CHAPTER 3

METHODS

3.1 Participants

The number of participants required to include in this study was derived from a sample size table suggested for a correlation study. From a sample size table (31), it was suggested that to achieve 80 % power, 49 participants were needed to achieve significant correlation between variables of STS test and knee extensor muscle strength and endurance.

Therefore, 50 participants (25 male and 25 female) were recruited to participate in the study. Eligible participants were recruited from Chiang Mai area (Muang district and vacinity) and screened according to inclusion and exclusion criteria. The ethical approval was obtained from the Research Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University (Appendix C).

Inclusion criteria: participants were included in the study if

1. They were 18 to 25 years old.
2. They were comprehended instructions and willing to participate in the study.

Exclusion criteria: participants were excluded from the study if

1. They had been diagnosed with neurological disorders (e.g. Parkinson's disease, stroke, brain injury) that affect lower extremity muscle strength and endurance.

2. They had been diagnosed with musculoskeletal disorders (e.g. rheumatoid arthritis, tendon or ligament tears, ulcers and fracture of lower extremity bone) that affect lower extremity muscle strength and endurance.

3.2 Equipment

1. PowerLab load cell (model ML840, ADInstrument Ltd, Australia)
2. Chair
3. Stopwatch
4. Tape measure
5. Standard goniometer
6. One-cm thick pieces of wood

3.3 Outcome measures

Variables obtained from STS test

1. Time to complete 5 repeated one-leg STS test (T5-STS)
2. Time to complete 10 repeated one-leg STS test (T10-STS)
3. Power of 5 repeated one-leg STS test (P5-STS)
4. Power of 10 repeated one-leg STS test (P10-STS)

Knee extensor function

1. Knee extensor muscle isometric maximum voluntary contraction
2. Knee extensor muscle time to fatigue

3.4 Data collection procedures

There were two testing sessions for data collection. The first session was set up for the STS test. In the second session, the leg strength and endurance were collected. The study's protocol was submitted for approval by the Research Ethics Committee of the Faculty of Associated Medical Sciences, Chiang Mai University.

3.5 Leg length and thigh circumference measurement

Measurement was performed with the participant on bed in supine lying position. The tester measured the dominant's leg length by using tape measure. The total leg length was the distance from the greater trochanter to lateral malleolus and the lower leg length was from lateral epicondyle of femur to lateral malleolus (33). Thigh circumference was also measured in supine lying position at the middle of thigh between ASIS and base of patella bone (34) as an additional physical characteristics.

3.6 Sit-to-stand test measurement

Prior to data collection, participants were informed about the purpose of the study and the procedures of this session by the tester. Next, they read and signed an informed consent and the demographic data including gender, age, body weight, height and thigh length were collected. Each participant was asked to kick a ball to define his or her dominant leg. A leg which used to kick a ball was the dominant leg. After that participants performed a regular warm-up including stretching the knee extensor muscles. During the actual test, participants performed the 5 and 10 repeated one-leg STS tests in random order using the dominant leg.

For the 5 repeated and 10 repeated one-leg STS tests, each participant sat on a chair with arms across his or her chest. Seat height was set to 120% of participant lower leg length (32). The tested (dominant) knee was set at 100° of knee flexion. The untested (non-dominant leg) was held in same position but the foot was not in contact with the floor. Before the test, participants were allowed to perform one set of the repetition one-leg STS at submaximal effort to be familiar with the test. For the actual test, participants were encouraged to perform the 5 and 10 repeated one-leg STS with maximum effort as fast and safe as possible (Fig 8). For each repetition, participants were instructed to stand up to full hip and knee extension then sit down to made contact buttock on the chair before starting the next repetition. The time (T-STS) was recorded using a stopwatch. The test was started when the tester said "Go" and ended when the participants fully sat on the 5^{th} or 10^{th} repetition, for the 5 and 10 repeated one-leg STS tests, respectively. Participants were tested twice for each of the 5 and 10 repeated one-leg STS tests. The trial with the best (shortest) time from the two trials was selected for data analysis.

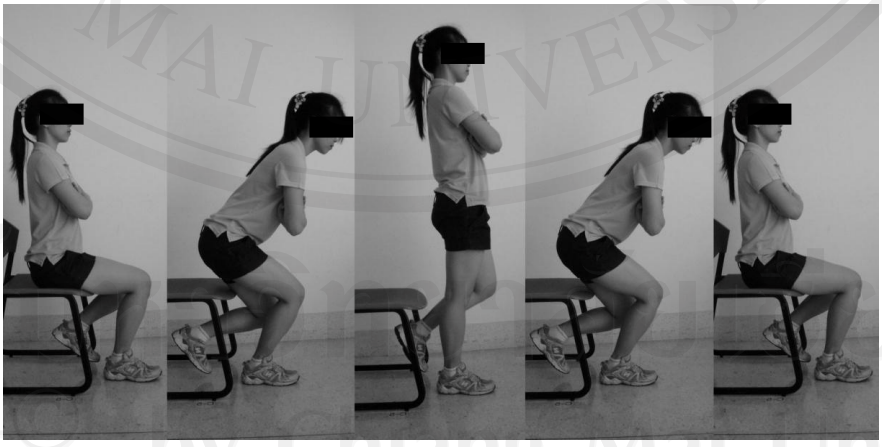


Figure 8 A sequence of one repetition of the one-leg STS movement

3.7 Calculation of the power of the STS movement (6)

The power of one-leg STS movement is calculated from following formula

$$\text{Power STS} = \frac{(L - H) \times W \times g \times N}{\text{Time STS}}$$

Where L (m) represents the total leg length
H (m) represents the chair height
} Estimation of the body CoM displacement

W (kg) represents body weight

g (m/sec^2) represents gravity acceleration (9.8 m/sec^2)

N represents number of repetition

Time STS (sec) represents the time that used on STS test

3.8 Knee extensor muscle strength test

Measurement of the knee extensor muscle strength was administered following the completion of the STS test and the participant took a rest for at least 15 min. Maximum isometric contraction of the knee extensor muscle strength (MVC) was measured using a strain-gauge load cell connected to a PowerLab data acquisition system. Each participant sat on a chair with the knee angle at 60° flexion. The strain-gauge load cell was placed one inch proximal to the lateral malleolus (Fig 9). Before testing, two practice trials with submaximal contractions were performed to familiarize with the experimental setup. During the test, each participant performed 3 maximal effort of knee extension isometric contraction. Each maximal effort was held for 4 seconds separated by a 2 minutes rest between efforts. The trial with

highest value of the three contractions was recorded as the maximum voluntary contraction (MVC).

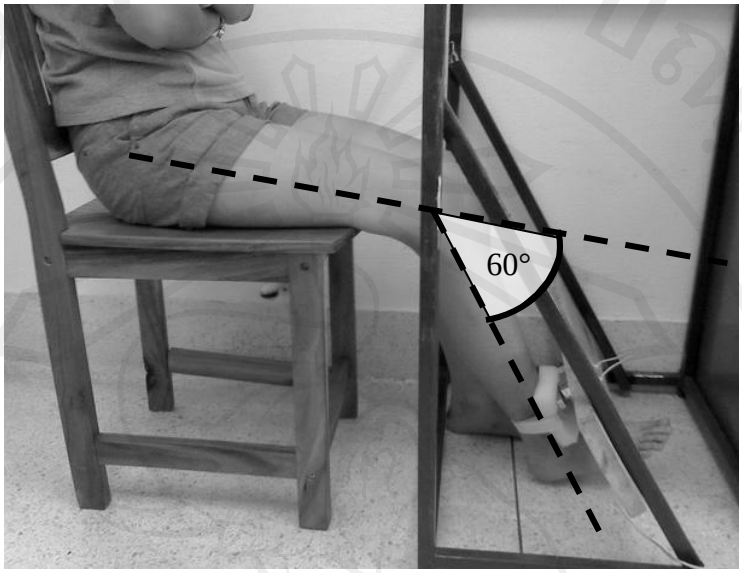


Figure 9 Knee extensor muscle isokinetic strength and endurance measurement

3.9 Knee extensor muscle endurance test

Following the knee extensor strength test, participants took a rest for at least 15 min. Then participants entered the knee extensor muscle endurance test. The same starting position as the knee extensor muscle strength test was used for the muscle endurance test (Fig 9). During the test, participants were instructed to contract the knee extensor muscle against the load cell and maintain the contraction force equal to 60% of their MVC as long as possible until exhaustion. A computer screen was used to provide feedback to participants in order to monitor the contraction force at 60% MVC. Participants were strongly encouraged using the same verbal command to maintain the 60% MVC force level as long as possible until the force level reduced to 50% MVC. Muscle endurance was assessed by the time to fatigue, defined as the period of time starting when participants reached isometric contraction force of 60%

MVC and ending at the force reduce to 50% MVC. A datapad function on the PowerLab software (chart 5) was used for extraction of the time to fatigue variable.

3.10 Statistical analysis

1. Descriptive statistics was used to describe data as mean and standard deviations.

2. Pearson product moment correlation coefficient statistics was used to determine the relationship between

- T5-STS and knee extensor muscle MVC
- T5-STS and knee extensor muscle time to fatigue
- T10-STS and knee extensor muscle MVC
- T10-STS and knee extensor muscle time to fatigue
- P5-STS and knee extensor muscle MVC
- P5-STS and knee extensor muscle time to fatigue
- P10-STS and knee extensor muscle MVC
- P10-STS and knee extensor muscle time to fatigue

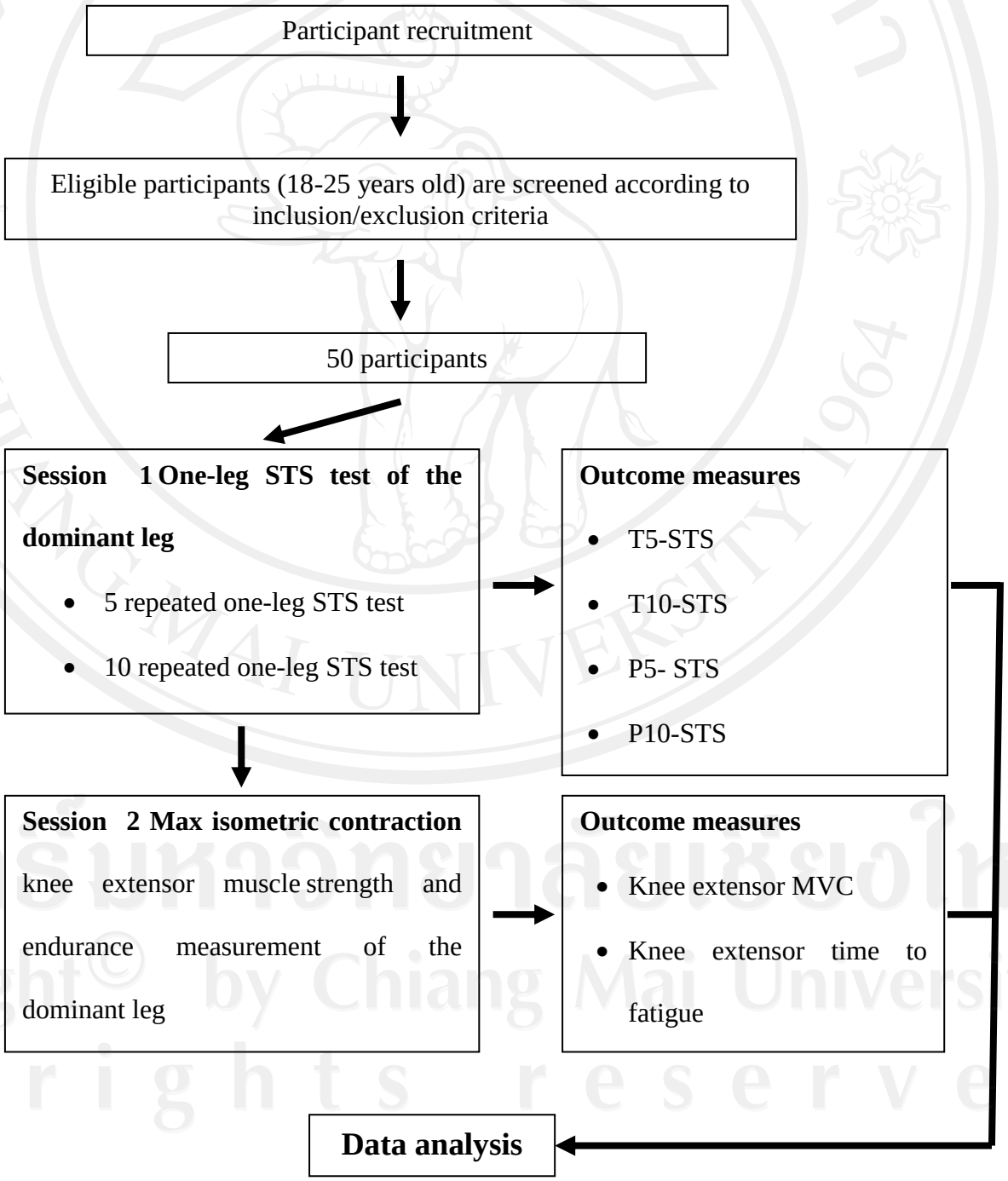
Statistical analysis was undertaken using the Social Sciences (SPSS version 11.0 for Windows). The alpha level was set at $p<0.05$ for all statistical tests.

3.11 Reliability of one leg sit-to-stand test, leg strength and endurance measurement

Test-retest reliability of the variables obtained from isometric assessment of the knee extensor muscle strength and endurance, and the variables obtained from assessment of 5 repeated and 10 repeated one-leg STS tests were determined.

Ten participants participated in the reliability study. They were tested and retested on 2 separate days (Three day apart). The intra-class correlation coefficients (ICC) was used to determine the test-retest reliability.

3.12 Diagram of data collection procedure



3.13 Location

The study was conducted in a biomechanics laboratory at Department of Physical Therapy, Faculty of Associated Medical Sciences in Chiang Mai University.