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PII: S0966-6362(20)30173-9

DOI: https://doi.org/10.1016/j.gaitpost.2020.05.024

Reference: GAIPOS 7556

To appear in: *Gait & Posture*

Received Date: 26 September 2019

Revised Date: 11 May 2020

Accepted Date: 17 May 2020

Please cite this article as: Rantalainen T, Teo WP, Ridgers ND, Nuzum ND, Valente L, Macpherson H, Laboratory-Based Gait Variability and Habitual Gait Entropy Do Not Differentiate Community-Dwelling Older Adults from Those with Subjective Memory Complaints, *Gait and amp; Posture* (2020), doi: https://doi.org/10.1016/j.gaitpost.2020.05.024

Laboratory-Based Gait Variability and Habitual Gait Entropy Do Not Differentiate Community-Dwelling Older Adults from Those with Subjective Memory Complaints

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Highlights

- Subjective memory complaints are not associated with a specific gait profile
- Free-living and laboratory-based estimates of gait variability were explored
- Subjective memory complaints in community may present a heterogeneous group

Abstract

Background: Age-related cognitive decline may be delayed with appropriate interventions if those at high risk can be identified prior to clinical symptoms arising. Gait variability assessment has emerged as a promising candidate prognostic indicator, however, it remains unclear how sensitive gait variability is to early changes in cognitive abilities.

Research question: Do community-dwelling adults over 65 years of age with subjective memory complaints differ from those with no subjective memory concerns in terms of laboratory-measured or free-living gait variability?

Methods: This cross-sectional study recruited 24 (age = 73.5(SD 6.4) years) community-dwelling people with subjective memory complaints and twenty seven (age = 70.9(4.3) years) individuals with no subjective memory concerns. A sample of 9 individuals with diagnosed mild dementia were also assessed (age = 86.5(7.0) years). Gait variability was assessed in a laboratory during walking at preferred pace (single-task) and while counting backward by seven (dual-task). Sixteen passes over a 4.88 m walkway in each condition were recorded and step length and duration variability was analysed. Free-living gait was assessed with a waist-worn accelerometer by identifying gait bouts of at least one min duration, and the mean multiscale sample entropy in one mins non-overlapping epochs is reported. Statistical inferences were based on analysis of variance using sex and group as the factors.

Results: No difference between those with subjective memory complaints and those without were observed in either laboratory- or free-living gait variability estimates. Both laboratory- and free-living gait variability were higher in those with mild dementia compared to the other groups.

Significance: Assuming that subjective memory complaints are on the pathway from cognitively intact to cognitively frail, the findings raise the hypothesis that subjective memory complaints occur earlier in the pathophysiology than measurable changes in laboratory or free living gait. Alternatively the gait variability assessments utilised may have been too insensitive.

Keywords: wearable; gait; cognitive impairment; screening; activity;

1. Introduction

Pre-clinical conditions, such as subjective memory complaints, thought to be on the pathway of progressing from cognitive robustness to cognitive frailty, and cognitive impairment [1], have been explored as indicators of impending cognitive impairment [2]. An alternative avenue has emerged from gait analysis, and a strong link between poorer cognitive performance and increased gait variability has been identified over the past few decades [3–5]. Subsequently, gait variability has been identified as a particularly promising indicator of impending cognitive decline [6]. Indeed, increased gait variability at baseline has been shown to be predictive of prospective cognitive decline over a four-year follow-up period among initially cognitively intact community-dwelling older adults [7].

While the link between future cognitive impairment and present gait variability still rests on only a few studies [6,7], cross-sectional studies have demonstrated that older adults with mild cognitive impairment have higher gait variability in various spatiotemporal characteristics (e.g. stride duration), compared to cognitively intact individuals [8]. Brain imaging studies have indicated that gait variability may be associated with areas important for sensorimotor integration and coordination, with the anatomical and functional characteristics of the prefrontal cortex and hippocampus possibly linked to increased gait variability in cognitive impairment and dementia [4]. Considering the accumulating evidence and the close link with the brain-related aetiology of cognitive impairment [4], it seems reasonable to postulate that changes in gait variability could indicate pre-clinical conditions, such as subjective memory complaints. Indeed, those with pre-clinical cognitive impairment (subjective memory impairment reported by the participant and/or

their spouse) have been found to have higher stride duration coefficient of variation under counting backwards dual-task condition compared to subjectively cognitively intact peers [9]. However, the aforementioned investigation targeted people referred to a memory clinic [9], and it remains unclear whether these results can be extrapolated to community-dwelling individuals without a specific memory-related referral.

While gait is typically assessed in a laboratory, the emergence of miniaturised wearable sensors over the past two decades has enabled free-living gait assessments based on prolonged waist-worn accelerometer recordings [10–13]. Although gait variability is typically captured using instrumented walkways, indirect indicators of variability have been utilised in free-living gait explorations. Particularly, complexity quantified by multiscale sample entropy has been successfully utilised and seen to be as or more predictive of impending falls among people with Parkinson's disease compared to laboratory-based gait variability assessments [12,13]. However, it needs to be kept in mind that complexity is not synonymous with variability as it captures non-linear characteristics of gait dynamics, which may be caused by factors other than variability as captured in the laboratory [14]. Therefore, further exploration of free-living complexity and laboratory-measured variability is warranted.

The purpose of the present study was to investigate whether community-dwelling adults over 65 years of age with subjective memory complaints differ from those with no subjective memory concerns in terms of laboratory-measured or free-living gait variability. A sample of individuals with diagnosed mild dementia were also assessed. It was hypothesised that those with subjective

memory complaints differ in terms of gait variability (step duration and multiscale sample entropy) from those without and that the difference is in the direction of the values observed in those with diagnosed mild dementia.

2. Methods

A total of 72 people aged ≥65 years of age were recruited for the study using newspaper advertisements and word of mouth. Three groups that consisted of community-dwelling older adults with no memory concerns (N = 33), community-dwelling older adults with subjective memory complaints (N = 28), and older adults with diagnosed mild dementia (N = 11) were targeted. Full datasets were obtained from 27, 24, and 9 participants, respectively. The inclusion criteria common to all groups were; in good general health, and no contraindications for performance testing. Exclusion criteria common to all groups included history of stroke, head trauma, alcohol or drug dependency, current clinical diagnosis of depression or anxiety, and contraindications for performance testing. Subjective memory complaints were defined using a modification of the Youn and colleagues (2009) subjective memory complaints questionnaire [15]. Subjective memory complaints were defined as answering ”yes” to the question ”do you feel like your memory is becoming worse?” and participants were subsequently required to provide three examples of day to day issues that have occurred regarding their memory in order to be included into the subjective memory complaints group. Participants with dementia were required to have been provided with a diagnosis by a medical professional prior to inclusion in the study. The study was approved by the Deakin University Human Research Ethics Committee (2017-054), conducted in accordance with the Helsinki Declaration and all participants or their carers gave written informed consent to participate.

2.1. Protocol

The volunteers were asked to attend a testing session at the Deakin University Burwood campus. The testing session included cognitive performance (Montreal Cognitive Assessment, MoCA), gait (single and dual-task), and performance testing (sit-to-stand test). At the end of the testing session the participants were fitted with an accelerometer (ActiGraph GT3X+, ActiGraph LLC, Pensacola, FL, USA) on the waist aligned with the right spina iliaca anterior superior and at the height of the iliac crest to be worn during waking hours for the subsequent eight days. The participants also reported their education status, and were classified into three categories accordingly (1 = less than high school, 2 = high school 3 = more than high school).

2.2. Assessments

Cognitive performance was assessed with the MoCA [16], and the sum of the points (score) is reported as the outcome.

Gait was assessed on a 10 m track with a 4.88 m long instrumented walkway (ZenoMetrics LLC, Peekskill, NY, USA, sampled at 120 Hz with a 0.5 cm spatial resolution) positioned on the track 2 m from the starting line. The participants were asked to complete 16 passes over the walkway under two conditions executed in the following order, 1) at their preferred walking pace (single-task), and 2) while counting backwards taking off 7 from a pre-randomised list of 3-digit numbers.

Step velocity, step length, step duration and the variation (measured as standard deviation) in step length and step duration were reported as the outcomes.

Lower limb physical performance was assessed using a five-repetition sit-to-stand test [17], which was repeated twice. The participants were asked to wear an inertial measurement unit (NGIMU, x-io Technologies Limited, UK; 3-dimensional accelerations and rotations sampled at 400 Hz with 16-bit analog-to-digital conversion; acceleration range ±16 multiples of gravitational acceleration [g], rotation range ±2000 °/s) mounted on an elastic belt on the right side of their body on the waist in line with the iliac crest while completing the sit-to-stands. Concentric phase power relative to body mass was subsequently calculated from orientation corrected vertical acceleration [18] following the rationale outlined by Zijlstra and colleagues [17]. The mean of the five sit-to-stands were used per trial, and the mean of the two trials used in the analyses.

Free-living physical activity was evaluated based on the free-living accelerometer recordings. The device was set to record continually at a 100 Hz sample rate with ±6 g measurement range with 12-bit analog-to-digital conversion. Analysis was conducted in 24 h epochs [19]. The norm (=resultant) of each of the 3-dimensional data points were calculated, and then pre-processed by calculating the mean amplitude deviation (MAD) [20] of the resultant in 5 s non-overlapping epochs and summarised minute-by-minute. Non-wear time was then defined as any continuous epochs of at least 60 min with MAD less than 0.02 g. The wear time was categorised into light-intensity activity (0.0167 g to < 0.091 g), and moderate to vigorous-intensity activity (≥ 0.091 g)

[21]. The mean minutes per day from participants with at least 3 valid days with at least 10 h wear-time are reported as the outcomes [19].

Free-living gait bouts were identified based on the data pre-processed into 5 s epochs as any continuous bout of at least 1 min above 0.05 g and the corresponding raw resultant signal was extracted. Refined compound multiscale entropy (RCME) was calculated on the raw resultant signal for each gait bout in one minute non-overlapping epochs [12] (https://github.com/tjrantal/javaMSE commit fcf6319). The remainder of each bout not amounting to a full minute was discarded. Twenty coarseness scales (τ = 20), template length of 4 (m = 4), and tolerance of 0.3 times the standard deviation of the given one minute epoch (r = 0.3) were used as the analysis parameters [12] (Figure 1). The time-scale of phenomena captured by each coarseness scale is in the order of sampling interval (10 ms between samples) multiplied by coarseness scale (1 to 20) multiplied by template length +1. That is, scale 12 would capture phenomena of 10 ms x 12 x 5 = 600 ms time scale. The mean of all bouts from all bouts for scales 1 through 20 are included in the analyses.

2.3. Statistical analysis

Sample size was decided based on statistical sensitivity analysis with the comparison between the two community-dwelling groups considered. A large statistical effect size of 0.7 was targeted, which could be detected with N > 25 per group. Mean (standard deviation) are reported where appropriate. A chi-squared test was used to evaluate whether education status differed between the

groups (no memory concerns, subjective memory complaints, diagnosed mild dementia). For all other comparisons, the groups were compared to each other using two-way analysis of variance (ANOVA) with sex and group as the factors. When normality assumption were violated, ANOVA findings were confirmed with Independent Samples Kruskal-Wallis Test. Tukey's honest significant difference (Tukey's HSD) tests were utilised in post hoc comparisons. Statistical analyses were executed with R (version 2018-12-18 r75863, https://www.R-project.org). Probability values ≤ 0.05 were considered statistically significant.

3. Results

The group with diagnosed mild dementia was older, and scored less in the MoCA than the two other groups (partial $\eta^2 = 0.502$ to $\eta^2 = 0.654$; all $p < 0.001$; Table 1). Men were 19.7 kg heavier and 13.6 cm taller than women (partial $\eta^2 = 0.294$ to $\eta^2 = 0.402$; $p < 0.001$). No statistically significant differences were observed in daily physical activity. Men produced 0.60 W/kg higher mean concentric power in the 5 repetition sit-to-stand test than women (partial $\eta^2 = 0.250$; $p = 0.008$), the group with no subjective memory concerns produced 0.56 to 1.38 W/kg more mean concentric power than the two other groups ($p < 0.001$ to $p = 0.048$). Education status was evaluated for men and women pooled and did not differ between the groups (no memory concerns N = 6/2/3; subjective memory complaints N = 7/2/15; mild dementia group N = 3/0/4; values for education status 1/2/3, χ^2 test $p = 0.775$).

Laboratory-based single-task gait assessments indicated that the group with diagnosed mild dementia had a 54 to 60 cm/s slower preferred gait velocity, 92 to 99 ms longer step duration, 23 to 25 cm shorter step length, and 102 to 104 ms higher step duration SD compared to the two other groups ($p < 0.001$ to $p = 0.001$; Table 2). The only group x sex interaction that was indicated was that the difference in step duration between groups was more pronounced in women compared to men (partial $\eta^2 = 0.178$; $p = 0.008$).

Compared to single-task gait, participants walked slower and with a shorter step length in the laboratory-based dual-task gait assessment compared to the single-task assessment ($p < 0.001$).

The dual-task gait assessments indicated that the group with diagnosed mild dementia had a 50 to 56 cm/s slower preferred gait velocity, 92 to 103 ms longer step duration, 19 to 21 cm shorter step length, 91 to 99 ms higher step duration SD, and 2.9 to 3.2 cm higher step length SD compared to the two other groups ($p < 0.001$ to $p = 0.033$; Table 2). Men had a lower mean step duration SD compared to women but the group x sex interaction revealed that this was driven by the high values in the group with mild dementia. That is, only women with mild dementia differed from the other groups.

Free-living gait bout identification did not indicate a statistically significant difference in the number of gait bouts per day or in the mean duration of a gait bout between the groups ($p = 0.053$ to 0.218; Table 3). The group with diagnosed mild dementia had higher RCME compared to the other groups on most coarseness scales from 1 to 11 (p was not significant for all diagnosed mild dementia vs. one of the other groups on all scales). Although ANOVA indicated a main effect between sexes at coarseness scales 1, 5, 10 and 11, only scale 1 remained significant in the Tukey's HSD posthocs with men exhibiting 0.03 higher RCME compared to women (Table 3).

4. Discussion

The primary findings of the present study were that those with subjective memory complaints do not differ from those without memory concerns in terms of laboratory or free-living measured gait. In line with previous literature we found that those with diagnosed mild dementia had higher step

duration variability in a laboratory setting [6]. Moreover, those with diagnosed mild dementia had higher free-living gait complexity compared to the groups with or without subjective memory complaints.

In the broader literature, those with cognitive impairment typically exhibit higher gait variability than those without in laboratory-based gait assessments [6]. In agreement, we found that those with diagnosed mild dementia did have both higher step duration variability in self-paced single- and dual-task laboratory walking, and higher gait complexity in free-living gait. However, no differences were observed between those with subjective memory complaints and those without. This finding is in contrast to a previous study, which did observe a difference in laboratory-measured gait variability between those with subjective memory impairment and those without [9]. The discrepancy is likely explained by differences in study design. In particular, the participants in the present study were not required to have been referred to a memory clinic whereas the participants in the previous study [9] were. Recruitment setting can modify the risk of developing dementia, with individuals recruited from memory clinics, with subjective cognitive impairment, more likely to progress to a preclinical stage of dementia [22].

Relatively few free-living gait complexity explorations in older adults with subjective memory complaints can be found in the literature. However, in the falls risk-related literature, free-living gait variability (quantified with complexity) has been found to differ between those classified as fallers and those who do not have a history of falls [12,13]. In this study we did not identify any evidence that free-living gait variability is impaired in those with subjective memory complaints,

despite observing these detriments in participants with dementia. Keeping in mind that subjective memory complaints are defined as self-experienced decline in cognitive capacity with normal performance in standardized cognitive tests [23], it is likely that any possible differences in cognitive abilities between the two groups may be rather small. This was also indicated by the MoCA tests utilised in the present study. This could at least partly explain the lack of measurable difference in gait characteristics between groups. Taken together, the present findings consistently indicate that no measurable difference in gait characteristics existed between those with subjective memory complaints and those without. Thus, the present findings indicate that spatiotemporal step variability in the laboratory, or free-living gait complexity may not be sensitive indicators of impending cognitive decline, and are, therefore, not indicated as a promising screening tool.

The only difference we observed between those with subjective memory complaints and those without was in lower 5-repetition STS mean concentric power in individuals with subjective memory complaints. This finding would need to be confirmed by other independent studies but our findings seem to suggest that 5-repetition STS may be more sensitive to subjective memory complaints than gait considering that no differences or even a consistent trend were observed in laboratory- or free-living gait characteristics. This would be in line with the 'motoric cognitive risk syndrome', which proposes shared pathophysiological pathways for both physical and cognitive impairments [24].

The study had several limitations that need acknowledging. Firstly, while the laboratory-based gait assessment was well controlled, the free-living gait bouts were entirely incidental and may have

included gait for any reason including single-task and dual-task gait. However, we did observe a marked difference in free-living gait between those with diagnosed mild dementia and those without, which taken together with fall-related research [12,13] attests to the potential pragmatic utility of free-living gait assessments despite the caveat of lack of control and standardisation. Secondly, cognitive performance or changes in cognitive performance during dual-tasking were not assessed. Assessing both, motor (gait) and cognitive performance would have enabled a more comprehensive evaluation of the laboratory testing paradigm. Thirdly, the mild dementia group had a smaller number of participants, was older, and some were unable to participate in the dual-task counting backwards assessments, and the free living accelerometry monitoring. The age difference between groups is particularly noteworthy because the observed differences between groups are in line with typical age-related changes in gait (i.e. slowing of gait, increased spatiotemporal variability) [25], which may occur independent of cognitive decline. However, even this small number of participants was sufficient to demonstrate the expected marked difference in gait characteristics compared to the two unaffected groups. Finally, targeting community-dwelling individuals with subjective memory concerns but without a referral to a memory clinic may have resulted in a heterogeneous participant group.

In conclusion, no difference in either laboratory-measured or free-living single- or dual-task gait variability was observed between community-dwelling older adults with subjective memory complaints compared to those without, whereas the group with diagnosed mild dementia was clearly distinct from the other groups. Assuming that subjective memory complaints are on the pathway from cognitively intact to cognitively frail, the findings raise the hypothesis that subjective memory complaints occur earlier in the pathophysiology than measurable changes in

single-task or free living gait and/or that subjective memory complaints in the absence to a referral to a memory clinic captures a more heterogeneous population compared to those with a referral.

Conflict of interest statement

None of the authors have conflicts of interests to report.

Acknowledgements

We wish to thank the participants who volunteered their time. The study was funded by an Alzheimer's Australia Dementia Research Foundation AADRF-Victoria Project Grant. TR was an Academy Research Fellow during the preparation of this manuscript (Academy of Finland grant numbers 321336 and 328818). NDR is supported by a National Heart Foundation of Australia Future Leader Fellowship (ID101895). Gerontology Research Center is a joint effort between the University of Jyväskylä and the University of Tampere.

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FIGURES

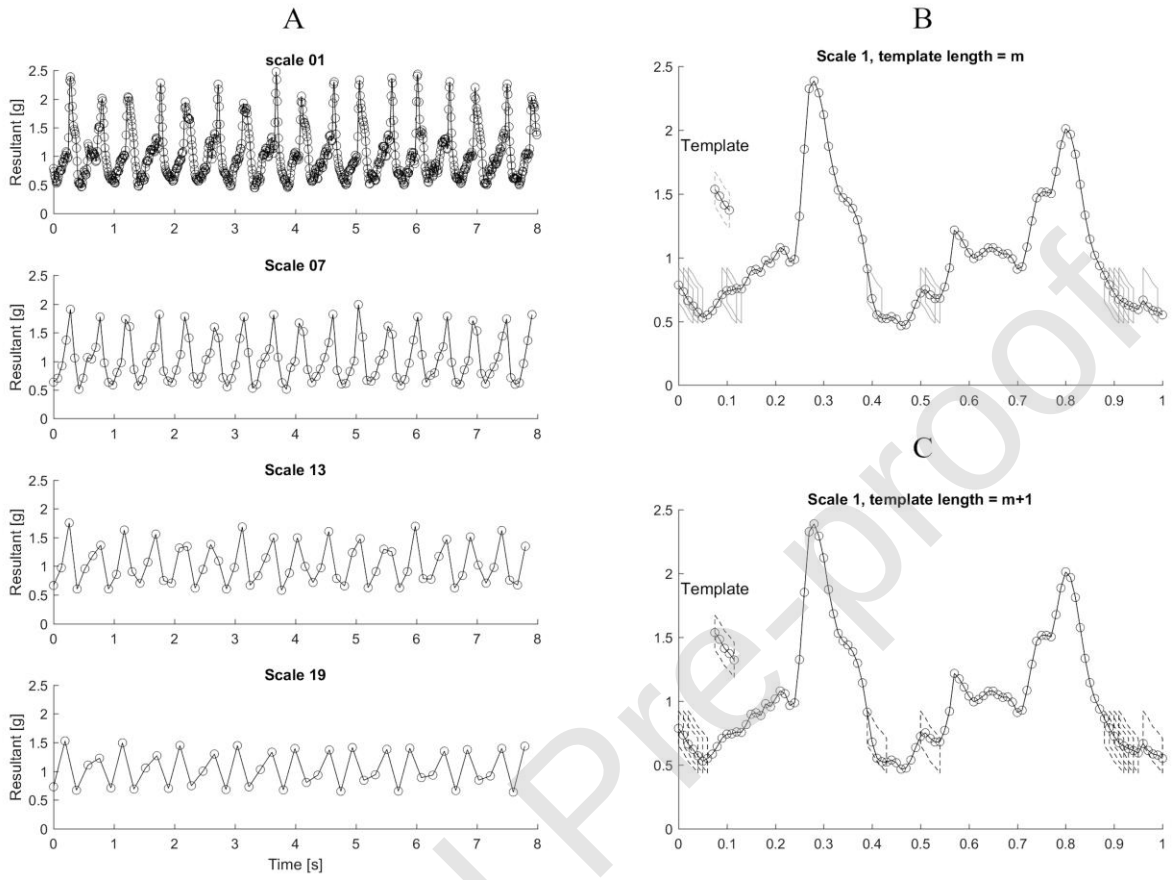

Figure 1. Pane A; Visualisation of the multiscale entropy temporal coarseness scaling (τ) effects on assessing various temporal scales from the accelerometry signal. Scale 1 = original sampled resultant acceleration; Scale 19 = mean of 19 consecutive samples in non-overlapping epochs. Pane B and C; Visualisation of the template matching with the used template length (m = 4). In pane B the first template sample is highlighted with the tolerance (r) indicated as a bounding box around the template. Matching epochs of the first template are indicated on the acceleration trace. In pane C the m+1 length template and corresponding matches are indicated. Entropy is calculated as the logarithmic ratio of matches with template m+1 and matches with template m. The entropy calculation process is repeated independently for each temporal scale.

TABLES

Table 1. Descriptive characteristics, Montreal cognitive assessment (MoCA), physical activity and sit-to-stand performance of the groups. Statistical comparisons based on ANOVA with group and sex as factors.

	Men			Women			ANOVA p-values		
	No Memory Concerns	Memory Complaints	Dementia	No Memory Concerns	Memory Complaints	Dementia	Group	Sex	Group x sex
N	14	11	4	13	13	5			
Age [years]	71.5 (4.5)	75.5 (6.5)	87.2 (8.5)	70.2 (4)	71.8 (6)	86 (6.5)	<0.001	0.212	0.718
Body mass [kg]	89.1 (15.6)	86 (13.9)	81.2 (6.5)	65.6 (13.8)	68.1 (8.8)	67.7 (13.1)	0.843	<0.001	0.545
Height [cm]	175 (6)	179 (6)	170 (10)	160 (6)	162 (4)	167 (10)	0.272	<0.001	0.033
MoCA [score]	28.4 (1.3)	27 (1.8)	19.8 (3.8)	27.8 (1.5)	28.6 (1.3)	21 (5)	<0.001	0.233	0.179
Light PA [min/day]^	262 (47)	249 (50)	194 (169)	293 (106)	296 (67)	244 (192)	0.372	0.161	0.94
MVPA [min/day]^	33.2 (20.2)	50.8 (33.3)	28.1 (36.2)	39.8 (35.7)	29.2 (16.4)	9.8 (16.9)	0.321	0.266	0.193
MAD [g]^	0.0135 (0.0034)	0.0166 (0.007)	0.0089 (0.0073)	0.0152 (0.0067)	0.0136 (0.0035)	0.0104 (0.0051)	0.059	0.968	0.273
STS power [W/kg]^^	5.44 (0.57)	4.98 (0.77)	4.23 (1.63)	4.91 (0.87)	4.35 (0.56)	3.38 (1.09)	0.001	0.014	0.893

^N = 27, 22, and 6 for reference, memory complaints, and dementia, respectively

^^N = 25, 21, and 6 for reference, memory complaints, and dementia, respectively

PA = Physical activity; MV = moderate to vigorous; MAD = mean amplitude deviation; STS = five repetition sit-to-stand test;

Table 2. Laboratory-based gait characteristics. Statistical comparisons based on ANOVA with group and sex as factors.

	Men			Women			ANOVA p-values		
	No Memory Concerns	Memory Complaints	Dementia	No Memory Concerns	Memory Complaints	Dementia	Group	Sex	Group x sex
Single-task									
N	14	9	4	12	12	4			
Velocity [cm/s]	142 (15)	139 (10)	78 (54)	148 (22)	139 (16)	91 (49)	<0.001	0.374	0.814
Step duration [s]	0.513 (0.029)	0.521 (0.03)	0.538 (0.034)	0.477 (0.034)	0.49 (0.039)	0.653 (0.202)	<0.001	0.39	0.008
Step length [cm]	72.9 (7)	71.9 (4.7)	40.9 (26.1)	70.1 (8.1)	67.7 (4.8)	52.4 (20.7)	<0.001	0.642	0.168
Step duration SD [ms]	17.9 (5.3)	26.3 (20.6)	142.8 (177.8)	30.4 (15.7)	19.2 (12.5)	108.8 (125.8)	<0.001	0.578	0.564
Step length SD [cm]	4.99 (2.64)	4.22 (2.16)	4.43 (1.47)	5.85 (3.07)	4.36 (2.54)	6.08 (3.14)	0.333	0.278	0.774
Dual-task									
N	14	9	3	12	12	3			
Velocity [cm/s]	134 (18)	129 (17)	74 (43)	134 (26)	127 (15)	83 (28)	<0.001	0.728	0.865
Step duration [s]	0.521 (0.031)	0.538 (0.053)	0.584 (0.066)	0.499 (0.045)	0.51 (0.047)	0.644 (0.084)	<0.001	0.836	0.124
Step length [cm]	69.6 (8.5)	68.2 (5.7)	42.2 (21.3)	66.3 (8.9)	64.2 (5)	51.6 (12)	<0.001	0.806	0.232
Step duration SD [ms]	28.3 (16.2)	39 (34.4)	59.7 (36.2)	23.7 (9.6)	29.9 (13.9)	190 (144.4)	<0.001	0.002	<0.001
Step length SD [cm]	5.02 (1.98)	4.92 (2.95)	5.53 (2.36)	4.08 (1.7)	3.81 (1.82)	9.5 (6.77)	0.025	0.449	0.08

Table 3. Free-living gait characteristics. Statistical comparisons based on ANOVA with group and sex as factors.

	Men			Women			ANOVA p-values		
	No Memory Concerns	Memory Complaints	Dementia	No Memory Concerns	Memory Complaints	Dementia	Group	Sex	Group x sex
N	14	11	3	13	12	3			
Bouts per day [No]	15.8 (6.7)	20.6 (8.7)	9.1 (9.9)	17.6 (9.5)	14.6 (6.6)	7.9 (9.4)	0.053	0.512	0.238
Bout duration [min]	1.8 (0.63)	2.28 (1.33)	1.51 (0.87)	1.83 (0.76)	1.71 (0.53)	1.16 (0.27)	0.218	0.285	0.442
RCME1	0.254 (0.036)	0.235 (0.03)	0.585 (0.614)	0.253 (0.032)	0.238 (0.03)	0.257 (0.021)	0.009	0.013	0.016
RCME2	0.364 (0.06)	0.335 (0.033)	0.608 (0.477)	0.375 (0.054)	0.365 (0.051)	0.423 (0.061)	0.006	0.184	0.095
RCME3	0.431 (0.078)	0.407 (0.037)	0.56 (0.251)	0.456 (0.067)	0.448 (0.069)	0.534 (0.093)	0.01	0.619	0.674
RCME4	0.471 (0.097)	0.448 (0.053)	0.551 (0.15)	0.505 (0.08)	0.484 (0.079)	0.625 (0.127)	0.013	0.098	0.874
RCME5	0.487 (0.116)	0.46 (0.068)	0.514 (0.176)	0.507 (0.086)	0.473 (0.079)	0.684 (0.157)	0.019	0.044	0.207
RCME6	0.494 (0.133)	0.462 (0.078)	0.508 (0.225)	0.506 (0.086)	0.458 (0.077)	0.716 (0.177)	0.015	0.055	0.11
RCME7	0.484 (0.144)	0.45 (0.081)	0.514 (0.253)	0.504 (0.097)	0.457 (0.081)	0.729 (0.204)	0.015	0.05	0.166
RCME8	0.479 (0.153)	0.43 (0.091)	0.507 (0.302)	0.48 (0.111)	0.445 (0.085)	0.727 (0.205)	0.018	0.081	0.186
RCME9	0.463 (0.157)	0.412 (0.094)	0.468 (0.315)	0.461 (0.109)	0.416 (0.078)	0.689 (0.186)	0.032	0.098	0.168
RCME10	0.446 (0.146)	0.393 (0.086)	0.414 (0.29)	0.451 (0.108)	0.392 (0.066)	0.68 (0.189)	0.027	0.034	0.058
RCME11	0.424 (0.126)	0.377 (0.076)	0.383 (0.28)	0.429 (0.101)	0.377 (0.062)	0.625 (0.158)	0.045	0.032	0.059
RCME12	0.407 (0.118)	0.361 (0.072)	0.356 (0.264)	0.407 (0.092)	0.358 (0.053)	0.557 (0.111)	0.084	0.058	0.086
RCME13	0.388 (0.099)	0.347 (0.067)	0.333 (0.25)	0.397 (0.083)	0.342 (0.048)	0.507 (0.075)	0.093	0.057	0.102
RCME14	0.377 (0.09)	0.338 (0.063)	0.313 (0.24)	0.39 (0.079)	0.337 (0.044)	0.489 (0.071)	0.113	0.033	0.079
RCME15	0.365 (0.091)	0.334 (0.063)	0.307 (0.252)	0.376 (0.071)	0.339 (0.037)	0.464 (0.052)	0.269	0.044	0.134
RCME16	0.357 (0.093)	0.33 (0.064)	0.304 (0.259)	0.372 (0.078)	0.339 (0.036)	0.46 (0.035)	0.341	0.042	0.167
RCME17	0.351 (0.087)	0.323 (0.06)	0.299 (0.259)	0.366 (0.071)	0.332 (0.036)	0.456 (0.047)	0.283	0.033	0.139
RCME18	0.344 (0.084)	0.312 (0.063)	0.285 (0.247)	0.357 (0.066)	0.321 (0.034)	0.445 (0.044)	0.235	0.027	0.113
RCME19	0.336 (0.079)	0.301 (0.073)	0.269 (0.234)	0.354 (0.064)	0.315 (0.027)	0.437 (0.028)	0.197	0.012	0.087
RCME20	0.33 (0.069)	0.297 (0.065)	0.257 (0.226)	0.35 (0.061)	0.312 (0.022)	0.406 (0.025)	0.227	0.012	0.115

RCME = refined compound multiscale entropy; RCME[1 through 20] correspond to coarseness scales 1 through 20. Coarseness scale 1 = original data, 2 = running non-overlapping mean of 2 consecutive samples before calculating entropy, … 20 = running non-overlapping mean of 20 consecutive samples before calculating entropy. The result of taking the running non-overlapping mean is to reveal phenomena occurring at different time-scales (conceptually e.g. scales 3 to 6 time-scale could reflect variations within stance phase while scales 12 and above could reflect variation between step cycles).