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Risk of falls in older people during fast-walking – The TASCOG study

M.L. Callisaya [a,b,*], L. Blizzard [b], J.L. McGinley [c], V.K. Srikanth [a,b]

[a] Stroke and Ageing Research Group, Department of Medicine, Southern Clinical School, Monash University, Victoria, Australia
[b] Menzies Research Institute Tasmania, University of Tasmania, Tasmania, Australia
[c] Physiotherapy – Melbourne School of Health Sciences, University of Melbourne, Victoria, Australia

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ABSTRACT

Aims: To investigate the relationship between fast-walking and falls in older people.
Methods: Individuals aged 60–86 years were randomly selected from the electoral roll ($n = 176$). Gait speed, step length, cadence and a walk ratio were recorded during preferred- and fast-walking using an instrumented walkway. Falls were recorded prospectively over 12 months. Log multinomial regression was used to estimate the relative risk of single and multiple falls associated with gait variables during fast-walking and change between preferred- and fast-walking. Covariates included age, sex, mood, physical activity, sensorimotor and cognitive measures.
Results: The risk of multiple falls was increased for those with a smaller walk ratio (shorter steps, faster cadence) during fast-walking (RR 0.92, CI 0.87, 0.97) and greater reduction in the walk ratio (smaller increase in step length, larger increase in cadence) when changing to fast-walking (RR 0.73, CI 0.63, 0.85). These gait patterns were associated with poorer physiological and cognitive function ($p < 0.05$). A higher risk of multiple falls was also seen for those in the fastest quarter of gait speed ($p = 0.01$) at fast-walking. A trend for better reaction time, balance, memory and physical activity for higher categories of gait speed was stronger for fallers than non-fallers ($p < 0.05$).
Conclusion: Tests of fast-walking may be useful in identifying older individuals at risk of multiple falls. There may be two distinct groups at risk – the frail person with short shuffling steps, and the healthy person exposed to greater risk.

1. Introduction

Up to 45% of older people living in the community fall annually [1]. Falls can result in injury, loss of independence and death [2]. Risk factors for falls include poorer physiological and psychological function [3]. It is desirable to be able to screen people in the community who may require detailed assessment for risk of falling. Gait patterns may provide valuable information toward identifying people at risk, as poorer gait reflects a person's inability to compensate for decline in physiological and psychological function [4].

A more cautious gait pattern, characterized by decreased speed and step length [5], has been reported to be associated with falls risk in hospitalized [6] and nursing home patients [7]. However, evidence is equivocal as to whether such gait patterns predicts falls [4,8] or not [9–13] in older people living in the wider community. Gait is often tested at a person's preferred speed of walking, but this may not be sufficiently sensitive to capture risk in such people. Walking at a person's fast speed (fast-walking) may place greater demand on physiological and cognitive systems [14,15], and could be more informative about falls risk. Furthermore those with a high falls-risk may have greater difficulty increasing walking speed due to greater levels of disability.

There have been few studies investigating falls-risk and fast-walking [16–18]. These studies have several limitations in that samples of convenience with small subject numbers were used. Moreover, these studies may have been affected by recall bias as a result of adopting a method where falls were counted retrospectively. The results of these studies have also been conflicting. In one study, people who fell had slower gait speed and cadence than non-fallers [17], yet others report no differences in gait speed [16], but faster cadence and shorter steps in fallers [18]. Therefore apart from these individual gait measures, the pattern or combination of step length and cadence used to increase speed may be an important measure of falls risk. A persons walking pattern can be summarized by the walk ratio (WR), calculated as step length divided by cadence [19], whereby a lower ratio is the result of shorter steps and/or a higher cadence.

* Corresponding author at: Level 5, Block E, Monash Medical Centre, 246 Clayton Road, Melbourne, Victoria 3168, Australia. Tel.: +61 3 6226 7700; fax: +61 3 6226 7704.
E-mail addresses: Michele.Callisaya@monash.edu, michelec@utas.edu.au (M.L. Callisaya).

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The primary hypotheses of this prospective population-based study were that those with: (1) poorer gait (slower speed, shorter steps and a smaller WR) during fast-walking and (2) a smaller change in gait from preferred- to fast-walking would have a greater risk of falls. The secondary hypothesis was that poorer physiological and psychological function would be associated with poorer gait at fast-walking and with change between preferred- and fast-walking.

2. Materials and methods

2.1. Participants

Participants were drawn from the Tasmanian Study of Cognition and Gait (TASCOG). Residents from southern Tasmania aged between 60 and 86 years ($n = 412$) were randomly selected from the electoral roll. In this sub-study the first consecutive 176 participants were included. Participants were excluded if they lived in a high-level care institution, were unable to walk without a gait aid, or if they had any contraindication to MRI scan, as this was a requirement of the larger study. The Southern Tasmanian Health and Medical Human Research Ethics Committee approved this study and written consent was obtained from all participants.

2.2. Gait

A 4.6 m instrumented walkway system (*GAITRite* CIR systems, USA) was used to measure gait speed and its determinants – step length and cadence. Participants started 2 m before and finished 2 m after the mat to ensure a steady speed. The average of six trials at both the preferred- and fast-walking tasks was used to calculate each gait variable. The WR was calculated as step length divided by cadence. The change in each gait variable between preferred- and fast-walking was calculated as a percentage for gait speed, step length and cadence, while absolute change was used for the WR.

2.3. Falls

Participants were sent a falls questionnaire every two months for 12 months to report on incident falls defined as 'an unexpected event in which the participant comes to rest on the ground, floor or lower level' [20]. They were also required to complete a falls calendar during this time to assist in recollection of falls. Falls were classified as either no, single or multiple falls (more than one fall).

2.4. Other measures

Self-reported medical history (arthritis, hypertension, diabetes mellitus, stroke, lower-limb pain) was obtained using a questionnaire. Physiological factors (reaction time, quadriceps strength, edge contrast sensitivity, proprioception and balance) were measured using the protocols of the Physiological Profile Assessment [21]. Cognitive function was assessed in four domains: *executive function/attention* – Controlled Word Association Test [22], Category Fluency [22], the Victoria Stroop test [23] and the Digit Span subtest of the Wechsler Adult Intelligence Scale (WIAS-III) [24]; *processing speed* – Symbol Search and Digit Symbol Coding subtests of the WAIS-III [24]; *visuospatial ability* – Rey Complex Figure copy task [22]; *memory* – Hopkins Verbal Learning Test and a delayed reproduction after 20 min of the Rey Complex Figure [22]. Mood was measured using the Geriatric Depression Scale (short version). A summary cognitive component for each cognitive domain was derived from the tests measuring that domain using principal components analysis and regression scores were generated for each component using Thomson's method for use in further analysis [25]. For physical activity, the average number of steps per day was measured using a Yamax Digi-Walker SW-200 pedometer worn for 7 days [26]. Self-reported medical history was obtained from those who declined to participate (non-responders) by telephone interview.

2.5. Statistical analysis

Responders and non-responders were compared using chi-squared analysis and *t*-tests. Pearson correlations adjusted for age, sex, height and weight (partial correlations) were estimated between physiological or cognitive variables and gait measures. Log multinomial regression was used to estimate risk and relative risk of single and multiple falls. This model is used to obtain relative risk estimates for nominal outcomes with more than two attributes [27]. The initial model was adjusted for age, sex, height and weight. Further adjustment was made for physiological or cognitive factors if a variable changed the coefficient of the gait variable by more than 10%. Quadratic trend was assessed by adding a square of the variable and testing its significance. Gait variables were categorized into quarters to further examine quadratic relationships, where the relative risk is the proportion of subjects with multiple falls at one of the gait measure relative to the proportion of subjects with multiple falls in the reference (first quarter) of the gait measure. Means of all covariates are presented stratified by categories of gait speed, and tests of trend and interaction with falls were assessed using linear regression. Data were analyzed using STATA version 10.1 (StataCorp, Texas, USA).

3. Results

The participant response proportion in the overall study was 51% (412/804). Responders were younger ($p = 0.01$) and had a lower self-reported history of hypertension ($p = 0.03$). There were no significant differences between the full sample and the 176 participants in this sub-study with respect to age, sex, height,

Table 1
Sample characteristics ($n = 176$).

Characteristic	Lost to follow up $n = 21$	No falls $n = 85$	Single fall $n = 42$	Multiple falls $n = 28$	Included in analysis $n = 155$
Age, mean (SD)	74.5 (6.6)	71.5 (6.8)	72.9 (5.8)	75.7 (8.5)	72.6 (7.0)
Sex (% male)	57.1	56.5	52.4	50.0	54.2
Height, cm (SD)	167.8 (8.5)	166.1 (7.8)	165.7 (9.1)	165.1 (9.1)	165.8 (8.0)
Weight, cm (SD)	81.3 (19.2)	74.7 (14.3)	77.2 (14.3)	73.7 (11.3)	75.2 (13.8)
Medical history (self-reported), *n* (%)					
Arthritis	11 (52.4)	31 (36.90)	21 (51.2)	11 (39.3)	63 (41.2)
Hypertension	9 (42.9)	37 (43.5)	23 (54.8)	13 (46.4)	73 (47.1)
Diabetes	4 (19.1)	9 (10.6)	7 (16.7)	2 (7.1)	18 (11.6)
Stroke	1 (4.8)	5 (5.9)	3 (7.1)	4 (14.3)	12 (7.7)
Gait measures, mean (SD)					
Preferred walking speed					
Gait speed, m/s	1.08 (0.21)	1.14 (0.19)	1.11 (0.17)	1.12 (0.26)	1.13 (0.20)
Cadence, steps/min	111.5 (10.1)	110.3 (9.7)	109.2 (9.4)	112.3 (11.3)	110.3 (9.9)
Step length, cm	58.1 (9.1)	62.0 (8.0)	60.9 (8.0)	59.7 (10.1)	61.3 (8.4)
Walk ratio	0.52 (0.08)	0.56 (0.08)	0.56 (0.09)	0.53 (0.09)	0.56 (0.09)
Fast walking speed					
Gait speed, m/s	1.45 (0.30)	1.59 (0.28)	1.54 (0.30)	1.51 (0.37)	1.56 (0.30)
Cadence, steps/min	131.3 (13.2)	132.4 (15.2)	133.0 (16.7)	137.3 (19.9)	133.5 (16.5)
Step length, cm	66.3 (11.7)	71.9 (10.2)	69.5 (10.4)	66.0 (12.2)	70.2 (10.8)
Walk ratio	0.51 (0.10)	0.55 (0.11)	0.53 (0.10)	0.49 (0.11)	0.53 (0.11)
Change from preferred- to fast-walking					
Gait speed, %	34.3 (10.3)	39.8 (17.7)	38.7 (14.3)	34.7 (13.5)	38.6 (16.2)
Cadence, %	17.8 (6.1)	20.2 (10.5)	21.7 (10.1)	22.1 (10.8)	21.0 (10.4)
Step length, %	13.9 (6.5)	16.0 (7.2)	13.9 (6.0)	10.4 (7.2)	14.4 (7.2)
Walk ratio	−0.02 (0.04)	−0.02 (0.05)	−0.03 (0.05)	−0.05 (0.05)	−0.03 (0.05)

Note: SD, standard deviation.

Table 2
Partial correlations between gait variables and covariates adjusted for age, sex, height and weight ($n = 155$).

	Fast-walking				Change from preferred- to fast-walking			
	Gait speed	Step length	Cadence	Walk ratio	Gait speed	Step length	Cadence	Walk ratio
Quadriceps strength	0.31*	0.27†	0.23†	0.05	0.14	0.16	0.08	0.06
Reaction time	−0.21†	−0.20‡	−0.15	−0.05	−0.02	0.01	−0.03	0.04
Proprioception	−0.06	−0.03	−0.04	0.02	0.06	0.06	0.04	0.03
ECS	0.06	−0.01	0.08	−0.07	0.04	0.06	0.02	−0.01
Balance eyes open	−0.17‡	−0.21‡	−0.05	−0.13	0.01	0.10	−0.04	0.12
Balance eyes closed	−0.21‡	−0.23†	−0.09	−0.12	−0.02	0.01	−0.03	0.08
Lower limb pain	−0.1	−0.17‡	0.00	−0.12	0.03	−0.04	0.07	−0.09
Mood	−0.17‡	−0.18‡	−0.07	−0.07	0.02	−0.02	0.04	−0.03
Memory	0.24†	0.17‡	0.19‡	−0.02	0.17‡	0.05	0.20‡	−0.17‡
Visuospatial ability	0.22†	0.15	0.21‡	−0.02	0.13	−0.00	0.19‡	−0.17‡
EF/attention	−0.28*	−0.23†	−0.21‡	−0.02	−0.13	−0.02	−0.17‡	0.17‡
Processing speed	0.30*	0.24†	0.23†	0.01	0.24†	0.11	0.25†	−0.16‡
Physical activity	0.18‡	0.21‡	0.10	0.13	−0.00	−0.02	0.01	−0.01

ECS, edge contrast sensitivity; EF, executive function. All models were adjusted for age, sex, height and weight. Higher scores of memory, spatial ability and processing speeds and lower scores of executive function/attention indicate better function.
* $p < 0.001$.
† $p < 0.01$.
‡ $p < 0.05$.

weight or self-reported medical history ($p > 0.05$). If participants had not completed all six questionnaires and had not reported a fall ($n = 21$), they were recorded as lost to follow-up, leaving 155 participants (88.1%) for analysis. Forty five percent (27% single fall, 18% multiple falls) of participants reported at least one fall in the follow-up period. Table 1 provides baseline characteristics for those lost to follow up, those with no falls, single falls and multiple falls. There were no significant differences between those lost to follow-up and those included in the analyses ($p > 0.05$).

3.1. Correlations between physical function, psychological function and gait variables

Table 2 provides the correlations between mood, physical activity, physiological and cognitive function and gait variables. During fast-walking, slower gait speed, shorter steps and a slower cadence were associated with poorer quadriceps strength, memory, processing speed and executive function ($p < 0.05$). Slower gait speed and shorter steps were associated with poorer reaction time, balance, mood and physical activity. Slower speed was also associated with poorer spatial ability, and shorter steps with reports of pain ($p < 0.05$). The WR was not associated with any of the covariates. A smaller change in gait speed from preferred- to fast-walking was associated with poorer memory and processing speed ($p < 0.05$). A smaller change in cadence and the WR were associated with poorer memory, processing speed, spatial ability and executive function ($p < 0.05$).

3.2. Gait and risk of falls

Table 3 presents the relative risk of each gait measure with single and multiple falls. None of the gait measures was associated with the risk of single falls. The following results describe the associations between gait measures and multiple falls.

3.3. Fast-walking

During fast-walking, after initial adjustment for age, sex, height and weight (Model 1), the risk of falls was associated with a faster cadence ($p = 0.04$) and a lower WR ($p = 0.04$). Further adjustment for physiological and psychological factors (Model 2) increased the strength of the association for cadence ($p = 0.004$), and the WR ($p = 0.002$). In addition a shorter step length ($p = .046$) was

Table 3
Adjusted association of average measures of gait with single and multiple falls ($n = 155$).

	One fall		Multiple falls	
	Model 1	Model 2	Model 1	Model 2
	RR 95% CI	RR 95% CI	RR 95% CI	RR 95% CI
Fast-walking				
Gait speed, cm/s	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.01 (0.99, 1.03)
Cadence, steps/min	1.00 (0.98, 1.02)	0.99 (0.96, 1.01)	1.02 (1.00, 1.05)	1.09 (1.03, 1.16)
Step length, cm	1.00 (0.97, 1.04)	1.00 (0.97, 1.03)	0.98 (0.95, 1.01)	0.95 (0.89, 0.99)
Walk ratio	1.01 (0.98, 1.04)	1.01 (0.98, 1.05)	0.96 (0.93, 0.99)	0.92 (0.87, 0.97)
Change from preferred- to fast-walking				
Gait speed, %	1.00 (0.99, 1.02)	0.99 (0.98, 1.01)	0.99 (0.96, 1.01)	0.98 (0.94, 1.02)
Cadence, %	1.01 (0.98, 1.03)	1.00 (0.97, 1.03)	1.01 (0.98, 1.04)	1.05 (1.01, 1.10)
Step length, %	0.99 (0.95, 1.03)	0.99 (0.95, 1.04)	0.93 (0.88, 0.97)	0.55 (0.36, 0.84)
Walk ratio	0.97 (0.92, 1.02)	0.98 (0.92, 1.04)	0.93 (0.88, 0.99)	0.73 (0.63, 0.85)

Notes: RR, relative risk; CI, confidence interval; walk ratio was multiplied by 100.
Model 1 adjusted for age, height, weight and sex.
Model 2 adjusted for age, height, weight, sex and additionally for other sensorimotor and cognitive measures as outlined below:
Gait speed: quadriceps strength, reaction time, mood, executive function and processing speed.
Step length: quadriceps strength, reaction time, proprioception, lower limb pain, mood, memory, executive function and processing speed.
Cadence: executive function, mood, reaction time, balance eyes closed, processing speed and memory.
Walk ratio: quadriceps strength, reaction time, lower limb pain and mood.

Table 4
Adjusted association of measures of gait with multiple falls ($n = 155$).

	No falls	Single falls	Multiple falls	
	n (%)	*n* (%)	*n* (%)	RR (95% CI)
Fast-walking speed (cm/s)				
1st quarter (65.4–139.6)	16 (41.0)	12 (30.8)	11 (28.2)	1.00
2nd quarter (139.7–154.4)	24 (61.5)	10 (25.7)	5 (12.8)	0.77 (0.22, 2.64)
3rd quarter (154.5–175.5)	23 (59.0)	12 (30.8)	4 (10.3)	0.93 (0.24, 3.56)
4th quarter (175.6–260.2)	22 (57.9)	8 (21.1)	8 (21.05)	2.75 (0.44, 17.13)
p-Value for quadratic trend				0.01
Step length (cm)				
1st quarter (34.2–62.9)	11 (28.2)	15 (38.5)	13 (19.8)	1.00
2nd quarter (63.0–71.3)	25 (64.1)	10 (25.6)	4 (10.3)	0.03 (0.00, 0.41)
3rd quarter (71.3–77.8)	27 (69.2)	7 (18.0)	5 (12.8)	0.02 (0.00, 0.32)
4th quarter (77.9–107.0)	22 (57.9)	10 (26.3)	6 (15.8)	0.07 (0.01, 0.72)
p-Value for quadratic trend				0.01

Notes: RR, relative risk; CI, confidence interval. Models adjusted as per Model 2 in Table 3.

Table 5
Mean (SD) of sensorimotor, cognitive and physical activity stratified by quarters of gait speed (fast pace).

	Q1		Q2		Q3		Q4		Trend
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	*p* value
Quadriceps strength, kg	25.4	(8.4)	30.9	(9.6)	31.1	(9.1)	38.8	(12.4)	<0.001
Reaction time, ms	257.4	(76.5)	227.7	(33.4)	222.6	(22.4)	213.1	(29.0)	<0.001
Proprioception, degrees	1.4	(1.0)	1.2	(1.1)	1.3	(1.0)	1.1	(1.0)	0.39
ECS, dB	19.7	(2.2)	20.6	(1.9)	20.9	(1.9)	20.9	(2.4)	0.007
Balance eyes open, mm	28.7	(31.8)	21.7	(9.6)	22.7	(7.3)	19.9	(5.8)	0.05
Balance eyes closed, mm	68.2	(66.7)	42.6	(31.1)	36.0	(13.5)	36.9	(15.5)	<0.001
Lower limb pain, *n* (%)	19	(48.7)	20	(51.3)	10	(25.6)	10	(26.3)	0.008
Mood	2.8	(2.6)	1.6	(1.4)	1.9	(2.4)	1.0	(1.9)	0.001
Memory	−0.51	(1.96)	−0.29	(1.21)	0.32	(1.09)	0.73	(1.36)	<0.001
Visuospatial ability	30.7	(5.4)	32.9	(4.0)	33.2	(3.7)	34.1	(2.3)	<0.001
EF/attention	1.3	(2.5)	0.1	(1.9)	−0.7	(1.0)	−0.7	(1.3)	<0.001
Processing speed	−0.9	(1.2)	−0.1	(1.2)	0.3	(1.1)	0.7	(1.3)	<0.001
Physical activity, steps/day	4302.3	(3260.6)	5092.8	(2515.1)	6586.6	(3510.3)	7435.7	(2762.1)	<0.001

Notes. SD, standard deviation; Q, quarter. Better function is represented by higher scores for quadriceps strength, ECS, memory, visuospatial ability, processing speed and physical activity.

associated with increased risk of falls. Tests of quadratic trend (Table 4) were significant for gait speed ($p = 0.01$) and step length ($p = 0.01$). The highest risk of falls was for those in the fastest quarter of gait speed.

3.4. Change in gait from preferred- to fast-walking

In Model 1 risk of falls was increased in those with a smaller change in step length ($p = 0.02$) and greater reduction in the WR ($p = 0.001$). In Model 2 there was a significant increase in risk of multiple falls for those with greater change in cadence ($p = 0.009$), smaller change in step length ($p = 0.006$) and greater reduction in the WR ($p = 0.003$). Change in gait speed was not associated with risk of falls ($p = 0.94$).

Further analysis was undertaken to investigate possible mechanisms for the increased risk of falls in the highest quarter of gait speed. Table 5 provides the means of each physiological and cognitive variable by quarters of gait speed. Other than for proprioception, there was a significant trend for better performance in all covariates with higher category of gait speed. For reaction time ($p = 0.04$), balance eyes open ($p = 0.01$), memory ($p = 0.04$) and physical activity ($p = 0.02$), the trend for better performance was stronger for fallers than non-fallers. The means of these variables further stratified by falls are provided in Table 6 (Supplementary data). For balance eyes open ($p = 0.02$) and memory ($p = 0.03$), the difference in means between non-fallers and fallers was reversed in the fourth quarter with fallers having better memory and balance.

4. Discussion

In this population-based study of older people the risk of multiple falls was increased in those with a lower WR during fast-walking and a greater reduction in the WR from preferred- to fast-walking. In addition, there was increased risk in those walking in the slowest and fastest quarters of gait speed during the fast-walking task, suggesting well-functioning older people may also be at greater risk of falling. These results support measuring gait at fast-walking speeds in order to identify those at risk of multiple falls.

During fast-walking, the increased risk of multiple falls in those with a smaller WR (e.g. every 1 unit decrease in the WR was associated with an 8% increased risk) was due to smaller steps and a faster cadence. Similarly, increased risk in those with greater reductions in the WR from preferred- to fast-walking was due to smaller increases in step length and larger increases in cadence. Although a quadratic trend was significant for step length at fast-walking, examination of quarters showed that essentially there was minimal risk of falls for those in the second, third and fourth quarters. No previous studies to our knowledge have examined the associations between the WR and falls risk. However, in support of our findings a previous study reported fallers walked with smaller steps and a faster cadence compared with non-fallers at selected speeds on a treadmill [18]. In contrast, Newstead et al. reported that in a sample of healthy older volunteers walking at fast speed, fallers had a slower cadence but similar step lengths compared with non-fallers [17]. Differences with this study may be due to differing sample selection. Our results build on the work of others who have suggested walk ratios may be a useful and reliable measure for assessing older people with impaired gait [19].

Although cross-sectional, our results suggest smaller steps during fast-walking are a marker of poorer sensorimotor and cognitive function, impairments that are also associated with falls [28]. In contrast, a higher cadence at fast-walking and greater change in cadence was associated with better cognitive function and quadriceps strength (fast-walking only). This suggests higher cadence may not necessarily indicate poorer function, but may be an adaptive strategy to spend less time in the unstable single support phase of gait or used as an alternative to increasing step length when asked to walk faster. Such a gait pattern of short steps and a high cadence may increase the chance of tripping [29].

This study had a number of negative findings. Firstly, none of the gait measures were associated with single falls. This is in agreement with others who have suggested single falls may not be due to physiological impairments [30] that impact on gait. Secondly, gait speed was not linearly associated with risk of falls, possibly due to opposing directions of associations between its determinants and falls. However, similar to our previous study at preferred speed [13], there was evidence that those with walking speeds in the slowest and fastest quarter were at increased risk of falls (Table 4). Those in the fastest quarter had the highest risk and these individuals performed better on memory and balance tests suggesting that they may be highly functioning individuals. Although we did not have information regarding whether these people fell whilst engaging in vigorous activities, we did identify that there was a stronger trend for greater physical activity for each quarter of gait speed for fallers, perhaps exposing them to a greater risk of falling. Alternatively, previous studies have identified that some people underestimate their falls risk [1]. Those who underestimate falls risk may increase gait speed to levels that are too fast for their ability [31]. However, in a recent study of older people at physiological risk of falling, a low perceived falls risk seemed to be protective against future falls [1]. Further research is required to unravel the relationship between gait speed, perceived falls risk and future falls.

Our findings support using fast-walking as a simple and challenging test to identify falls risk in community-settings. Although in this study step length and cadence were collected on the GaitRite mat, they can be collected inexpensively using a measured distance on the floor and a stop watch. Our results indicate that targeting factors such as pain, mood, physical activity, physiological and cognitive function may improve gait patterns during fast-walking. Our results also suggest a second high-functioning group of older people at risk of falling, perhaps due to engagement in higher activity levels. Although it may not be beneficial to recommend reducing activities in this group, assessment needs to be made to ensure sufficient balance and cognitive function for selected activities and sufficient vitamin D and bone density levels to reduce the risk of fractures.

There are several strengths to this study. It is the first population-based study to examine associations between tests of fast-walking and falls risk and we included gait measures other than speed such as its determinants – step length, cadence and the WR. We used a prospective design for falls collection limiting recall bias, carefully examined for non-linear association and adjusted for a large number of potential confounders. Although this study was more generalizable to the wider population of older people it is possible that there was some bias due to selection or drop out. Participants were included only if they could walk without the use of a gait aid, possibly resulting in a healthier sample than the general population. The response rate was moderate and a number of participants did not complete the falls follow-up. However, there was no difference between those who did and did not complete follow-up. Finally, it would be interesting to compare fast-walking with other challenging tests (such as dual-task activities) in predicting falls risk and to investigate the role of self-efficacy in ability to change walking speeds.

4.1. Summary

Gait measured during fast-walking may provide a useful falls screening test. Risk of multiple falls was increased in tests of fast-walking in those with a smaller WR and slowest gait speeds, and in those with a greater reduction in the WR from preferred- to fast-walking. In addition, those walking in the fastest quarter of gait speed during fast-walking were also at increased risk perhaps due to engagement in greater levels of activity, suggesting two distinct groups at risk of falls.

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Conflict of interest statement

There are no conflicts of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.gaitpost.2012.05.003.

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