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Effect of Hypoventilation training on endurance of Handball players

Dr. Sonia Kanwar, Dr. Gurcharan Singh Gill
Associate Professor, Sri Guru Gobind Singh College, Chandigarh, India
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Abstract
The purpose of this study was to examine the effect of hypoventilation training on selected physiological and respiratory variables among male handball players. Forty players aged 18–25 years were randomly divided into an experimental group (n=20) and a control group (n=20). The experimental group underwent hypoventilation training for eight weeks, while the control group followed regular training. Variables measured included resting heart rate, systolic blood pressure, diastolic blood pressure, vital capacity, and VO2 max. Paired sample t-tests were used for statistical analysis. Significant improvements were observed in resting heart rate, vital capacity, systolic blood pressure, and VO2 max in the experimental group ($p < .05$), while diastolic blood pressure showed non-significant changes.

Keywords: Hypoventilation training, handball players, VO_2 Max, Vital Capacity, resting heart rate, blood pressure

Introduction

Sports training methods have evolved significantly in recent years due to advancements in exercise physiology and sports science. Coaches and sports scientists continuously search for innovative training methods capable of improving endurance performance and physiological efficiency among athletes. Buzzichelli (2018) [2] highlighted that endurance training methods involving respiratory stress can improve cardiovascular adaptations and sports-specific performance. Hypoventilation training has emerged as one such advanced method designed to improve respiratory and cardiovascular adaptations by deliberately reducing breathing frequency during exercise. Handball players require high endurance and cardiovascular fitness to maintain performance throughout competitive matches. Physiological variables such as resting heart rate, blood pressure, vital capacity, breath-holding time, and VO2 max are considered important indicators of endurance performance. Katch (2015) [4] explained that controlled respiratory training contributes to improved lung function, greater tidal volume, and enhanced aerobic efficiency. Xavier.M (2008) have conducted many studies/experiments on hypoventilation training at low pulmonary volume. He is the pioneer of this new technique of hypoventilation training.

Hypoventilation training has been used in many sports and obtained remarkable results. It is possible to obtain positive results after 7-8 training sessions with hypoventilation.

Objectives of the Study: To find out the effect of Hypoventilation training on the endurance of Handball players

Methodology and Procedure

The present study attempts to investigate the influence of hypoventilation training on selected physiological and respiratory variables among male handball players aged 18–25 years. Participants were randomly assigned to an experimental group and a control group. Resting Heart Rate (bpm), Systolic Blood Pressure (mmHg), Vital Capacity (L), VO2 Max (ml/kg/min), Diastolic Blood Pressure (mmHg). The study employed a pre-test and post-test randomized group design. The findings may provide useful guidance for coaches, trainers, and sports scientists in developing scientifically designed endurance training programs.

Statistical Analysis

Paired sample t-tests were applied to determine significant differences between pre-test and post-test scores at the 0.05 level of significance.

Table 1: Showing comparison of difference in pre-test and post-test results

Variable	Exp Pre Mean	Exp Post Mean	Exp t	Exp p	Con Pre Mean	Con Post Mean	Con t	Con p
Resting Heart Rate (bpm)	77.31	70.2	6.16*	0.0	76.89	75.87	0.76	0.4552
Systolic Blood Pressure (mmHg)	123.88	118.18	4.72*	0.0002	122.43	122.24	0.11	0.9102
Vital Capacity (L)	3.9	4.34	-4.73*	0.0001	4.03	3.99	0.39	0.6988
VO2 Max (ml/kg/min)	42.38	47.96	-5.5*	0.0	43.49	44.83	-1.7	0.1054
Diastolic Blood Pressure (mmHg)	81.19	80.24	2.57	0.056	81.79	79.89	1.44	0.1671

*Significant at 0.05 level

The findings revealed significant improvement in resting heart rate, systolic blood pressure, vital capacity, and VO2 max in the experimental group. However, diastolic blood pressure did not show significant improvement.

Findings and Discussion

The statistical analysis revealed significant improvement in resting heart rate as the Pre Mean 77.31 and Post Mean 70.2, the t value 6.16 shows the significant differences

among the experimental group following eight weeks of hypoventilation training. The reduction in resting heart rate indicates improved cardiovascular efficiency and enhanced parasympathetic adaptation. Athletes with lower resting heart rates generally demonstrate superior endurance capacity and recovery ability.

A significant improvement was also observed in systolic blood pressure among the experimental group. The calculated Pre Mean was123.88 and Post Mean 118.18 which is significant at 0.05 level i.e. the t-value was 4.72. The reduction in systolic blood pressure may be attributed to improved vascular function and cardiovascular adaptation resulting from respiratory-restricted training. Vital capacity showed a highly significant increase in the experimental group. This improvement suggests enhanced respiratory muscle strength and increased lung efficiency. Improved vital capacity allows athletes to intake larger volumes of oxygen during exercise, thereby improving endurance performance.

The experimental group demonstrated substantial improvement in VO2 max after the training period.VO2 max is considered one of the most important indicators of aerobic fitness and endurance performance. The increase in VO2 max indicates enhanced oxygen transport and utilization capacity among the handball players. Although diastolic blood pressure showed slight improvement as Pre Mean 81.19 and Post Mean was 80.24, the change was statistically non-significant as the t –value is 2.57. This may be due to the relatively short duration of the training program or the stability of diastolic blood pressure among healthy young athletes.

The control group did not demonstrate significant changes in most variables, indicating that regular training alone was insufficient to produce substantial physiological adaptations compared to hypoventilation training. Overall, the findings of the present study support previous research indicating that hypoventilation training can positively influence cardiovascular and respiratory efficiency, thereby improving endurance performance among athletes.

Conclusion

The study concluded that hypoventilation training positively affects selected physiological and respiratory variables among handball players. Coaches may incorporate hypoventilation exercises into endurance training programs. Modern competitive handball requires players to sustain high intensity efforts for prolonged periods. Traditional endurance training methods are effective; however, innovative methods such as hypoventilation training may provide additional physiological benefits. The present study is significant because it investigates a relatively less explored training method among handball players in the Indian context.

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