CHAPTER 4

RESULTS

1. Reliability of measurements

Ten healthy participants (4 men and 6 women) with a mean age of 26.10 ± 2.61 years volunteered to the reliability study of measurements. The mean height and weight of the participants were 166.00 ± 8.63 cm, and 55.63 ± 13.35 kg, respectively. Characteristic and demographic data of the participants participating in the reliability study are presented in Table 1.

Table 1 The demographic characteristics of the participants in the reliability study

Characteristics	Mean	SD	Minimum	Maximum
Age (years)	26.10	2.61	24	30
Height (cm)	166.00	8.63	154	180
Weight (kg)	55.63	13.35	44	89

The data from this reliability study established test-retest reliability of pain-free knee extension strength, and pain-free double legs and single leg strength tests between two occasions that was separated by 24 hours. As shown in Table 2, the values of the $ICC_{(3,3)}$ for pain-free knee extension strength, and pain-free double legs and single leg strength measures used in the thesis study were 0.92, 0.96, and 0.89, respectively. In addition, the standard error of measurements (SEMs) of these measurements were 0.50, 1.91, and 1.34 kg, respectively. The results indicate that the test-retest reliability for these measurements were high with a minimal error of measurement (SEMs were less than 5%).

Table 2 The intraclass correlation coefficients (ICC $_{(3,3)}$) and standard error of measurements (SEMs) of pain-free knee extension strength, and pain-free double legs and single leg strength tests

Tests	ICC $_{(3,3)}$	SEMs
Pain-free knee extension strength test	0.92	0.50
Pain-free double legs strength test	0.96	1.34
Pain-free single leg strength test	0.89	1.91

2. Demographic characteristics of the participants

Eleven Thai national weightlifters with knee pain comprising 4 men and 7 women participated in the study. Seven participants had bilateral knee pain, and four had unilateral knee pain. Thus, 18 knees (10 right knees and 8 left knees) were studied in this thesis. In each of these knees, 8 knees had 1 pathology, and 3 remaining knees had 2 pathologies (see more detail in Appendix S). The participants' knee pathologies consisted of Osgood-Schlatter syndrome (4 knees), patellar tendinopathy (3 knees), patellofemoral syndrome (3 knees), iliotibial band syndrome (2 knees), Sinding-Larsen-Johansson syndrome (1 knee), fat pad syndrome (1 knee), medial collateral ligament sprain (1 knee), patellar tendinopathy with Sinding-Larsen-Johansson syndrome (1 knee), and fat pad syndrome with Sinding-Larsen-Johansson syndrome (2 knees). The mean duration of symptoms was 69.68 weeks. Table 3 shows the demographic characteristics of the participants. The mean age, height, and weight of the participants were 21.55 ∂ 3.91 years, 161.09 ∂ 11.14 cm, and 69.18 ∂ 15.99 kg, respectively.

Table 3 The demographic characteristics of the participants (N=11)

Characteristics	Mean	SD	Minimum	Maximum
Age (years)	21.55	3.91	18	31
Height (cm)	161.09	11.14	147	179
Weight (kg)	69.18	15.99	47	94
Duration of symptoms (weeks)	69.68	98.12	0.3	243

3. Attendance rate

All participants safely completed the 8-week intervention and 12-week follow-up, with no reports of any complications or adverse events. During 8-week period of knee educational program that consisted of 16 intervention sessions, all participants strictly adhered to study protocol. Seven participants well attended full session or 100% of intervention sessions. Three participants attended 15 sessions (93.75%) and only 1 subject attended 14 sessions (87.5%) which was higher than a minimal criteria for participating in the study (Table 4). The average attendance was 15.55 ∂ 0.69 sessions (97.19%).

Table 4 Percentage of attendance during 8-week period of knee educational program

Participants (number)	Intervention sessions (number)	Attendance (percentage)
7	16	100%
3	15	93.75%
1	14	87.5%

For a specific detail during 6 weeks of an exercising period (week 3rd to week 8th) that consisted of 42 training sessions, based on participant documentation in the daily log book, participants completed an average of 36.55 sessions (87.01%). The maximum and minimum numbers of training sessions that participants completed were 40 (95.24%) and 34 (80.95%) sessions, respectively.

4. Stability of the outcome measures before intervention

Before intervention, statistical analysis of the outcome measures, which consisted of average knee pain VAS, pain-free knee extension strength, and pain-free double legs and single leg strengths, knee functional ability VISA scale, and quality of lifting was performed using the Wilcoxon signed-ranks test. The results revealed that a significant change was only found in the pain-free knee extension strength in which it was significantly decreased (p=0.04) from 31.76 ± 12.01 kg at pre-baseline to 28.68 ± 10.72 kg at baseline (week 0) assessments (Table 5). Significant changes in other outcome measures were not found (p∅0.23). It was concluded that all outcome measures did not naturally improve during the 4-week interval before starting the knee educational program.

Table 5 Mean values of the outcome measures before intervention (Mean ± SD)

Outcome measures	Pre-baseline	Baseline	*p*-values
Average knee pain VAS score (100 mm)	52.50 ± 33.79	59.17 ± 31.54	0.36
Pain-free knee extension strength (kg)	31.76 ± 12.01	28.68 ± 10.72	0.04 *
Pain-free double legs strength (kg)	129.68 ± 60.90	125.97 ± 63.08	0.86
Pain-free single legs strength (kg)	51.04 ± 29.64	49.55 ± 27.15	0.62

Table 5 (Continued)

Outcome measures	Pre-baseline	Baseline	*p*-values
Knee function VISA score (20 points)	74.50 ± 14.90	73.33 ± 11.64	0.71
Quality of lifting			
Average pain VAS score (100 mm)			
During snatch	40.05 ± 22.67	47.81 ± 35.55	0.35
During clean	37.97 ± 26.38	50.00 ± 30.22	0.23
During jerk	38.44 ± 32.95	47.19 ± 31.94	0.41
Worst pain VAS score (100 mm)			
During snatch	42.50 ± 24.90	51.25 ± 37.39	0.32
During clean	40.31 ± 27.60	51.88 ± 31.88	0.25
During jerk	41.25 ± 35.75	50.00 ± 34.64	0.29
Painful phase (number)			
During snatch	1.44 ± 0.89	1.56 ± 1.15	0.79
During clean	1.56 ± 1.15	1.69 ± 1.08	1.00
During jerk	1.25 ± 1.13	1.44 ± 1.21	0.77

* Significant difference ($p<0.05$) from pre-baseline values.

5. Knowledge of knee care

Knowledge of knee care was determined using knowledge questionnaire. As presented in Table 6 and Figure 3, the knowledge score increased significantly from 13.27 ± 3.00 points at baseline to 18.64 ± 0.93 points at week 8th of assessment (p=0.003). Significant increase in knowledge score from baseline to week 12th (18.27

± 1.10 points) was also found (p=0.003). However, knowledge score did not significantly alter from week 8th to week 12th (p=0.157), suggesting a sustain of knowledge in knee management for at least 4 weeks after completion of the program.

Table 6 The knowledge score and average pain VAS score at baseline (week 0), week 8th, and week 12th (Mean ± SD).

Outcome measures	Week 0	Week 8th	Week 12th
Knowledge score (20 points)	13.27 ± 3.00	18.64 ± 0.92 *	18.27 ± 1.10 *
Average pain VAS score (100 mm)	59.17 ± 31.54	42.78 ± 38.17	27.78 ± 30.98 *

* Significant difference (p<0.0167) when comparing to baseline data (week 0)

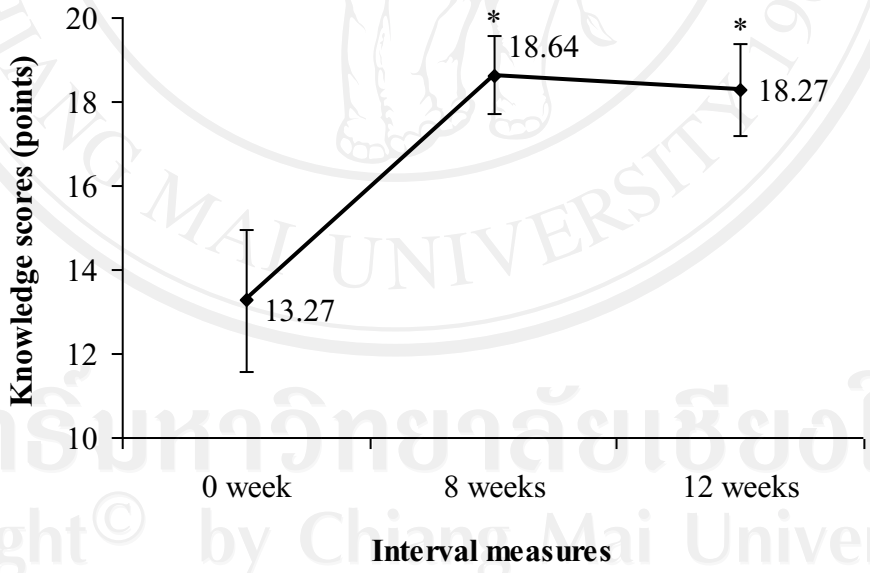

Figure 3 Data of Mean ± SD in knowledge of knee care at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) when comparing to baseline data (week 0).

6. Intensity of knee pain

Average knee pain at rest was assessed using 100 mm VAS. The VAS score were declined from 59.17 ± 31.54 to 42.78 ± 38.17 and to 27.78 ± 30.98 mm at baseline, week 8th, and week 12th, respectively. The result indicated that the VAS score was significantly decreased from baseline to week 12th (p=0.005). However, the decrease in VAS score from baseline to week 8th, and from week 8th to week 12th were not significant (p=0.027 and 0.045, respectively) (Table 6 and Figure 4).

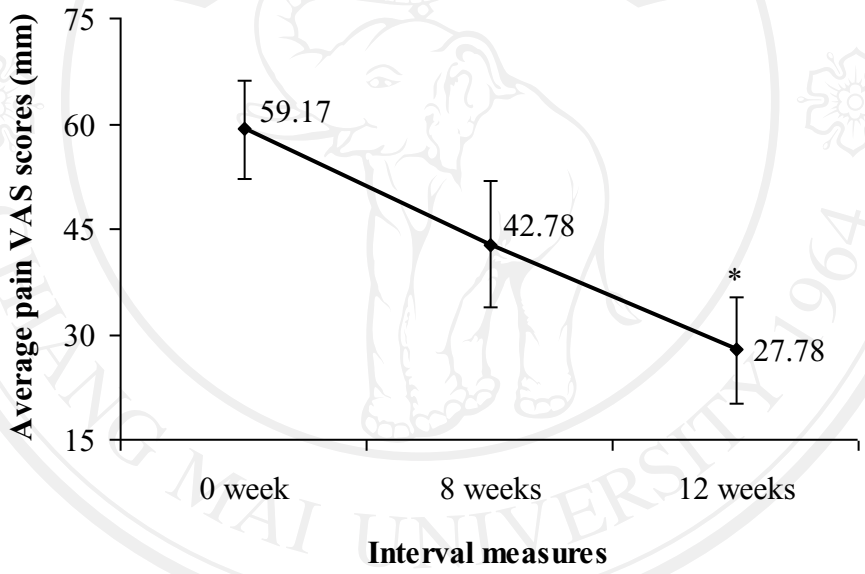

Figure 4 Data of Mean ± SEM in average knee pain (VAS scores) at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) from baseline value.

7. Pain-free knee extension strength

As presented in Table 7 and Figure 5, pain-free knee extension strength at baseline, week 8th and weeks 12th were 28.68 ± 10.72, 33.01 ± 11.39, and 36.93 ± 16.78 kg, respectively. At week 12th, pain-free knee extension strength were significantly increased from baseline value (p=0.003). Conversely, the significant

difference between baseline and week 8th, and between week 8th and week 12th were not met (p=0.025 and 0.026, respectively).

Table 7 The pain-free knee extension strength, and double legs and single leg strengths at different assessment periods (Mean ± SD).

Outcome measures	Week 0	Week 8th	Week 12th
Pain-free knee extension strength (kg)	28.68 ± 10.72	33.01 ± 11.39	36.93 ± 16.78 *
Pain-free double leg strength (kg)	125.97 ± 64.97	146.26 ± 65.90	153.64 ± 71.61 *
Pain-free single leg strength (kg)	49.55 ± 27.15	54.81 ± 25.88	63.62 ± 33.56 *

* Significant difference (p<0.0167) when comparing to baseline data (week 0)

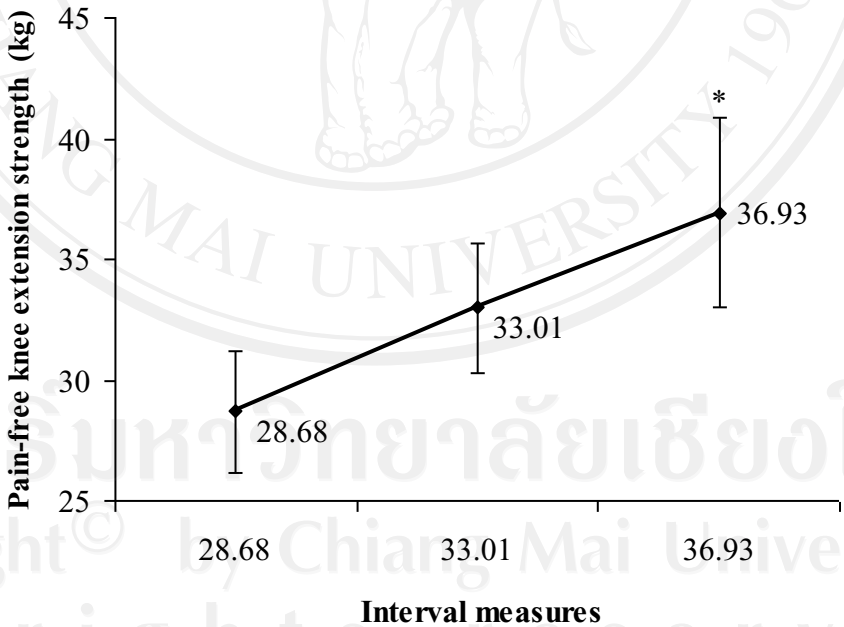

Figure 5 Data of Mean ± SEM in pain-free knee extension strength at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) when comparing to baseline data (week 0).

8. Pain-free double legs and single leg strengths

The pain-free double legs strength was increased significantly from 125.97 ± 64.97 kg at baseline to 153.64 ± 71.61 kg at week 12th (p=0.008). At week 8th, pain-free double legs strength was 146.26 ± 65.90 kg. There were no significant increase in pain-free double legs strength from baseline to week 8th (p=0.026), and from week 8th to week 12th (p=0.029) (Table 7 and Figure 6).

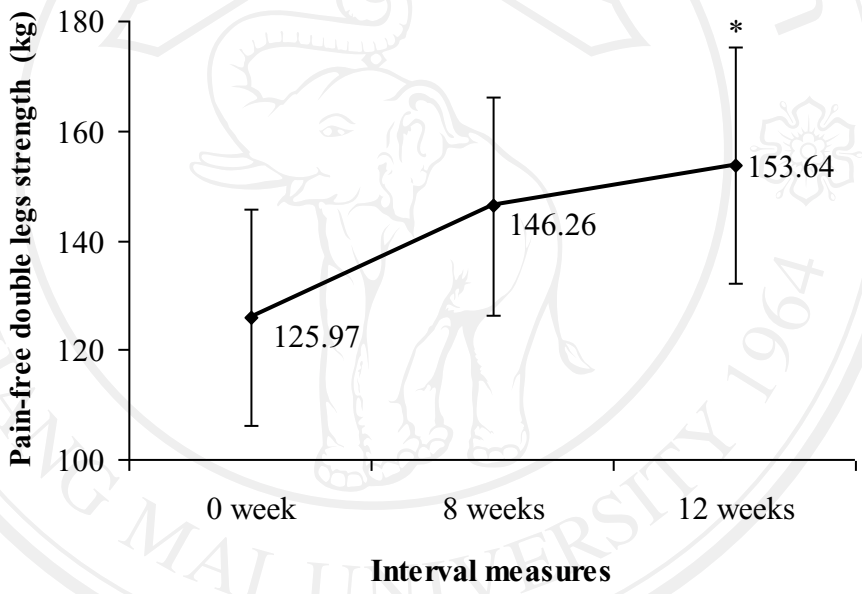

Figure 6 Data of Mean ± SEM in pain-free double legs strength at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) from baseline value.

As illustrated in Table 7 and Figure 7, at baseline, week 8th, and week 12th, pain-free single leg strength were 49.55 ± 27.15, 54.81 ± 25.88, and 63.62 ± 33.56 kg, respectively. Like pain-free double legs strength, pain-free single leg strength at week 12th was increased significantly when comparing to the baseline value (p=0.014).

Pain-free single leg strength was not significantly increased form baseline to weeks 8, and from week 8th to week 12th (p=0.026 and 0.028, respectively).

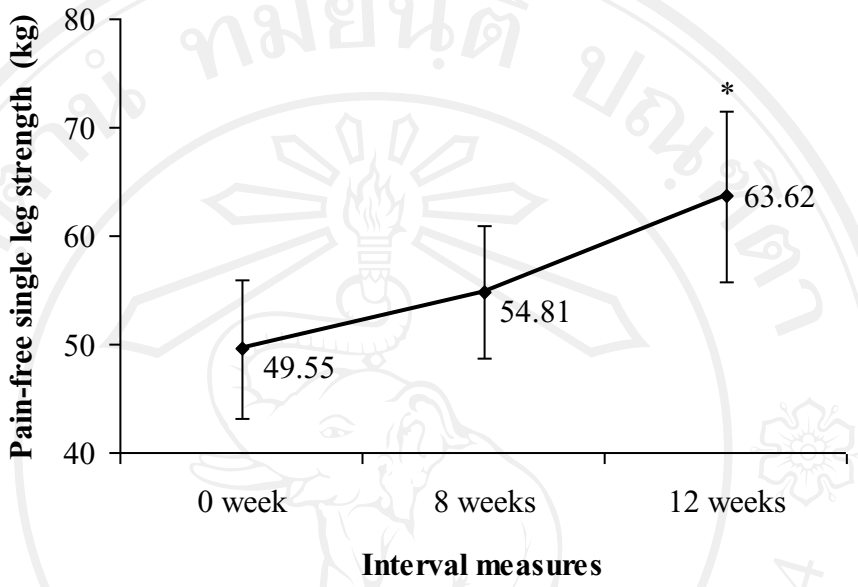

Figure 7 Data of Mean ± SEM in pain-free single leg strength at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) from baseline value.

9. Knee functional ability

Knee functional ability was determined using VISA scale. The VISA score at baseline, week 8th, and week 12th were 73.33 ± 11.64, 79.50 ± 14.65, and 86.33 ± 9.51 points, respectively. No significant increase in VISA score from baseline to week 8th, and form weeks 8th to weeks 12th were found (p=0.038 for both). However, significant increase in VISA score from week 0 to week 12th was found (p=0.001) (Table 8 and Figure 8).

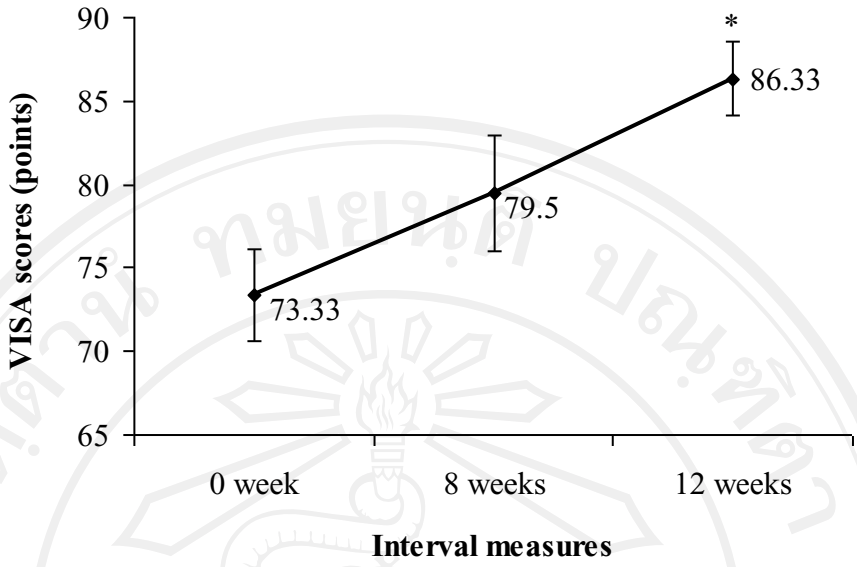

Figure 8 Data of Mean ± SEM in VISA scores at baseline (week 0), week 8th, and week 12th. * Significant difference (p<0.0167) from baseline value.

10. Quality of lifting

10.1 Intensity of knee pain during lifting

The intensity of knee pain during snatch, clean, and jerk lifts in weightlifting including the average and worst pain was determined using 100 mm VAS as prescribed in Appendix C.

10.1.1 The average pain

Snatch

Table 8 and Figure 9 show that average pain VAS scores during snatch were declined from 47.81 ± 35.55 to 33.75 ± 36.25, and to 29.38 ± 35.30 mm at baseline, week 8th, and week 12th, respectively. However, the results revealed that there was no statistically significant difference between these three values (p=0.19).

Clean

During clean, average pain VAS score at baseline, week 8th, and week 12th were 50.00 ± 30.22, 34.90 ± 33.52, and 30.63 ± 32.35 mm, respectively. However, no significant difference between these three values were found (p=0.13) (Table 8 and Figure 9).

Jerk

As illustrated in Table 8 and Figure 9, average pain VAS score during jerk at baseline, week 8th, and week 12th were 47.19 ± 31.94, 35.00 ± 33.67, and 24.38 ± 33.46 mm, respectively. Like snatch and clean, no significant difference between these three values were found (p=0.11).

Table 8 The knee functional ability VISA scores and quality of lifting at different assessment intervals (Mean ± SD).

Outcome measures	Week 0	Week 8th	Week 12th
VISA scores (100 points)	73.33 ± 11.64	79.50 ± 14.65	86.33 ± 9.51*
Quality of lifting			
1. Average pain VAS scores (100 mm)			
During snatch	47.81 ± 35.55	33.75 ± 36.25	29.38 ± 35.30
During clean	50.00 ± 30.22	34.90 ± 33.52	30.63 ± 32.35
During jerk	47.19 ± 31.94	35.00 ± 33.67	24.38 ± 33.46
2. Worst pain VAS scores (100 mm)			
During snatch	51.25 ± 37.39	34.38 ± 38.29	32.50 ± 39.58
During clean	51.88 ± 31.88	36.25 ± 34.62	31.88 ± 33.71
During jerk	50.00 ± 34.64	36.88 ± 34.20	27.50± 37.86

Table 8 (Continued)

Outcome measures	Week 0	Week 8th	Week 12th
3. Painful phase (numbers)			
During snatch	1.56 ± 1.15	1.06 ± 1.24	0.88 ± 1.15
During clean	1.69 ± 1.08	1.25 ± 1.29	0.94 ± 1.00
During jerk	1.44 ± 1.21	1.06 ± 1.12	0.75 ± 1.13

* Significant difference (p<0.0167) from baseline value.

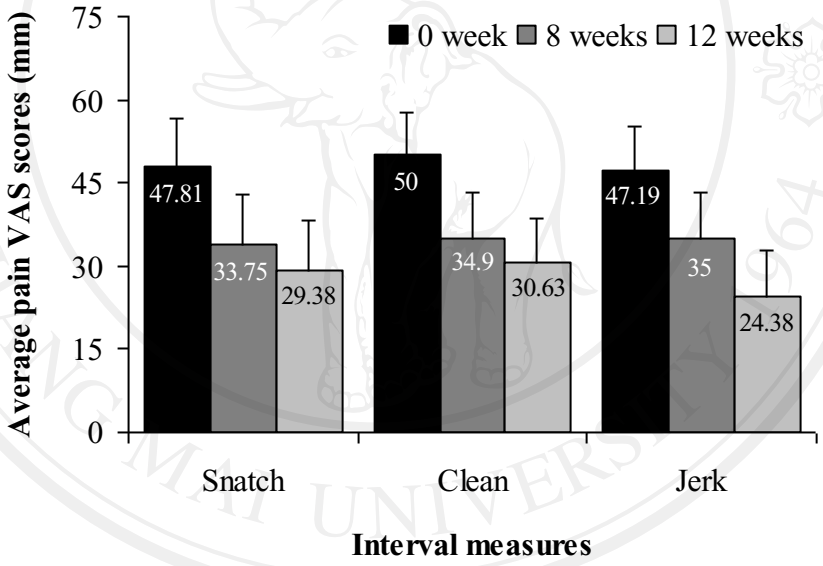

Figure 9 Data of Mean ± SEM in average pain (VAS score) during snatch, clean, and jerk at different assessment intervals.

10.1.2 The worst pain

Snatch

The average worst pain VAS scores during snatch were decreased from 51.25 ± 37.39 to 34.38 ± 38.29 and to 32.50 ± 39.58 mm at baseline, week 8th, and week

12th, respectively. Statistically, there was no significant (p=0.09) difference between these three values (Table 8 and Figure 10).

Clean

During clean, the average worst pain VAS scores at baseline, week 8th, and week 12th were 51.88 ± 31.88, 36.25 ± 34.62, and 31.88 ± 33.71 mm, respectively. However, these three values were not significantly different (p=0.12) as presented in Table 8 and Figure 10.

Jerk

During jerk, the average worst pain VAS scores at baseline, week 8th, and week 12th were 50.00 ± 34.64, 36.88 ± 34.20, and 27.50 ± 37.86, respectively. No significant difference between these three values were found (p=0.06) as displayed in Table 8 and Figure 10.

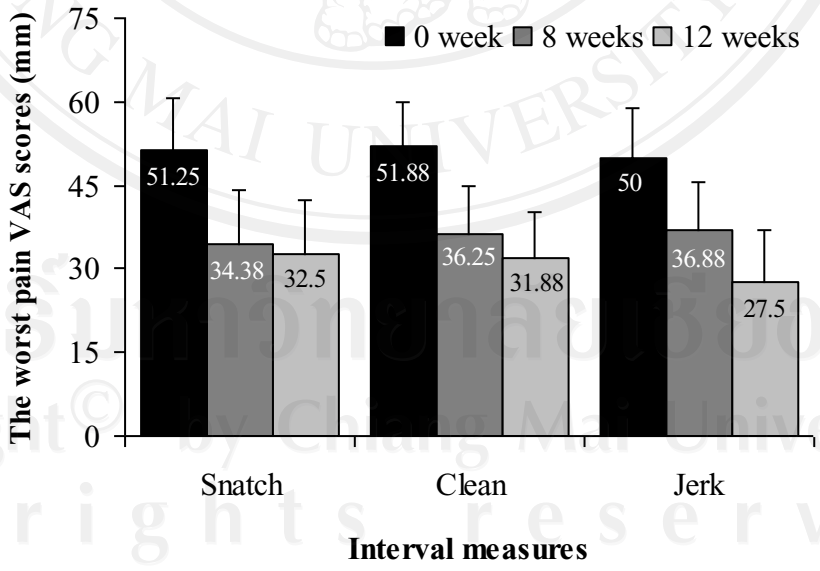

Figure 10 Data of Mean ± SEM in the worst pain (VAS score) during snatch, clean, and jerk at different assessment intervals.

10.2 Numbers of painful phase

Snatch

During snatch, the mean numbers of painful phase were decreased from 1.56 ± 1.15 to 1.06 ± 1.24 and to 0.88 ± 1.15 phases at baseline, week 8th, and week 12th, respectively. However, the differences between theses three measures were not statistically significant (p=0.12) (Table 8 and Figure 11).

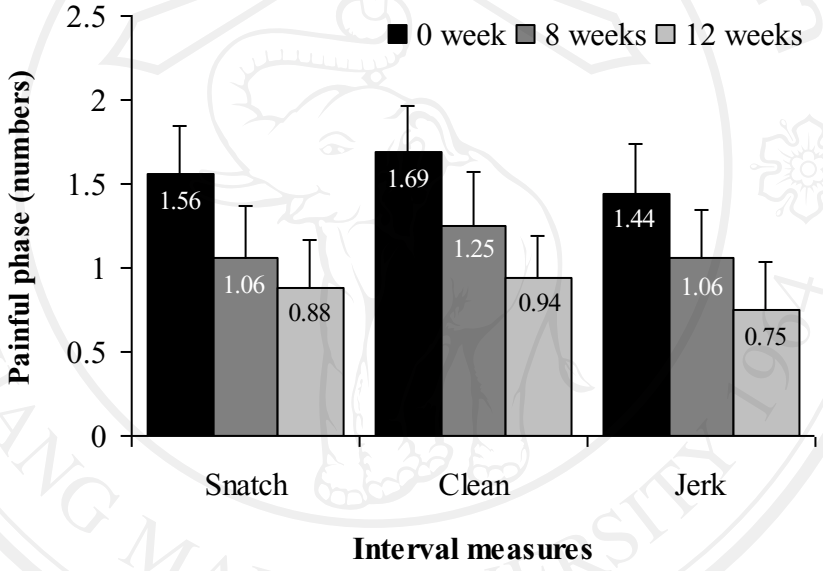

Figure 11 Data of Mean ± SEM in the number of painful phase in snatch, clean, and jerk at different assessment intervals.

Clean

As illustrated in Table 8 and Figure 11, the mean numbers of painful phase during clean at baseline, week 8th, and week 12th were 1.69 ± 1.08, 1.25 ± 1.29, and 0.94 ± 1.00 phases, respectively. Differences between these three means were not significant (p=0.11).

Jerk

Like snatch and clean, the average numbers of painful phase during jerk were 1.44 ± 1.21, 1.06 ± 1.12, and 0.75 ± 1.13 phases at baseline, week 8th, and week 12th, respectively. However, there was no significant difference between three measures (p=0.07) (Table 8 and Figure 11).

11. Participants' satisfaction with knee educational program

The participants' satisfaction with knee educational program was determined using satisfaction questionnaire as prescribed in Appendix C. Immediately post-intervention (week 8th), all participants rated the levels of satisfaction in each item as very high to high levels (Table 9). For the overall satisfaction, the majority of the participants (63.64%) had very high satisfaction, whereas 36.36% had high satisfaction. Regarding the satisfaction with usefulness of knee educational program, possibilities of applying knowledge to use, and suitability of time during 8-week intervention period, 54.55% of participants had very high satisfaction, whereas 45.45% had high satisfaction. Regarding the satisfaction with the sufficiency of follow-up visits from the researchers and suitability of materials and exercise booklets, the majority of the participants (63.64%) satisfied at very high level, whereas 36.36% of the participants satisfied at high level.

Table 9 The levels of satisfaction with knee educational program.

Items of satisfaction	Levels of satisfaction				
	Very high	High	Moderate	Low	Very low
1. Overall satisfaction with knee educational program	63.64% (7)	36.36% (4)	0% (0)	0% (0)	0% (0)
2. Usefulness of knee educational program	54.55% (6)	45.45% (5)	0% (0)	0% (0)	0% (0)
3. Possibilities of applying knowledge to use	54.55% (6)	45.45% (5)	0% (0)	0% (0)	0% (0)
4. Suitability of time during 8-week intervention period	54.55% (6)	45.45% (5)	0% (0)	0% (0)	0% (0)
5. Sufficiency of follow-up visits from the researchers	63.64% (7)	36.36% (4)	0% (0)	0% (0)	0% (0)
6. Suitability of materials and booklets	63.64% (7)	36.36% (4)	0% (0)	0% (0)	0% (0)

Values presented as percentage (number) of participants.