over 4 years FU
n = 85
No decline over 4 years FU
n = 255

Table 1. Baseline characteristics of study participants (mean & standard deviation (SD)).

	All (N = 340)	NO, decline over 4 y FU (n = 255)	YES, decline over 4 y FU (n = 85)	p-value[a]
Female, n (%)	60.3 %	55.3 %	75.3 %	
Age [years]	78.0 (3.2)	77.9 (3.1)	78.6 (3.4)	.147
Weight [kg]	74.5 (13.1)	74.1 (12.7)	75.7 (14.2)	.660
Height [cm]	164.2 (8.8)	165.0 (8.8)	161.9 (8.5)	**.003**
MMSE [points]	27.7 (2.2)	27.7 (2.2)	27.6 (2.0)	.240
Number of diseases [n]	3.0 (1.8)	2.7 (1.7)	3.7 (1.9)	**.000**
Short Physical Performance Battery [points]	10.5 (1.7)	10.6 (1.6)	10.4 (1.9)	.534
Lab-assessed 5xSTS total time [s]	12.3 (3.7)	12.2 (3.6)	12.4 (4.1)	.857
Lab-assessed maximal isometric knee strength [N]	354.7 (112.9)	369.7 (112.5)	309.8 (102.0)	**.000**
Free-living STS peak angular velocity [deg/s]	102.7 (21.3)	105.0 (20.3)	95.9 (22.8)	**.000**
Free-living STS mean angular velocity [deg/s]	57.8 (8.8)	58.2 (8.4)	56.3 (9.9)	.091
Free-living no of STS [no/d]	44.7 (17.0)	45.4 (16.6)	42.6 (18.1)	.251

Note. FU = Follow-Up, MMSE = Mini-Mental State Examination, STS = sit-to-stand, N = newton. [a]Independent-Samples Mann-Whitney U Test. Bold font indicates statistical significance (p < .05).

Table 2. Predictor for lower extremity physical functioning decline in the 4-year-follow-up.

Variables	Model 1 OR (95 % CI)	Model 2 OR (95 % CI)	Model 3 OR (95 % CI)
Free-living STS peak angular velocity [20 deg/s]	**0.63 (0.49 - 0.83)**	**0.70 (0.52 – 0.92)**	**0.72 (0.54 – 0.96)**
Sex		**2.17 (1.23 – 3.84)**	1.28 (0.63 – 2.61)
Age [years]		1.06 (0.98 – 1.15)	1.05 (0.96 – 1.13)
Baseline SPPB [points]		1.03 (0.88 – 1.20)	1.09 (0.92 – 1.28)
Lab-assessed maximal isometric knee strength [50 N]			**0.82 (0.69 – 0.97)**
Free-living STS mean angular velocity [10 deg/s]	0.77 (0.58 – 1.03)	0.86 (0.63 – 1.17)	0.90 (0.66 – 1.22)
Sex		**2.39 (1.36 – 4.21)**	1.37 (0.68 – 2.76)
Age [years]		1.07 (0.99 – 1.16)	1.05 (0.97 – 1.14)
Baseline SPPB [points]		0.99 (0.85 – 1.15)	1.05 (0.90 – 1.23)
Lab-assessed maximal isometric knee strength [50 N]			**0.81 (0.69 – 0.95)**
Free-living no of STS [10 no/d]	0.91 (0.78 – 1.05)	0.97 (0.83 – 1.14)	0.96 (0.82 – 1.13)
Sex		**2.45 (1.39 – 4.31)**	1.35 (0.66 – 2.74)
Age [years]		1.07 (0.99 – 1.16)	1.05 (0.97 – 1.14)

Baseline SPPB [points]	0.98 (0.84 – 1.13)	1.05 (0.90 – 1.23)
Lab-assessed maximal isometric knee strength [50 N]		**0.80 (0.68 – 0.95)**

Note. OR = Odds Ratio, CI = Confidential interval, bold font indicates statistical significance (p < .05).

Model 1: Unadjusted model.

Model 2: Adjusted for baseline age, sex, SPPB total points.

Model 3: Adjusted for baseline age, sex, SPPB total points and maximal isometric knee extension strength.

Supplemental table 1. Comparison of Short Physical Performance Battery components (sub-tests) between physical functioning decline and non-decline groups.

	All (N = 340)	NO, decline over 4 y FU (n = 255)	YES, decline over 4 y FU (n = 85)
Total points			
Baseline	10.5 ±1.7	10.6 ±1.6	10.4 ±1.9
Follow-up	9.8 ±2.3	10.7 ±1.5	7.3 ±2.3
Absolute difference	0.7	-0.1	3.1
p-value[a]	< .001	.619	< .001
Balance points			
Baseline	3.8 ±0.5	3.8 ±0.5	3.7 ±0.7
Follow-up	3.6 ±0.8	3.9 ±0.5	3.0 ±1.1
Absolute difference	0.2	0.0	0.7
p-value[a]	< .001	.401	< .001
Walking speed points			
Baseline	3.7 ±0.6	3.8 ±0.6	3.6 ±0.7
Follow-up	3.4 ±0.9	3.7 ±0.6	2.7 ±1.1
Absolute difference	0.3	0.1	0.9
p-value[a]	< .001	.331	< .001
5xSTS points			
Baseline	3.0 ±1.1	3.0 ±1.1	3.1 ±1.2
Follow-up	2.8 ±1.2	3.2 ±0.9	1.6 ±1.0
Absolute difference	0.2	-0.2	1.5
p-value[a]	.003	.161	< .001

Note. FU = Follow-up, STS = Sit-To-Stand. [a] Independent-Samples Mann-Whitney U Test

Supplemental table 2. Spearman's rank correlation coefficient between variables.

	Lab-assessed isometric knee strength [N]	Free-living STS peak angular velocity [deg/s]	Free-living STS mean angular velocity [deg/s]
Free-living STS peak angular velocity [deg/s]	0.32**		
Free-living STS mean angular velocity [deg/s]	0.25**	0.77**	
Free-living number of STS transitions [no/d]	0.16**	0.55**	0.52**

Note. STS = sit-to-stand, N = newton. ** p < .01.

Supplemental table 3. Comparison between included and lost to follow-up participants in this follow-up study (mean & standard deviation (SD)).

	AGNES Baseline (N = 479)	Included (n = 340)	Lost to follow-up (n = 139)	p-value[a]
Female, n (%)	59.9 %	60.3 %	59.0 %	
Age [years]	78.3 (3.4)	78.0 (3.2)	79.0 (3.8)	**.030**
Weight [kg]	73.9 (13.3)	74.5 (13.1)	72.4 (13.8)	**.036**
Height [cm]	163.9 (8.8)	164.2 (8.8)	163.0 (8.9)	.166
MMSE [points]	27.4 (2.7)	27.6 (2.6)	26.7 (2.9)	**< .001**
Number of diseases [n]	3.1 (1.9)	3.0 (1.8)	3.4 (2.0)	.052
Short Physical Performance Battery [points]	10.3 (1.9)	10.5 (1.7)	9.8 (2.3)	**< .001**
Lab-assessed 5xSTS total time [s]	12.3 (4.1)	12.1 (3.9)	12.9 (4.4)	**.026**
Lab-assessed maximal isometric knee strength [N]	342.0 (118.1)	354.7 (112.9)	311.0 (125.2)	**< .001**
Free-living STS peak angular velocity [deg/s]	101.5 (20.9)	102.7 (21.3)	98.6 (19.8)	.108
Free-living STS mean angular velocity [deg/s]	57.5 (8.9)	57.8 (8.8)	56.9 (9.3)	.384
Free-living no of STS [no/d]	43.7 (16.9)	44.7 (17.0)	41.3 (16.7)	.053

Note. MMSE = Mini-Mental State Examination, STS = sit-to-stand, N = newton. [a]Independent-Samples Mann-Whitney U Test. Bold font indicates statistical significance ($p < .05$).

Supplementary Figure 4