EFFECT OF DIFFERENT INTERMITTENT HYPOXIC TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES INFLUENCING AEROBIC AND ANAEROBIC PERFORMANCE

SYNOPSIS OF THE THESIS

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INTRODUCTION

Hypoxia training is used to enhance exercise performance at sea level by sports scientists, numerous athletes, and coaches. Training at high altitude can be done in a variety of ways, such as Live High Train Low (LHTL) and Live High Train High (LHTTH). In the field of altitude/hypoxic training, living low training high (LLTH) techniques have grown in popularity in recent years. Athletes who live in low-lying coastal areas may find it beneficial to practise at altitudes between 2,000 and 4,500 metres. The literature supports this view (Faiss et al., 2013a; Girard et al., 2017; Hamlin et al., 2010).

Because Intermittent Hypoxic Training (IHT) often involves less time and amount of hypoxia exposure, it may be of interest to athletes and coaches. This type of hypoxic exposure typically lasts between two and six weeks, with each session lasting less than three hours. (McLean et al., 2014). Combining the physiological stress of hypobaric or normobaric hypoxic exposure with the psychological stress of training may amplify exercise-induced alterations in aerobic exercise capacity (Czuba et al., 2011). Biochemical and anatomical changes in skeletal and cardiac muscles that are more amenable to oxidative activities may be induced by intermittent hypoxic training (IHT). What this means is that IHT has the potential to enhance erythropoietic and metabolic processes, leading to increased red blood cell volume, serum erythropoietin production, higher blood flow, and enhanced exercise economy. Research has shown that this is the case (Czuba et al., 2011; Geiser et al., 2001; Hamlin et al., 2010). The debate continues over whether or not sea-level athletes can benefit from Intermittent Hypoxic Training (IHT) to increase their aerobic exercise capacity. Aerobic capacity may improve during Intermittent Hypoxic Training (IHT) due to enhanced blood oxygen transport or utilisation. Many studies support this (Ponsot et al., 2006; Czuba et al., 2011). A number of research have failed to show that IHT (Beidleman et al., 2009; Katayama et al., 2004; Rodriguez et al., 2007; Roels et al., 2007) improves performance during aerobic activity.

Blood oxygen levels are lowered to the point of hypoxia adaptation in intermittent hypoxic training, with rest periods in between to prevent overtraining. Hypoxia adaptation and the generation of new defence mechanisms cause beneficial physiological changes and clinical consequences when oxygen levels are decreased (Bernardi et al., 2001). These proteins include antioxidant enzymes and heat shock proteins.

By breathing in oxygen-depleted air (normobaric hypoxia), blood oxygen levels can be lowered and tissue hypoxia can occur. Periods of hypoxia are interspersed with periods of normoxia or hyperoxia in a hypoxic regimen known as intermittent hypoxia (IH) or intermittent hypoxia-hyperoxia (IHH) (Susta et al., 2020).

In addition, various researches have revealed that IHT showed no extra anaerobic performance improvements when compared to equivalent training in normoxia (Faiss et al., 2013a; Millet et al., 2014). In order to overcome the major drawbacks of IHT (reduced training stimulus owing to hypoxia), Rectus Sheath hematoma (RSH) is used. This approach significantly improved athletes' anaerobic power (Faiss et al., 2013b; Galvin et al., 2013; Hamlin et al., 2017) by increasing blood perfusion variations in working muscles, molecular adaptations, increased glycolytic enzyme activity, higher muscle buffering capacity, and increased lactate tolerance.

Muscle strength and endurance, as well as the role of metabolites (such as blood lactate, inorganic phosphate, and hydrogen ion), hormones, neuromuscular adaptation, and muscle growth and development in RTH, have been the subject of current research. According to previous studies (Nishimura et al., 2010; Scott et al., 2014), the key causes of RTH's influence on muscle strength and endurance augmentation are the accumulation of metabolites and an enhanced hormone response (testosterone, adrenaline, norepinephrine). Experts are split on whether or not RTH actually increases muscular performance, and the mechanism by which it does so is unclear (Park, 2018).

Recent research has demonstrated that there are no additional benefits to training in normoxia when compared to the positive effects shown with IHT, RSH, and RTH. It's possible that methodological discrepancies are to blame for the incongruous results found in research examining the efficacy of hypoxic training in enhancing sea level muscle function, aerobic exercise capacity, and anaerobic power. However, it's also possible that a number of other factors are at play here to get similar results. It has been shown that hypoxia training is more effective when carried out in accordance with established training protocols (Park et al., 2016).

Since competitive swimmers participate in nearly every event requiring aerobic exercise capacity, anaerobic power, pull and push muscular strength, and upper limb endurance, it would be useful to explore how RTH, IHT, and RSH affect normoxic exercise performance. They put up a lot of labour and train hard to improve their endurance, strength, and swimming speed in water (Moschovis et al., 2016).

Aerobic exercise, as defined by the American College of Sports Medicine (ACSM), involves the usage of large muscle groups, has a steady heart rate, and may be performed for extended periods of time. Muscles that engage in aerobic metabolism naturally create ATP since it may be synthesised from amino acids, glucose, and fatty acids. Aerobic activities like cycling and dancing are great examples. Other examples of aerobic activities include: hiking, jogging, swimming, and walking. The American College of Sports Medicine (ACSM) says that the optimum method to take part in these activities is to make use of your aerobic capacity, which is the sum of your heart rate and your body's ability to take in oxygen through your skeletal muscles. Peak oxygen consumption (VO2) is the gold standard for determining aerobic capacity, and it may be determined using a variety of approaches, including treadmill protocols, oxygen consumption, and graded exercise ergometry, analyzers, and even mathematical calculations. Peak VO2 was calculated in conjunction with other factors in a study by Vaitkevicius et al. (1993), and the researchers found that higher physical conditioning was linked to lower arterial stiffness. This finding suggests that peak VO2 is important. Athletes at sea level can benefit from training to increase red blood cell mass and improve oxygen transport in hypoxic (low oxygen) circumstances. Training masks have no effect on athletes' haemoglobin or hematocrit levels since they do not alter the oxygen content of the air athletes breathe in (Park, 2018).

However, it appears that they cause an adaptive physiological response in the form of increased respiratory muscle resistance by reducing oxygen delivery. Athletes should train their diaphragms, intercostals, and the skeletal muscles that support them in the same way that they train any other muscle group. It was created with the sole intention of strengthening the respiratory muscles. RMT, or respiratory muscle training, is one method of conditioning. Respiratory muscle training (RMT) has been shown to dramatically improve athletes' strength, velocity, and endurance. Preoperative Inspiratory Muscle Training (IMT) and Respiratory Muscle Training (RMT) are used to reduce the risk of postoperative pulmonary complications in patients undergoing cardiac or abdominal surgery. You may improve your respiratory muscle fitness at any time and in any place by using a training mask. Because of the devices' capability to restrict the user's breathing, the user's cardiorespiratory fitness can be increased. Great athletes may be held back by their lungs (Sheel et al., 2002).

Reflexive muscle training (RMT) has been shown to benefit athletes in a number of ways, although its benefits on performance remain unclear. Gigliotti et al. (2006) conducted a comprehensive literature review and found that RMT increases important performance indicators; however, the mechanisms underlying these gains are not fully understood and require further exploration.

OBJECTIVES OF THE STUDY

Since the researcher designed a comprehensive study to look at how various intermittent hypoxic training regimens affect the physiological variables of physically fit people.

The objectives of the study were

- To invetigate the physiological effects of intermittent hypoxic training in variables such as VO_2 max, Maximum Pulse Rate, Resting Pulse Rate, blood-oxygen saturation level, Fatigue Index among male individuals.
- To examine the impact of sporadic hypoxic training on specific haematological variables in males, such as HBG, MCH, and RBC.

HYPOTHESES

- **H_0:** It was hypothesized that there would be no significant improvement due to different intermittent Hypoxic training in selected Physiological variables such as VO_2 max., maximum pulse rate, blood-oxygen saturation level, fatigue index and resting pulse rate among male individuals.
- **H_0:** It was further hypothesized that there would be no significant improvement due to different intermittent Hypoxic training in selected Hematological variables such as HBG, MCH, RBC among male individuals.

DELIMITATIONS

- 30 male members of the Beraboni club served as participants in this investigation.
- Participants age was between 18 and 22 years with the majority falling somewhere in the middle.
- The training session was delimited to eight weeks.
- Every member of the masked group used an elevation training mask in this investigation.

LIMITATIONS

To understand the study's findings, the following limitations was considered:

- The respondent’s prior experience in sports and games was not considered, which might have an impact on training and statistics.
- There was no control over psychological aspects, such as eating habits, sleeping patterns, and lifestyles.
- Temperature, humidity, and other weather variables was not considered during testing and training times.

SIGNIFICANCE OF THE STUDY

- The aim of physical education research is to support physical education instructors and coaches in enhancing their athletes' and players' performance through innovative training methods.
- The research would provide fresh information to our understanding of sports training.
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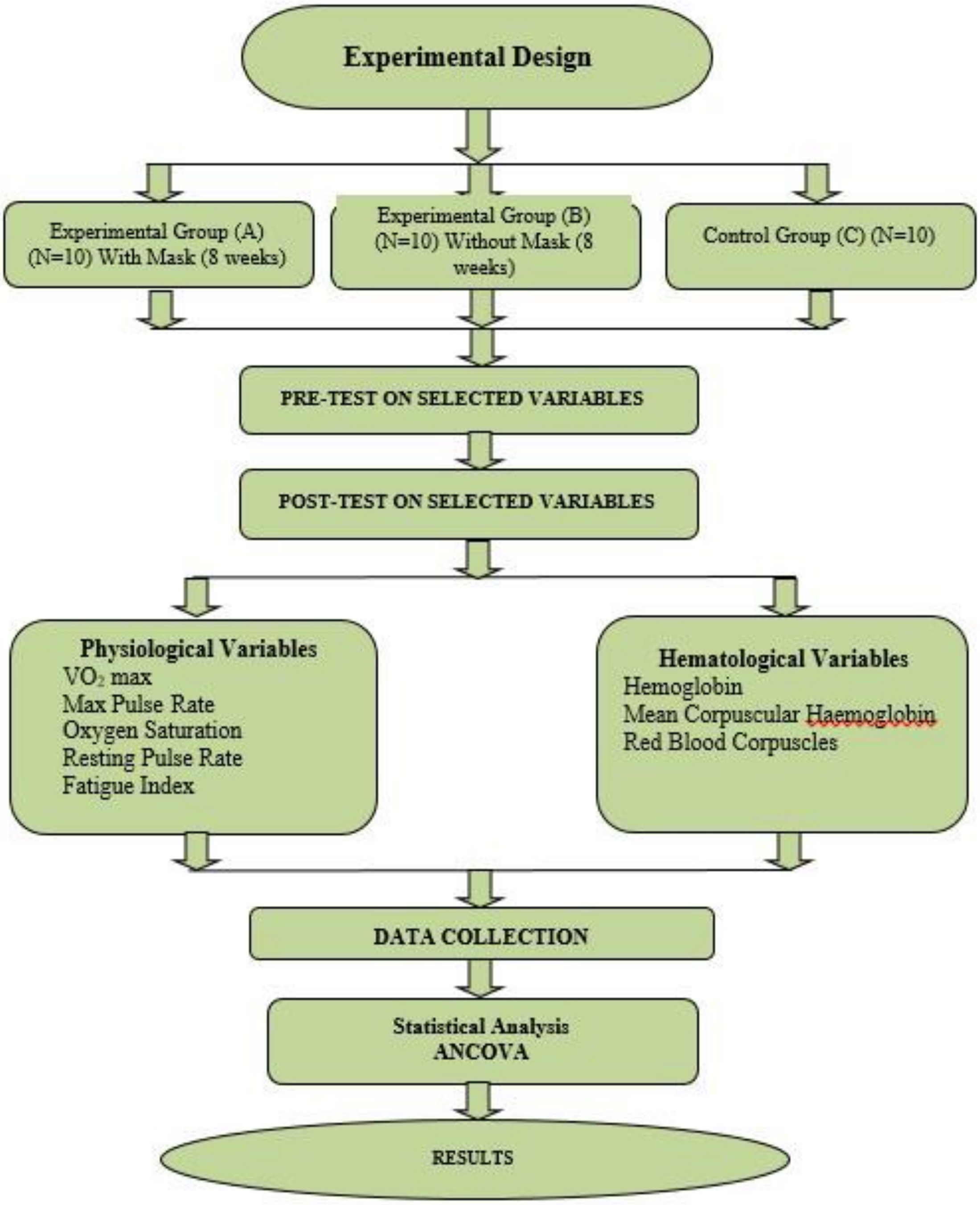
- Physical Educators and Coaches would be able to use the findings of the research as a guide for developing practise regimens.
- The training with intermittent hypoxia will assist to strengthen the influence of physiological variables on persons who are physically fit.
- The performance of physically fit persons will also be improved as a result of this research, both in terms of their aerobic and anaerobic capacities.
- The future researcher will be able to understand the mechanism by which hypoxic training with elevation training mask (ETM) improves athletic performance.
- The research would provide fresh information to our understanding of sports training.

DESIGN OF THE STUDY



SELECTION OF THE TESTS

S.No	Variables		Test/Instruments	Unit of Measureme nt
1	**Physiological**	VO_2 max	Cooper's 12 Minutes Run/Walk Test	ml/kg/min
2		Max Pulse Rate	Pulse count	Beats/min
3		Blood-Oxygen Saturation Level	pulse "oximetry"	Percentage (%)
4		Resting Pulse Rate	Pulse count	beats/min
5		Fatigue Index	Repeated Sprint Ability test	M
6	**Hematological**	Hemoglobin (HGB)	**Sysmex XP-100 Automatic hematology analyzer** **(**Sysmex corporation , Kobe, Japan) *Code No. BB556095* *Manufactured : July 2012* *Software version: 00-05 and onwards* □ Khode V et al. (2012) □ Barsam SJ et al. (2011) □ Eguchi A et al. (2010) □ Ranjith MP et al. (2009) Analytical principle: □ WBC: DC detection method □ RBC/PLT: DC detection method □ HGB: Non-cyanide hemoglobin analysis method	g/dL
7		Mean Corpuscular Haemoglobin (MCH)		Pg/dL
8		Red Blood Corpuscles (RBC)		x10 ^{6} /µL

RESULTS

On the basis of analysis of data the following results were obtained for the present thesis:-

Significant gains in VO2 max were seen after 8 weeks of intermittent Hypoxic training. There were no differences in maximal Pulse Rate, blood-oxygen saturation Level, resting

Pulse rate, Fatigue Index, Red blood Corpuscle, Hemoglobin and Mean Corpuscular Hemoglobin.

DISCUSSION

From the results of an intermittent hypoxia training plan lasting 8 weeks, we were able to derive the following conclusions.

- Although the Elevation Training Mask (ETM) can simulate some of the mild hypoxia observed at high altitudes by restricting airflow, it may not be able to recreate the severe hypoxia experienced there. Physiological adaptations may not occur in healthy people who are exposed to hypoxia for short or long periods of time.
- To mimic the effects of exercising at high elevations, the Elevation exercising Mask (ETM) makes breathing more difficult during exercise. It's promoted under the false premise that it will allow users to "train as if" they are at a greater altitude, where oxygen levels are lower.
- Keep in mind that the ETM may provide a moderate hypoxic influence, but it cannot completely replicate the physiological conditions of actual altitude training. By lowering the partial pressure of oxygen, training at high elevations mimics real-world hypoxia. Increases in oxygen-carrying capacity and new red blood cell production are only two of the many positive physiological adaptations that may be prompted by this type of exercise.
- However, using the ETM makes it more challenging to breathe because it activates only when you exhale. The amount of oxygen in the air is unaffected, but you may find yourself breathing more rapidly and taking in less oxygen as a result. That's why we didn't see the same physiological reactions from ETM use as we did from actual altitude training.
- Experts are divided on whether or not the ETM can successfully simulate altitude training and cause the same changes as exercising at high elevations, despite the fact that its use has been shown to improve respiratory muscle strength and endurance. While some studies have found conflicting results, others have found potential advantages. If an athlete wishes to experience the physiological changes that come with altitude training particularly, then using the ETM may not be as successful as actual training at higher elevations or using altitude chambers/tents under expert supervision.

- Long-term, consistent use of the ETM may also degrade its performance. Consistent, extended use of the mask, as opposed to occasional, brief use, is more likely to result in the same adjustments.
- Depending on one's motivations for exercising, the ETM's efficiency may vary from user to user. It may increase the strength and endurance of the respiratory muscles, although its effects on performance measures like VO2max and cardiovascular adaptations are still unknown.

CONCLUSIONS

The following observation were concluded in the study.

1) When compared to training in a control group or without a mask, intermittent hypoxia training is more successful at raising VO2 Max.
2) However, it turns out that both the masked and non-masked groups fared better than the control group. The non-masked participants in the masked group outperformed those in the control group, when compared to the control group.

RECOMMENDATIONS

1) The physiological and health-related physical fitness of men across age groups may benefit from hypoxic training in conjunction with elevation training masks.
2) Hypoxia training may increase physical fitness, cardiovascular fitness, power, and strength, and it might be studied in high school and college-aged males and females.
3) It is possible to study how middle-aged men's mental health, recovery heart rate, and health-related fitness are affected by hypoxia training.
4) The benefits of hypoxia training could also be studied in older adults who have musculoskeletal problems and low levels of health-related physical fitness.
5) To investigate the physiological consequences of a hypoxia training regimen at varying intensities, an elevation training mask can be employed.
6) Multiple Interval Hypoxic Training procedures would allow for comparable research.
7) The concept of specificity might be considered while choosing an exercise programme with a particular objective in mind.
8) Similar studies may be undertaken on adult athletes, but with a wider range of controls.

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