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Review Article

Can gait speed test be used as a falls risk screening tool in community dwelling older adults? A review

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ABSTRACT

Introduction: Gait speed is a simple and easy to perform outcome measure that does not require expensive equipment or complex instructions. However, whether gait speed test can be used as a falls risk screening tool among community dwelling older adults is still unclear.

Aim: The objective of this review was to summarize the evidence on gait speed as a falls risk screening tool among community dwelling older adults.

Material and methods: Articles were searched from two electronic databases, reference lists of studies and reviewed articles. Five articles met the criteria for review.

Results and discussion: Based on the review performed, it was concluded that there is no consensus whether gait speed can be used to identify fallers and non-fallers among community dwelling older adults. The discrimination and predictive validity of gait speed as a tool to identify the risk of falls is not available. However, risk of falls have been categorized into four categories based on gait speed. The categories were <0.6 m/s as slow, 0.6–1.0 m/s as intermediate, 1.0–1.3 m/s as normal performance walker and >1.3 m/s as fast performance walker. Majority of authors have reported high risk of falls among groups with gait speed that ranged 0.6–1.0 m/s. This suggests that decreased gait speed among older adults would likely increase the probability of falls risk.

Conclusions: The discrimination and predictive validity of gait speed test as a tool to identify the risk of falls among community dwelling older adults is yet to be established.

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1. Introduction

Falls among older adults can be considered synonymous with co-morbidity, disability and dependency. Global statistics showed that fall-induced injuries were the fifth leading cause of mortality among older adults.[1,2] Approximately 30%–60% older adults fall each year.[3] In a developed country such as United States of America, more than 15 400 deaths were caused by falls.[4] The percentage of older adults who experience falls annually varies as 19%–28%, depending on the settings.[5,6] Malaysia as a nation that is aging has approximately 47% and 33% of its older adults having history of falls in the past year assessed at primary and inpatient care settings respectively.[7,8] In a recent study, it was demonstrated that approximately 98% of older adults living in residential institutions had a significant high marked risk of falls.[9]

The best predictors of risk of falls are a history of previous falls and walking abnormalities.[10] Walking is an important form of locomotion in activities of daily living and the characteristics of walking are referred to as gait. The recommended longest distance and safest walking velocities during road crossings in healthy adults are 480 m and 30.0–82.5 m/min, respectively.[11] However, these parameters depend on age and other related factors. Normal gait speed was found to be influenced by body weight, height, gender and non-dominant hip abduction strength.[12] Gait, balance ability and falls avoidance involve integration of similar systems that include neuromusculoskeletal, visual and vestibular systems.[13] Thus, gait speed may be a useful tool to screen for risk of falls.

Gait speed test is a reliable, simple and easy to perform outcome measure that does not require expensive equipment or complex instructions. Gait speed test has been used in measuring survival,[14–16] estimating risk of hospitalization[17,18] and morbidity levels.[19,20] The reference values of gait speed is 0.4–1.3 m/s depending on the population and settings where the test was conducted.[15,17,18,21]

Gait speed has also been tested in relation to falls among older adults in residential homes.[22] In this population, gait speeds for those with no history, history and recurrent falls were documented as 0.75 m/s, 0.73 m/s and 0.59 m/s, respectively. Gait speed was reported to have both sensitivity and specificity of above 70% to predict falls among frail older men when using a cut-off value of 0.56 m/s.[23] It is conjectured that speed partly provides stability during movements and acts as a compensatory mechanism for the maintenance of upper body dynamic stability in the prevention of falls.[24]

There is no published information regarding gait speed in relation to risk of falls among community dwelling older adults. A screening tool should be simple, easy to deliver and have the ability to detect future disability or incidence such as falls, institutionalization and cognitive decline.[25] These screening should be performed at a prevention phase in order to provide early intervention.[26,27] To answer whether gait speed test can be used as a risk of falls screening tool in community dwelling older adults, a review of the literature was performed.

2. Aim

The objective of this review was to summarize the evidence on gait speed as a falls risk screening tool among community dwelling older adults.

3. Material and methods

The reference to an older adult varies, but in most developed countries it is accepted as a person aged 65 years and older.[28] To put this into perspective, older adults in this article refer to adults aged 60 years and older in reference to the Malaysian context. The term ''community dwelling'' describes a population who lives in community housing areas with common facilities.

3.1. *Literature search strategy*

Two major electronic databases (Medline and CINAHL) were accessed and articles published from 2003 to 2013 were researched. Key search terms used included ''gait speed,'' ''walking speed,'' ''usual gait speed,'' ''falls'' and ''older adults.'' Search was limited to English language articles.

3.2. *Selection of articles*

Articles researched were based on specified pre-determined criteria that included prospective study in gait speed as a measurement tool in screening risk of falls among community dwelling older adults. The study population comprised of adults 60 years of age and above.

3.3. *Search results*

In total, 175 articles were researched through the two search engines. After excluding non-academic journals (6) and age limitation factors (94), 75 potential articles were identified based on key search terms. Further 70 articles were excluded from the study. Reasons for exclusion included duplicated articles (10), studies not related to falls (57) and incomplete information on gait speed assessment (3). A total of 5 articles were included in the present review.[5,21,29–31] The overall articles researched and selected to be included in this review are as depicted in Fig. 1.

4. Results

4.1. *Study design*

All five studies included for the review were longitudinal studies with duration of follow-up from 12 to 24 months. Four studies were conducted in community settings and one study in the laboratory (Table 1).

A minimum of 140 and a maximum of 1 517 participants from community dwelling older adults were involved in reviewed studies.[5,31] About 60% of the reviewed studies

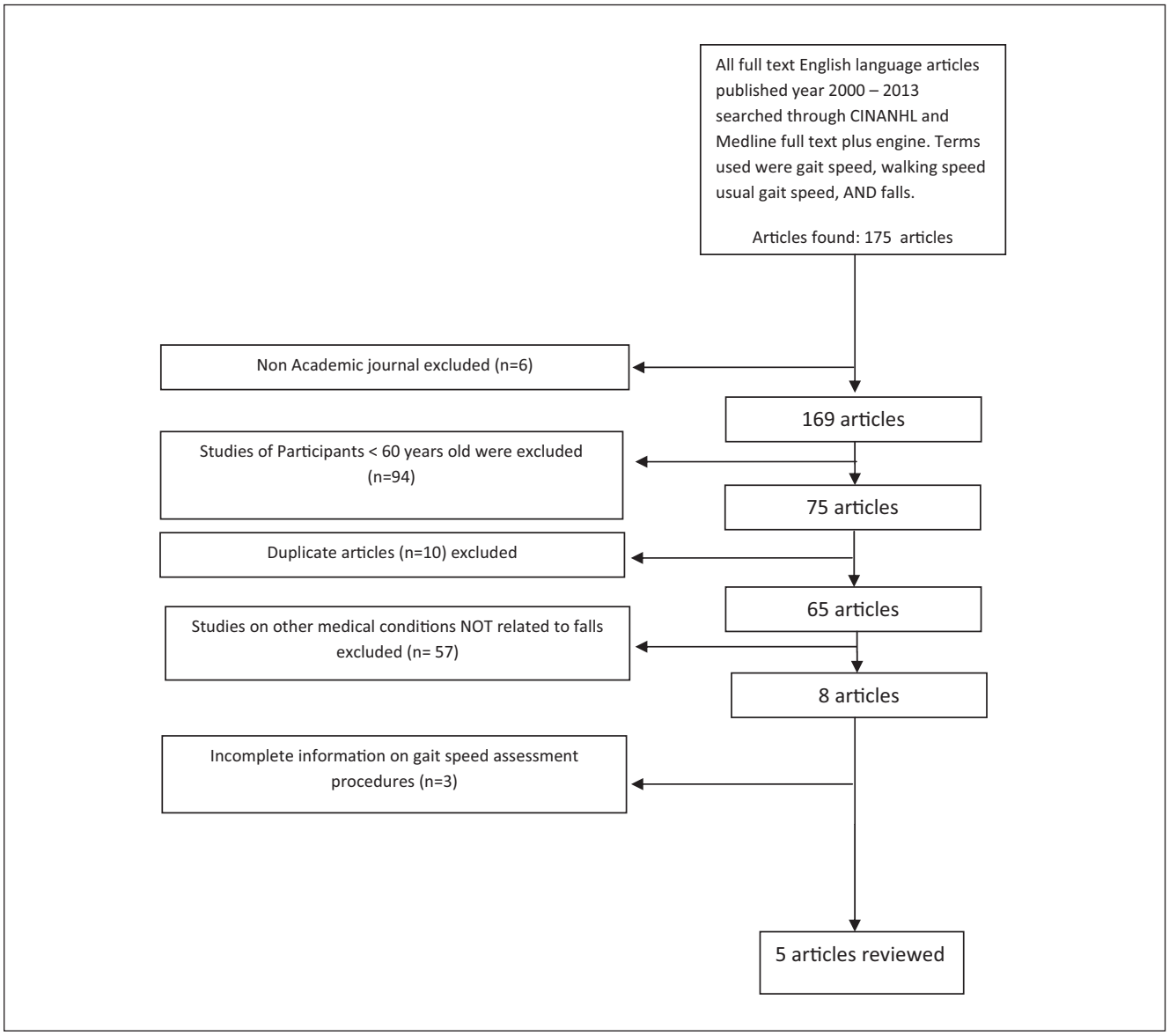

Fig. 1 – Flow chart showing retrieval and selection process of articles in the present review.

involved participants aged 75 years and older and the remaining were 65 years and older. The combined total number of participants in all the reviewed studies was 3 474 out of which 54.78% (1 903) were females and the remaining males (1 571).

4.2. *Falls monitoring procedure*

Duration of falls history follow-up among the studied participants varied between 12 and 24 months. In three studies, the history of falls was obtained via a retrospective reporting system using phone calls and face to face interviews.[5,29,30] In the remaining studies, prospective reporting was via a monthly postcard calendar immediately after a fall event.[21] Routine surveillance and abstraction from medical records[31] were also used.

4.3. *Cut-off score of gait speed for falls risk identification*

None of the reviewed studies reported cut-off scores of gait speed which indicate risk of falls among older adults. However categorization of gait speed based on history of falls and using mean values of gait speed were reported in four studies and are as in Table 2.[21,29–31]

Slow performers with lower gait speed values were reported to have greater risk of falls compared to intermediate and high performers.[29] Mean gait speed values of less than 0.6 m/s were considered as slow performance. The authors suggested that gait speed performance is a useful measurement in discriminating between low and high risk of falls. In another study, it was demonstrated that there was a U-shaped relationship between gait speed and falls.[21] Slow (<0.6 m/s, IRR = 1.60, 95%CI = 1.06–2.42) and fast performers (>1.3 m/s,

Table 1 – Summary of reviewed studies using gait speed as falls screening tool in functionally independent community dwelling older adults.

Authors	Population	Type of study and measurement of falls	Tools used to measure gait speed	Reported cut-off score indicating risk of falls	Findings on validity of gait speed, a fall risk screening
Viccaro et al., 2011	Participants from two primary clinics. Living in community dwelling. Aged 65 years and above. N = 457 (199 females, 258 males)	Prospective cohort study. 12 months follow-up through study visits: every 3 months visit for the first year and every 6 months visit for 2 years more.	Tool: timed 4 m walk. Type of instruction: usual speed.	Not reported.	Predictor for falls risk. Area under the receiver operating characteristic curve. No history of fall – 0.598. >1 baseline falls – 0–726. Multiple falls – 0–792.
Quach et al., 2011	Participants from community dwelling. Aged 78 ± 5 years. N = 763 (488 females, 275 males)	Population based cohort study. 18 months follow-up: falls were tracked by using monthly postcard calendar.	Tool: timed 4 m walk. Type of instruction: usual speed.	Not reported.	Predictor for falls risk. A declining gait speed of more than 0.15 m/s per year was predictive of falls (IRRs = 1.86, 95% CI = 1.15–3.01 fully adjusted model).
Verghese et al., 2009	Participants from community dwelling. Aged 75 years and above. N = 597 (370 females, 227 males)	Prospective cohort study. Convenient sampling. 20 months follow-up: research assistance contacted participants through phone call every 2–3 months.	Tool: GAITRite with computerized walkway mat with dimension of 180 × 35.5 × 0.25 in. Type of instruction: normal pace.	Not reported.	Predictors for falls risk. Quantitative gait markers were independent and strong predictors. Swing (RR = 1.406, 95%CI 1.027–1.926). Double support phase (RR = 1.165, 95% CI = 1.026–1.321). Swing time variability (RR = 1.007, 95% CI = 1.004–1.010). Stride length variability (RR = 1.076, 95% CI = 1.030–1.111). Gait speed less than 100 cm/s (RR = 1.276, 95% CI = 0.906–1.768) were increased in risk of fall.
Montero-Odassa et al., 2005	Participants from community dwelling. Aged 75 years and above. N = 140 (100 females, 40 males)	Prospective study. Random sampling. 24 months of follow-up by telephone interview analysis of survey database. Frequency: – Not specified – monitoring done for 2 years. – Falls event were collected from health maintenance organization record and confirmed via phone call.	Tool: timed 8 m walk test. Type of instruction: comfortable pace.	Not reported.	Predictors for falls risk. Univariate analysis showed low gait velocity was associated with new falls (RR = 5.4, 95% CI = 2.0–14.3). Multiple regression analysis showed gait velocity as the better predictor of falls (OR = 10.9, 95%CI = 2.0–57.9).
Chu et al., 2005	Participants from community dwelling. Aged 65 years and above. N = 1 517 (746 females, 771 males)	Prospective population based cohort study. Follow-up 12 months: phone call every 2 months to look for any occurrence of incidence of falls.	Tool: timed 5 m walk. Type of instruction: walk as fast as possible.	Not reported.	Predictors for falls risk. Logistic regression analyses showed slow gait speeds were predictors of recurrent fall (RR = 0.93, 95% CI = 0.89–0.97, *P* = 0.002).

IRRs – incidence rates ratios, RR – risk ratio, CI – confidence intervals, OR – odd ratio, *P* – alpha level.

Table 2 – Summary of categorization of gait speed.

	Slow performance walker	Intermediate performance walker	Normal performance walker	Fast performance walker
Viccaro et al., 2011	**<0.6 m/s**	0.6–1.0 m/s		>1.0 m/s
	12% (56 cases)	58% (264 cases)		30% (137 cases)
Quach et al., 2011	**<0.6 m/s**	0.6–1.0 m/s	1.0–1.3 m/s	**>1.3 m/s**
	10% (73 cases)	48% (365 cases)	35% (265)	**8% (60 cases)**
Montero-Odasso et al., 2005	**<0.7 m/s**	0.7–1.0 m/s		>1.1 m/s
	25% (26 cases)	42% (42 cases)		34% (34 cases)
Verghese et al., 2009	**0.7 m/s**	**0.7–1.0 m/s**		>1.0 m/s
	54% (322 cases)	**18% (107 cases)**		28% (168 cases)

Bold indicated gait speed with high risk of falls.

IRR = 2.12, 95%CI = 1.48–3.04) were reported to be at a higher risk of falls compared to older adults with normal gait speed (<1.3 m/s, RR = 1.0). Decline in gait speed by 0.15 m/s per year was also an indicator in predicting falls (IRR = 1.86, 95% CI = 1.15–3.01).[21] In addition, gait speed more than 0.7 m/s was reported to be associated with new falls (RR = 5.4, 95% CI = 2.0–14.3, $P < 0.0005$) and as a predictor of falls (OR = 10.9, 95%CI = 2.0–57.9) compared to other mobility tests.[31]

In one study, quantitative gait markers were used as the parameters to predict falls.[30] The results showed that there were four gait markers that were able to predict risk of falls if participants performed poorly. These gait markers were swing phase (RR = 1.406, 95%CI = 1.027–1.926), double support phase (RR = 1.165, 95%CI = 1.026–1.321), swing time variability (RR = 1.007, 95%CI = 1.004–1.010) and stride length variability (RR = 1.076, 95%CI = 1.030–1.111). The authors also categorized that participants with gait speeds less than 1.0 m/s were susceptible to increased risk of falls (RR = 1.26, 95% CI = 0.906–1.768).

Based on the categorization of gait speed, authors of all studies reported that gait speed was able to discriminate risk of falls among older adults. Mean gait speed value that was less than 0.7 m/s was considered as slow, 0.6–1.0 m/s as intermediate and more than 1.0 m/s as fast performance walkers. All reviewed studies reported slow gait speed performers to have a greater risk of falls,[21,29–31] except for one study that added fast gait speed performers (>1.3 m/s) to have high risk of falls.[21] Even though different parameters of gait speed were used as the measure of falls in the reviewed studies, the main objective was still to evaluate the ability of gait speed to categorize fallers and non-fallers.

4.4. *Predictive ability of gait speed performance as a falls risk tool*

Information on predictive validity of gait speed as a predictor for falls is important to provide evidence for its use as a falls screening tool. Predictive validity is referred to the probability of condition being present or absent after obtaining the results of the tests.[32] Even though none of the studies reviewed provided a clear cut-off score of time in m/s as a guide in using gait speed as a screening tool, other statistical test findings were reported. Only one study compared gait speed test with another tool which was time up and go test and analyzed the results using receiver operating characteristic (ROC) to measure falls prediction. In other remaining studies, regression analysis test was used as a statistical test in predicting falls.

Based on ROC curves, it was reported that the area under the curve (AUC) for gait speed showed that older adults with history of falls and multiple falls had an acceptable degree of discrimination as predictor of falls.[29] AUC values of group with history of falls and multiple falls were greater than 0.72 compared to 0.59 for the group without a history of falls. The study findings suggested that gait speed may be valuable in predicting falls among older adults with history of falls but it is not useful for those without history of falls.

5. Discussion

The objective of this review was to determine whether gait speed test can be used as a falls risk screening tool among community dwelling older adults. All the studies reviewed reported that gait speed is able to categorize fallers and non-fallers among community dwelling older adults.[5,21,29–31] However, none of the reviewed studies reported cut-off scores for gait speed that indicates falls risk among community dwelling older adults. It was found that majority of the high risk of falls were from slow performance walkers.[21,29–31]

Based on Table 2, gait speeds were categorized based on mean gait speeds for high risk of falls group that ranged 0.6–1.0 m/s. This may suggest that decreased gait speed among older adults increases the probability to falls risk. On the other hand, fast gait speed is also reported to be associated with falls.[21] Clinically, increasing gait speed alone will not provide a guarantee that an older adult is safe from falls. Multiple prerequisites from various body systems that include adequate muscle strength, balance ability, joint proprioception, cognitive, vision and vestibular function are required for execution of daily living activities especially during walking.

Predictive validity of gait speed is necessary in order to provide an accurate and strong evidence for its use as a falls screening tool. Only one reviewed study reported predictive validity of gait speed for falls among community dwelling older adults.[29] In this study, time up and go test and gait speed were validated concurrently.[29] However, the results showed that combinations of two tests do not give added value to predict the incident of falls. Gait speed or time up and go test alone was concluded to be able to predict the occurrence of falls. Gait speed can be performed in a short period of time, is simple and no sophisticated equipments are

required. Moreover, gait speed procedure can be easily standardized between assessors and this would reduce inter-reliability issues.

Heterogeneity in gait speed and falls assessment in the present reviewed studies may have influenced the reviewed findings. However, in terms of the duration of follow-up for falls events, all studies complied with an adequate follow-up period which varied from 12 to 42 months. A 12 months follow-up period is argued to provide better outcome compared to shorter period.[33,34] Sensitivity of self-reporting and calendar records of falls over 12 months were also found to be better (79.5%) compared to 6 months duration (56.0%).[33,35,36] It is believed that telescoping memory effect may be the reason for these differences, whereby a distant event is remembered and reported rather than a more recent one.[36]

This review is limited to only community dwelling older adults. The findings may not be applicable to older adults with frailty and living in assisted institutions. Similar reviews for older adults from different settings may be required for complete information on the usefulness of gait speed as a falls risk screening tool.

The findings of the present review showed that currently, there are no specific cut-off points for gait speed that can be used to identify fallers and non-fallers among community dwelling older adults. All reviewed articles however reported the reference values of gait speed that were based on mean values of gait speed and number of falls reported by the participants prospectively. Moreover, these gait speed reference values reported have not been cross-validated in any study.

The simplicity of using gait speed test as a falls screening tool will enable it to be used by oneself, carer or non-clinician. Thus, further studies to investigate the usefulness of this test to predict falls in this population are recommended. This can assist in early identification of the risk of falls among older adults following which healthcare providers can plan appropriate falls prevention strategies and further management in an effort to minimize falls and its related injuries.

6. Conclusions

The discrimination and predictive validity of gait speed test as a tool to identify the risk of falls among community dwelling older adults is yet to be established.

Conflict of interest

No potential conflicts of interest were disclosed.

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