CHARTER IV

RESULTS

A total of fifteen healthy elderly women participated in the study. Their mean age was 67.87±4.02 yrs, mean height was 150.23±5.73 cm, and mean weight was 54.13±6.99 kg. The characteristics of the participants are presented in Table 1. All participants were healthy elders who had not fallen in the previous year and were able to walk independently without use of an assistive device. These participants lived at home and led an active life. Most of them (80%) exercise regularly (at least 3-4 days/week). After being recruited, the participants were interviewed about their health status, congenital disease and medical use. The participants were excluded from the study if they had pathology or unstable medical problems, severe deformity, chronic diseases, uncorrected visual impairment and use of medications that may affect balance. Each participant read and signed an informed consent approved by the ethical research committee of the Faculty of Associated Medical Sciences, Chiang Mai University.

Table 1 Characteristics of the participants

Variables	Mean±SD	Range (min-max)
Age (yr)	67.87±4.02	63-75
Height (cm)	150.23±5.73	143.5-160.5
Weight (kg)	54.13±6.99	40-64
Preferred gait speed (m/s)	0.72±0.25	0.42-0.89

Gait parameters

The mean and standard error (SE) of spatial-temporo parameters are shown in Table 2. Repeated measure ANOVA revealed significant differences of all dependent variables among the three testing conditions except for double support time.

Table 2 Comparisons between three surface conditions for gait parameters during walking on a treadmill

(Values presented as mean ± standard error)

Variables	Conditions			*p*-value
	Level surface	Upslope surface	Downslope surface	
Step length (m)	0.45±0.03	0.37±0.02	0.36±0.02	0.001*
Double support time (% of gait cycle)	36.69±0.81	36.93±0.62	35.81±0.53	0.299
Toe clearance (cm)	2.0±0.3	5.0±0.4	1.0±0.3	0.010*
Maximal sole inclination (°)	9.14±1.48	10.2±1.2	5.87±1.6	0.025*

*A repeated measures ANOVA showed significant difference at $p \leq 0.05$

Step length was highest in the level surface (LS) condition and lowest in the downslope surface (DS) condition. Post hoc analysis (LSD) revealed a significant differences between the LS condition and the upslope surface (US) condition ($p=0.002$), and the LS condition and DS condition ($p=0.002$). However, there was no significant difference between the US condition and DS condition. The comparisons between each walking condition for step length are presented in Figure 5.

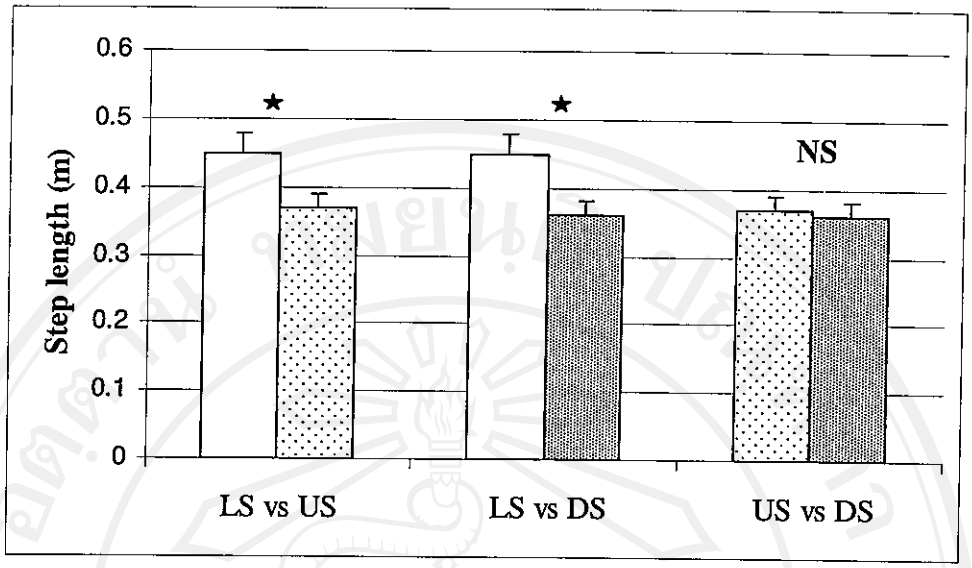


Figure 5 Comparison between each walking condition for step length

★ LSD showed significant difference at $p \leq 0.05$

NS = Non significance

Toe clearance was highest in the US, LS and DS condition, respectively. LSD revealed significant differences across conditions. Toe clearance during the swing phase of the US condition was significantly higher than the LS ($p=0.0001$) and DS condition ($p=0.031$). There was no significant difference between the LS condition and DS condition. The comparisons between each walking condition for toe clearance are shown in Figure 6.

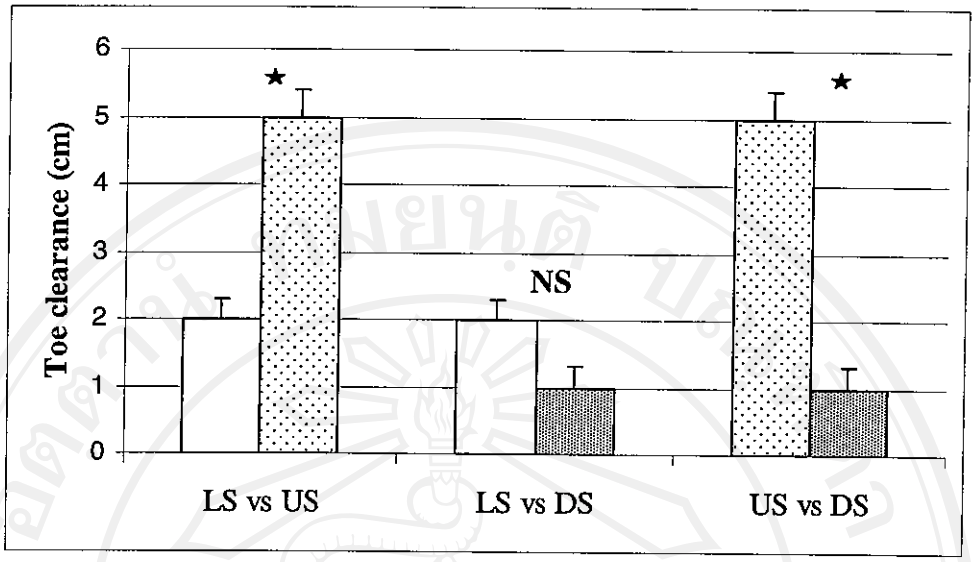


Figure 6 Comparison between each walking condition for toe clearance

★ LSD showed significant difference at $p \leq 0.05$

NS = Non significance

Maximal sole inclination was highest in the US condition and lowest in the DS condition. LSD showed statistical differences between the LS and DS condition ($p=0.025$), and the US and DS condition ($p=0.0001$). There was no significant difference between the LS and US condition. The comparisons between each walking condition for maximal sole inclination are shown in Figure 7.

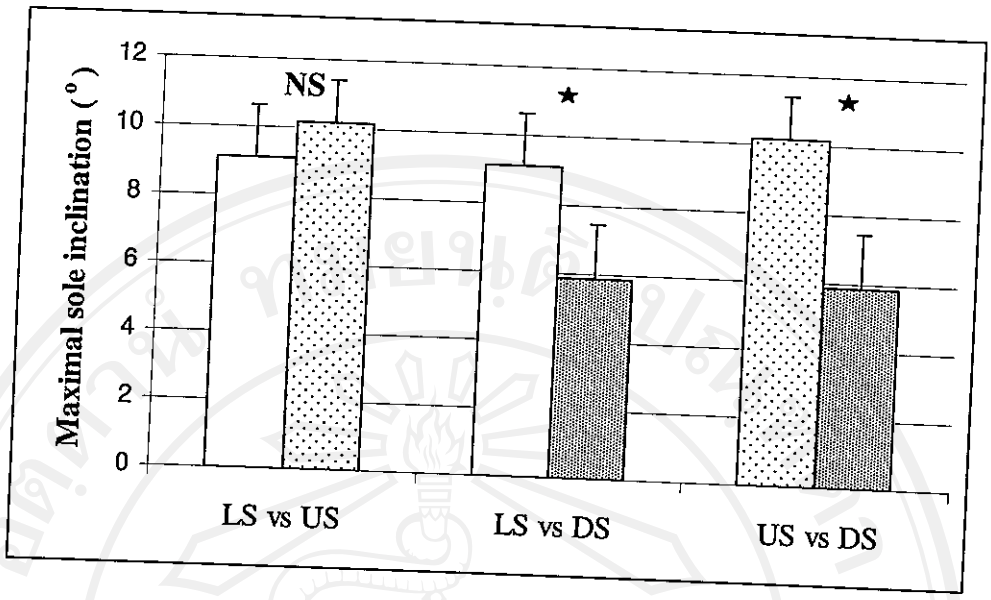


Figure 7 Comparison between each walking condition for maximal sole inclination

★ LSD showed significant difference at $p \leq 0.05$

NS = Non significance

Gait variability

Coefficient of variation of stride length and stride time is presented in Table 3. Both stride length variability and stride time variability were highest in the US, DS and LS condition, respectively. However, repeated measures ANOVA revealed no significant differences between the three walking conditions for stride length and stride time variability

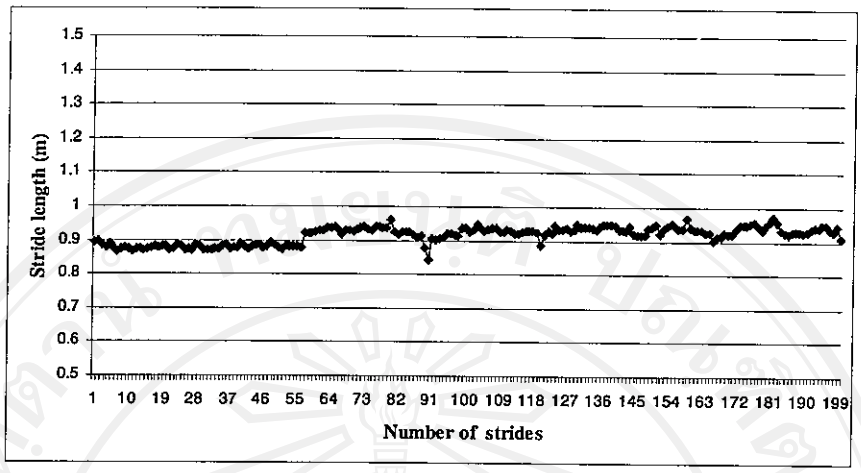
Table 3 Comparison between three surface conditions for gait variability during walking on a treadmill

(Values presented as mean ± standard error)

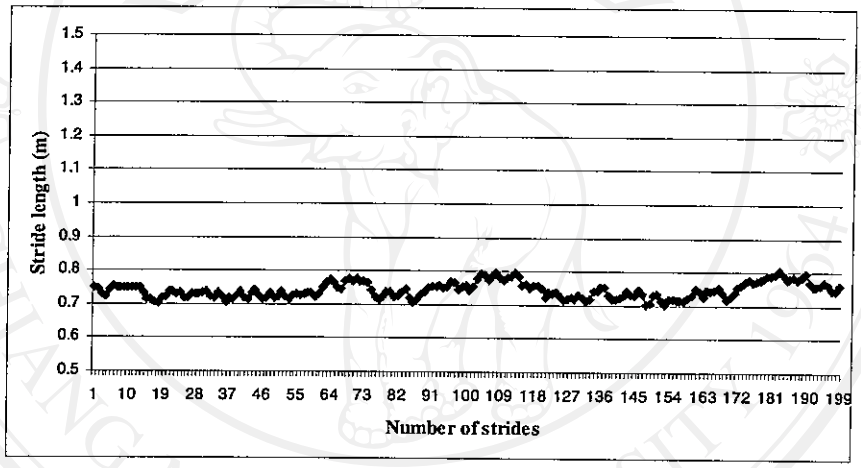
Variables	Conditions			*p*-value†
	Level surface	Upslope surface	Downslope surface	
Stride length variability (COV %)	5.04±0.36	6.28±0.7	5.64±0.5	0.352
Stride time variability (COV %)	8.33±1.28	8.52±1.11	8.39±0.94	0.970

† A repeated measures ANOVA

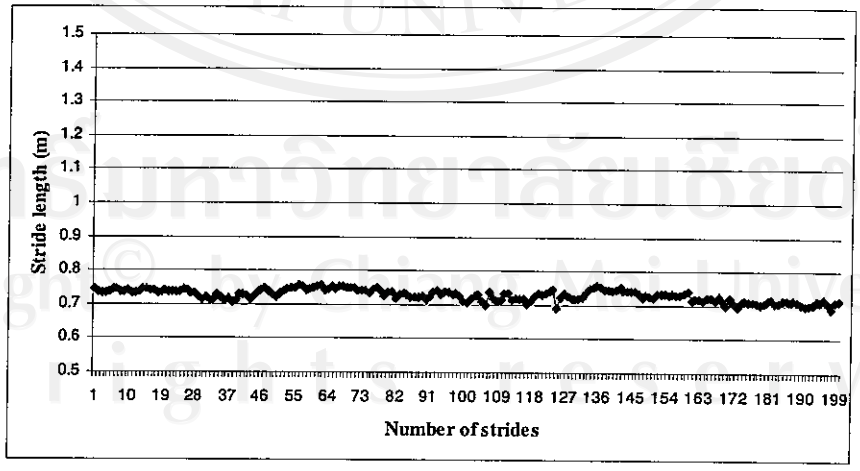
Average stride length and stride time of all participants over 200 strides are presented in Figure 8 and 9. Both stride length and stride time were consistent across three surface conditions.



LS condition

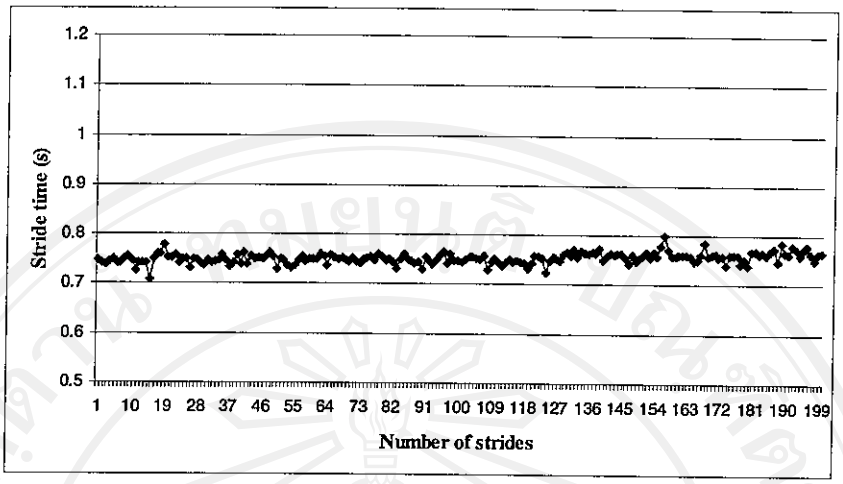


US condition

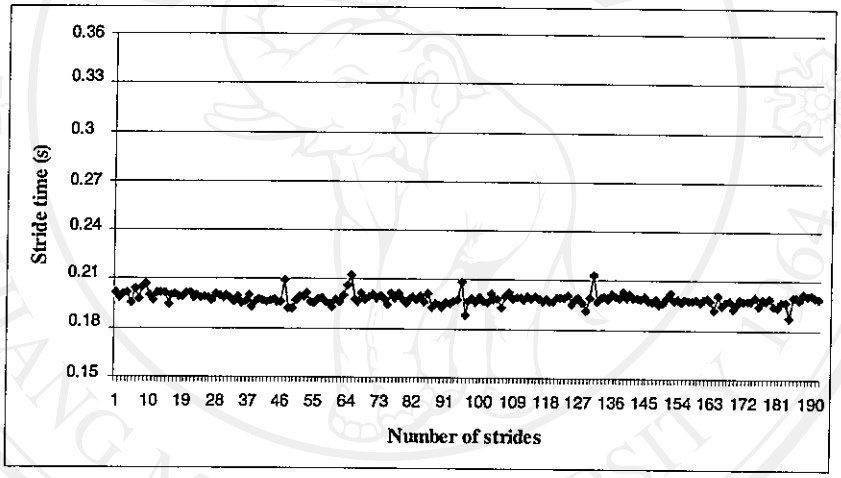


DS condition

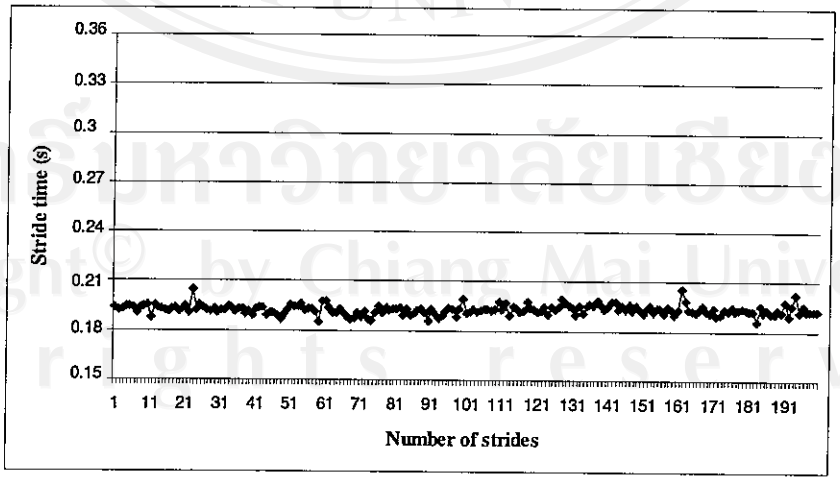
Figure 8 Average stride length of all participants (n=15) over 200 strides for each surface condition



LS condition



US condition



DS condition

Figure 9 Average stride time of all participants (n=15) over 200 strides for each surface condition

Changes of all dependent variables during up- and downslope walking in relation with level surface walking are summarized in Table 4.

Table 4 Changes of gait parameters and variability during up- and downslope walking in relation with level surface walking

Variables	**Conditions**		
	Level Surface	**Upslope surface**	**Downslope surface**
Step length (m)	BS	D	D
Double support time (% of gait cycle)	BS	ND	ND
Toe clearance (cm)	BS	I	ND
Maximal sole inclination (°)	BS	ND	D
Stride length variability (COV %)	BS	ND	ND
Stride time variability (COV %)	BS	ND	ND

BS = Baseline data

D = Decreased (compared with BS)

I = Increased (compared with BS)

ND = Not different (compared with BS)