Analyses of gait parameters and fall risk in Korean older adults

SCHOOL OF COMMUNITY HEALTH SCIENCES, COUNSELING AND COUNSELING PSYCHOLOGY

Hannah Fiscus[1], Ho Han, PhD[1], Hyun-Joo Kang, PhD[2]

[1]Oklahoma State University, Stillwater, OK, [2]Soonchunhyang University, Asan-si, Korea

INTRODUCTION

Millions of older adults – more than one out of four – fall each year.[1] As the first fall doubles one's chances of falling again,[2] fall prevention in older adults is a public health priority. It is well established that most falls occur on flat surfaces during walking. In addition, shorter step length and slower step time were associated with an increased risk of falls in older adults.[3] Thus, identifying the changes in gait parameters before experiencing the first fall may be a strong predictor of falling.

PURPOSE

This study aimed to examine gait parameters and trends in older adults associated with the risk of falls.

METHODS

Two hundred older adults (72.8 ± 5.6 years; 74% women) participated in the study. Participants' gait parameters were measured through a gait analysis system. The Fall Risk Assessment (FRA) system measuring sensory, nervous, integrated balance abilities, and musculoskeletal systems was used to assess participants' fall risks. Participants were then classified into one of two groups: low-risk and high-risk of falls based on the FRA scores. Independent t-tests were used to compare gait parameters between the two groups. One-way ANOVAs were also performed to compare the differences in gait parameters by age (65-69, 70-74, 75-79, and ≥80 years). Lastly, Pearson correlation and logistic regression were used to examine the relationship between step length and risk of falls.

RESULTS

For both men and women, there are significant differences ($p < .001$) in all gait parameters between the high-risk and low-risk groups except for cadence in men **(Table 1)**. There were also significant changes in trends of gait parameters by age in both men and women except for cadence in men ($P_{trend} < .001$). Lastly, significant positive correlations were observed between adjusted stride length (stride length/height) and the FRA scores ($r = .524$ and $.323$ for men and women, respectively) **(Table 2)**. For both men and women, the participants in the fourth quartile (shorter) of adjusted stride length were more likely to increase the risk of falls (OR = 9.10 and 7.88; 95% CI: 1.39, 59.62, and 2.50, 24.84 for men and women, respectively) compared to the first quartile (longer) **(Table 3)**.

Table 1. Gait parameters associated with risk of falls

	Risk of falls	TOTAL M	TOTAL SD	TOTAL P	MEN M	MEN SD	MEN P	WOMEN M	WOMEN SD	WOMEN P
Step length (R)	HIGH	574.19	79.01	**<.001**	614.81	106.86	**0.001**	560.65	63.03	**<.001**
	LOW	654.09	82.47		705.22	76.49		635.31	76.74	
Step length (L)	HIGH	591.38	89.36	**<.001**	616.25	107.26	**0.003**	583.08	82.17	**<.001**
	LOW	655.57	83.87		700.42	79.31		639.1	79.72	
Stride length	HIGH	1165.6	158.77	**<.001**	1231.1	211.27	**0.001**	1143.7	132.66	**<.001**
	LOW	1309.7	163.65		1405.6	151.72		1274.4	154.08	
Step (R) / height	HIGH	0.37	0.05	**<.001**	0.37	0.07	**0.016**	0.37	0.04	**<.001**
	LOW	0.42	0.05		0.42	0.04		0.41	0.06	
Step (L) / height	HIGH	0.38	0.06	**<.001**	0.38	0.07	**0.029**	0.38	0.05	**0.001**
	LOW	0.42	0.05		0.42	0.04		0.42	0.06	
Stride / height	HIGH	0.75	0.1	**<.001**	0.75	0.13	**0.02**	0.75	0.09	**<.001**
	LOW	0.83	0.1		0.84	0.08		0.83	0.11	
Walking speed (m/s)	HIGH	1.11	0.19	**<.001**	1.14	0.24	**0.003**	1.11	0.17	**<.001**
	LOW	1.3	0.2		1.33	0.2		1.28	0.2	
Walking speed / height	HIGH	0.72	0.12	**<.001**	0.69	0.15	**0.008**	0.72	0.11	**<.001**
	LOW	0.82	0.14		0.79	0.11		0.84	0.14	
Stance Phase (%)	HIGH	60.01	2.4	**<.001**	58.73	3.29	**0.002**	60.46	1.84	**<.001**
	LOW	56.94	3.21		55.8	2.84		57.36	3.26	
Double Supporting Stance Phase (%)	HIGH	20.04	4.87	**<.001**	17.38	6.67	**0.003**	20.98	3.7	**<.001**
	LOW	13.87	6.38		11.64	5.79		14.69	6.42	
Cadence (steps/min)	HIGH	113.85	10.85	**0.016**	109.71	13.15	0.413	115.23	9.74	**0.008**
	LOW	117.69	8.92		112.67	7.81		119.53	8.62	

Note: FRA=Fall Risk Assessment; M=mean; SD=standard deviation; R=right; L=left; P<.05.

Table 2. Adjusted stride length (SL/height) and FRA scores correlations

	Total r	Total p	Men r	Men p	Women r	Women p
Sensory ability	0.18	**0.011**	0.206	0.142	0.175	**0.034**
Balance ability	0.293	**<.001**	0.359	**0.009**	0.276	**0.001**
Nervous ability	0.213	**0.003**	0.425	**0.002**	0.171	**0.038**
Musculoskeletal systems	0.345	**<.001**	0.504	**<.001**	0.299	**<.001**
Total FRA Score	0.361	**<.001**	0.524	**<.001**	0.323	**<.001**

Note: FRA=Fall Risk Assessment; SL=stride length; p<.05.

Table 3. Odds of high-risk of falls across adjusted stride length (SL/height)

	Total OR	Total 95% CI	Men OR	Men 95% CI	Women OR	Women 95% CI
1st Quartile (longer)	**Ref.**		**Ref.**		**Ref.**	
2nd Quartile	1.78	**0.63, 5.05**	2.5	**0.41, 15.29**	1.44	**0.39, 5.28**
3rd Quartile	3.46	**1.29, 9.26**	2.6	**0.28, 23.81**	3.56	**1.15, 11.02**
4th Quartile (shorter)	8.19	**3.08, 21.80**	9.1	**1.39, 59.62**	7.88	**2.50, 24.84**

Note. OR=odds ratio; CI=confidence interval; SL=stride length.

CONCLUSION

The risk of falls in older adults was increased by the changes in gait parameters such as shorter and slower gait cycles and higher proportions of the stance phase and double supporting phase. Gait changes could be a successful indicator for identifying older adults at high-risk of falls.

REFERENCES

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