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CHANGES IN LUNG VOLUMES DURING A PERIODIZED TRAINING YEAR OF HANDBALL PLAYERS

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ABSTRACT

The aim of the current study was to assess the changes in lung volumes during a periodized training year of handball players. The subjects employed in the present study were fourteen male handball 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 lung volumes selected for the investigation are forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), FEV_1/FVC and peak expiratory flow (PEF). The repeated measures of analysis of variance (ANOVA) indicated no significant differences between testing sessions for FVC ($F = 1.675$, $p > 0.05$), FEV_1 ($F = 1.415$, $p > 0.05$), FEV_1/FVC ($F = 0.971$, $p > 0.05$) and PEF ($F = 1.349$, $p > 0.05$). It is concluded that lung volumes remain unaltered during a periodized training year of handball players.

INTRODUCTION

The lungs serve a primary function of transferring oxygen from the atmosphere to the blood, and for the removal of carbon dioxide from the body. Pulmonary ventilation, or breathing, is the movement of air into and out of the lungs. Lung volume figures are not particularly important in determining athletic performance. Pulmonary diffusion is the exchange of oxygen and carbon dioxide between the lungs and the blood. In normal individuals, pulmonary diffusion is not a limiting factor to VO_2max. However, in well-trained endurance athletes, with much higher cardiac outputs (which is the product of heart rate and stroke volume), pulmonary diffusion may become a limiting factor to VO_2max. The very high cardiac outputs that highly trained athletes attain shortens the time period for blood to pick up oxygen in the lungs, possibly leading to lower blood oxygen saturation levels (Robergs and Roberts, 1997). Despite this possibility, pulmonary diffusion is thought to play a minor role in the overall limitation of oxygen delivery for endurance performance.

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Evaluating and understanding of physiological capabilities throughout the course of a training season may be of great value in prespective of physical performance. The training imposes cardiovascular and pulmonary adaptation and their effect on performance are noticed. Lack of studies on empirically investigating the adaptation of physiological capabilities during a training season has motivated to taken up a study in enriching quantum of theory in the field of training methods. The aim of the current study was to assess the changes in lung volumes during a periodized training year of handball players.

MATERIALS AND METHODS

Subjects

The subjects employed in the present study were fourteen male handball players from the Annamalai University team (Mean ± SD: Age 23.0 ± 3.4 years, Height 174.7 ± 7.9 cm, Body Mass 69.4 ± 6.1 kg) preparing for the 2013 South Zone Inter University handball tournament. All the players had been part of the team for a minimum of 2 years. All subjects were familiar with all the testing that took place, which included both field and laboratory assessments.

Table 1. Lung volumes during per iodized training year

Variables	Testing Sessions				F	Sig.
	T1	T2	T3	T4		
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	$p > 0.05$
FEV_1/ FVC (in %)	91.0±8.84	91.4±7.62	91.5±7.32	91.3±7.61	0.97	$p > 0.05$
PEF	7.70±1.94	7.91±1.39	8.13±1.71	7.98±1.53	1.34	$p > 0.05$

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.

The study commenced after the end of the previous competitive season and at the beginning of the general preparation phase of training. The handball 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 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 lung volumes (FVC, FEV_1, FEV_1/FVC and PEF) are measured through SpiroStar DX Spirometer (Finland), which is available at SAP Laboratory, Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram, Tamilnadu, India. Handball players were taken to laboratory and measures lung volumes FVC, FEV_1, FEV_1/ FVC and PEF. These can be measured with a full maximal expiration. The subjects were asked to fill their lungs completely, seal their lips around the mouthpiece, and empty their lungs as hard and fast as possible. The better of two trials is recorded. A complete Spirometry exam, including explanation and setup, should take no more than 15 minutes.

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 1. Repeated measures of analysis of variance (ANOVA) indicated no significant differences between testing sessions for FVC, FEV_1, FEV_1/ FVC and PEF. Since F is not significant post hoc test was not applied.

DISCUSSION

There is an increasing evidence to show that pulmonary functions improves significantly as a result of exercise (Shashikala and Sarath, 2011 Courteix *et al*., 1997; Yu *et al*., 2004). Possible explanation for this could be regular forceful inspiration and expiration for prolonged period during training leads to strengthening of the respiratory muscles. This helps the lungs to inflate and deflate maximally. This maximum inflation and deflation is an important physiological stimulus for the release of surfactant (Hildebrean *et al.,* 1981). Athletes with greater inspiratory muscle strength alone doesn't improve lung volume but height, fat free mass, alveolar distensibility, age at start of training, sternal length or chest depth, wider chests, containing an increased number of alveoli also contribute to the changes in lung (Armour, Donnelly and Bye, 1993). However, there are studies which show no significant change in pulmonary functions as an effect of exercise (Hamilton and Andrew 1976; Kuppu Rao and Vijayan 1988). The training workload of athletes increases during the course of the sport season. Consequently, phases of hyperventilation are more common and longer during the competitive period.

In spite of a progressive increase in the training work load over the course of the year, no significant reductions in FVC and FEV_1 were noted at rest and after exercise. Surprisingly, FEV_1 increased over the 12 months of the study, although the heights of the athletes did not change significantly. This increase in the FEV_1 at rest from basic endurance training to competition was not statistically significant (Pellegrino et al., 2005). In the present study reveal that FVC, FEV_1, FEV_1/ FVC and PEF showed slight alteration but statistically no significance was elicited. This finding is in accordance with Pellegrino *et al*., (2005). This suggests that lung capacity was not influenced by different phases of training on handball players. The Values for FVC and FEV1 in the present study were within the normal range of the male population and not significantly different between squads neither from values reported from studies of soccer players by other investigators (Resina *et al*., 1991; Biancotti *et al*., 1992).

Conclusion

The current study is the first to examine the lung volume changes of handball players over the course of a periodized training year. It is concluded that lung volumes remain unaltered during a periodized training year of handball players.

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