CHAPTER V

DISCUSSION AND CONCLUSION

Discussion

Peak physiologic response during cycle pedaling.

The mean VO_2max for eighteen subjects (was 42 ml/kg/min) compares favorably with VO_2max values reported in other sports (Table 7) and reflects the relatively high level of aerobic power in these players.

This study revealed that VO_2max values were in fact relatively high as compared to these measured in other sports such as volleyball (48-52ml/kg/min) (Neumann, 1988), basketball (40-45ml/kg/min) (Neumann, 1988), therefore training of maximal aerobic power must be one of the fundamental components in a physical training program.

Physiological response to match-play.

The average HR (140 beats/min or 78 % of HRmax) that the current ST player maintained throuhout match-play suggests that ST is an appropriate activity for meeting the ACSM standards for developing or maintaining cardiorespiratory fitness (ACSM, 1990)

The heart rate responses of the subjects during competition indicated both the intermittent nature of the game and also the intensity of the exercise involved. Exercise intensity classification of physical activity was classified exercise as heavy it resulted in an energy expenditure and VO_2 in excess of 5.5 kcal/min and 19.9 ml/kg/min, respectively.

Classification of physical activity as heavy if it resulted in an energy expenditure in excess of 5.5 kcal/min (see table 6). The mean heart rate in this study is 140±8 beats/min and converted to estimated energy expenditure to an average of 6.1±1.2 therefore indicative of the high physiological requirement of the game. The HR also gives some idea of energy systems being used.

Figure 16 shows typical HR trace recorded during the entire match. It is into their submaximal and maximal on several occasions. It is reasonable to suggest that ST approximately a 75 % aerobic, 25% anaerobic contribution to energy expenditure. From the ratio of these two systems, it is evident that the conditioning programme for ST players should include both aerobic and anaerobic training.

The average exercise intensity maintained throughout match-play (54% VO_2max) is likely to elicit a physiological training effect (Astrand and Rodahl, 1987). It is reasonable therefore to suggest that the competitive match itself is a valuable training stimulus for the individual player and the number of matches a player can participate in is also a function of her training.

It has been demonstrated in numerous team sports that players execute different movement patterns on the court according to their positional requirements, and as such have different physiological demands imposed upon them (Bale, 1986). The heart rate data and estimated energy expenditure for the various playing positions, suggest that the Back-group, in particular the Right inside-group, is more physiologically demanding than the Left inside-group.

Factor that affect during match-play.

It is clearly established that heart rate is affected by factors other than workrate, and therefore estimations of energy expenditure based on heart rate data may be inaccurate. Temperature, (Brooks, Hittelman and Faulkner, 1971), emotion (McArdle, Foglia and Patti, 1967), and arm work (Vokac, 1975) have all been shown to alter the heart rate-VO_2 relationship. However, since the subjects did not have humidity conditions and did relatively little vigorous arm work, these are unlikely to affect the heart rate responses to any appreciable extent.

As far as the emotional influence on heart rate is concerned it has been suggested that psychological factors have more influence on heart rate at rate or during low intensity work, but at higher work intensities the emotional influence on heart rate is somewhat neutralized by the higher workload (Astrand and Saltin, 1961). The average exercise intensity recorded in this study was relatively high (54% VO_2max) suggesting therefore that the heart rates recorded during competition represent the actual work-rate. The level of experience of the players, as well as their familiarity with the testing procedures would also tend to reduce the psychological stress associated with elite ST.

At a given submaximal VO_2 or percent of VO_2max, the physiologic strain is greater in upper- compared to lower- body exercise (Sawka, 1986, Toner, 1990). More specifically, HR, pulmonary ventiration and perception of effort are used in comparison to exercise with the legs (Montoye, 19984).

The elevated HR response in submaximal arm compared to leg exercise is probably the result of a larger in put to the medullary control center from the central commaned in the brain (feed-forword stimulation) as well as an increased feedback stimulation to the medulla from peripheral recepters in active tissue with upper body exercise, a greater strain (i.e., force per unit muscle, greater percentage of maximum, and increased metabolic by-products) is placed on the relatively smaller upper body musculature for any level of submaximal exercise. This aguments perpheral feedback to the medulla, and there is an increase in HR (and blood pressure).

Method

Energy expenditure is typically estimated from HR through the use of a heart rate-oxygen uptake regression line. The HR-VO_2 line is developed by having the subject exercise in the laboratory at the different work rates, while HR and VO_2 are simultaneously recorded (Bardfield, 1971). Regression analysis is than applied to develop an equation, which predicts VO_2 from HR. This equation is then used to convert HR recorded in the field to VO_2.

Although the technique for using HR to estimate energy expenditure is practical, it is of limited use for research purpses its validity has yet to be adequately established for more than a few general activities. The VO_2

determined from HR measurements during ST is probably somewhat overestimated, as condition- such as static muscle contractions, environmental temperature, emotional stress, body position and muscle groups exercise that cause HR but not VO_2 to rise. During arm exercise or when muscles are acting statically in a straining type exercise, HR are consistently higher compared to dynamic leg exercise at any particular submaximal VO_2 uptake. Consequently, when HR-VO_2 line developed during running or cycling, the result is an overprediction of the actual oxygen uptake (Maas, 1989). However, the high correlation coefficients ordinarily obtained between HR and VO_2 (Christensen et al., 1984, Morgan and Bennett, 1976) support the use of the HR-VO_2 relation for estimating energy expenditure.

Conclusion

The result of the study of energy demands during competition in Thai National female Sepak Takraw athletes before the 1998 13th Asian Games, Thailand, are:

1. The means of heart rate responses to match-play was 140±8 beats/min in all playing positions.
2. The means of oxygen uptake (VO_2) during match-play was 22±5 ml/kg/min in all playing positions.
3. The means of exercise intensity (%VO_2max) during match-play was 54±10% in all playing positions
4. The means of energy expenditure during match-play was 6±1 kcal/min (25±5 kJ/min) and entire match was 271±52 kcal (1.1±0.2 MJ) in all playing positions.

5. The energy systems contribution of LA, LA-O_2, and O_2 during match-play were 25%, 43%, and 32%, respectively, in all playing positions.

The aforementioned results suggested that a heart rate monitoring is a feasible method of estimating energy expenditure in elite female Sepak Takraw athletes. The competitive match-play is a non-continuous, high intensity, intermittent activity which places heavy demands on the aerobic energy system. The level of performance in a match requires players to exercise above 54% VO_2max and expend energy at relatively high levels.

Table 6 . Five-level classification of physical activity in terms of exercise intensity[a].

Level	*Energy Expenditure*			
	Men			
	Kcal/min	L/min	ml/kg/min	METs
Light	2.0-4.9	0.40-0.99	6.1-15.2	1.6-3.9
Moderate	5.0-7.4	1.00-1.49	15.3-22.9	4.0-5.9
Heavy	7.5-9.9	1.50-1.99	23.0-30.6	6.0-7.9
Very heavy	10.0-12.4	2.00-2.49	30.7-38.3	8.9-9.9
Unduly heavy	12.5-	2.50-	38.4-	10.0-
	Women			
	Kcal/min	L/min	ml/kg/min	METs
Light	1.5-3.4	0.30-0.69	5.4-12.5	1.2-2.7
Moderate	3.5-5.4	0.70-1.09	12.6-19.8	2.8-4.3
Heavy	5.5-7.4	1.10-1.49	19.9-27.1	4.4-5.9
Very heavy	7.5-9.4	1.50-1.89	27.2-34.4	6.0-7.5
Unduly heavy	9.5-	1.90-	34.5-	7.6-

[a]L/min based on 5 kcal/l of oxygen; ml/kg based on man and 55-kg woman; one MET is equivalent to the average oxygen uptake.

Table 7 . Typical values of maximal oxygen intake in various sports.

	Maximal oxygen intake(ml/kg/min)	
Type of event	Men	Women
Endurance sports		
Long-distance running	75-80	65-70
Middle-distance running	70-75	65-68
Road cycling	70-75	60-65
Swimming	60-70	55-60
Canoeing	60-68	50-55
Walking	60-65	55-60
Games		
Football (soccer)	50-57	-
Handball	55-60	48-52
Ice hockey	55-60	-
Volleyball	55-60	48-52
Basketball	50-55	40-45
Tennis	48-52	40-45
Table tennis	40-45	38-42

Modified from Neumann, 1988.