CHAPTER 1

INTRODUCTION

Strength and endurance of the leg muscles are important in human movement and activity in daily life such as walking, running and moving from sit to stand. A sit-to-stand (STS) movement is prerequisite to functional independence. The STS movement uses major force from hip and knee extensor muscles relatively more than other muscle groups (1). Wretenberg and Aborelius reported that the knee extensor and hip extensor muscles contribute 72 % and 27 % respectively in STS movement (2). At present, several methods are available for measurement of muscle strength: both direct and indirect methods. Isokinetic dynamometry and hand-held dynamometry are considered the standard in force measurement (3). However, these methods have some limitations in clinical use due to high cost and limit availability to only specific hospitals and research laboratories. Thus, direct methods are less applicable than indirect methods (functional tests) for measuring muscles strength for individuals living in community.

In the literature, a STS test is often assessed in association with force-generating capacity of the leg muscle (4-6). Several previous studies explored the relationship between leg muscles strength and variables derived from the STS test. However, the association between STS performance and leg strength is still inconclusive. Jones et al (7) reported that the number of completed standing in a 30-second STS test was highly correlated with leg press strength (one repetition maximum) in elderly people (r = 0.71 and 0.78 for men and women, respectively).

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In Jones et al study, leg press was used to represent leg strength because similar muscle groups and ranges of motion used are similar to the sit-to-stand movement. In contrast, Macfarlane et al (8) found a low correlation between the number of completed standing in a 30 second STS test and maximum isometric voluntary contraction force of the knee extensor muscle in elderly people (r = 0.3 - 0.4). In addition, McCarthy et al (9) reported that knee extensor and hip extensor muscle's isokinetic peak torque had low to moderate correlation with both of the time to complete a 5 repeated STS test (r = -0.46 for knee extensor and -0.29 for hip extensor) and the number of completed standing in a 30 second STS test (r = 0.44 for knee extensor and 0.33 for hip extensor). These previous studies suggest that variables directly measured from the STS test such as time and the number of movement were not consistently associated with knee extensor and hip extensor muscle strength.

In 2009, Takai et al (6) studied the relationship between cross-sectional area, maximum isometric voluntary contraction force of knee extensor muscle and the time to complete a 10 repeated STS test. The results confirmed that there was no relationship between time to complete a 10 repeated STS test and each of cross-sectional area and maximum isometric voluntary contraction force. However the power index calculated by time to complete a 10 repeated STS test, body mass and estimated center of mass (CoM) displacement was highly correlated with cross-sectional area (r = 0.80) and the maximum isometric voluntary contraction force (r = 0.73).

Relationship between muscle endurance and the STS test has been received less attention although muscles endurance might also affect the STS performance.

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Netz et al (10) also reported a low correlation between time to complete a 10 repeated STS test and the knee extensor muscle isokinetic endurance. Findings of several previous studies suggest that the measures of STS performance in absolute terms such as time or numbers of repetitions are not consistently related with knee extension strength and endurance. Individual differences in physical characteristics such as body mass and leg length lead to differences in the body center of mass displacement, and in turns the mechanical work and power during the STS task. In other words, for the same time taken for a STS task, work and power done by individuals can be different due to different body size of the individuals being tested. Therefore, in this study it is proposed that for valid assessment of knee extensor strength, the average power generated during the STS test should be used in stead of the absolute time measure.

Majority of previous studies related to the STS test were done in elderly people. Participants performed the STS test with two leg support that is a safety protocol for elders who might have balance deficit (11). However, the STS test may be appropriate for testing in young adult if the protocol is modified to be more physically challenging. Standing up and sitting down using one leg requires higher amount of force generated from knee extensor muscle to control the movement of the whole body. In addition, one-leg STS test can be used to isolate strength measurement for each leg. There has been no report about the relationship between a one-leg STS test and leg muscles (knee extensor muscles) strength and endurance in young adults. Therefore, it is of interest to validate if the one-leg STS test can be used to assess knee extensor muscle strength and endurance in young individuals.

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1.1 Purpose of the study

The main purpose of the study was to validate the use of a repeated one leg STS test for assessment of strength and endurance of the knee extensor muscle by exploring the relationship between variables obtained from the 5 and 10 repeated one-leg STS tests (time to complete the 5 and 10 repeated one-leg STS tests and power of the test) and variable representing strength and endurance of the knee extensor muscle.

1.2 Hypotheses of the study

1. Time to complete the 5 and 10 repeated one-leg STS tests (T5-STS and T10-STS) would be negatively correlated with leg strength and the selected variable representing endurance of the knee extensor muscle (fatigue rate).
2. The power of 5 repeated and 10 repeated one-leg STS test (P5-STS and P10-STS) would be positively correlated with leg strength and the selected variable representing endurance of the knee extensor muscle (fatigue rate).

1.3 Advantages of the study

The knowledge gained from this study may provide a basis for development of a new functional test (one-leg STS test) that could be used to evaluate knee extensor muscle strength and endurance in each leg. Due to the fact that a STS test was convenient to adminster using only a chair and a stop watch, an application of a new developed STS test can be used in community testing. The average power during the STS test can be estimated and used to reflect force generating capacity of the knee

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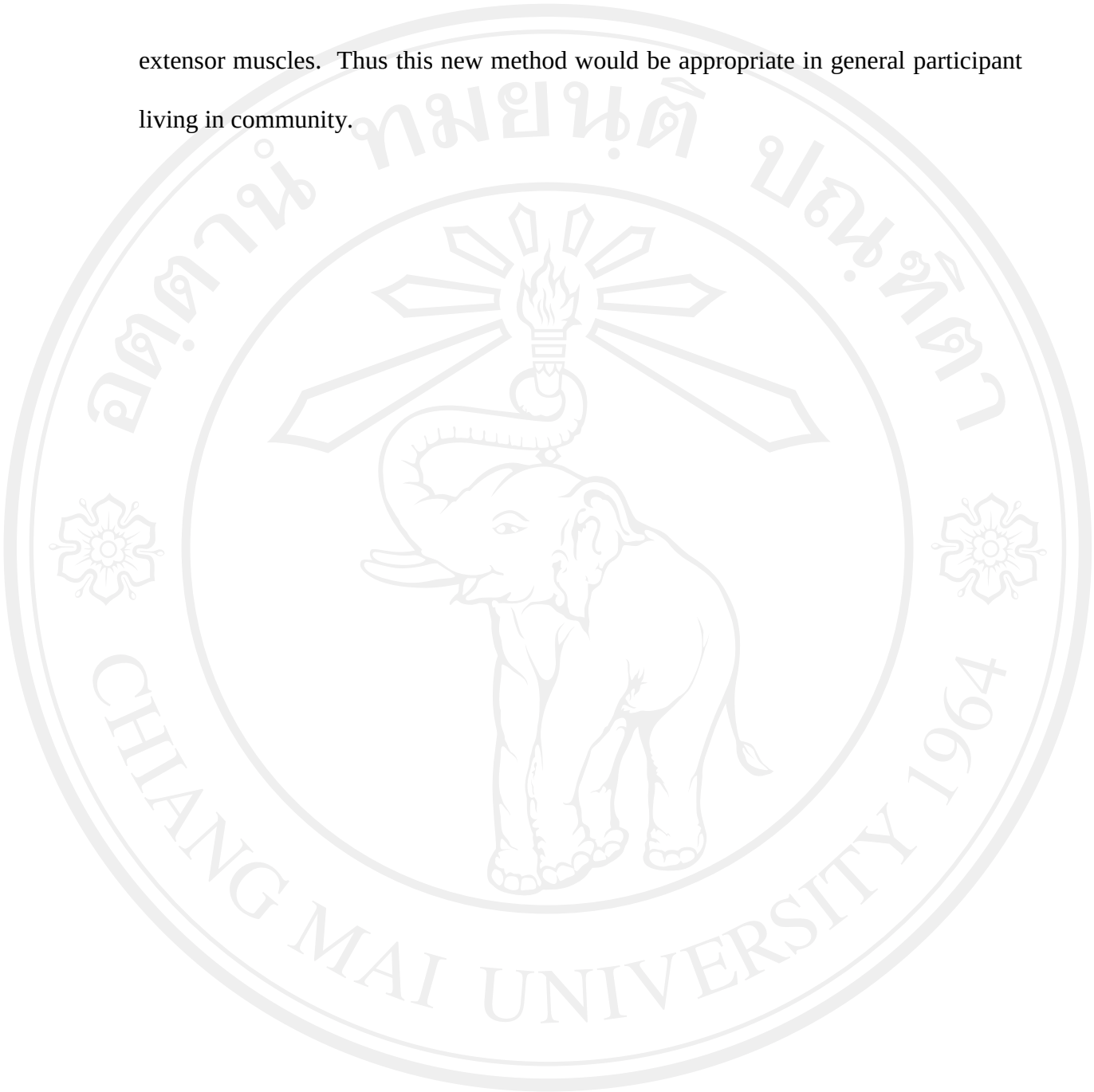
extensor muscles. Thus this new method would be appropriate in general participant living in community.



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