



CHAPTER I INTRODUCTION

Background and Rationale

Thailand is a developing country, with fast development of science and technology that has a great impact on Thai people. Sedentary lifestyles and insufficient physical activity have reached epidemic proportions among Thais. The National Statistical Office of Thailand reported in 2004 that 21.2% of Thais engaged in exercise. This behavior is associated with low levels of cardiorespiratory fitness and an increased risk of cardiovascular disease, type 2 diabetes, obesity, hypertension, and mortality (ACSM, 2000).

Physical fitness test, especially cardiorespiratory fitness test can indicate health status and physical condition. Cardiorespiratory fitness is one of the best indices reflecting the level of health (Blair et al., 1989). Recently, Thai Ministry of Public Health has focus on measures that can prevent diseases rather than on attempting to cure already present ailments. Its importance to health is by the fact that low levels of cardiorespiratory fitness are associated with an increased risk of cardiovascular disease and premature death, whereas higher levels are associated with higher levels of habitual physical activity and reduction in all cause of mortality (Blair et al., 1996). The level of cardiorespiratory fitness can be a useful tool in promoting health by motivating Thai people to change to positive lifestyles. For example, it enables a baseline of fitness to be established, it allows an exercise programmed to be more individually prescribed, it provides a system for monitoring change and it may be used as a health risk indicator (ACSM, 2000). Because many causes of death and disease are directly related to an individual's lifestyle, positive lifestyle changes can drastically reduce the incidence of adverse metabolic risk factor profiles and risk of cardiovascular disease, type 2 diabetes, and mortality (Hermansen et al., 1969).

Cardiorespiratory fitness is commonly assessed by the maximal oxygen uptake (VO_{2max}) (Sykes and Roberts, 2004). VO_{2max} or maximal aerobic capacity is defined as the body's ability to extract and use oxygen in a manner that permits

continuous exercise, physical work, or physical activity. VO_2 max has been accepted to be the best indicator of cardiorespiratory fitness (ACSM, 2000; Keren et al., 1980; McArdle et al., 1996; Matthew et al., 2004).

The level of VO_2 max can be obtained during maximal exercise or submaximal exercise tests. The direct measurement of VO_2 max during maximal exercise test using a motor driven treadmill is now widely accepted as the reference gold standard for assessing aerobic power (Patton et al., 1982). Whilst this is the gold standard, the equipment is expensive, requires a high level of technical expertise and supervision, is impractical in non-laboratory and field-test situations and is unsuitable for those individuals for whom exhaustive exercise is not recommended (Sykes and Roberts, 2004). Therefore, the complexity of maximal exercise test led to the development of several methods for estimating VO_2 max based on heart rate or respiratory exchange ratio measured during submaximal exercise (Astrand, 1976; Margaria et al., 1965; Keren et al., 1980). Submaximal exercise test require little equipment, are less expensive and take less time than maximal exercise test. In addition, the obvious advantages of submaximal exercise test are: 1) motivation might be eliminated as a factor in testing, 2) sedentary or older individuals can be tested without the discomfort and potential hazards attendant with a maximal effort and, 3) they can be administered to a large number of subjects in a short time period (Rowell et al., 1964; Glassford et al., 1965; Davies 1968; Patton et al., 1982).

Two most popular submaximal exercise tests in Thailand commonly used to estimate aerobic fitness and VO_2 max are the Astrand and Rhyming cycle ergometer test and the three minute step test (3-minute step test) (The Sports Authority of Thailand, Thai Health Promotion Foundation, 2006). The original Astrand Rhyming nomogram has been reported to under estimate measured VO_2 max from a maximal treadmill test and overestimate measured VO_2 max from a maximal cycle test (Astrand, 1954). In 1960, Astrand tested 144 additional subjects, and reported high correlation ($r = 0.86$ for males and $r = 0.84$ for females) when comparing a submaximal cycle test to a maximal cycle test.

In 1989, compared with the Astrand Rhythmic mentioned above, the newly developed YMCA cycle test by Golding was reported to be higher correlated with Graded Exercise Test (GXT) in The United States ($r = 0.94$). A more recent study confirmed the result by Golding that YMCA cycle test ($r = 0.83$, $p < 0.001$) provided a more accurate estimate of $VO_2\text{max}$ as compared to the Astrand Rhythmic test ($r = 0.56$, $p = 0.006$) (John et al., 2005). The YMCA cycle test is even more attractive as it adjusts work load corresponding to the subject's heart rate response, so the individual physical fitness is taken into account during testing. Additionally, YMCA cycle test has a better test safety than Astrand because the test limits the heart rate at 85% age-predicted maximal heart rate. Therefore this study was designed to validate YMCA cycle test against gold standard $VO_2\text{max}$ by GXT in Thais.

The three minute step test was originally designed by Kasch and Boyer (1961) to evaluate cardiorespiratory fitness. It is also known as the Kasch Plus Recovery Step Test. The test protocol on a bench height 11.25 inches was set at a rate of 24 steps per minute for three minutes. In 1989, Golding developed the 3 minute step test using 12 inch height bench at a rate of 24 steps per minute for three minutes. It has been reported a high correlation between the 3 minute step test and GXT ($r = 0.92$) in the United States (Golding, 1989). Although, the three minute step test has long been a popular test in Thailand (Thai Health Promotion Foundation, 2006), it has not been validated against gold standard $VO_2\text{max}$ among Thais. Therefore, the purpose of this study was to validate the YMCA cycle ergometer test and the three minute step test to evaluate cardiorespiratory fitness in Thais.

Research Question

Which of the two submaximal exercise tests, YMCA cycle ergometer test and the 3 minute step test, has a better validity to predict maximal oxygen uptake in Thais ?

Hypothesis

Predicted values of maximal oxygen consumption from YMCA cycle ergometer test and the 3 minute step test will have different correlations with measured maximal oxygen uptake values.

Objective

To validate the two different submaximal exercise tests, YMCA cycle ergometer test and the 3 minute step test, for predicting maximal oxygen uptake.

Limitations

1. This study was only volunteered by 125 healthy subjects aged between 18-60 years.
2. Subject motivation may not have been equal in all subjects.
3. Nutritional status and genetic make up of individual subjects were not controlled.

Expected benefits and application

1. Providing recommendation on reasonable submaximal exercise protocol to evaluate cardiorespiratory fitness in Thais.
2. Providing tool for motivation to promote health and physical fitness in Thais.
3. Providing initial reference data of cardiorespiratory fitness in Thais.
4. Providing the preliminary data for further research.

Conceptual Framework

