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GAIT SPEED AT USUAL PACE AS A PREDICTOR OF ADVERSE OUTCOMES IN COMMUNITY-DWELLING OLDER PEOPLE AN INTERNATIONAL ACADEMY ON NUTRITION AND AGING (IANA) TASK FORCE

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Abstract: *Introduction:* The use of a simple, safe, and easy to perform assessment tool, like gait speed, to evaluate vulnerability to adverse outcomes in community-dwelling older people is appealing, but its predictive capacity is still questioned. The present manuscript summarises the conclusions of an expert panel in the domain of physical performance measures and frailty in older people, who reviewed and discussed the existing literature in a 2-day meeting held in Toulouse, France on March 12-13, 2009. The aim of the IANA Task Force was to state if, in the light of actual scientific evidence, gait speed assessed at usual pace had the capacity to identify community-dwelling older people at risk of adverse outcomes, and if gait speed could be used as a single-item tool instead of more comprehensive but more time-consuming assessment instruments. *Methods:* A systematic review of literature was performed prior to the meeting (Medline search and additional pearling of reference lists and key-articles supplied by Task Force members). Manuscripts were retained for the present revision only when a high level of evidence was present following 4 pre-selected criteria: a) gait speed, at usual pace, had to be specifically assessed as a single-item tool, b) gait speed should be measured over a short distance, c) at baseline, participants had to be autonomous, community-dwelling older people, and d) the evaluation of onset of adverse outcomes (i.e. disability, cognitive impairment, institutionalisation, falls, and/or mortality) had to be assessed longitudinally over time. Based on the prior criteria, a final selection of 27 articles was used for the present manuscript. *Results:* Gait speed at usual pace was found to be a consistent risk factor for disability, cognitive impairment, institutionalisation, falls, and/or mortality. In predicting these adverse outcomes over time, gait speed was at least as sensible as composite tools. *Conclusions:* Although more specific surveys needs to be performed, there is sufficient evidence to state that gait speed identifies autonomous community-dwelling older people at risk of adverse outcomes and can be used as a single-item assessment tool. The assessment at usual pace over 4 meters was the most often used method in literature and might represent a quick, safe, inexpensive and highly reliable instrument to be implemented.

Background

One of the main characteristics of the elderly population is its heterogeneity and older people at a same range of age show a wide variance with regard to their risk of disability, cognitive impairment, hospitalisations, institutionalisation, falls, and mortality. To prevent these adverse outcomes, population-based intervention programs should be targeted at the population at risk. A feasible and valid screening tool available for research and clinical settings is therefore required to identify target populations. Although many single and composite tools are proposed, none are consensual, most are time-consuming while evaluating different domains of impairments, and many are not validated. This tool should have the capacity to easily identify from the community-dwelling population, those older people at risk of adverse outcomes in order to implement primary preventive measures. The task to find a single, reliable, valid, sensitive (not necessarily specific), cheap, safe, quick and simple tool that identifies older people at risk is not yet resolved.

During the past ten years, gait speed has been repeatedly reported as an appealing instrument to be implemented both in research and clinical settings to evaluate older people at a high risk of adverse outcomes (1). Evans and colleagues recently stated that gait speed was the functional test closest to be ready for pharmacological trials (2). In the line with previous articles, Guralnik and colleagues expressed that of the available physical performance measures, usual gait speed may represent

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the most suitable one to be implemented in the standard clinical evaluation of older persons (3).

Gait speed is probably an illustration of a multi-systemic wellbeing and slow gait speed might traduce a sub-clinical impairment in health status. Many plausible mechanisms have explained the connection between physical performance measures and risk of adverse outcomes. Muscular factors like decrease in motor units, impaired muscular activation, substitution of type II by type I fibers and therefore diminished contraction speed and velocity, or neurological factors like diminished cutaneuos sensitivity, decreased nerve conduction velocity and reaction time, decreased grey matter volume with functional brain impairment, and the presence of white matter lesions have all been linked with diminished gait speed (4-15). Inflammatory markers, present in many physio-pathological pathways, were also implicated in sarcopenia and the loss of muscle strength and may represent an independent predictor of decrease in walking speed and progression to severe walking disability (16, 17).

The aim of the International Academy on Nutrition and Aging (IANA) task force, through a systematic review of literature along with an international expert panel opinion, was to examine if gait speed, assessed at usual pace and over a short distance, may have the capacity to identify autonomous community-dwelling older people at risk of adverse outcomes, and if gait speed might be used as a single-item tool instead of more comprehensive but time-consuming assessment instruments.

Methods

A Medline literature search of all articles published from January 1994 to March 2009 (last 15 years) using the Medical Subject Heading (MeSH) terms “Human”, “English”, “Aged: 65+ years”, “80 and over: 80+years”, combined with the terms “Walking Speed” and “Gait Speed” was performed in order to obtain relevant articles published in the field. Further search limitations where set up in order to retrieve a final selection of 207 articles (see figure 1). The identified abstracts were independently evaluated by two reviewers (GAvK and YR) based on the STrenghtening the Report of OBservationnal studies in Epidemiology (STROBE) checklist that described items that should be included in reports of cohort studies (18). For those abstracts which fulfilled the inclusion criteria the full articles were retrieved and for the final selection, 4 additional criteria had to be fulfilled:

a) Gait speed, at usual pace, had to be specifically assessed as a single-item tool.

b) The assessment of gait speed had to be performed over a short distance (long distance assessment instruments were excluded from the present review) in order to obtain evidence on a feasible and quick performance test, to be used in everyday clinical practice.

c) At baseline, participants had to be autonomous, community-dwelling older people.

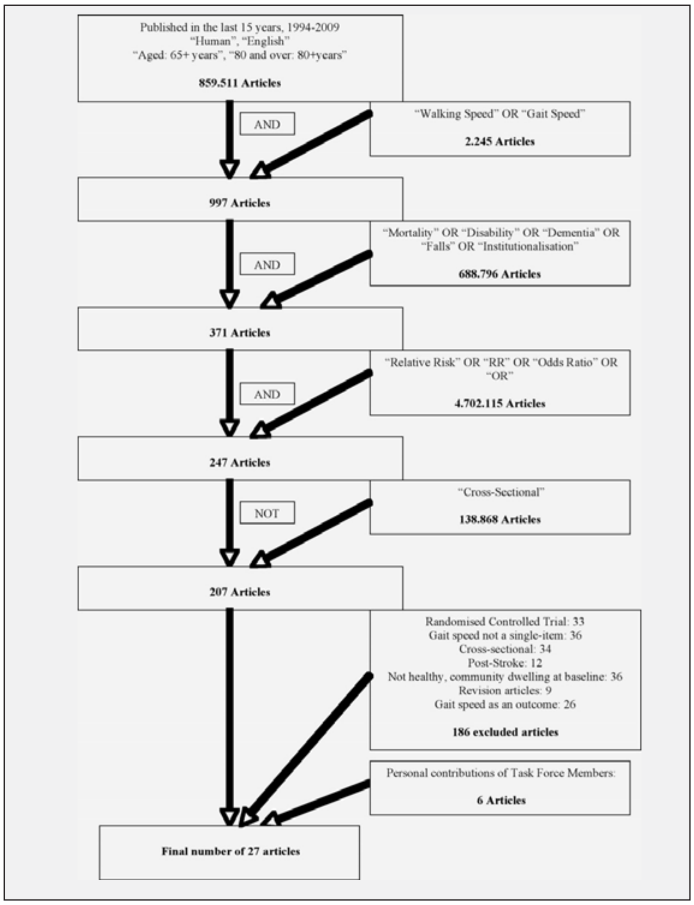
d) The evaluation of adverse outcomes (disability, cognitive impairment, institutionalisation, falls, and/or mortality) had to be assessed longitudinally over time.

The review and cross-sectional articles found during the process were retained for background and discussion purposes and in order to ensure a comprehensive approach, 2 supplementary sources were used to identify relevant articles:

a) The reference lists of the identified papers were pearled for relevant literature.

b) The members of the Task Force additionally supplied key articles (and were included if the specified criteria were fulfilled).

Figure 1
Pub-Med Search: Flow chart of retrieved and selected articles



A final selection of 27 articles was used for the purpose of this review (19-45). GAvK and YR wrote a preliminary draft before the meeting held in Toulouse, France on March 12-13, 2009. During this 2-day meeting, the manuscript was revised and discussed by the IANA Task Force expert panel with the aims of addressing the issues of gait speed at usual pace as a predictor of adverse outcomes in older people and gait speed as a single-item tool. The draft was re-edited after the 2-day meeting and once more critically reviewed by all Task Force members before final submission.

Results: Gait speed as a predictor of adverse outcomes

Gait speed as a predictor of mobility disability (Table 1)

In non-disabled, community-dwelling, older people, physical performance measures have shown to be predictive of the onset of activity of daily living (ADL) and mobility disability over a wide variety of populations.

The Health, Aging and Body Composition study (Health ABC) is one of the main cohorts evaluating physical performance measures and risk of adverse outcomes. One main limitation of this cohort is that the participants had to be well-functioning to be included at baseline and the cutpoints found for gait speed in the cohort cannot be generalised to all older people at high risk of adverse health outcomes. Slow gait speed (considered as less than 1 ms^{-1}), assessed in the 3047 older persons (mean age of 74.2 years) of the cohort, on a 6-meter course, predicted persistent lower extremity limitation with a Relative Risk, RR of 2.2 (95% CI 1.76-2.74) after a mean follow up of 4.9 years. Persistent lower extremity limitation was defined as 2 consecutive self-reports of having any difficulty walking one-quarter of a mile or climbing up 10 steps without resting (19). A second analysis of the same cohort after a longer follow-up (median of 6.9 years) with slightly lower participants (n=3024) found that gait speed continued to predict persistent lower extremity limitation with a RR of 1.53 (95%CI 1.35-1.74) (20). 3156 participants free from ADL disability at baseline and cognitively intact, were evaluated from the Cardiovascular Health Study using a 5-meter walking course. During the median follow-up of 8.4 years, 35% of the participants developed incident disability defined as self-reported difficulty or inability to perform at least 1 ADL. Gait speed over 1 ms^{-1} presented a Hazard Ratio, HR of 0.88 (95% CI 0.81-0.97) in predicting incident disability (in a controlled model of many confounders including brain MRI-imaging) (21). Gait speed (measured over 4 meters), among all lower and upper extremity performance measures, was the only measure significantly associated with catastrophic disability (defined as onset of ADL disability within 1 year). A RR of 0.72 (95% CI 0.53-0.99) per 0.31 ms^{-1} was found, when 1002 women from the Women Health and Aging Study-I were evaluated during a 3-year period (22).

In the same line, many other authors have evaluated gait

Table 1
Gait speed and ADL or mobility disability

Study	Characteristics of participants	Gait Speed	Outcomes
Health Aging and Body Composition study, Health ABC study (19)	N=3047 Mean age 74.2 Well-functioning older persons 4.9 years of follow-up	6 meter walk < 1.0 ms^{-1}	Persistent lower extremity limitation RR 2.20 (1.76-2.74)
Health ABC study (20)	N=3024 Well-functioning older persons 6.9 years of follow-up	6 meter walk < 1.0 ms-1	Persistent lower extremity limitation RR 1.53 (1.35-1.74)
Cardiovascular Health Study, CHS (21)	N=3156 Free from disability, cognitively intact 8.4 years of follow-up	15-foot walk < 1.0 ms-1⇔ >1.0 ms^{-1}	Incident ADL disability HR 0.88 (0.80-0.96)
Women's Health and Aging Study, WHAS-I (22)	N= 1002 No ADL disability 3 years of follow-up	4 meter walk	Incident ADL disability RR 0.72 (0.53-0.99) per 0.31 ms^{-1} increase
Hispanic Established Population for the Epidemiological Study of the Elderly, EPESE (23)	N= 1946 Community dwelling Well functioning 2-year follow-up	8-foot walk Highest vs lowest gait speed group	ADL disability OR 5.4 (1.2-23.6) Mobility disability OR 3.4 (1.8-6.5)
Medicare Health maintenance organisation, HMO, and Veterans Affairs, VA (24)	N= 487 > 65 years Cognitively intact No mobility disability 1-year follow-up	4 meter walk Fast walkers >1 ms^{-1}	Difficulty in personal care: OR 0.62 for every 0.2 ms^{-1} increase
Health ABC study (25)	N=3056 Free from disability, cognitively intact 2-year follow-up	LDCW 400 meter walk < 1.0 ms^{-1}	New mobility limitations Men OR 2.15 (1.44-3.20) Women OR 1.33 (0.99-179)
Tokyo Metropolitan Institute of Gerontology Longitudinal Interdisciplinary Study on Aging (26)	N=736 Aged 65 and older Well-functioning Community-dwelling 6-year follow-up	11 meter walk Highest vs lowest gait	Onset of functional ADL dependence Age 65-74: HR 2.43 (1.42-4.17) Age >74: HR 6.18 (3.16-12.1)
Hong Kong Chinese cohort (27)	N=2032 Aged 70 and older Community-dwelling Well-functioning 3-year follow-up	16-feet walk Highest vs lowest gait speed group	ADL dependency Men: OR 1.19 (1.13-1.26) Women: OR 1.16 (1.12-1.21)
Hong-Kong Old Study (28)	N=1483 Community-dwelling Well-functioning 18-months follow-up	8-foot returned walk	ADL mobility decline OR (per second of increase) 1.12 (1.09-1.16)

speed at baseline as a predictor of future ADL or mobility disability. Six other articles were identified by the systematic review, all consistent with previous exposed results (23-28).

Gait speed as a predictor of cognitive decline (Table 2)

Gait speed diminishes with age and at age 80 it is approximately 10 to 20% slower than in younger adults, but an accelerated decline of gait speed could also be an early warning sign for future dementia (29).

Data from the Hispanic EPESE (H-EPESE) showed that slow gait speed (measured over a 2.4 meter walking course) was an independent predictor of MMSE-score decline after a 7 year period of follow-up, and showed that the lowest quartile of gait speed lost on average 0.23 points per year more than the fastest quartile. The H-EPESE was composed of 2070 non-institutionalised Mexican-American, men and women aged 65 and older who had a Mini-Mental State Examination (MMSE) score of 21 or greater at baseline (29). The Health ABC study was used to address the issue of cognitive impairment in slow walkers. Usual gait speed (over 6 meters) and the Digital Symbol Substitution Test, DSST, (a simple test for attention and psychomotor speed) were measured at baseline. After 5 years, of the assessed 2776 baseline participants, 389 (17.1%) declined in DSST. Compared to those in the highest quartile of gait speed (>1.35 ms^{-1}), participants in the lowest quartile (<1.05 ms^{-1}) were more likely to decline in DSST with an Odds Ratio, OR of 1.74 (95% CI 1.21–2.51) (30). In a prospective cohort study of 2288 persons, 65 years and older without dementia with a mean follow-up of 9 years, 319 participants developed dementia. Diminished gait speed (assessed over a 10 feet walking course) was associated with an increased risk of dementia and Alzheimer's disease, AD, with an HR of 0.79 (95% CI 0.70-0.89) and 0.81 (95% CI 0.71-0.94) respectively for each quartile of increase in performance. The authors suggested that poor physical functioning may precede the onset of dementia and that higher levels of physical functioning may be associated with a delayed onset (31).

Other authors have assessed cognitive decline over time comparing slow and fast walkers using gait speed assessment at usual pace. All identified articles conclude in the same line as the previous cited papers, and it has to be stated that gait speed predicts risk of future onset of dementia, and Alzheimer's disease or progression of cognitive decline (32-35).

Gait speed as a predictor of mortality (Table 3)

In a pooled analysis of 9 cohorts (34.370 older adults) a 15-year survival of 34% in older people with gait speed ≤ 0.4 ms^{-1} and 83% in ≥ 1.4 ms^{-1} was found. [Studenski, personal communication, IAGG Paris 2009] The survival benefit persisted after controlling for numerous medical, functional, and psychosocial factors that are known to affect survival and was highly consistent across a variety of subgroups. Short-term mortality was also strongly predicted by usual gait speed, and a cutpoint of 1 ms^{-1} predicted risk of mortality in many cohorts of

Table 2
Gait speed and dementia

Study	Characteristics of participants	Gait Speed	Outcomes
Hispanic Established Populations for Epidemiological Study of the Elderly H-EPESE (29)	2070 community-dwelling Aged 65 and older MMSE >21 Follow-up7 years	8-foot walk Highest vs lowest gait speed group	Slow gait speed was an independent predictor of greater MMSE score decline over a 7-year period (0.23 points per year)
The Health Aging and Body Composition Study, Health ABC (30)	2776 Well-functioning, community-dwelling Mean age 73.5y Follow-up 5 years	6-meter walk Highest vs lowest gait speed group	Slow gait speed predicted DSST decline OR 1.74
Adult Changes in Thought Study ACT Study (31)	2288 community-dwelling Aged 65 and older MMSE > 25-26 Follow-up 6 years	10-foot walk Score of performance	Dementia: HR for each 1-point increase in score: 0.79 (0.70-0.89) AD: HR for each 1-point increase in score: 0.81 (0.71-0.94)
Sydney Older Persons Study, SOP Study (32)	630 community-dwelling 75 years and older Follow-up 6 years	5-meter returned walk Highest vs lowest gait speed group	MCI with low gait speed presented higher risk of progression to dementia OR 5.6 (2.5-12.6)
Women's Health and Aging Study WHAS-I (33)	558 community-dwelling Women Aged 65 and older MMSE >24 Follow-up 3 years	4-meter walk Highest vs lowest gait speed group	Low gait speed was associated with combined (cognitive and physical) decline. OR of 0.46 (0.22-0.97) per 0.24 ms^{-1} increase
The Oregon Brain Aging Study OBA Study (34)	108 community-dwelling 65 years and older MMSE > 24 Follow-up 6 years	15 foot returned walk Highest vs lowest gait speed group	Slow gait speed predicted onset of dementia, with an increased risk of 1.14 for every second of increase in walking time
OBA Study (35)	N=85 65 years and older MMSE > 24 3-year follow-up	15 foot returned walk	18 participants developed cognitive impairment. OR 1.26 (1.01-1.6) for every 1-second increase in baseline gait speed

MMSE stands for Mini-Mental State Examination, AD for Alzheimer's disease, and MCI for mild cognitive impairment.

autonomous older people (19, 20, 21, 27, 32, 36, 37, 38).

Of the 3050 older adults from the H-EPESE cohort, aged 65 years and older, 198 died after a 2-year follow-up. The highest quartile of performance, on an 8-foot walk, was compared to the lowest, finding an OR of 3.64 (95% CI 1.93–6.85) for risk of mortality (controlled for co-variables, including life-threatening medical conditions). Compared to the fastest quartile, the participants who were unable to perform the task raised their risk of death to an OR of 7.47 (95% CI 3.83–14.55). The introduction of ADL disability into the equation showed that it was not a predictor of short term mortality nor did the introduction change the OR found for gait speed (39).

Gait speed as a predictor of falls (Table 4)

The relationship between falls and gait speed has been less thoroughly explored. Nevertheless, it could be hypothesised that due to neurological and muscular factors, the risk of falls must be correlated with gait disorders and subsequently with gait speed. Even more, fear of falling was found to be associated to slower gait speed and appropriate interventions increased gait speed significantly (40, 41).

The Epidemiologie de l'Osteoporose study, EPIDOS, assessed fall-related factors in 7575 community-dwelling French women aged 75 years and older. Compared to the highest quartile, the slowest quartile of walking speed presented a RR (per standard deviation, SD, increase) of 1.4 (95% CI 1.1-1.6) of femoral neck fracture risk associated with falls after a mean follow-up of 1.9 years (42). Other cohorts with similar follow-ups and population have shown results in the line with the EPIDOS cohort (43-45).

Gait speed as a predictor of institutionalisation (Table 5)

Institutionalisation and hospitalisation are health-related conditions that were identified by physical performance measures like gait speed in a variety of populations (19, 20, 27, 43).

Gait speed (measured over 4 meters) was associated with future hospitalisation in 487 older adults, aged 65 and older, autonomous and cognitively intact, with an OR of 0.62 for every 0.2 ms^{-1} increase in gait speed (24).

Table 3
Gait speed and Mortality

Study	Characteristics of participants	Gait Speed	Outcomes
Health Aging and Body Composition study, Health ABC study (19)	N=3047 Mean age 74.2 Well-functioning older persons 4.9 years of follow-up	6 meter walk < 1.0 ms^{-1}	Mortality RR 1.64 (1.14-2.37)
Health ABC study (20)	N=3024 Well-functioning older persons 6.9 years of follow-up	6 meter walk < 1.0 ms^{-1}	Mortality RR 1.49 (1.23-1.80)
Cardiovascular Health Study, CHS (21)	N=3156 Free from disability, cognitively intact 8.4 years of follow-up	15-foot walk < 1.0 ms^{-1} ⇔ >1.0 ms^{-1}	Mortality HR 0.87 (0.78-0.98)
Hong Kong Chinese cohort (27)	N=2032 Aged 70 and older Community-dwelling Well-functioning 3-year follow-up	16-feet walk Highest vs lowest gait speed group	Mortality Men: OR 1.08 (1.05-1.11) Women: OR 1.04 (1.02-1.05)
Sydney Older Persons Study, SOP Study (32)	630 community-dwelling 75 years and older Follow-up 6 years Mild cognitive impairment	5-meter returned walk Highest vs lowest gait speed group	MCI with low gait speed presented higher risk of mortality OR 3.3 (1.6-6.9)
Hispanic Established Populations for Epidemiological Study of the Elderly H-EPESE (36)	1630 community-dwelling Aged 65 and older MMSE >21 Follow-up 7 years	8-foot walk Highest vs lowest gait speed group	Slow gait speed was an independent predictor of mortality HR 4.12 (2.85-5.97)
Invecchiamento e Longevita nel Sirente, ilSIRENTE (37)	335 community-dwelling Aged 80 and older Follow-up 2 years	4-meter walk Highest vs lowest gait speed group	Rapid gait speed was an independent predictor of survival HR 0.73 (0.54-0.99)
Epidemiologie de l'Osteoporose, EPIDOS (38)	7250 community-dwelling Well-functioning Women Aged 65 and older MMSE >21 Follow-up 3.8 years	6-meter walk Highest vs lowest gait speed group	Slow gait speed was an independent predictor of mortality OR 2.47 (1.67-3.67) Unable to perform assessment OR 6.01 (2.81-12.83)
Hispanic Established Populations for Epidemiological Study of the Elderly H-EPESE (39	3050 community-dwelling Aged 65 and older MMSE >21 Follow-up 7 years	8-foot walk	Slow gait speed was an independent predictor of Highest vs lowest gait speed group mortality OR 3.64 (1.93-6.85) Unable to perform assessment OR 7.47 (3.83-14.55)

Table 4
Gait speed and falls

Study	Characteristics of participants	Gait Speed	Outcomes
Epidemiologie de l'Osteoporose, EPIDOS (42)	7575 community-dwelling Well-functioning Women Aged 75 and older MMSE >21 Follow-up 1.9 years	6-meter walk Highest vs lowest gait speed group	Gait speed was an independent predictor of fall-related femoral neck fracture RR 1.4 (1.1-1.6) for every SD decrease
Estudio de Evaluación Funcional del Anciano, EFA (43)	N= 102 Community dwelling Well functioning 2-year follow-up	10 meter walk <0.7 ms-1⇔ 1.1 ms^{-1}	Gait speed was an independent predictor of falls with a RR of 5.4 (2-14.3)
Hong-Kong prospective study (44)	N= 1517 Community dwelling Well functioning 1-year follow-up	5 meter walk Highest vs lowest gait speed group	Gait speed was an independent predictor of falls with a RR of 0.23 (0.11-0.5)
General Sick Fund Members (45)	N= 283 Community dwelling 1-year follow-up	5 meter walk <0.5 ms-1⇔ ≥ 0.5 ms^{-1}	Slow gait speed (<0.5 ms^{-1}) was an independent predictor of falls with a RR of 1.41 (1.16-1.73)

Table 5
Gait speed and Institutionalisation or Hospitalisation

Study	Characteristics of participants	Gait Speed	Outcomes
Health Aging and Body Composition study, Health ABC study (19)	N=3047 Mean age 74.2 Well-functioning older persons 4.9 years of follow-up	6 meter walk Slow gait speed group ($<$ 1.0 ms^{-1})	Hospitalisation RR 1.48 (1.02-2.13)
Health ABC study (20)	N=3024 Well-functioning older persons 6.9 years of follow-up	6 meter walk Slow gait speed group ($<$ 1.0 ms^{-1})	Hospitalisation RR 1.26 (1.00-1.58)
Medicare Health maintenance organisation, HMO, and Veterans Affairs, VA (24)	N= 487 > 65 years Cognitively intact No mobility disability 1-year follow-up	4 meter walk Fast walkers >1 ms^{-1}	Risk of hospitalisation: OR 0.62 for every 0.2 ms^{-1} increase
Hong Kong Chinese cohort (27)	N=2032 Aged 70 and older Community-dwelling Well-functioning 3-year follow-up	16-feet walk Highest vs lowest gait speed group	Institutionalisation Men: OR 1.09 (0.99-1.19) Women: OR 1.03 (1.00-1.06)
Estudio de Evaluación Funcional del Anciano, EFA (43)	N= 102 Community dwelling Well functioning 2-year follow-up	10 meter walk Lowest vs highest group: <0.7 ms-1 ⇔ 1.1 ms^{-1}	Gait speed was an independent predictor of hospitalisation with a RR of 5.9 (1.9-18.5)

Results: Gait speed as a single-item tool

Gait speed as a single-item tool

Because gait speed is easy to measure and may be done quickly in clinical settings, it is useful to evaluate whether measuring gait speed alone may capture the predictive power of a more comprehensive battery, like the Short Physical Performance Battery, SPPB. Extensive work on the SPPB has demonstrated excellent reliability, predictive validity for a large number of adverse outcomes and sensitivity to clinical important change (3). Physical performance measures of lower extremity function accurately predicted disability in 6534 non-disabled, community-dwelling patients after a follow-up of 1-6 years. Of the 3 components of the SPPB (balance, chair stands and gait speed), the steepest gradient of risk of disability was observed across the categories of gait speed and the subsequent Receiver-operator characteristic (ROC) curves for the prediction of ADL and mobility disability proved that gait speed alone was nearly as good a predictor of disability outcomes as the full performance battery (3). In detail, the ROC curves showed very similar areas under the curve (AUC) for gait speed (0.67) and SPPB (0.69) showing a non-significant p-value (p=0.18) in between the curves when predicting ADL disability at 4 years of follow-up (3).

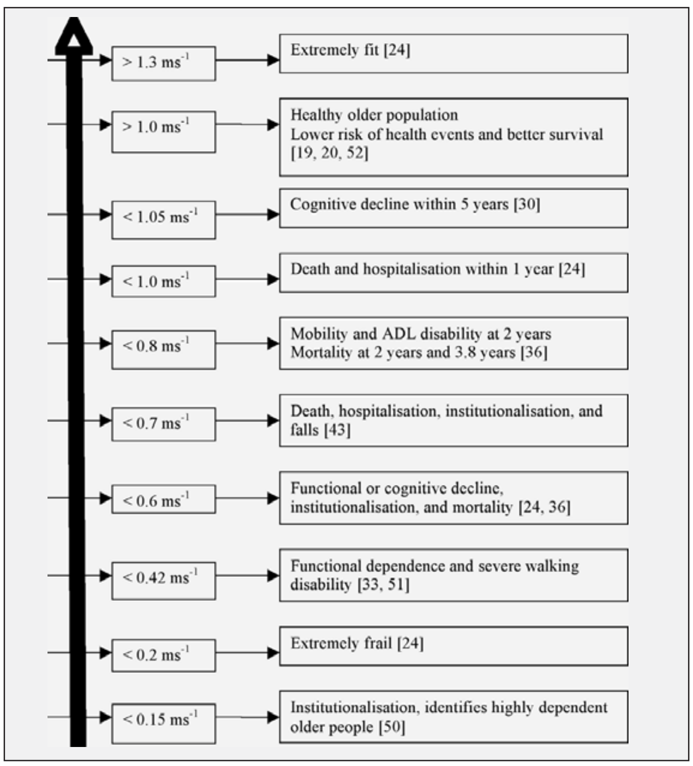
In the same line, 487 older adults were assessed using performance measures, alone or in combination, to predict 1-year outcomes. ROC curves showed that gait speed did at least as well as the SPPB in predicting risk for hospitalisation, or decline in health, but functional decline was best predicted with the full battery (24).

Other authors have also analysed upper and lower extremity physical performance measures alone or in combination finding that gait speed alone performs as well as more comprehensive batteries (or combinations of tests) in predicting adverse health outcomes in most of the cases (23, 31, 36-39, 43, 46, 47).

Distance and cut-points reported in literature for a single-item tool (Figure 2)

The walking distance used in the selected articles was found to be between 2.44 meters (8 feet) and 6 meters making the tool more or less time-consuming. However, the use of gait speed at usual pace as a predictor makes the course-distance of less importance. As stated by Guralnik and colleagues, the assessment of gait speed over a short distance, such as the 4-meter walk, should be the choice because it has been demonstrated to be feasible at home as well as in clinical settings and its longer distance (compared to the 8 feet walk) may improve measurements accuracy (3). In addition, the 4-meter walking test had also shown sufficient reliability and test-retest reliability (48). In the present review, most of the retrieved articles assessed gait speed using the 4-meter and the 6-meter walking courses.

Figure 2
Cut-points of gait speed at usual pace and risk of adverse outcomes found in literature



Many cutpoints for gait speed as predictors of adverse outcomes have been proposed depending on the length of track, outcome, settings and assessed population (which might limit generalization). Older people might be categorized as slow, intermediate, or fast walkers using cut-points of 0.6 and 1.0 ms^{-1}. Those with slower gait are at higher risk for functional or cognitive decline, institutionalisation, and mortality. Older persons who walk faster than 1.0 ms^{-1} generally have lower risk of health events and better survival. The 1.0 ms^{-1} cutpoint was used to predict mortality (19, 20) while the 0.8 ms^{-1} cut-point seemed a more sensible (and more often used) cut-point for health adverse outcomes (23, 24, 30, 33, 36-38, 43, 50, 51, 52).

Discussion

The review of the final selection of 27 articles found that gait speed at usual pace was a strong and consistent predictor of adverse outcomes, and gait speed as a single-item tool was at least as sensible as the composite tools in predicting these outcomes over time. The predicting capacity of adverse outcomes was consistent when gait speed was measured in different populations and when the statistical equations were controlled for numerous medical, functional, and psycho-social factors. Diminished gait speed should be considered as a marker of poor health status, and impaired sub-clinical neurological and muscular factors in between others could be responsible for these consistent outcomes.

Comparing the single-item tool to more comprehensive batteries like the SPPB, it is important to notice that the SPPB score includes two other tasks in addition to gait speed, and it is likely that the chair rise, the tandem stand, or both provide an additional explanatory value (in risk assessment for adverse outcomes) in different well-functioning populations. This extra information is in detriment of time to complete the full battery (2-3 times as long), but the added information of the complete battery could probably discriminate risks among high-functioning older people (24).

Even if gait speed is a consistent predictor of adverse outcomes, the tool is scarcely used in clinical practice. One of the main limits might be the use of cutpoints based on tertiles or quartiles (used for statistical analyses). To be used in clinical practice in autonomous older people, cut-points should be easy to remember. The IANA expert panel considered that, using a 4-meter test and based on the systematic review of literature, the "easy-to-remember" cutpoint might be 0.8 ms^{-1} (more then 5 seconds to perform a 4 meters course) for risk of adverse outcomes.

In more disabled populations, the cutpoint of 0.6 ms^{-1} might also be a useful threshold to identify risk of further functional decline in already functionally impaired older adults. Indeed, a gait speed lower then 0.6 ms^{-1} predicted the probability (>80%) of not performing a 400-meter test (49). This finding may prove useful to future clinical trials and observational studies that involve assessment of mobility limitations in older adults. Being unable to perform a 400-meter walk (predicted by the 4-meter walking test), could be useful to classify patients who would not be able not follow an active physical intervention program. During discussion, and not soundly based on the existing literature, it was also suggested that gait speed could be used as a possible exclusion/inclusion criterion. Although more specific research is needed, the high degree of attrition observed in trials involving older people could be diminished by including a meaningful gait speed cutpoint as an exclusion criterion. If it could be proven that below a certain cutpoint, the attrition increases dramatically (due to incident adverse health outcomes during the trial), standard exclusion criteria would need to include a physical performance measure like gait speed. This point is rather critical as the threshold should be sensible enough to exclude persons at high risk of attrition but not exclude older and fatigued persons, who potentially may benefit from the intervention. Along same line, thresholds of gait speed could also be useful as an inclusion criterion to identify target populations at a higher risk for a specific adverse outcome. In a fall trial, for instance, gait speed could render the sample at high risk by excluding well-functioning older people with low falls risk from the trial.

A meaningful change in gait speed has been established at 0.1 ms^{-1} (at usual pace in a 4-meter walk), and it has been proven that increases in gait speed due to intervention increases survival, as high as a reduction of 17.7% in absolute risk of death (46, 47). Therefore gait speed at usual pace could be proposed as an outcome measure in clinical trials that test drug-interventions or specific programs that aim at frailty or sarcopenia.

Finally, more research on physical performance measures should be performed in clinical settings with frail older adults to assess their association with adverse outcomes. Up to date, most cohort studies assessed community-dwelling well-functioning older people and the identified cutpoints in these populations might differ from the frail older people seen in everyday clinical practice.

Conclusion

Gait speed is a simple, safe and un-expensive assessment tool that measures different aspects of the aging process which may be involved in the onset of adverse outcomes.

Based on the systematic revision of literature, the Task Force stated that there is sufficient evidence to consider gait speed as a strong and consistent predictor of adverse outcomes in community-dwelling older people, and to considered gait speed, as a single-item tool, to be at least as sensible as the composite tools in predicting most of these outcomes over time. The "easy-to-remember" cutpoint, based on literature, could be established at 0.8 ms-1 (5 seconds to perform a 4 meters course) in order to predict adverse outcomes. Although it is a domain that needs further enquiry, the Task Force also suggested that gait speed could be used in clinical trials as exclusion-inclusion criteria or as an outcome.

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