Effects on Haemoglobin Concentrations with 15-day Altitude Training on Female Hockey Players

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ABSTRACT

High attitude training has yet to prove its efficacy vis-a-vis the Conventional Fartlek and Interval training. The aim of this study was to see whether a 15-day high attitude training at 2450m above sea level was good-enough to bring desired physiological adaptation in terms of haemoglobin content in case of 19 junior female field players. Analysis of pre-and post training blood samples of the subjects showed non signified effects due possibly to insufficient training period.

INTRODUCTION

The pursuit of maximal aerobic performance has been one of the goals of coaches, physiologists and scientists since the inception of organised sport. Coaches and athletes alike have strived to identify methods in which their maximal aerobic capacity could be increased so as to potentially improve performance. Medthods used to improve this characteristic in athletes have ranged from Fartlek training (Bale, Bradbury & Colley, 1986) and high intensity interval training (Laursen & Jenkins, 2002) to more modern or non-conventional methods such as altitude training (AT) (Levine & Stray-Gunderson, 1997). The common theme of all these training methods is to elicit physiological adaptation pertaining to mitochondrial capacity, anaerobic enzyme activity, increased oxygen carrying capacity and increased oxygen utilization (Bailey & Davies, 1997; Geiser et al., 2001). It has been suggested that training in a hypoxic environment, for example, at altitudes at least 2500 metres above sea level, the increased training stimulus places an increased load on the athlete, thereby amplifying some

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physiological benefits (Bigard, Brunet, Guezennec & Monod, 1991; Terrados, Mizuno & Andersen, 1985). One of the most common is to seek the increased oxygen (O_2) carrying capacity or increased haemoglobin (Hb) concentration of the blood (Bale et al., 1986; Levine & Stray-Gunderson, 1997).

This increase in Hb has been shown in previous studies to lead to increase performance markers (Celsing, Svedenhag, Pihlstedt & Blom, 1987; Wolfarth, Heinicke, Heinicke & Schmidt, 2005). It is thought that the reduced PO_2 seen at eltitude increases erythropoietin (EPO) release and in turn causes a marked increase in red blood cell volume (Schmidt, Spielvogel, Eckardt, Quintela & Penaloza, 1993). This increase in red blood cell volume increases the O_2 carrying capacity of the blood. This increase in O_2 carrying capacity has been shown to equate increased values in performance markers such as VO_2 max (Celsing et al., 1987). These increases in performance markers are the desired effects sought by coaches and physiologists working with athletes through variety of endurance based sports.

Research on altitude training in team sports is in a paucity of studies in regard to the effects of altitude training involving field hockey athletes (Bishop & Girard, 2013). The aim of the present study was to investigate the haematological adaptations, in particular Hb after a bout of altitude training. This study implemented a protocol based around living and training at altitude which is in contrast to many other studies in which athletes train above 2500m but live below this level (Geiser et al., 2001) and others that have investigated the effects of training at sea level and living at altitude (Levine & Stry-Gunderson, 1997). It was hypothesised that the relatively short altitude exposure time in this study will fail to illicit significant increases in Hb concentration. This assumption is reinforced by Bailey & Davies (1997) who state a three week period is the minimum time frame for optimal haematological adaptations to take place.

METHODOLOGY

The present study recruited a total of 26 junior elite, female field hockey players. Due to the inability to obtain data both before departing of altitude and returning to sea level, the data of 7 athletes were not included thus leaving a total pool of 19 participants (age 18.47 ± 1.43). These participants were asked to provide blood samples for analysis of blood haemoglobin prior to departing for a 15-day training. The training was completed at the Rajiv Gandhi Altitude Training Centre, Shilaru, Himachal Pradesh (altitude 2450m). All participants were pre-screened for injury and the training was provided as a conditioning phase in the annual cycle. On return to sea level, blood samples were again collected for analysis. This was completed within 24 hours of return to see level.

Upon data collection, statisical analyses took place. A paired sample t-test was performed whilst correlations between base level and the difference between the two tests were also calculated.

RESULTS

Table 1 displays the descriptive statistics pre and post altitude training.

From Table 1 a non-significant mean difference between Haemoglobin concentrations pre and post altitude training

Table-1: Haemoglobin concentrations seen prior to and post altitude training

	[Hb] Pre	[Hb] Post	Difference	Effect size
Mean ± SD	11.24 ± 1.40	11.88 ± 0.74	0.64 ± 55	0.55
SE mean	0.321	0.171	0.332	

Haemoglobin concentration prior to altitude training [Hb] Per, haemoglobin concentration post altitude training [Hb] Post. Data presented as mean values ± standard deviation, Gm/dl

(11.24 ± 1.40 to 11.88 ± 0.74 Gm/dl) is viable. The moderate effect size also demonstrates a defference between the two trials, however this was not large enough to be significant at the $p \leq 0.05$ level (0.07). A strong correlation (0.86) was seen between pre-altitude results and the difference between pre and post altitude indicating that previously increased contentrations of Hb will see larger gains in the period exposed to altitude.

DISCUSSION

The results displayed support the hypotheses that a 15 day period of exposure to altitude is insufficient to elicit significant haematological adaptations in pre elite athletes. This has been supported by multiple authors, stating that a three week period is needed to see benefits great enough to convert to increased performance (Bailey & Davies, 1997; Dick, 1992). Given longer periods of exposure to altitudes such as those seen at Rajiv Gandhi Altitude Training Centre, there is reasonable evidence to suggest that greater physiological adaptations can be caused.

The non-significant adaptations seen in this study may also be due to other physiological factors. Much research has been conducted on the increased demand on iron stores in altitude (Hannon, Shields & Harris, 1969; Reynafarje, Lozano & Valdivieso, 1959). It is believed that the increased demand for iron mobilisation leads to decreased levels of erythropoiesis and thus limits the adaptive ability of the body (Stray-Gunderson, Alexander, Hochstein & Levine, 1992). This is possibly due to the already low values of Hb seen prior to departing for altitude training. The inability to gain an insight into full iron status however limits the certainty with which this claim can be made.

PRACTICAL IMPLICATION

As stated above, give longer periods of exposure there is reasonable evidence to suggest that altitude training in India can elicit sigificant haemotological changes in elite hockey athletes. These changes are yet to be investigated for their carry over value to athletic performance; however, increased physiological capacities at least allow for the possible enhancement of performance. The testing of performance characteristics per and post altitude training is an area that requires further emphases before the effectiveness of this method of training is taken for grant.

Certain other considerations need to be kept in view when attempting to implement altitude training programes. One these concerns the iron reserve the female athlete populate. Given the greatly increased demands of the iron reserves of the body, placing athletes with depleted iron reserves in a high altitude environment may decrease performance as well as place them at increased risk of disease and immuno-suppression. It is imperative that athletes are given full panel blood testing to investigate the iron status and assess the risk of placing the athlete is such a demanding environment.

Secondary to this would be the consideration of supplementation. Along with a well-planned preparatory period, athletes entering high altitude environments have an increased need for iron supplementation. This will help to ensure that desired haematological adaptations are possible without relying on an already depleted source. This supplementation plan needs to be prospective in nature and started prior-one month as a minimum guide - to an athlete departing for altitude. Give strict guidelines and allowing time for adaptation, there may be an excellent opportunity for hockey athletes to increase performance on return to sea level.

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