INFLUENCE OF HIGH ALTITUDE TRAINING AND LOW ALTITUDE TRAINING ON SELECTED BIOCHEMICAL VARIABLES AMONG LONG DISTANCE RUNNERS

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Abstract:

Background: the main aim of this research was to evaluate the effectiveness of high altitude training and low altitude training on selected biochemical variables among long distance runners. **Method:** Therefore the purpose of the study was to investigate the influence of high altitude training and low altitude training on High density lipoprotein, Low density lipoprotein, and Total cholesterol among long distance runners. In this study thirty (30) subjects, of long distance runners were randomly selected in high altitude training group and in low altitude training group, fifteen (15) in each group. (n=30). **Timeline:** The high altitude training and in low altitude training consisted of 45-60 min/day, 3 days in a week till twelve weeks from the affiliated colleges of Kashmir University, Srinagar. Biochemical variables completed of the both groups at zero time and after twelve weeks of high altitude training and in low altitude training intervention group. **Results:** In present study, HDL (45.53 ± 4.91, 45.47 ± 3.98), LDL (134.33 ± 5.15, 134 ± 4.85) and TC (217.92 ± 7.34, 217.60 ± 8.97) were changed significantly. **Conclusion:** The advantage of high altitude training is that the muscles get a natural boost when more oxygen is available during lower-altitude training. High altitude training gives greater reduction of LDL and Total cholesterol compared to low altitude training. Both training was given better benefits of HDL. Therefore high altitude training and low altitude training covered in this study are beneficial for the long distance runners.

Keywords: High Altitude Training, Low Altitude Training, Paired 't' test, Biochemical variables, Long Distance Runners.

Introduction:

Nowadays, altitude training has become a standard training protocol in many aerobic sports to increase exercise capacity at sea level or to acclimatize prior to competitions at altitude or before ascending to altitude (Wilber, 2007). Sudden exposure of the human body to a hypoxic environment or staying at altitude induces numerous adaptations which can lead to improved athletes' performance at sea level. These mechanisms are generally attributed to either hematological (Levine and Stray-Gundersen, 1992), cardiovascular (Naeije, 2010), or ventilatory (Townsend et al., 2016) effects of altitude training. However, altitude training can also lead to improved muscle buffering capacity (Gore et al., 2001), increased glycolytic enzyme activity (Katayama et al., 2004), enhanced capillary density (Vogt et al., 2001), muscle mitochondrial volume (Geiser et al., 2001), and myoglobin concentration (Terrados et al., 1990; Zoll et al., 2006). Expected effects may be achieved by applying one of the recognized high-altitude training methods, i.e., live high-train high (LH-TH), live high-train low (LH-TL), and live low-train high (LL-TH). An up-to-date survey of altitude training methods with a modified nomenclature which analyzed the opportunities to combine different hypoxic methods was conducted by Millet et al. (2013).

In the classical LH-TH method, which is the first concept of altitude training, the athletes live and train at moderate altitudes (2,000–3,000 m) to stimulate erythropoiesis, which increases erythrocyte volume, thus enhancing sea-level endurance performance. This method is still in use today, but one major conclusion drawn from scientific research and sport practice is that athletes are not able to train at an equivalent, or near-equivalent, intensity as at sea level. Thus, athletes may return to sea level in a detrained state (Wilber, 2007). To overcome this problem, athletes often descend from altitude to perform intensive training sessions, returning to altitude at night to continue the acclimatization process. This LH-TL model of altitude training was developed in the early 1990s (Levine and Stray-Gundersen, 1992) and received considerable attention. Today, several training strategies can be used based on the LH-TL principles. Athletes can live in a natural hypobaric hypoxic environment, or use special technologies such as nitrogen dilution or oxygen filtration to create a normobaric hypoxic environment (Mattila and Rusko, 1996; Gore et al., 2001). However, there are still many controversies about the mechanisms of hematological and non-hematological adaptations to LH-TL and the extent of enhanced sport performance (Lundby and Robach, 2016). The quality and quantity of the results in the literature are still insufficient to elucidate the mechanism of the effect of LH-TL on sport performance. It is considered that the positive effects of LH-TL are mainly due to the increase of red cell volume (RCV) (Levine and Stray-Gundersen, 2005), but there exists a contrary opinion that improvements in the energy cost of exercise seem more likely than increases in RCV as a result of LH-TL (Gore and Hopkins, 2005).

In the LL-TH protocol, athletes live under normoxic conditions and train in a natural, hypobaric, or simulated normobaric hypoxic environment. The LL-TH method can be used by athletes at rest (intermittent hypoxic exposure; IHE) or during training sessions (intermittent hypoxic training; IHT) (Terrados et al., 1988; Casas et al., 2000; Czuba et al., 2011). However, during the LL-TH protocol, the exposure to acute hypoxia is too short (1–2 h per day), and insufficient to modify hematological variables (Czuba et al., 2011, 2017, 2018), but the LL-TH method can contribute to the activation of non-hematological adaptive mechanisms (Girard et al., 2017; Millet and Girard, 2017).

Although the concept of altitude or hypoxic training to improve sea-level sport performance has been known for nearly 50 years, its efficacy remains somewhat controversial. Whilst some studies support the ergogenic effects of altitude training on sport performance (Mattila and Rusko, 1996; Gore et al., 2001), others do not (Ashenden et al., 2000; Hinckson et al., 2005). There are also conflicting reports on the efficacy of altitude training in improving hematological variables. These discrepancies may be due to differences in duration of hypoxia exposure, intensity of the hypoxic stimulus, type of training model, volume and intensity of exercise during the experiment, and the sports skill level of study participants. Methodological approaches and measurement techniques used by researchers are also significant.

Therefore the aim of this research influence of high altitude training and low altitude training on selected biochemical variables among long distance runners.

Methodology:

The purpose of the study was to find out the influence of high altitude training and low altitude training on selected biochemical variables among long distance runners. To achieve the purpose of the study, thirty college long distance runners were selected from in and around affiliated colleges of Kashmir University. The subjects were randomly assigned in to two equal groups namely, high altitude training (HATG) and low altitude training group (LATG) each group consist of (n=15). The respective training was given to the experimental group the 3 days per weeks (alternate days) for the training period of twelve weeks. Design: The biochemical variables such as High density lipoprotein, Low density lipoprotein and Total cholesterol were selected as dependent variables. Sample collection: Five milliliters of peripheral fasting blood was collected, following informed consent, from all individuals who participated in this study before high and low altitude training intervention and again fasting blood was collected after twelve weeks of high altitude training group and low altitude training intervention group. Serum was separated by centrifuge machine (3500—4000 rotations/min) at room temperature. Total cholesterol, LDL, and HDL cholesterol were measured after overnight fasting (12 h after meal).

Statistical Analysis:

The collected data before and after training period of 12 weeks on the above said variables due to the influence of high altitude training and low altitude training was statistically analyzed with paired ‘t’ test test to find out the significant improvement between pre and post-test. In all cases the criterion for statistical significance was set at 0.05 level of confidence. ($P<0.05$)

Table I

Computation of ‘t’ Ratio on Selected Biochemical Variables of Long Distance Runners on High Altitude Training and Low Altitude Training Group

Group	Variables		Mean	N	Std. Deviation	Std. Error Mean	t ratio
High Altitude Training	LDL	Pre	134.33	15	5.15	1.33	15.95*
		Post	122.80		4.68		
	HDL	Pre	45.53	15	4.91	1.27	11.13*
		Post	48.93		4.89		
	Total Cholesterol	Pre	219.74	15	5.71	1.89	9.60*
		Post	205.81		5.84		
Low Altitude Training	LDL	Pre	134.00	15	4.85	1.25	10.40*
		Post	124.00		1.07		
	HDL	Pre	45.47	15	3.98	1.03	9.74*
		Post	48.60		3.94		
	Total Cholesterol	Pre	217.92	15	7.34	2.32	8.90*
		Post	207.66		6.20		

*Significant level 0.05 level degree of freedom (2.14, 1 and 14)

Table I reveals the computation of mean, standard deviation and 't' ratio on selected biochemical variables namely High density lipoprotein, Low density lipoprotein and Total cholesterol high altitude training group. The obtained 't' ratio High density lipoprotein, Low density lipoprotein and Total cholesterol were 15.95, 11.13 and 9.60 respectively. The required table value was 2.14 for the degrees of freedom 1and 14 at the 0.05 level of significance. Since the obtained 't' values were greater than the table value it was found to be statistically significant. Further the computation of mean, standard deviation and 't' ratio on selected biochemical variables namely High density lipoprotein, Low density lipoprotein and Total cholesterol low altitude training group. The obtained 't' ratio on High density lipoprotein, Low density lipoprotein and Total cholesterol were 10.40, 9.74 and 8.90 respectively. The required table value was 2.14 for the degrees of freedom 1and 14 at the 0.05 level of significance. Since the obtained 't' values were greater than the table value it was found to be statistically significant.

Figure 1

Bar diagram showing the pre, post means values of high altitude training group on biochemical variables.

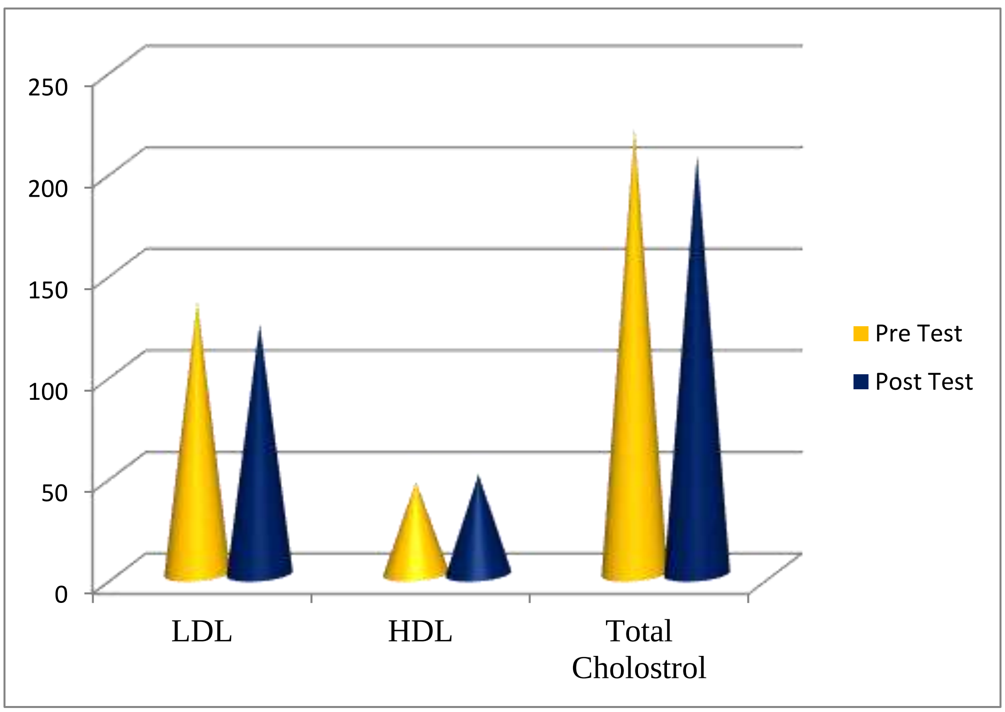
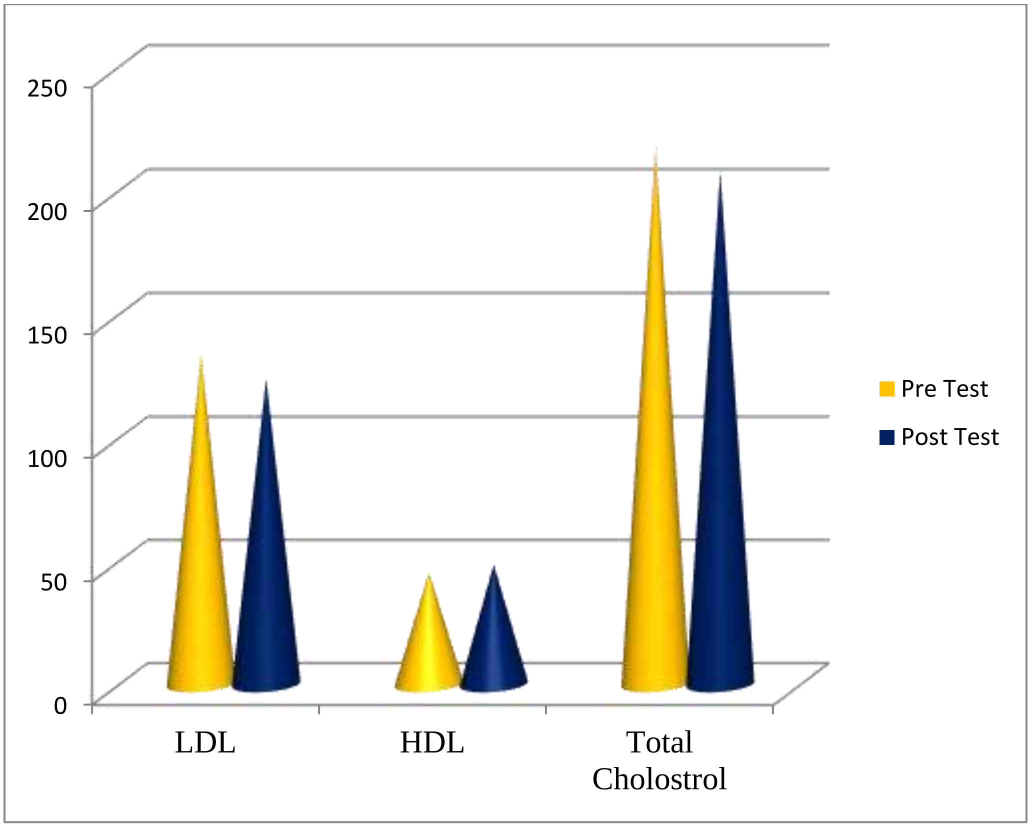


Figure 2

Bar diagram showing the pre, post means values of low altitude training group on biochemical variables.



Discussion Findings:

In this study the effect of high altitude training low altitude training was seen on the lipid profile in the long distance runners. Significant improvement in high density lipoprotein was observed and other researchers also corroborate with our findings. Study held in Ontario, Canada also corroborate with our study and state that training increases HDL cholesterol and several studies have confirm this belief (Leon AS 2001). It is well known that high and low altitude training are beneficial for the long distance runners. The level of cholesterol and LDL was significantly reduced in this study after high and low altitude training. Physical exercises including yogic practices along with dietary modification have been observed to control lipid content of blood and to treat and prevent CAD (Srivastava et al 2011). In a study conducted in

Mumbai, India, it was observed that in study group average total cholesterol level fell to 184.8 mg% ($p < 0.05$) from the baseline level of 247.2 mg% ($p < 0.05$) and LDL cholesterol level fell to 108.4 from basal of 146.4, even without the use of statins (Yogendra et al 2004).

In future this study could be repeated in other populations also. Further, some other high altitude training low altitude training may be tried and compared with the present ones. More scientific co-relations could be seen before and after high altitude training low altitude training interventions. Qualitative analysis (psychological variables) of the subjects may be useful for discussing the variables changed after high altitude training low altitude training intervention. high altitude training low altitude training may also be responsible in creating positive changes in plasma catecholamines, cytokines and leukotrienes levels thus benefiting the long distance runners. Study of such factor could be helpful for athletes.

Conclusion:

Reduction of total cholesterol and LDL after regular high altitude training low altitude training is beneficial for long distance runners. Therefore high altitude training low altitude training included in this study are helpful for the long distance runners.

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