P-8

Comparison of Upper Body Movements during Gait in Older Adults With and Without Back or Knee Pain

Eun-Hye Chung[1]*, Se-Young Bak[1], Seyoung Shin[1,2,3], HyeongMin Jeon[1,2,3]† and MinYoung Kim[1,2,3]†

[1]Department of Rehabilitation Medicine, CHA Bundang Medical Center, CHA University School of Medicine, Seongnam, Republic of Korea
[2]Digital Therapeutics Research Team, CHA Future Medicine Research Institute, Seongnam, Republic of Korea
[3]Rehabilitation and Regeneration Research Center, CHA University School of Medicine, Seongnam, Republic of Korea

Introduction & Objective

- Musculoskeletal disorders, including lower back and knee pain, are prevalent among the older adult and may alter their gait dynamics.
- While lower limb compensatory mechanisms in older adults have been well studied, the role of upper limb movements with upper body stability during gait remains unclear.
- This study aims to analyze differences in upper limb motion and upper body stability during walking between older adults with and without pain in the back or knee joint.

Method

Study Design

- This study is a cross-sectional study.
- Inclusion criteria
  - Participants were older adults who experienced low back or knee joint pain with a Visual Analogue Scale (VAS) score of ≥1 and older adults without pain. Participants were able to walk independently.
- Exclusion criteria
  - Individuals with neurological disorders, a history of lower limb surgery, current use of pain medication, or severe balance impairment were excluded from the study.

Variables

- Kinematic: arm swing range of motion (ROM).
- Kinetic: acceleration and angular velocity of the head, trunk, and pelvis
  - Anterior-posterior [AP]
  - Medial-lateral [ML]
  - Superior-inferior [SI] directions

Equipments

- 3D motion capture system (Qualysis, Sweden)
- Two force plate (Kistler, Swiss)

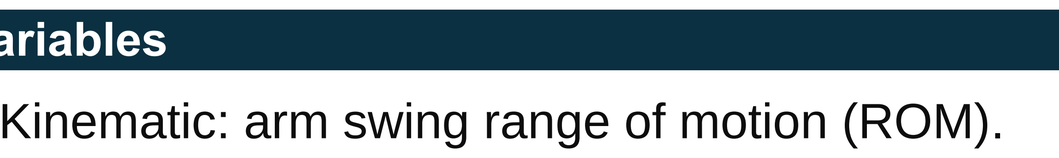

Figure 1. Experimental Equipment

Statistical Analysis

- To determine the statistical significance of the data, we used SPSS version 25.
- Each variable was analyzed using a normality test, with an Independent t-test used for normally distributed variables and the Wilcoxon signed-rank test for non-normally distributed variables.
- The statistical power was set at $p < 0.05$.

Result

- 18 older adults were classified into three groups (n=6 per group), and there were no differences in demographic findings between the groups.

Table 1. Basic characteristics of participants

	Healthy (n=6)	Back pain (n=6)	Knee pain (n=6)	Health vs Back pain *P*-value	Health vs Knee pain *P*-value
Age	70.33 (3.88)	74.50 (4.32)	74.17 (8.35)	0.110	0.332
Height (cm)	157.47 (9.92)	162.17 (8.66)	157.17 (6.52)	0.402	0.952
Weight (kg)	60.73 (7.63)	61.87 (16.00)	62.93 (5.99)	0.879	0.591
VAS (score)	-	1.50 (1.22)	4.00 (1.26)	-	-

Values are presented as median (interquatile). Abbreviations: VAS Visual analogue scale
Statistically significant differences between the healthy and low back pain groups and between the healthy and knee pain groups using paired t-test, Mann–Whitney U test. *$P < 0.05$

- In lower back pain group, RMS angular velocity of the trunk in the ML direction was significantly higher than control group ($p < 0.05$).
- In knee pain group,
  - Increased ROM of the arm swing and a greater RMS angular velocity of the trunk in the AP direction on the painless leg side during walking than the healthy group ($p > 0.05$).
  - Greater peak negative acceleration of the head in the ML direction on the painful leg side than the healthy group ($p > 0.05$).

Table 2. Gait kinematic and kinetic differences among older adults with low back pain, knee pain, and healthy controls

			Healthy (n=6)	Back pain (n=6)	Knee pain (n=6)	
					Painful side	Painless side
Arm swing angle (degree)			16.01 (6.95)	24.75 (19.75)	26.50 (13.33)	**24.51 (13.17)†**
Peak negative accerlation (m/s^2)	Head	AP	-1.39 (0.18)	-1.48 (0.73)	-1.26 (0.22)	-1.40 (0.21)
		ML	-1.21 (0.23)	-1.52 (0.69)	**-1.6 (0.37)†**	-1.94 (0.52)
		SI	-1.58 (0.28)	-1.82 (1.04)	-1.47 (0.10)	-1.46 (0.26)
	Trunk	AP	-1.38 (0.33)	-1.16 (0.58)	-1.49 (0.28)	-1.54 (0.29)
		ML	-1.51 (0.49)	-1.62 (0.56)	-1.88 (0.51)	-2.01 (0.59)
		SI	-1.61 (0.27)	-1.90 (1.12)	-1.83 (0.29)	-1.71 (0.21)
	Pelvis	AP	-1.39 (0.28)	-1.32 (0.59)	-1.41 (0.27)	-1.40 (0.19)
		ML	-2.08 (0.55)	-2.16 (0.83)	-2.29 (0.65)	-2.48 (0.49)
		SI	-1.50 (0.24)	-1.80 (1.13)	-1.78 (0.37)	-1.67 (0.32)
RMS angular velocity (°/s)	Head	AP	0.20 (0.06)	0.19 (0.13)	0.21 (0.07)	0.23 (0.10)
		ML	0.11 (0.03)	0.12 (0.07)	0.11 (0.04)	0.12 (0.05)
		SI	0.16 (0.05)	0.14 (0.07)	0.14 (0.05)	0.17 (0.07)
	Trunk	AP	0.14 (0.03)	0.17 (0.07)	0.17 (0.03)	**0.17 (0.02)†**
		ML	0.08 (0.03)	**0.11 (0.02)***	0.08 (0.02)	0.09 (0.02)
		SI	0.28 (0.05)	0.26 (0.11)	0.25 (0.07)	0.24 (0.07)
	Pelvis	AP	0.11 (0.02)	0.15 (0.04)	0.13 (0.03)	0.13 (0.02)
		ML	0.23 (0.08)	0.23 (0.12)	0.23 (0.03)	0.23 (0.03)
		SI	0.31 (0.08)	0.30 (0.14)	0.34 (0.13)	0.32 (0.11)

Values are presented as median (interquartile).
Abbreviations: AP anterior-posterior, ML medial-lateral, and SI superior-inferior
Statistically significant differences between the healthy and low back pain groups and between the healthy and knee pain groups using paired t-test, Mann–Whitney U test. *$P < 0.05$ †$P<0.1$.

Conclusion & Discussion

- Low back pain group:
  - ✓ Increased ML trunk angular velocity indicates reduced trunk stability and upper body compensatory movements.
- Knee pain group:
  - ✓ Head movement toward the painful side may indicate compromised balance.
  - ✓ Increased AP trunk angular velocity and arm swing ROM on the painless leg suggest upper body compensation for lower limb dysfunction.
- These compensatory patterns may lead to inefficient gait and increased fall risk.
- Balance training considering both lower and upper body movements is essential for effective gait rehabilitation in older adults.

Acknowledgement

This research was supported by the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare, Republic of Korea (HR22C1605; RS-2023-00262005).