CHAPTER IV

RESULTS

For recruitment of subjects the researcher explained the purpose of research project and brief-protocols to potential participants who are members of the Piyamal elderly service center and the social welfare development center for the older person, Tammapakorn, Chiang Mai. Reviewing and initial screening for eligible subjects were done through the records of members and resident of the centers. Initially, thirty-five and thirty elderly adults from the Piyamal elderly service center and the social welfare development center, respectively, met the inclusion and exclusion criteria of the study, however, thirty elderly women voluntarily participated in the present study.

Fifteen elderly women of the balance-impaired (BI) group had the Berg Balance Scale (BBS) scores ranging from 42 to 45. They permanently lived at the Tammapakorn, residential house without relatives. The other fifteen older adults with the BBS scores more than 45 were allocated into the non-balance-impaired (NBI) group. Their BBS scores ranged from 48 to 56. They lived independently at their own home and were able to regularly participate in several activities led by the local senior citizen service center such as aerobic dance exercise, and traveling. Five members of the BI group reported use of a one or three point cane when they ambulated outside the center; however, they were able to walk independently without ambulatory aid in daily activities in the residential center. Demographic data of the participants in both groups are presented in Table 1. There were no significant differences for age, leg length, and the TMSE between the two groups. Mean body height and weight of the BI group were significantly less than the NBI group ($p<0.05$)

Table 1 Demographic data of the BI and the NBI groups

Demographic data	BI (n=15)	NBI (n=15)	P-value: Independent t-test	P-value: Mann-Whitney test
Age (year)	71.9 ± 3.5	69.9 ± 4.2		0.096
Weight (kilogram)	47.6 ± 8.9	58.2 ± 8.2	0.002*	
Height (centimeter, cm)	145.4 ± 9.3	151.6 ± 5.0	0.030*	
BMI	22.5 ± 3.1	25.3 ± 3.2	0.024*	
Average leg length (cm)	78.2 ± 6.3	80.4 ± 4.3	0.289	
TMSE (0-30)	26.4 ± 1.9	27.0 ± 1.8		0.309
BBS (0-56)	44.0 ± 1.2	53.4 ± 2.7		0.000**
TUG (second)	18.0 ± 4.1	11.2 ± 0.9	0.000**	

Note: Values are means ± S.D. * Significant difference at $p<0.05$, ** $p<0.001$.

Gait parameters of level walking

All gait parameters during walking on level surface were normally distributed except walking speed. Mann-Whitney U test showed that the BI group walked significantly slower than the NBI group ($p<0.001$). Walking speed of the BI and the NBI groups were 0.60 ± 0.15 and 1.36 ± 0.69 m/s, respectively. Independent sample t-test showed that step length of the BI groups also significantly shorter than the NBI and ($p<0.001$). Step length of the BI and the NBI groups were 42.29 ± 7.23 and 55.20 ± 7.23 cm, respectively. However, toe-clearance of both groups was not significantly different. Toe-floor clearance of the BI and NBI groups were 3.34 ± 0.99 and 4.78 ± 2.96 cm, respectively.

Gait parameters of crossing step

For the walking over an obstacle task, the obstacle heights for the BI and the NBI groups in both 10%LL and 30%LL conditions were not different. The average obstacle height in 10%LL condition of the BI and the NBI groups were 7.80 ± 0.63 and 8.04 ± 0.43 cm, respectively. The average obstacle height in 30%LL condition of the BI and the NBI groups were 23.48 ± 1.90 and 24.12 ± 1.29 cm, respectively. During performing the tasks, participants of both groups completed the entire obstacle testing without difficulty, except for the 30%LL condition that three of the BI members had their trailing limb contacted the obstacle. The results of this study showed that gait parameters of crossing step of the BI group including crossing speed, crossing step length, leading and trailing limb elevations and pre-and post-obstacle distances were less than the NBI group in both 10%LL and 30%LL conditions. Gait parameters of crossing step of both groups are presented in Table 2.

Table 2 Gait parameters of crossing step

Variable	group	Obstacle height		p-values	
		10%LL	30%LL		
Crossing speed (m/s)	BI	0.41± 0.10	0.33 ± 0.13	p_g = 0.000**	p_h= 0.000**
	NBI	0.74 ± 0.19	0.65 ± 0.13	p_{gh}= 0.696	
Crossing step length (cm)	BI	44.04 ± 5.14	44.30 ± 5.42	p_g = 0.000**	p_h= 0.134
	NBI	57.83 ± 6.57	54.54 ± 5.30	p_{gh}= 0.082	
Leading limb elevation (cm)	BI	18.46 ± 3.69	33.42 ± 4.25	p_g = 0.006*	p_h= 0.000**
	NBI	24.52 ± 8.71	36.32 ± 4.01	p_{gh}= 0.259	
Trailing limb elevation (cm)	BI	18.03 ± 3.58	32.50 ± 4.25	p_g = 0.002*	p_h= 0.000**
	NBI	25.15 ± 8.63	37.38 ± 6.02	p_{gh}= 0.447	
Pre-obstacle distance (cm)	BI	8.16 ± 4.40	10.02 ± 4.09	p_g = 0.000**	p_h= 0.420
	NBI	19.55 ± 8.16	16.08 ± 4.05	p_{gh}= 0.011*	
Post-obstacle distance (cm)	BI	13.88 ± 3.97	11.43 ± 4.81	p_g = 0.032*	p_h= 0.148
	NBI	16.12 ± 5.40	16.21 ± 4.81	p_{gh}= 0.120	

Note: Values are means ± S.D. p values: p_g represents group effect; p_h represents obstacle height effect; p_{gh} represents group x obstacle height interaction.

* Significant difference at $p<0.05$, $^{**}p<0.001$.

Peak trunk acceleration amplitude of level walking

Typical acceleration patterns in vertical, anteroposterior and mediolateral directions of the BI and the NBI groups during walking on level surface and obstacle tasks obtained from the accelerometry system are shown in Figure 12 and 13, respectively.

Acceleration data were normally distributed in the vertical and anteroposterior directions. In vertical direction, independent sample t-test showed that peak acceleration amplitude of the BI and the NBI groups was not different ($p=0.141$). Peak acceleration amplitude in vertical direction of the BI and the NBI groups were 0.42 ± 0.13 and 0.48 ± 0.13 g, respectively. In anteroposterior direction, peak acceleration amplitude of the BI and the NBI groups was not different ($p=0.085$). Peak acceleration amplitude in anteroposterior direction of the BI and the NBI groups were 0.33 ± 0.14 and 0.41 ± 0.14 g, respectively. In contrast, in mediolateral direction, Mann-Whitney U test showed that peak acceleration amplitude of the BI and the NBI groups was significantly different ($p=0.006$). Peak acceleration amplitude in mediolateral direction of the BI group was lower than the NBI groups, 0.23 ± 0.16 and 0.38 ± 0.16 g, respectively.

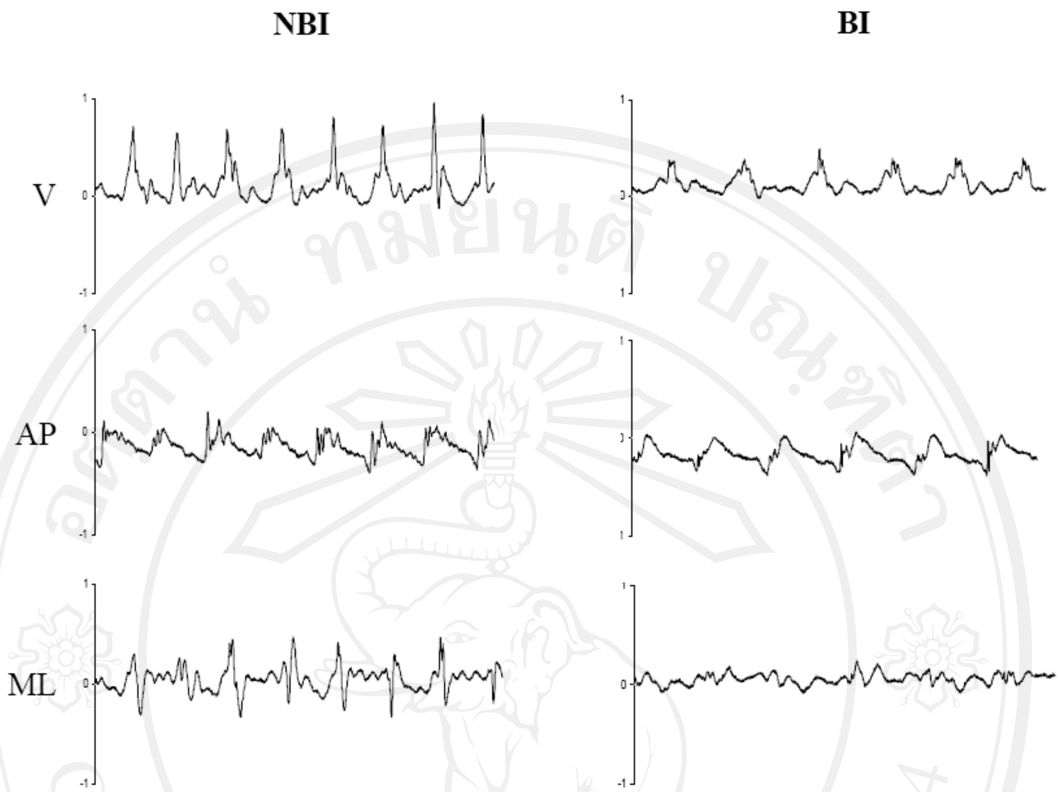

Figure 12 Typical trunk acceleration patterns of the BI and the NBI groups in vertical (V), anteroposterior (AP) and mediolateral (ML) directions during walking on level surface. Each trace represents 4 seconds. Vertical scale in units of gravity (g).

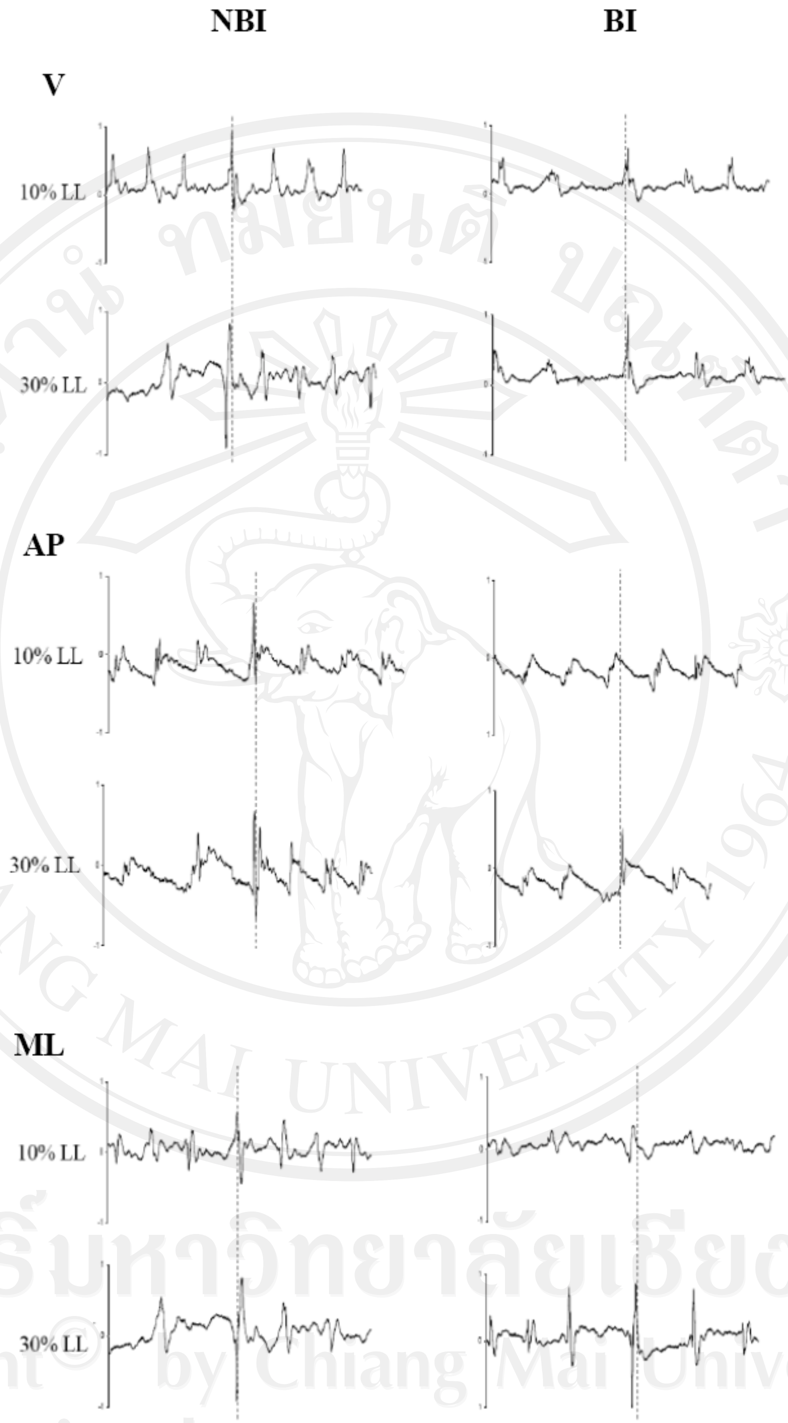

Figure 13 Typical trunk acceleration patterns of the BI and the NBI groups in vertical (V), anteroposterior (AP) and mediolateral (ML) directions during obstacle crossing of the 10% and 30%LL. Each trace represents 4 seconds and dashed line represents peak acceleration amplitude. Vertical scale in units of gravity (g).

Peak trunk acceleration amplitude of crossing step in vertical direction

Peak acceleration amplitude in vertical direction of the BI and the NBI groups in obstacle tasks are shown in Figure 14. There was no significant group x obstacle height interaction (p=0.764) for peak trunk acceleration amplitude in vertical direction. However, there was a significant group effect (p=0.034) and a significant effect of the obstacle height (p=0.027) on the vertical trunk acceleration amplitude. The BI group had significantly lower peak trunk acceleration amplitude in the vertical direction compared to the NBI group regardless of the walking conditions. As obstacle height increased, peak trunk acceleration amplitude in vertical direction of the BI and the NBI groups increased 0.10 and 0.07 g when changing from the level condition to the 10%LL and 30%LL conditions, respectively.

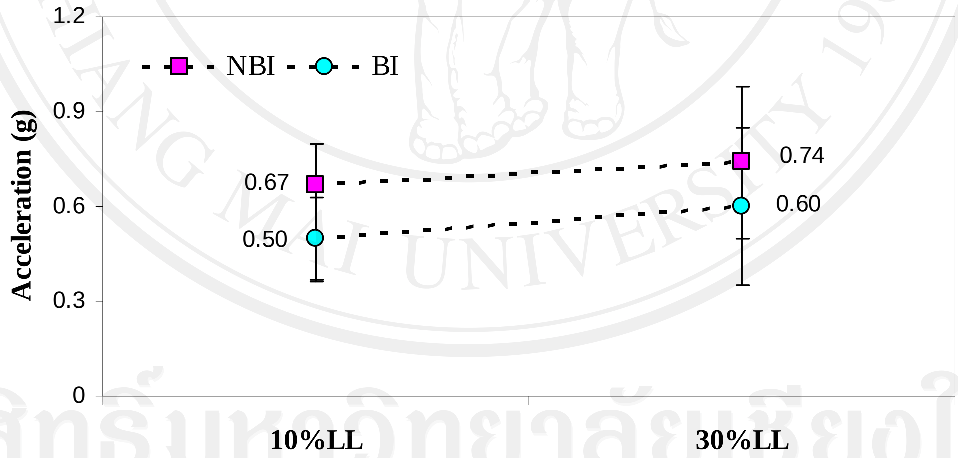

Figure 14 Peak trunk acceleration amplitude in vertical direction of the BI and the NBI groups for the two obstacle tasks. Bars indicate SD.

Peak trunk acceleration amplitude of crossing step in anteroposterior direction

Peak trunk acceleration amplitude in the anteroposterior direction of the BI and the NBI groups during obstacle tasks are shown in Figure 15. There was no significant group x obstacle height interaction (p=0.081) for peak trunk acceleration amplitude in anteroposterior direction. There was no significant effect of the obstacle height on the anteroposterior acceleration amplitude (p=0.200). However, there was a significant group effect on the anteroposterior acceleration amplitude (p<0.001). The BI group had significantly reduced peak trunk acceleration amplitude in the anteroposterior direction compared to the NBI group regardless of walking conditions.

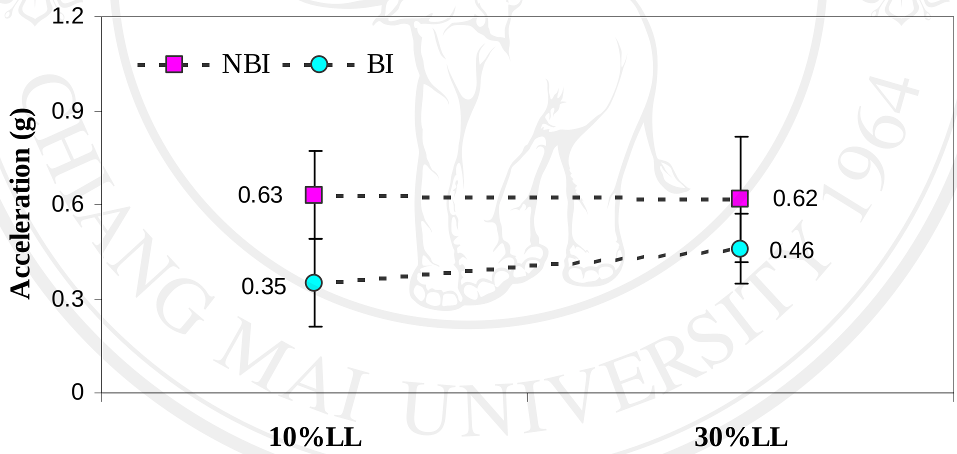

Figure 15 Peak acceleration amplitude in anteroposterior direction of the BI and the NBI groups for the two obstacle tasks. Bars indicate SD.

Peak trunk acceleration amplitude of crossing step in mediolateral direction

Peak acceleration amplitude in mediolateral direction of the BI and the NBI groups in obstacle tasks are shown in Figure 16. There was a significant group x obstacle height interaction (p<0.001) for peak trunk acceleration amplitude in mediolateral direction. As obstacle height increased, peak acceleration amplitude of the NBI group did not changed when changing from 10%LL to 30%LL. For the BI group, peak trunk acceleration amplitude increased 0.56 g when changing from 10%LL to 30%LL. There was also a significant effect of the obstacle height on the mediolateral acceleration amplitude (p<0.001). However, there has no significant effect of group on the mediolateral acceleration amplitude (p=0.883).

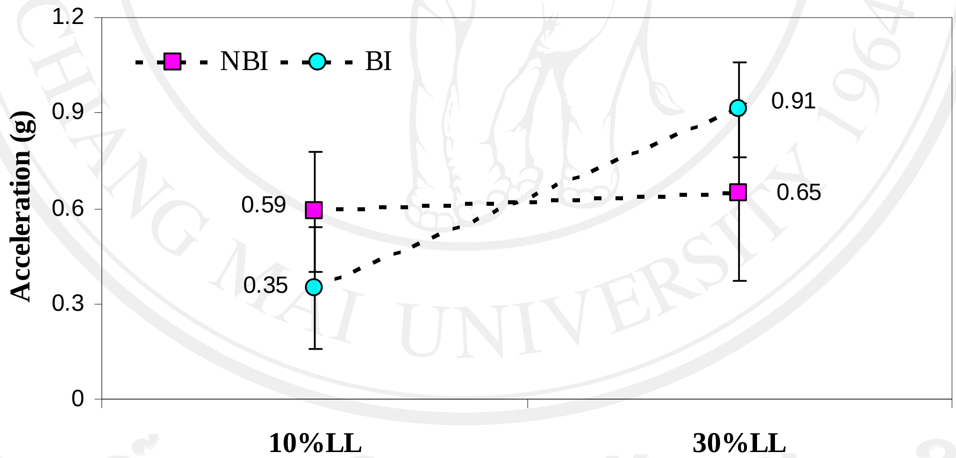

Figure 16 Peak acceleration amplitude in mediolateral direction of the BI and the NBI groups for the two obstacle tasks. Bars indicate SD.