

CHAPTER III

MATERIALS AND METHODS

1. Subjects

Fifteen top female ST players from the Thai-National female ST athlete volunteered to participate in the study prior to selection of the Thai-National team for the 1998 13th Asians Games in Bangkok, Thailand. Athletes living in the Supanburi sport school underwent training six hours a day, 6-day per week and 10 months prior to Asian Games.

2. Materials

2.1 Weight and height scale (Detecto, USA)

2.2 Skinfold caliper (TKK, Japan)

2.3 Heart rate telemetric set (Polar accurex plus, Polar electro, Finland)

2.4 Gas Analyzers (Cosmed K2, Italy)

2.5 Electronic bicycle ergometer (Combi, Aerobike75XL computronic, Korea)

2.6 Treadmill (Vision Fitness, Taiwan)

2.7 Computer (Atec-compatible computer, USA)

2.8 Software Analysis (Polar Precision Performance 2.0, Italy)

3. General Procedure

3.1 Anthropometric Measurement

Weight and height of each subject were measured at the first stage, followed by the estimation of body fat percentage (%FAT) and fat free mass (FFM) using skinfold caliper to measure the subcutaneous fat at 4 sites. The selected sites were as follows (Durnin and Rahaman, 1967; Durninn and Womersley 1974):

1. Bicep
2. Tricep
3. Subscapular
4. Suprailiac

3.2 Electrocardiographic Recording (ECG Recording)

The ECG of each subject was recorded at 5-second intervals during competition using the Polar Accurex Plus (Polar electro, Finland). The equipment consisted of an electrode belt with a transmitter, which records ECG and sends radio signals to receiving watch, incorporating a microprocessor which stores heart rate and time. The belt was strapped around the chest at the lower end of sternum. The data stored in the watch was later transferred to an ATEC-compatible computer by computer interface.

3.3 VO₂max Measurement

Maximal oxygen uptake (VO₂max) was measured using a continuous pedaling test performed on an electronically braked cycle

ergometer. The seats could be adjusted appropriately for each subject (Astrand and Rodahl, 1986).

Measurement of VO_2 max could get directly from the exercise test. Subjects were advised to rest on cycle ergometer for 5 minutes. After that, all subjects were familiarized with the testing procedures prior to data collection. Following a 5 minutes warm up at 0 watt (50-60 rpm.), the subject begin pedaling at a work load of 50 watt for 5 minute and this was increased by 20 watt every two minutes, while the pedaling constant at 50-60 rpm.

Gas analysis apparatus was calibrated by using ambient gas. The pneumotachograph signal was calibrated by using spirometer as standard volume calibrator. Heart rate was monitored continuously by ECG (Polar Electro, Finland). The test was terminated when one or more of the following criteria were achieved:

1. A test heart rate had reached 90%HRmax of the age related theoretical maximum ($220 - \text{Age}$) (ACSM, 1994).
2. Volitional exhaustion.
3. The subject was unable to continue pedaling at the prescribed rate.

Metabolic and respiratory measurements were obtained using a Cosmed K2 and include VE , VO_2 and FEO_2 , which were computed and displayed every 5 seconds.

3.4 Anaerobic Threshold (AT)

- (1.) AT was measured using a continuous incremental running test performed on a motorized treadmill (Fitness line, Taiwan).
- (2.) Begin the heart rate recording at the starting point, using a 5-second interval.
- (3.) Initial treadmill speed was 4 km/h and this was increased by 0.5 km/h every 200 meter, while the gradient remained constant at 0 %.
- (4.) End the test after heart rate have reached maximum heart rate and stop the recording.
- (5.) Download the data of the test exercise into computer for calculating the AT.

4. Experimental Protocol

Subjects were divided into 5 teams (Team A, B, C, D and E), which were competition for 4 game for each team (Table 2).

The first phase, subjects had a 2-3 sets match for measurement of HR during the game. They played the game wearing a transmitter and a receiver for recording HR and time period.

The HR during the game was monitored continuously with short range radio telemetry. The match-play was chosen to simulate an actual competition according to the rules of the Takraw Association of Thailand. The measurement was finished in the same week or not longer than 7 days, because the time interval must affect the accuracy of results.

The second phase, maximal oxygen uptake was measured in laboratory for calculated HR-VO₂ regression line and then the HR data from competition were then compared with HR-VO₂ regression line measured in the laboratory. The regression equations were established from their data to estimate energy expenditure competition.

Table 2. Shows competition event program.

Teams	A	B	C	D	E
A		A-B	A-C	A-D	A-E
B			B-C	B-D	B-E
C				C-D	C-E
D					D-E
E					

A-B = A versus B

5. Energy Expenditure (Exp.) Calculations

$$\text{Exp.} = \text{VO}_2 \text{ uptake} \times \text{RER (kcal/min)}$$

$$\text{Exp.} = \text{VO}_2 \text{ uptake} \times \text{RER} \times \text{Time (kcal)}$$

RER = Respiratory exchange ratio, (This study RER was assumed that = 1.00)

The conversion of oxygen uptake in to energy equivalents was 1L of O₂ = 5kcal (20.9 kJ) (Scott C.B., 1997).

6. Energy Contributions Measurement

The threshold of between Aerobic threshold (AerT) and Anaerobic threshold (AT) of heart rate indicates that anaerobic and aerobic system (LA-O₂) or transition zone. Higher levels of AT indicate that anaerobic or lactic acid system (LA) dominates, while lower levels indicate that the aerobic system (O₂) dominates. The equivalent threshold heart rate is said to be $\text{AerT} = \text{AT} - 20 \text{ bpm}$.

These energy contributions can be summarized as follows:

> AT = Anaerobic System (LA).

$\text{AerT} - \text{AT}$ = Anaerobic and Aerobic System (LA-O₂).

< AerT = Aerobic System (O₂).

7. Data Analysis

To identify significant differences between playing positions a one-way analysis of variance (ANOVA) was carried out on all variables. Where difference was found post-hoc analyses were employed using the Tukey Test. Significant was set at the 0.05 level of confidence. All data are reported as mean \pm SD.