

## CHAPTER IV

### RESULTS

A total of 350 joggers for health were recruited through direct explanation of the details of the study by researcher at the public park. We started to find participants since April, 2007. Of the initial 261 eligible subjects, who jogging at the public park in Bangkok. This study used the Suan Lumpini park as a main place. The final subject number was 250, who completed the entire study (May – September, 2007). The reason for dropping out by the remaining 250 subjects included stop running because of their health and loss to follow up.

#### Characteristics of subjects

Baseline characteristics of the subjects were summarized in Table 4.1 and Table 4.2. The average age of the subjects was  $53.5 \pm 6.39$  years and the age range was 45 to 73 years old. Table 4.2 shows that a large discrepancy was noted in this study with respect to sex, with 226 (90.4%) male and 24 (9.6%) female participants.

Most joggers were normal arch (47.6% and 46.4%) followed by low arch (46.8% and 46%) and then high arch (5.6% and 7.6%) for right and left foot, respectively. The Q-angle (stand and supine position), was analyzed by taking the average Q-angle of the right and left legs. Close to 70% of the participants had Q-angle  $\geq 10^\circ - < 15^\circ$  in both supine and standing position. Most participants had leg length discrepancy  $< 0.5$  centimeter. Few joggers had a leg length discrepancy of  $\geq 0.5$  centimeter. Moreover, most joggers (68%) did not participate in other activities, 68.4% had no medical condition, and 72.8% were not used any drug.

Table 4.1: Baseline characteristics of the subjects (n = 250)

Characteristics	Mean $\pm$ SD
Age (years)	53.50 $\pm$ 6.39
Weight (kilograms)	66.16 $\pm$ 9.98
Height (centimeters)	166.02 $\pm$ 6.89
BMI (kg/m <sup>2</sup> )	23.94 $\pm$ 2.82
Arch index	
Right	0.259 $\pm$ 0.04
Left	0.259 $\pm$ 0.04
Q-angle (stand)	
Right	13.93 $\pm$ 2.99
Left	13.46 $\pm$ 2.88
Q-angle (supine)	
Right	13.67 $\pm$ 3.21
Left	13.20 $\pm$ 2.74
True leg length (centimeters)	
Right	83.22 $\pm$ 4.29
Left	83.26 $\pm$ 4.26

Table 4.2: Baseline characteristics of the subjects (n = 250)

Characteristics	No. (%)
Sex	
Male	226 (90.4)
Female	24 (9.6)
BMI (kg/m <sup>2</sup> )	
Normal: 18.5 – 24.9	176 (66.8)
Overweight: 25.0 - 29.9	83 (33.2)
Arch type (Right)	
High arch	14 (5.6)
Normal arch	119 (47.6)
Low arch	117 (46.8)
Arch type (Left)	
High arch	19 (7.6)
Normal arch	116 (46.4)
Low arch	115 (46.0)
Q-angle (Stand): mean right and left legs	
< 10°	12 (4.8)
≥ 10° - < 15°	172 (68.8)
≥ 15° - < 20°	54 (21.6)
≥ 20°	12 (4.8)
Q-angle (Supine): mean right and left legs	
< 10°	13 (5.2)
≥ 10° - < 15°	175 (70.0)
≥ 15° - < 20°	51 (20.4)
≥ 20°	11 (4.4)

Table 4.2: Baseline characteristics of the subjects (continuous)

Characteristics	No. (%)
Leg length discrepancy (cm.)	
< 0.5	195 (78.0)
0.5 – 0.9	28 (11.2)
≥ 1.0	27 (10.8)
Other physical activities	
None	170 (68.0)
Participate in other activities	80 (32.0)
Medical condition	
No medical condition	171 (68.4)
Had medical condition	79 (31.6)
Drug used	
None	182 (72.8)
Drug used	68 (27.2)

#### Characteristics of jogging

The information of the characteristics of jogging were collected from the questionnaire and were summarized in Table 4.3 and Table 4.4.

The participants ran an average duration of  $3.47 \pm 1.96$  hours per week, an average distance of  $31.38 \pm 18.51$  kilometers per week and average running experience was  $11.36 \pm 7.97$  years. Most joggers ran regularly (97.6%) and 42% of all subjects had running experience 5-10 years. The jogging frequency, duration and distance were analyzed as a simple dichotomy ( $\leq 3$  and  $> 3$  days/week;  $\leq 30$  and  $> 30$  minutes/day;  $< 32$  and  $\geq 32$  km/week) and found that most participation ran more than 3 days/week, more than 30 minutes/day and ran less than 32 km/week.

Furthermore, most joggers (61.2 %) 'Always' did stretching exercises and only 43 joggers (17.2 %) never did stretching exercises. All of 207 subjects who did stretching exercises, most of them (67.6 %) did stretching exercises before and after jogging. The most common muscle stretched was calf muscle (77.6 %). In addition, most participants preferred to perform stretching only one time per stretch and hold less than 15 seconds per each stretch. Most joggers (68 %) ran on asphalt surface, 13.6% ran on concrete/cement, 11.6 % ran on asphalt alternating concrete, and 6.8% ran on other surfaces such as grass, track, or treadmill.

**Table 4.3: Characteristics of jogging (n = 250)**

Characteristics	Mean $\pm$ SD
Experience (years)	11.36 $\pm$ 7.97
Duration of jogging for 16 weeks (hrs.)	54.52 $\pm$ 31.59
Duration of jogging per week (hrs.)	3.47 $\pm$ 1.96
Jogging distance for 16 weeks (km.)	492.67 $\pm$ 296.68
Jogging distance per week (km.)	31.38 $\pm$ 18.51

Table 4.4: Characteristics of jogging (n = 250)

Characteristics	No. (%)
Jogging habits	
Regularly	244 (97.6)
Sometimes	6 (2.4)
Jogging experience (years)	
< 5 years	49 (19.6)
5 – 10 years	105 (42.0)
> 10 years	96 (38.4)
Jogging frequency per week	
≤ 3 days	44 (17.6)
> 3 days	206 (82.4)
Duration of jogging per day	
≤ 30 minutes	70 (28.0)
> 30 minutes	180 (72.0)
Jogging distance per week	
< 32 km	155 (62)
≥ 32 km	95 (38)
Stretch habits	
Always	153 (61.2)
Sometimes	54 (21.6)
Never	43 (17.2)
Stretching (n = 207)	
Before jogging	19 (7.6)
After jogging	19 (7.6)
Before and after jogging	169 (67.6)



Table 4.4: Characteristics of jogging (continuous)

Characteristics	No. (%)
<b>Muscle stretched (total responses: 752)</b>	
Quadriceps	181 (72.4)
Hamstrings	188 (75.2)
Calf	194 (77.6)
Back	119 (47.6)
Others	70 (28.0)
<b>Perform each stretch (n = 207)</b>	
1 time/stretch	95 (38.0)
2 – 4 times/stretch	79 (31.6)
≥ 5 times/stretch	33 (13.2)
<b>Holding duration (n = 207)</b>	
< 15 seconds	74 (29.6)
15 – 30 seconds	73 (29.2)
> 30 seconds	60 (24.0)
<b>Jogging surface</b>	
Concrete/cement	34 (13.6)
Asphalt	170 (68.0)
Concrete and asphalt	29 (11.6)
Others	17 (6.8)

### Characteristics of shoes and orthoses used

The information of the characteristics of shoes and orthotics used were collected from the questionnaire and were summarized in Table 4.5.

Almost of all the participants (95.2%) used running shoes. Most shoes used (65.6%) were using for more than 1 year. In addition, only 30.4% used orthotic devices and the heel support was mostly used (34.1%), followed by knee support (26%) and insole (26%).

In addition, the record of pictures of wear and tear patterns of shoes was taken in this study. Most shoes (84%) were shown wear and tear pattern on the lateral side of heel or heel strike. At the forefoot, most shoes (48.8%) were shown wear and tear pattern on middle of shoe or normal foot motion, followed by 7.6% were shown wear and tear pattern at the lateral side of shoe or supinate foot motion, 4% were shown at medial side of shoe or pronated foot motion, respectively.

Table 4.5: Shoes and orthoses used (n = 250)

Characteristics	No. (%)
Type of shoes	
Running shoe	243 (97.2)
Others	7 (2.8)
Duration of running shoe had been using	
1 – 6 months	48 (19.2)
7 – 12 months	38 (15.2)
> 1 years	164 (65.6)
Pair of shoes used for each participant	
Used only one pair of shoes	147 (58.8)
Used more than one pair of shoes	103 (41.2)



**Table 4.5: Shoes and orthoses used (continuous)**

Characteristics	No. (%)
Orthoses used	
No orthosis	174 (69.6)
Used orthosis	76 (30.4)
Types of orthoses used (total response:88)	
Heel support	30 (34.1)
Arch support	3 (3.4)
Insole support	26 (29.5)
Knee support	26 (29.5)
Ankle support	2 (2.3)
Calf support	1 (1.1)

#### **Running injuries and incidence of running injuries**

During the 16-week investigation, 121 joggers (48.4%) incurred 163 running-related injuries. A total of 163 injuries were sustained, with 27 runners experienced two injuries, 3 experienced three and only one jogger experiencing four, 11 subjects had injuries that caused them to stop running completely. The incidence was calculated according to the duration of jogging. The exposure of jogging time of 250 subjects was 13,630.118 hours for 16-week study period. So the incidence of running injuries was 11.96 per 1000 hours of running for 163 injuries in this study. All the injuries, regardless of whether self reported or evaluated by researchers, were included in the total.

According to self-reported, 31.9% of the injured runners experienced a new injury, and 68.1% had recurrence of previous injuries. Most injuries (32.5%) were grade 3 (pain during running and restricted distance and speed). The most common site of injury was the knee (46.6% of the total injuries). Other common sites were reported in Table 4.6.

Table 4.6: Injury profile and incidence of running injuries.1000 h<sup>-1</sup> (n = 250)

	No. (%)	Incidence of running injuries.1000h <sup>-1</sup> of running
<b>Injury history</b>		
None	107 (42.8)	-
Had previous injury	143 (57.2)	-
<b>Injuries in 16 weeks</b>		
None	129 (51.6)	-
Had injuries	121 (48.4)	8.9
<b>Localization of injury (total response: 163)</b>		
Knee	76 (46.6)	5.6
Foot	32 (19.6)	2.4
Achilles tendon	15 (9.2)	1.1
Shin	9 (5.5)	0.7
Ankle	9 (5.5)	0.7
Calf	7 (4.3)	0.5
Low back	6 (3.7)	0.4
Hip/pelvis	5 (3.1)	0.4
Hamstrings	3 (1.8)	0.2
Quadriceps	1 (0.6)	0.1
<b>Level of injury (all injuries: 163)</b>		
1. pain only after running	47 (28.8)	3.4
2. pain during running, but not restricted distance or speed	52 (31.9)	3.8
3. pain during running and restricted distance and speed	53 (32.5)	3.9
4. Could not run due to pain	11 (6.7)	0.8
<b>Recurrence of injuries (all injuries: 163)</b>		
New injuries	52 (31.9)	3.8
Recurrence	111 (68.1)	8.1

### The Characteristics of injured and non-injured groups

The information of characteristics were summarized in Table 4.7 - 4.12.

**Table 4.7: Baseline characteristics of the subjects of injured and non-injured groups**

Characteristics	Injured	Non-injured	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	
	n = 121	n = 129	
Age (years)	53.74 $\pm$ 6.47	53.28 $\pm$ 6.35	0.567
Weight (kilograms)	67.61 $\pm$ 9.31	64.79 $\pm$ 10.42	0.025*
Height (centimeters)	166.67 $\pm$ 6.56	165.41 $\pm$ 7.16	0.150
BMI (kg/m <sup>2</sup> )	24.29 $\pm$ 2.67	23.61 $\pm$ 2.92	0.057
Arch index			
Right	0.267 $\pm$ 0.037	0.253 $\pm$ 0.037	0.003*
Left	0.265 $\pm$ 0.413	0.252 $\pm$ 0.419	0.013*
Q-angle (stand)			
Right	13.71 $\pm$ 3.16	14.14 $\pm$ 2.84	0.259
Left	13.26 $\pm$ 2.97	13.66 $\pm$ 2.79	0.269
Q-angle (supine)			
Right	13.51 $\pm$ 3.13	13.81 $\pm$ 3.28	0.458
Left	13.07 $\pm$ 2.83	13.32 $\pm$ 2.67	0.484
True leg length (centimeters)			
Right	83.51 $\pm$ 4.37	82.96 $\pm$ 4.20	0.311
Left	83.54 $\pm$ 4.33	82.99 $\pm$ 4.19	0.313

\* Statistically significant using Independent-samples t test ( $p < 0.05$ )

The average age, height, BMI, Q-angle, and True leg length were similar in the injured and non-injured groups. But, weight were statistical significance difference between injured and non-injured group, the injured group had more weight than non-injured group (67.61  $\pm$  9.31 kg VS. 64.79  $\pm$  10.42 kg, respectively). In addition, Arch index in injured group were quite low arch type. It is 0.267  $\pm$  0.037 and 0.265  $\pm$  0.413 of the right and left foot respectively. While in non-injured group, the arch index is normal arch type. It is 0.253  $\pm$  0.037 and 0.252  $\pm$  0.419 of the right and left respectively (Table 4.7).

Table 4.8: Baseline characteristics of the subjects of injured and non-injured groups

Characteristics	Injured	Non-injured	p-value
	No. (%)	No. (%)	
	n = 121	n = 129	
Sex			
Male	114 (94.2)	112 (86.8)	0.077**
Female	7 (5.8)	17 (13.2)	
BMI			
Normal: 18.5 – 24.9	78 (64.5)	89 (69.0)	0.532
Overweight: 25.0 - 29.9	43 (35.5)	40 (31.0)	
Arch type (Right)			
High arch	4 (3.3)	10 (7.8)	0.020*
Normal arch	50 (41.3)	69 (53.5)	
Low arch	67 (55.4)	50 (38.8)	
Arch type (Left)			
High arch	6 (5.0)	13 (10.1)	0.064**
Normal arch	51 (42.1)	65 (50.4)	
Low arch	64 (52.9)	51 (39.5)	
Q-angle (Stand)			
< 10°	7 (5.8)	5 (3.9)	0.254
≥ 10° - < 15°	87 (71.9)	85 (65.9)	
≥ 15° - < 20°	20 (16.5)	34 (26.4)	
≥ 20°	7 (5.8)	5 (3.9)	
Q-angle (Supine)			
< 10°	7 (5.8)	6 (4.7)	0.819
≥ 10° - < 15°	86 (71.1)	89 (69.0)	
≥ 15° - < 20°	22 (18.2)	29 (22.5)	
≥ 20°	6 (5.0)	5 (3.9)	
Leg length discrepancy (cm.)			
< 0.5	93 (76.9)	102 (79.1)	0.066**
0.5 – 0.9	10 (8.3)	18 (14.0)	
≥ 1.0	18 (14.9)	9 (7.0)	
Other physical activities			
None	83 (68.6)	87 (67.4)	0.952
Participate in other activities	38 (31.4)	42 (32.6)	
Medical condition			
No medical condition	80 (66.1)	91 (70.5)	0.538
Had medical condition	41 (33.9)	38 (29.5)	
Drug used			
None	86 (71.1)	96 (74.4)	0.652
Drug used	35 (28.9)	33 (25.6)	

\* Statistically significant using Chi-Square test ( $p < 0.05$ )

\*\* Statistically significant using Chi-Square test ( $p < 0.1$ )

There were more male and overweight joggers in injured group than non-injured group (Table 4.8). Most of the injured group had low arch (55.4% right foot and 52.9% left foot) but in non-injured group, mostly had normal arch (53.5% right foot and 50.4% left foot). The average Q-angle of right and left legs of most joggers in injured and non-injured group values  $\geq 10^\circ$  -  $< 15^\circ$  in both lying and standing position. Moreover, the subjects who had average Q-angle  $< 10^\circ$  and  $\geq 20^\circ$  had tendency to injure but found no statistical significance difference of Q-angle between injured and non-injured group. In addition, the value of leg length discrepancy was statistically significant difference between injured than non-injured group ( $p < 0.1$ ).

Other factors such as participants in other activities, medical condition, and drug used were not statistical significance difference between injured and non-injured group.

**Table 4.9: Characteristics of jogging of injured and non-injured groups**

characteristics	Injured	Non-injured	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	
	n = 121	n = 129	
Experience (years)	11.85 $\pm$ 8.11	10.89 $\pm$ 7.84	0.343
Duration of jogging for 16 weeks (hrs.)	58.10 $\pm$ 33.30	52.59 $\pm$ 29.80	0.139
Duration of jogging per week (hrs.)	3.66 $\pm$ 2.06	3.29 $\pm$ 1.85	0.146
Jogging distance for 16 weeks (km.)	530.19 $\pm$ 297.11	457.47 $\pm$ 293.07	0.053
Jogging distance per week (km.)	33.76 $\pm$ 18.57	29.15 $\pm$ 18.25	0.049*

\* Statistically significant using Independent-samples t test ( $p < 0.05$ )

Only weekly mileage was statistical significance difference between the injured and non-injured group as shown in Table 4.9. The mean weekly running distance was 33.76 and 29.15 km/week for the injured and non-injured groups respectively.

Table 4.10: Characteristics of jogging of injured and non-injured groups

characteristics	Injured	Non-injured	p-value
	No. (%)	No. (%)	
	n = 121	n = 129	
Jogging habits			
Regularly	117 (96.7)	127 (98.4)	0.434
Sometimes	4 (3.3)	2 (1.6)	
Jogging experience (years)			
< 5 years	21 (17.4)	30 (23.3)	0.511
5 – 10 years	52 (43.0)	51 (39.5)	
> 10 years	48 (39.7)	48 (37.2)	
Jogging frequency per week			
≤ 3 days	17 (14.0)	27 (20.9)	0.207
> 3 days	104 (86.0)	102 (79.1)	
Duration of jogging per day			
≤ 30 minutes	26 (21.5)	44 (34.1)	0.038*
> 30 minutes	95 (78.5)	85 (65.9)	
Jogging distance per week			
< 32 km	68 (56.2)	87 (67.4)	0.089**
≥ 32 km	53 (43.8)	42 (32.6)	
Stretch habits			
Always	75 (62.0)	78 (60.5)	0.032*
Sometimes	32 (26.4)	22 (17.1)	
Never	14 (11.6)	29 (22.5)	
Stretching (n = 207)			
Before jogging	8 (7.5)	11 (11.0)	0.427
After jogging	12 (11.2)	7 (7.0)	
Before and after jogging	87 (81.3)	82 (82.0)	
Muscle stretched (total responses: 752)			
Quadriceps : not stretched	29 (24.0)	40 (31.0)	0.270
stretched	92 (76.0)	89 (69.0)	
Hamstrings : not stretched	25 (20.8)	36 (27.9)	0.304
stretched	95 (79.2)	93 (72.1)	
Calf : not stretched	20 (16.5)	36 (27.9)	0.045*
stretched	101 (83.5)	93 (72.1)	
Back : not stretched	62 (51.7)	68 (52.7)	1.000
stretched	58 (48.3)	61 (47.3)	
Others : not stretched	85 (70.2)	95 (73.6)	0.648
stretched	36 (29.8)	34 (26.4)	

\* Statistically significant using Chi-Square test ( $p < 0.05$ )

\*\* Statistically significant using Chi-Square test ( $p < 0.1$ )

Table 4.10: Characteristics of jogging of injured and non-injured groups (continuous)

characteristics	Injured	Non-injured	p-value
	No. (%)	No. (%)	
	n = 121	n = 129	
Perform each stretch (n = 207)			
1 time/stretch	45 (42.1)	50 (50.0)	0.333
2 – 4 times/stretch	46 (43.0)	33 (33.0)	
≥ 5 times/stretch	16 (15.0)	17 (17.0)	
Holding duration (n = 207)			
< 15 seconds	42 (39.3)	32 (32.0)	0.008*
15 – 30 seconds	44 (41.1)	29 (29.0)	
> 30 seconds	21 (19.6)	39 (39.0)	
Jogging surface			
Concrete/cement	16 (13.2)	18 (14.0)	0.652
Asphalt	81 (66.9)	89 (69.0)	
Concrete and asphalt	17 (14.0)	12 (9.3)	
Others	7 (5.8)	10 (7.8)	

\* Statistically significant using Chi-Square test ( $p < 0.05$ ) \*\* statistically significant using Chi-Square test ( $p < 0.1$ )

Most of the injured group jogged more than 30 minutes per day ( $p < 0.05$ ) and running  $\geq 32$  km/week ( $p < 0.1$ ) compared to non-injured group. This was statistical significance difference between injured and non-injured group (Table 4.10).

Most runners in both groups 'always' did stretching exercises, although more in the non-injured group 'always' did stretching exercises compared with the injured group. There was no statistical significance difference between injured and non-injured group when analyzed each stretched muscles, except the calf muscle. Stretching exercises are also done in injured group more than non-injured group except the back muscle. Moreover, most of the injured group (41.1%) held stretching as guideline of ACSM (15-30 seconds), 39.3% held for less than 15 seconds for each stretching exercise, while most of the non-injured group (39%) held stretching for more than 30 seconds. There was statistically significant difference between injured and non-injured group associated with injury by univariate analysis.

Table 4.11: Shoes and orthoses used of injured and non-injured group

characteristics	Injured	Non-injured	p-value
	No. (%)	No. (%)	
	n = 121	n = 129	
Type of shoes			
Running shoe	119 (98.3)	124 (96.1)	0.496
others	2 (1.7)	5 (3.9)	
Duration of running shoe had been using			
1 – 6 months	26 (21.5)	22 (17.1)	0.394
7 – 12 months	15 (12.4)	23 (17.8)	
> 1 years	80 (66.1)	84 (65.1)	
Pair of shoes used for each participant			
Have only one shoe	66 (54.5)	81 (62.8)	0.232
Owning more shoes	55 (45.5)	48 (37.2)	
Orthoses used			
No orthosis	75 (43.1)	99 (56.9)	0.016*
Used orthosis	46 (60.5)	30 (39.5)	
Type of Orthoses used (total response: 88)			
Heel support : not used	102 (84.3)	118 (91.5)	0.121
used	19 (15.7)	11 (8.5)	
Arch support : not used	119 (98.3)	128 (99.2)	0.612
used	2 (1.7)	1 (0.8)	
Insole support : not used	107 (88.4)	117 (90.7)	0.704
used	14 (11.6)	12 (9.3)	
Knee support : not used	105 (86.8)	119 (92.2)	0.227
used	16 (13.2)	10 (7.8)	
Ankle support : not used	121 (100)	127 (98.4)	0.499
used	0 (0)	2 (1.6)	
Calf support : not used	121 (100)	128 (99.2)	1.000
used	0 (0)	1 (0.8)	

\* Statistically significant using Chi-Square test ( $p < 0.05$ )

Table 4.11 show that, the characteristics of shoes (type of shoes and age of shoes) and type of orthoses used were not statistically significant difference in injured and non-injured group. However, respect to age of shoe, found that joggers who worn more than 6 months old had fewer injuries, compared with non-injured group, but this was not significant. The injured group used orthotic devices than non-injured group. This was significantly different between injured and non-injured group.



Table 4.12: History of previous Injury of injured and non-injured group

	Injured	No injured	p-value
	No. (%)	No. (%)	
	n = 121	n = 129	
Injury history			
None	22 (18.2)	85 (65.9)	0.000*
Had previous injury	99 (81.8)	44 (34.1)	

\* statistically significant using Chi-Square test ( $p < 0.05$ )

Previous injury was statistically significant difference between injured and non-injured group (Table 4.12).

Form Table 4.7 – 4.12, after univariate analysis found that weight, arch index, sex, Arch type (right), arch type (left), leg length discrepancy, jogging distance per week, duration of jogging per day, stretching habit, calf muscle stretched, holding duration of each stretch, orthoses used and injury history significantly associated with running injuries ( $p < 0.05$  and  $p < 0.1$ ). These variables were included in the multivariate logistic regression model.

### Risk factors of running injuries

The risk factors in this study were show in Table 4.13. After multivariate analysis found as the follows:

- Men had tendency to the risk of injury 3.8 times of women.
- Low arch had a chance of injury 5.8 times of high arch.
- If held less than 15 seconds, the risk of injury was 2.7 times of group that held stretching for more than 30 seconds.
- The one who had previous injury had tendency to have risk of injury 9.99 times.

**Table 4.13: Risk factors of running injuries**

Risk factors	df	Sig.	Exp(B)	95.0% C.I. for	
			Adjust Odd Ratio	Lower	Upper
Sex	1	.016	3.801	1.279	11.292
Arch type	1	.026	5.811	1.238	27.273
Hold each stretch	1	.021	2.734	1.166	6.409
Injury history	1	.000	9.996	4.974	20.088

### Reliability of measurement of area of footprints by Image pro plus program

Intraclass correlation coefficients (ICC) were used to estimate agreement between two examiners and same examiner for determine area of the footprints by using Image pro plus program.

The ICC for the 14 paired area of footprints taken by the two observers and the same observer was 0.9828 and 0.9971 for intertester reliability and intratester reliability of measurement by Image pro plus program, respectively.

The ICCs revealed that the Image pro plus program for determine area of the footprint were highly reliable between the two observers and between the same observer.