Associations of Frailty With Consecutive Gait Speed Trails Measured Both With and Without Additional Stressors

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FRAILMatics

tilda Staidéar Fadaimseartha na hÉireann um Dhul in Aois

The Irish Longitudinal Study on Ageing

BACKGROUND

Frailty is a geriatric syndrome defined as an increased vulnerability to stressors. Gait speed is associated with frailty and slow gait speed is commonly used as a criteria in its classification. A persons preferred (usual) gait speed is most often measured for this purpose but speed under additional stressors such as a cognitive task or walking at maximum pace can also be measured. Typically multiple trails are measured and an average value used. In this work however the consecutive nature of the trails are considered as an additional longitudinal stressor and we investigate a hypothesis that higher levels of frailty as classified by a frailty index are associated with greater reduction in speed across consecutive gait speed trails.

Method

Using a 32-item frailty index (FI) we derived non-frail, pre-frail, and frail groups. Gait speed was measured using a 4.88 m walkway (GAITRite, CIR Systems, NY, USA). Speed measurements were made for three walking conditions with two trials (1 and 2) per condition: usual gait speed (UGS), walking under the cognitive load of reciting out loud every second letter of the alphabet (CGS), and walking at maximum pace (MGS)

Sample

Data from a total of 4055 participants aged 50+ years from Wave 3 of The Irish Longitudinal Study on Ageing were used. Of these 4054 had UGS data, 3884 had CGS data, and 3884 had MGS data.

Statistical Analysis

Normality of the gait variables was assessed using the Kolmogorov-Smirnov test and found to be non-normally distributed. Given this, statistical difference between walk 1 and walk 2 distributions was assessed for the entire cohort, and non-frail, pre-frail, and frail groups for each walking condition using related samples Wilcoxon signed rank tests. The median walk 2 – walk 1 difference was determined using the related-samples Hodges-Lehman Median difference test. To compare the distributions of walk 2 – walk 1 across frailty groups the independent samples Kruskal-Wallis test was employed. Statistical significance was set at $p<0.05$.

Descriptives

Table 3. Statistics of age, mean usual gait speed, mean cognitive gait speed, and mean maximum gait speed are shown for the entire cohort and each frailty group. The mean and standard deviation (SD) are used for age and the median and inter-quartile range (IQR) are shown for the rest. Sex is described as the proportion female of the total N for each group.

		N (% Female)	Range	Minimum	Maximum	Mean/Median	SD/IQR
Age	All	4055 (55)	44	50	94	64.79	8.015
	Non-frail	2321 (52.9)	38	50	88	62.60	7.033
	Pre-frail	1389 (56.7)	44	50	94	67.30	8.184
	Frail	345 (64.9)	42	50	92	69.40	8.607
Mean Usual Gait Speed	All	4054 (55)	166.2	41.3	207.5	137.100	25
	Non-frail	2320 (52.5)	139.6	67.9	207.5	142.6	21.5
	Pre-frail	1389 (56.7)	121.4	63.4	184.8	131.2	24.8
	Frail	345 (64.9)	136.3	41.3	177.6	117.1	30.1
Mean Cognitive Gait Speed	All	3884 (55.2)	177.1	26.2	203.3	116.6	32.9
	Non-frail	2278 (52.4)	177.1	26.2	203.3	121.350	30.6
	Pre-frail	1306 (57)	150.3	26.2	176.5	111.2	32.4
	Frail	300 (65)	134.8	32.7	167.5	102.050	32.0
Mean Maximum Gait Speed	All	3884 (54.9)	247.2	63.0	310.2	172.0	34.6
	Non-frail	2286 (52.3)	219.6	90.6	310.2	178.2	30.6
	Pre-frail	1307 (57.2)	202.6	80.9	283.5	162.750	34.5
	Frail	291 (64.3)	191.5	63.0	254.5	148.2	37.4

References

[1]
[2]

Results

For each frailty group in all walking conditions walks 1 and 2 where significantly different from each other based on the median of differences between walk 1 and 2 (Figure. 1) and the related samples Wilcoxon signed rank tests (Table. 2). For UGS and CGS the median difference in speed was positive, i.e. there was a speeding up, and for MGS the median difference in speed was negative, i.e. there was a slowing down.

Table 2. Results of the related-samples Wilcoxon signed rank test. The table presents the significance p-values for the test that the walk 1 and walk 2 speed distributions are different for each walking condition and frailty group.

	UGS (p-value)	CGS (p-value)	MGS (p-value)
Non-frail	<0.001	<0.001	<0.001
Pre-frail	<0.001	<0.001	<0.001
Frail	<0.001	0.023	0.007

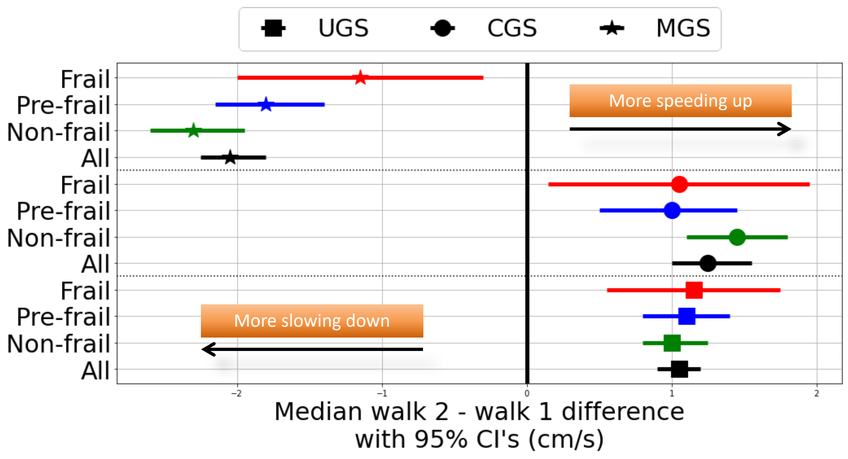

Figure 1. Hodges-Lehman median difference between walk 1 and walk 2 for each frailty group and each walking condition. Error bars represent the 95% confidence intervals (CI's) on the median difference.

Table 3. Results of the independent samples Kruskal-Wallis test to compare the walk 2 – walk 1 distributions across frailty groups for each walking condition. Pairwise group comparisons were not carried out for UGS and CGS as the overall test showed no significant group differences. The adjusted significance is in the form of a Bonferroni correction for multiple comparisons

	UGS2 -UGS1	CGS2 -CGS1	MGS2-MGS1	
	p-value	p-value	p-value	Adj. p-value
Overall Test	0.878	0.243	0.016	
Non-frail vs. Pre-frail	-	-	0.053	0.159
Non-frail vs. Frail	-	-	**0.014**	**0.041**
Pre-frail vs. Frail	-	-	0.182	0.547

When comparing the walk 2 – walk 1 distributions across frailty groups (Table. 3) we see that only the non-frail vs. frail with respect to MGS returns a statistically significant difference. Indeed in Figure.1 there appears to be a trend in MGS where the less frail groups slow down more than the frailer groups across consecutive trials. Whilst the remaining comparisons in Table.2 *are not* statistically significant and there are overlapping confidences intervals in Figure.1 there appears to be suggestions of trends in Figure.1 when observing the median differences: UGS appears to increase more for the frailer groups and the non-frail CGS seems to increase more than for the other two frailer groups.

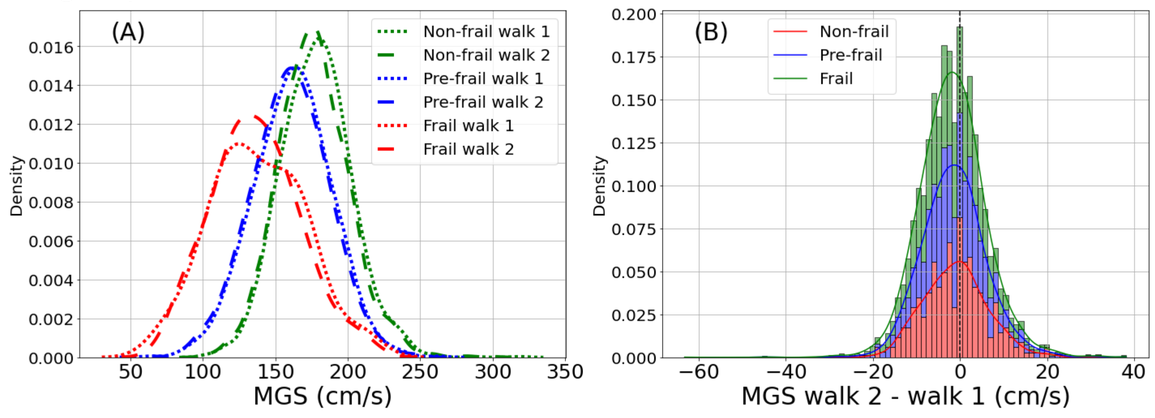

Figure 2. **(A)** Kernel density plots of the distributions of walk 1 (dotted) and walk 2 (dashed) gait speeds for each frailty group for maximum gait speed (MGS). **(B)** Histogram with overlaid kernel density plot for the distribution of MGS 2 – MGS 1 for each frailty group. Non-frail is coloured green, pre-frail blue, and frail red in both **(A) and (B)**.

Figure.2(A) presents the individual MGS 1 and MGS 2 distributions by frailty group and Figure. 2(B) shows the MGS 2 – MGS 1 distributions by frailty group. It is clear that although there is a greater difference between walking trials for the less frail groups, the difference is small and the differences in absolute gait speeds between frailer groups is much more apparent.

CONCLUSION

For the usual, cognitive, and maximum gait conditions there are statistically significant differences between consecutive walking trials for the entire cohort and for each frailty group. These median differences are however clinically small (a range of ~1 – 2.3 cm/s). This supports the use of taking the average of the two walking trials for analysis.

When comparing the difference in speed across trails we found that only non-frail vs frail for the maximum condition was statistically significant with the non-frail group slowing down *more* than the frail group. This goes against our original hypothesis. We now posit that the less frail groups have a greater physiological reserve that is disproportionately used up in the first trial; the more frail groups on the other hand may be ordinarily operating closer to a full capacity that is lower than the less frail group and thus do not have as much room to slow down in the second trial. Whilst remembering that the remaining group comparison are not statistically significant some potential trends are suggested by the results. The suggestion that the frailer groups speed up more in the usual condition could be due to an increased confidence during the second trial. The potential trend of the non-frail group speeding up in the second trial could be due to a greater learning effect with respect to the cognitive task.

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For what's next

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