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RESEARCH ARTICLE

Cardiopulmonary changes in male KHO KHO players during a periodized training year

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ABSTRACT

The aim of the current study was to obtain cardiopulmonary changes of male kho kho players and to monitor any changes at designated points within the periodized training year. The subjects employed in the present study were twelve male kho kho players. Testing took place at four points during the periodized training year; at the beginnings of general preparation (T1), specific preparation (T2), and competition phase beginning (T3) end of competition phases of training and peaking (T4). The cardiopulmonary variables selected for the investigation are resting heart rate, peak heart rate, aerobic capacity, forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). The repeated measures of analysis of variance (ANOVA) indicated significant differences between testing sessions for resting heart rate, peak heart rate and VO_2 max. *Post-hoc* analysis revealed that the significant differences for resting heart rate and peak heart rate.

Key words: Kho Kho, Physiological, aerobic capacity, heart rate, bodymass, training year.

INTRODUCTION

Kho-Kho is considered to be one of the most popular traditional sports in India and it is played quite extensively in the country. The origin of Kho-Kho is difficult to trace, but many historians believe, that it is a modified form of 'Run Chase', which in its simplest form involves chasing and touching a person. With its origins in Maharashtra, Kho-Kho in ancient times, was played on 'raths' or chariots, and was known as Rathera. This game is simple, inexpensive and enjoyable. This can be played by men, women and even children. It is essentially a version of tag, which endows it with a few qualities - it is both simple, and inexpensive - that make the game as enduring as it is endearing. Inside are some of the salient features of the game to enable you to appreciate and understand it. The game of Kho-kho basded on natural principles of Physical and Mental developdment, is vigorous and fosters a healthy combative spirit among the youth. Kho-Kho demand physical fitness, strength, speed and endurance, and a certain amount of agility. Dodging, feinting and bursts of controlled speed make this game quite thrilling. To catch by pursuit - to chase, rather than just run - is the capstone of Kho-Kho. The game develops psychological qualities such as obedience, discipline, sportsmanship, and loyalty between team members.

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Monitoring of a training programme provides useful information to both scientists and coaches in relation to its effectiveness, the athlete's physical condition and preparation for competition [1]. In order for monitoring to be effective (i.e. providing updated and accurate information on physiological profiling), the tests need to be administered at regular, pre-determined intervals based on training cycles. Additionally, testing should be specific to the sport [2], ideally conducted in the athlete's training environment in order to obtain ecologically valid and reliable results. A situation where physiological, anthropometric and sport-specific data can be obtained simultaneously provides the most accurate and informative results, due to the ease of comparisons and the complete profiling achieved [3,4]. Periodizedtraining programs that focus on the development of explosive power in the land surface, and high-intensity cardiorespiratory conditioning are often utilized to enhance the sports-specific fitness of kho kho players and ensure their performance is maximized during the competitive season. Monitoring can be deemed a vital aspect of periodized planning. Research in other team sports has suggested that changes in performance parameters over the course of a season may not follow the expected trend. It was found that preseason training of field hockey players decreased body fat percentage, increased maximum oxygen uptake, but decreased muscular strength [5]. Furthermore, it was found decreases in maximum oxygen uptake and muscle mass over the course of a competitive women's soccer season [6]. Finally, it was found to increases in muscular strength, but only in sport-specific activities, in female handball players over the course of a competitive

season [7].Cardiorespiratory function is critical to the performance of many sports and physical activities, such as kho kho, long distance running and swimming. In endurance-trained adult athletes, the cardiorespiratory system typically shows evidence of having undergone a series of favorable adaptations [8], which are thought to contribute to performance. Exercise produce a marked change in cardiovascular and lungs are no exception. Sedentary life styles could be associated with less efficient cardio and pulmonary functions. There are several studies that have shown significant improvement in pulmonary functions as a result of the effect of exercise [9, 10, 11].

There are several studies which show significant change in cardiovascular functions as an effect of exercise [12, 13]. The aim of this study was to determine if any cardiopulmonary changes of male kho kho players and to monitor any changes at designated points within the periodized training year. Cardiovascular and lung function were checked four times in the year. As the level of training and quality of inhaled air can be confounding factors in the development of respiratory disorders in athletes [14], time and intensity of training, and meteorological data were collected presented in table 1, however allergen and air pollution data were not collected.

Table 1. Metrological data recorded during testing of kho-kho players within the periodized training year

Parameters	T1	T2	T3	T4
Mean temperature	27°C	32°C	29°C	27°C
Maximum temperature	32°C	39°C	34°C	31°C
Minimum temperature	22°C	26°C	24°C	23°C
Average humidity	74	64	67	86

MATERIALS AND METHODS

Subjects

The subjects employed in the present study were twelve male kho kho players from the Annamalai University team (Mean ± SD: Age 22.0 ± 2.4 years, Height 168.7 ± 7.9 cm, Body Mass 65.9 ± 6.1 kg) preparing for the 2011 South Zone Inter University Kho Kho tournament. All the players had been part of the team for a minimum of 2 years. The study was approved by the Departmental Ethics Committee and the players provided written, informed consent to participate. All subjects were familiar with all the testing that took place, which included both field and laboratory assessments.

Testing Procedure

Testing took place at four points during the periodized training year; at the beginnings of general preparation (T1), specific preparation (T2), and competition phase beginning (T3) end of competition phases of training and peaking (T4). A full testing battery was conducted at T1 and T4, while two minor testing sessions were conducted at T2 and T3.A schematic figure of the periodized year can be found in Figure 1.

Table 1. A schematic representation of the periodized training year of the Annamalai University Kho Kho team. The different training phases, as well as the testing points are presented.

March	April	May	June	July	Aug	Sep	Oct	Nov
General preparation T1			Specific preparation T2			Competition T3		Peak T4

The study commenced after the end of the previous competitive season and at the beginning of the general preparation phase of training. The training year was divided into three mesocycles (general preparation, March to May; specific preparation, June to August; competition, September to November). The players trained daily and thus it is not possible to quantify exact training loads. The battery of tests utilized was based on selected anthropometrical and cardiopulmonary parameters, comprising both laboratory and sport-specific protocols. All subjects were familiarized with the procedures prior to testing. Sport-specific testing had been used frequently as part of the training programme, while for the laboratory-based tests the subjects undertook specific familiarization trials prior to the testing sessions. The subjects had been instructed to refrain from strenuous exercise for forty-eight hours prior to testing and to avoid food and caffeine intake for two hours preceding the assessments. All subjects completed testing at the same time of day to avoid any circadian rhythm effects [15].

Variables and Tests

The variables and tests selected for the study are presented in Table 2.

Table 2. Variables and tests selected for investigation

No	Variables	Tests/Measures
1	Height (cm)	Stadiometer
2	Body mass (kg)	Digital standing scale
3	Resting heart rate (bpm)	Automated upper arm-cuff HR monitor (Omron)
4	Peak heart rate (bpm)	Automated upper arm-cuff HR monitor (Omron)
5	Aerobic capacity (ml/kg/min)	Treadmill (Bruce protocol)
6	Forced vital capacity (FVC) (Litres)	SpiroStar DX Spirometer (Finland)
7	Forced expiratory volume in one second (FEV_1) (Litres)	SpiroStar DX Spirometer (Finland)

Statistical analyses

Descriptive statistics were calculated for all variables. A repeated measures analysis of variance (ANOVA) was utilized to determine significant differences for each variable between the testing sessions. Tukey's *post-hoc* test was used to locate differences between testing sessions. Significance level was set at $P < 0.05$. All statistical analyses were conducted using SPSSv11.5.

RESULTS

Descriptives (mean ± SD) of the results can be found in Table 2. Repeated measures of analysis of variance (ANOVA) indicated significant differences between testing sessions for resting heart rate ($F = 8.05$, $P = 0.001$), peak heart rate ($F = 48.30$, $P = 0.001$) and aerobic capacity ($F = 4.95$, $P = 0.006$). No statistically significant differences were found

for height, body mass, FVC and FEV_1. *Post-hoc* analysis revealed that the significant differences for resting heart rate existed between T1-T2, for peak heart rate between T1- T2, T1-T3, T1-T4, T2-T4, and T3-T4. Aerobic capacity showed no significant difference in post-hoc analysis. The percentage reduction for resting heart rate between T1-T2 was 7.30%. The reductions in peak heart rate between T1- T2, T1-T3, T1-T4, T2-T4, and T3-T4 were 3.25%, 5.99%, 8.11%, 5.02%, and 2.25% respectively.

Table 2. Physiological assessment results for all four testing sessions (T1,T2,T3&T4)

Variables	Testing Sessions					
	T1	T2	T3	T4	F	Sig.
Height (cm)	170.0±10.8	170.0±10.8	170.0±10.8	170.0±10.8	0	$P > 0.05$
Body mass (kg)	65.19±2.37	65.69±1.73	64.77±1.51	64.60±1.47	1.34	$P > 0.05$
Resting heart rate (bpm)	58.9±2.71	54.6±2.34	56.9±2.46	56.3±2.10	8.05*	$P < 0.001$
Peak heart rate (bpm)	161.16±4.78	155.91±5.03	151.50±7.76	148.08±6.62	48.30*	$P < 0.001$
Aerobic capacity(ml/kg/min)	58.90±1.15	60.09±1.48	59.84±1.14	59.81±1.09	4.95*	$P < 0.006$
FVC (Litres)	3.84±0.44	3.96±0.56	4.12±0.53	4.06±0.49	1.67	$P > 0.05$
FEV_1 (Litres)	3.50±0.53	3.62±0.62	3.77±0.73	3.71±0.74	1.41	$P > 0.05$

*Significant at 0.05 level of confidence

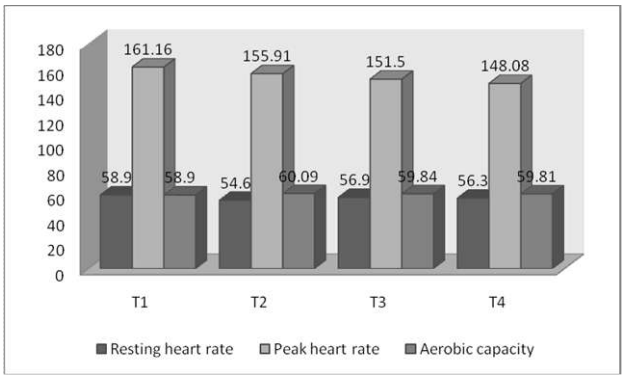

Figure 2. A schematic representation of the resting heart rate, peak heart rate and aerobic capacity of Kho Kho players at different training phases, as well as the testing points are presented

DISCUSSION

This is the first study to monitor physiological parameters over an entire periodized season in male kho kho players of Annamalai University. Periodization aims to maximize performance by organizing the training duration into distinct periods and reducing the potential for injury [16,17]. The training duration is usually divided into larger training phases (macrocycles) further divided into smaller ones (microcycles) [16,17]. Each cycle has its own aims, emphasizing different objectives, with the athlete ideally peaking at the major goal of the training programme [16,17]. The primary findings of the current study demonstrated that significant alterations in resting heart rate, peak heart rate and VO_2 max are presented in figure 2. No changes, however, occurred during the season in any measure of height, body mass, FVC and FEV_1. It is interesting to note that running VO_2max did not change over the seasons probably because of insufficient increases in training volume and/or intensity to induce cardio-respiratory adaptations or because subjects had reached their potential in this component. Similar results over yearly phases of training have been reported by others [18,19,20]. It has been suggested that the maintenance training program performed by athletes during the regenerative phase is sufficient to maintain their VO_2max in spite of a fairly reduced volume [18]. This tends to indicate that, in well trained subjects, maximal trainability appears to be maintained with a relatively small volume of training provided that training intensity is adequate [21,22]. In cardiovascular system a significant difference was observed in resting heart rate and peak heart rate values during a training year of kho kho players. These results are in agreement with some previous reports [23,24,25,26,27,28].

However, in pulmonary parameters, the values of FVC, and FEV_1 at rest were found to be not significant at four points during the periodized training year. There was slight change was noted in FVC and FEV_1 could be explained due to better strengthening of respiratory muscles as a result of physical training. Skeletal muscle control many crucial elements of aerobic conditioning including lung ventilation. There might be increase in the maximal shortening of the inspiratory muscles as an effect of training, which has been shown to improve the lung function parameters [29]. In the Amsterdam Growth and Heart study, physical activity was observed to be positively correlated to changes in FVC between ages 13-27 years over a period of 15 years [30]. This is supported by a number of previous studies as well [31, 32, 33, 34]. A recent study also observed increment in FVC as an effect of increased physical activity [35].

Conclusion

The current study is the first to examine the cardiopulmonary changes of kho kho players over the course of a periodized training year. The results demonstrated that significant alteration in aerobic capacity, resting heart rate and peak heart rate occurred as the training year progressed.

REFERENCES

[1] Johnson, G.O., L. J. Nebelsick-Gullett, W. G. Thorland, and T. J. Housh. 1989. The effect of a competitive season on the body composition of university female athletes. J Sports Med Phys Fitness, 29:314-320.

[2] Pavicic, L., E. Tomany, and V. Lozovina. 2000. A study of anthropometric differences among elite water polo players with different team role assignments. In Proceedings of the 2000 Pre - Olympic Congress (p. 503). Brisbane: Australian Sports Commission.

[3] Rodríguez, F. A. (1994). Cardiorespiratory and metabolic field testing in swimming and water polo: from physiological concepts to practical methods. In Keskinen, K. L., Komi, P. V., & Hollander, A. P. (Eds). VIII International Symposium on Biomechanics and Medicine in Swimming (pp. 219-226). Jyväskylä: Gummerus Printing.

[4] Tumilty, D., Logan, P., Clews, W., & Cameron, D. (2000). Protocols for the physiological assessment of elite water polo players, In Gore, I. (Ed). Physiological tests for elite athletes (pp. 411-421). Champaign, IL: Human Kinetics.

[5] Astorino, T. A., P. A. Tam, J. C. Rietschel, S. M. Johnson, and T. P. Freedman. 2004. Changes in physical fitness parameters during a competitive field hockey season. J Strength Cond Research., 18(4): 850-854.

[6] Miller, T. A., R. Thierry-Aguilera, J. J. Congleton, A. A. Amendola, M. J. Clark, S. F. Crouse, S. M. Martin, and O. C. Jenkins. 2007. Seasonal changes in VO2max among Division 1A collegiate women soccer players. J Strength Condit Res, 21(1):48-51.

[7] Gorostiaga, E. M., C. Granados, J. Ibañez, J. J. González-Badillo, and M. Izquierdo. 2006. Effects of an entire season on physical fitness changes in elite male handball players. Med Sci Sport Exerc, 38(2):357-366.

[8] Ikaheimo MJ, Palatsi IJ, Takkunen JT. 1979. Noninvasive evaluation of the athletic heart: sprinters versus endurance runners. Am J Cardiol 44:24–30.

[9] Chandran CK, Nair HK, Shashidhar S 2000. Respiratory functions in kalaripayattu practitioners. India J Physiol Pharmacol, 48(2): 235-240.

[10] Cedric N, Fabien D, Comlavi G, Georges B, Claudine F, et al. 2005. High intensity intermittent running training improves pulmonary function and alters exercise breathing pattern in children. Eur J Appl Physiol, 94: 415-423.

[11] Shivesh P, Sushant M, Ujjwal R 2007. Athletes, yogis and individuals with sedentary lifestyles; do their lung functions differ? Ind J Physiol Pharmacol, 51(1): 76-80.

[12] Smith SA, Humphrey RH, Wohlford DLF. 1994. Myocardial adaptation and weight fluctuation in college wrestlers. Int J Sports Med 15:70–3.

[13] Stork T, Mockel M, Muller R. 1992. Left ventricular filling behavior in ultra endurance and amateur athletes: a stress Doppler-echo study. Int J Sports Med 13:600–4.

[14] Maiolo C, Fuso L, Todaro A, et al. 2004. Prevalence of asthma and atopy in Italian Olympic athletes. Int J Sports Med; 25:139–44.

[15] Atkinson, G., and T. Reilly. 1996. Circadian variation in sports performance. Sports Medicine, 21: 292-312.

[16] Kraemer, W. J., N. D. Duncan, and J. S. Volek. 1998. Resistance training and elite athletes: adaptations and program considerations. J Orthop Sports Phys Ther, 28:110-119.

[17] Stone, W. J., and P. M. Steingard. 1993. Year-round conditioning for basketball. Clin Sports Med, 12: 173-191.

[18] Barbeau, P., O. Serresse, and M. R. Boulay. 1993. Using maximal and submaximal aerobic variables to monitor elite cyclists during a season. Medicine and Science in Sports and Exercise, 25:1062-1069.

[19] Bunc, V. and J. Heller. 1989. Energy cost of running in similarly trained men and women. European Journal of Applied Physiology and Occupational Physiology, 59:178-183.

[20] Perez, H. R. 1981. The effects of competitive road racing on the body composition, pulmonary function, and cardiovascular system of sport cyclists. Journal of Sports Medicine and Physical Fitness, 21:165-172.

[21] Hickson, R. C., C. Foster, M. L. Pollock, T. M. Galassi, and S. Rich. 1985. Reduced training intensities and loss of aerobic power, endurance, and cardiac growth. Journal of Applied Physiology, 58:492- 499.

[22] Koutedakis, Y. 1995. Seasonal variation in fitness parameters in competitive athletes. Sports Medicine, 19:373-392.

[23] Basset, F. A. and M. R. Boulay. 2000. Specificity of treadmill and cycle ergometer tests in triathletes, runners and cyclists. European Journal of Applied Physiology and Occupational Physiology, 81:214- 221.

[24] Martinez, M. L., A. Modrego, J. Ibanez Santos, A. Grijalba, M. D. Santesteban, and E. M. Gorostiaga, 1993. Physiological comparison of roller skating, treadmill running and ergometer cycling. International Journal of Sports Medicine, 14:72- 77.

[25] McArdle, W. D. and J. R. Magel. 1970. Physical work capacity and maximum oxygen uptake in treadmill and bicycle exercise. Medicine and Science in Sports and Exercise, 2:118-123.

[26] Medelli, J., Y. Maingourd, B. Bouferrache, V. Bach, M. Freville, and J. P. Libert. 1993. Maximal oxygen uptake and aerobic-anaerobic transition on treadmill and bicycle in triathletes. Japanese Journal of Physiology, 43:347-360.

[27] Schneider, D. A. and P. Pollack, .1991. Ventilatory threshold and maximal oxygen uptake during cycling and running in female triathletes. International Journal of Sports Medicine, 12:379- 383.

[28] Zhou, S., S. J. Robson, and A. J. Davie. 1997. Correlations between short-course triathlon performance and physiological variables determined in laboratory cycle and treadmill tests. Journal of Sports Medicine and Physical Fitness, 37:122-130.

[29] Fanta CH, Leith DE, Brown R 1983. Maximal shortening of inspiratory muscles: effect of training. J Appl Physiol, 54: 1618-1623.

[30] Twisk JW, Staal BJ, Brinkman MN, Kemper HCG, Van Mechelen W 1998. Tracking of lung function parameters and the longitudinal relationship with lifestyles. Eur Respir J, 12: 627-634.

[31] Armour J, Donnelly PM, Bye PT 1993. The Large Lungs of Elite Swimmers: An Increased Alveolar No. Eur Respir J, 6(7): 237-247.

[32] Lakhera SC, Kain TC, Bandopadhyay P 1994. Changes in lung functions during adolescence in athletes and non athletes. J Sports Med Phys Fitness, 34(3): 258- 264.

[33] Mehrotra PK, Verma NS, Tiwari S, Kumar P 1998. Pulmonary functions in Indian sportsmen playing different sports. Ind J Physiol Pharmacol, 42(3): 412-416.

[34] Birkel DA, Edgren L 2000. Hatha Yog; improved vital capacity of college students. Altern Ther Health Med, 6: 55-63.

[35] Fuster V, Rebato E, Rosique J, Fernandez Lopex JR 2008. Physical activity related to Forced Vital Capacity and strength performance in a sample of young males and females. Coll Antropol, 32(1): 53-60.