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The Impact of Aerobic Capacity and Elevation Training Mask Using High Intensity Training Method on The Physiological Performance of Female Futsal Players

Asep Sumpena^{1*}, Dikdik Zafar Sidik²¹Program Studi Pendidikan Jasmani, Kesehatan dan Rekreasi, Universitas Pendidikan Indonesia.²Program Studi Pendidikan Keperawatan Olahraga, Universitas Pendidikan Indonesia.

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Abstract

This study was aimed at investigating the effect of using an Elevation Training Mask (ETM) with the High Intensity Interval Training (HIIT) Method on physiological performance based on aerobic capacity. This research was an experimental study with a 2x2 factorial design. This study used aerobic and anaerobic physical component test instruments. This study involved 20 female futsal players as participants. Data analysis used statistical calculations with the help of the SPSS application. The results of the study showed that there was no increase in the physiological performance of female futsal players based on the use of ETM. It indicated that there was an increase in the physiological performance of female futsal players based on the aerobic performance and there was no interaction between the use of ETM and aerobic capacity in increasing the physiological performance of female futsal players. This study also concluded that female futsal players with a high aerobic capacity were more effective than female futsal players with a low aerobic capacity using the HIIT training method, both for the high aerobic capacity using ETM and not using ETM compared to the low aerobic capacity using ETM and without ETM. Apart from that, there was no interaction found. The implication of the research result shows that, in physical training, the training method must be adjusted to the aerobic capacity of the player by paying more attention to the principles of the training and specificity. Besides that, it is necessary to carry out further research using ETM to see the effect in lung capacity, so that it would be more comprehensive.

INTRODUCTION

Looking for a new method of training to improve the ability of the body in utilizing oxygen absorption is an essential aspect in sport science. Taking aerobic sport in the high altitude is proven to increase the VO₂max and to produce other physiological adaptations, including the adaptation of ventilation such as improving the Forced Vital Capacity (FVC) and Forced Inspiratory Vital Capacity (FIVC) (Chapman, 2013; Dunham & Harms, 2012; Michael M. Smith, Allan J. Sommer, Brooke E. Starkoff, 2013).

One of the advancements in the field of sport science is the high altitude training simulation that could produce the effect similar to a training in a high altitude. One of the means of the high-train simulation method is to induce the hypoxia norm baric condition, or to minimize the air consumed by an individual (O. Orhan, U. Bilgin, E. Cetin, 2010; Orhan, U. Bilgin, E. Cetin, 2010). It is also known that the performance of aerobic endurance has significantly increased for the last few years.

To maintain the competitiveness, the athletes and coaches keep searching for the way to improve the achievement. Some of training methods had been studied to find out the best method to improve the performance of the athletes in competitive sports (Robertson, Saunders, & Anson, 2010). The High Intensity Interval Training (HIIT) method is assumed to be able to improve physiological performances, but there has not been evidence to prove the assumption. Therefore, the research is needed to be conducted to prove the assumption, thus there will be no doubt to use the HIIT training method by utilizing the ETM.

Elevation Training Mask (ETM) is a product available in the market claiming to be able to increase the aerobic endurance performance. The ETM covers nose and mouth and has different opening and flux valve. The opening and flux valve can be adjusted to increase the respiration endurance, thus it is harder to breath while using the mask (Thomas et al., 1998).

In the High Training simulation, the mask should have a mechanism to decrease the oxygen pressure partially, thus it drives the hypoxia during training. Therefore, the aim of this research was to find out the effect difference of the use of ETM with the HIIT training method on the physiological performance based on the aerobic capacity on futsal female players. (Bruno Bal-

ke, Nagle, F J, Daniels, 1965) examined that the capacity of aerobic performance is increased when coming back to the lower height (400 m) after the high training in the medium height (2300 m). Since then, many people studied the effect of high training on the performance of the trained or elite athletes (Martin Buchheit, Sami Kuitunen, Sven C. Coss, Benjamin K. Williams, Alberto Mendez-Villanueva, 2012; Bruno Balke, Nagle, F J, Daniels, 1965; Julian et al., 2004; Stray-gundersen et al., 2012; Mclean, Gore, & Kemp, 2014; Robertson et al., 2010; Julian et al., 2004)

The purpose of this study was to find out the difference of the use of ETM with the HIIT training method on physiological performance based on the aerobic capacity. In the training with a short duration, HIIT has been suggested as one effective way to improve aerobic capacity (Burgomaster, Heigenhauser, Gibala, Kirsten, & Heigenhauser, 2006; Burgomaster et al., 2008; Burgomaster et al., 2010) and proven beneficial during the training of the endurance sport such as running, cycling, and swimming (Burgomaster et al., 2008; Burgomaster et al., 2008; Laursen, Shing, Peake, Coombes, & Jenkins, 1801; Libicz, Roels, & Millet, 2014). A short duration of performance interval conducted on or near the speed related to VO₂max could lengthen the time where 95-100% VO₂max intensity can be maintained during the training session (Daniels, Scardina, & West, 1984).

The previous research mainly focus on the work to-rest ration from 1:1 or more (2: 1, 4: 1) with the interval duration started from 15 seconds to 2,5 minutes. In this study, the increase of VO₂max and the speed related to VO₂max had been presented. Besides, a variety of passive and active recovery periods after activity in 50-70% VO₂max intensity combined to create ration work-to rest 1: 1, 2: 1, and 4: 1 had been checked. The results of this study confirm the beneficial impact from temporary interval training as well as presenting limitation to complete all training program when the training intensity is too high and the recovery time is too short although the subject has an excellent physical level (Billat, Paris, & Bocquet, 2001; Ralph Rozenek, Kazuo Funato, Junjiro Kubo, 2007).

In this research, the duration of work to rest was 1 : 1 with working time 30 seconds and rest 30 seconds. Therefore, the study aimed at finding out if there is any difference in the increase of physiological performance

based on the aerobic capacity and if there is an interaction between the use of ETM and the aerobic capacity on the increase of physiological performance.

METHODS

The aim of this research was to find out the different effect of the use of Elevation Training Mask (ETM) with High Intensity Interval Training (HIIT) training method on physiological performance based on the aerobic capacity. This research was an experimental research with factorial 2x2 design.

Participants

The obtained data were analyzed by statistical analysis. The result of analysis is presented in the following table. Tabel 1 shows descriptive results of the statistical data analysis.

Table 1. Subject Characteristics

Variable	With ETM	Non ETM
Age, yr	20±1	20±1
Height, cm	156±1	156±2
Weight, kg	52±2	51±2
VO2max, l/min	34±1	35±1

This research involved 20 female futsal players as participants. Before the study was conducted, the players signed informed consent as the proof of their agreement to be involved in the research. To collect the data, the starting condition of the players was firstly tested. After that, the players were divided according to the aerobic capacity ranking into two groups, including high aerobic capacity and low aerobic capacity. The high aerobic capacity group was divided into two groups, including the group using ETM and the non-ETM group. The low aerobic capacity group was also divided into two groups, including low aerobic capacity group using ETM and non-ETM. The treatment was given to the players by using the HIIT training method for 16 meetings with the decided program earlier. The final test was then conducted. When the data were gained, the data analysis was conducted statistically by using SPSS software.

The population who became the samples of this study were the members of Female Futsal Student Activities consisting of 20 persons. The samples were se-

lected purposively as a research requires a special criteria, so that the samples involved aligning with the purpose of the study. Therefore, the research problems were answered and resulted in a more representative value. Therefore, the 20 samples were involved in this study.

Materials and Apparatus

Samples of this research were divided into four groups, 2 groups were using ETM and 2 groups were not using ETM. The selection of the members of the group was based on the rank of the aerobic capacity level of the samples at the pre-test. The ETM used in this study was a training mask type 3.0 in 1 ETM tool with the specification 1 Reinforced Overmolded Composite Rubber Mask 1 Quad Layer CryoActiv® Performance Sleeve and 1 Logoed Shroud Plate.

There were 10 ETMs used in this research. The ETM was used in the lowest setting. If we used the moderate or the high setting, the samples would not have been able to complete the training program due to the capacity of lungs that requires a further research. The duration of this research, between the work to-rest, was 1:1 or 30 seconds work and 30 seconds rest.

Procedures

Before conducting the research, the players filled in the consent form showing agreement to involve in the study. The player then should follow the anatomy adaptation because the HIIT training is a training method started from 85%-95% intensity and a part of the interval method training. After passing the pre-research, the pre-test was then conducted. This research used physical aerobic test component instrument by using a bleep test (Luc A. Leger and J. Lambert, 1982) and anaerobic test that consisted of 20 meter dash sprint (Wood, 2008), shuttle run 4 m x 5 rep (Mackeinze, 2005; 178), 3 Hop Test (Wood, 2008), multi stages hurdle jump test (Wood, 2008), and Running-based Anaerobic Sprint Test (RAST) (Queiroga et al., 2013). The initial data were used to arrange a training program that were relevant with principles and norms of training. The categorization of aerobic capacity used the VO2max result measured by bleep test. The result was then ranked. The rank was then divided into two groups, including the high aerobic capacity group and low aerobic capacity group.

Each group was then divided into two groups including high aerobic capacity with ETM group consisting of 5 players, high aerobic capacity group without ETM consisting of 5 players, low aerobic capacity with ETM group consisting of 5 players, and low aerobic capacity group without ETM consisting of 5 players. Therefore, the total number of the players were 20 players. The treatment was the conducted 16 times ended by the post test.

Data Analysis

Data gained from the posttest were then converted into standard scores by using z-score formula, then converted into t-score preceded by conducting descriptive analysis to interpret the data from the samples by collecting, arranging, and classifying the data by calculating the mean and standard deviation. Before using the two way ANOVA analysis, the assumption test, using the normality test and homogeneity test, were conducted. When the requirements were met, the Two Way ANOVA test to answer the hypothesis or the problems of the study in this research was conducted by using SPSS software.

RESULT

According to the data from the post-test, the normality test was conducted to find out whether the data were normally distributed or not. The result of the data analysis using SPSS are presented in Figure 1.

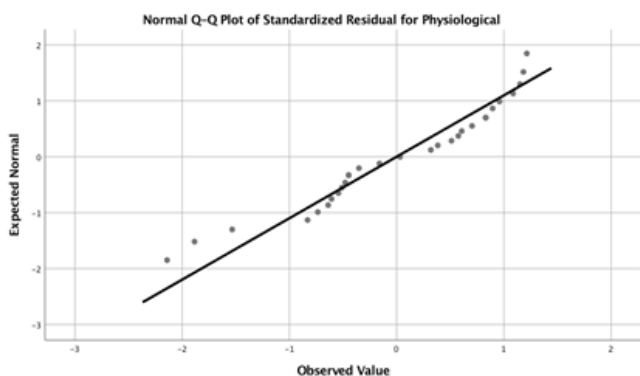


Figure 1. Normal probability plot

Figure 1 explains that data of variable were normally distributed. It is indicated by the presence of the distributed dots around the diagonal line. The distribu-

tion of the dots of the data were distributed in the direction of the diagonal line. If the distribution of the dots follows the direction of the diagonal line, the regression model meets the assumption of normality.

According to Table 2, the gained significance value was 0,728. Since the significance value $0,728 > 0,05$, it concludes that the physiological performance is homogenous. Therefore, the homogeneity assumption in the two way ANOVA test was fulfilled.

Table 2. Homogeneity Test

		Levene's Test of Equality of Error Variances ^{a,b}			
		Levene Statistic	df1	df2	Sig.
Physiological Abilities	Based on Mean	1.982	5	24	.118
	Based on Median	.562	5	24	.728
	Based on Median and with adjusted df	.562	5	13	.728
	Based on trimmed mean	1.817	5	24	.148

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a Dependent variable: Physiological Abilities

b Design: Intercept + ETM + Aerobic + ETM * Aerobic

Further process was hypothesis testing by using two way ANOVA. The purpose of this test was to find out if there is any impact between the independent variable (aerobic capacity) on attributive variable (with ETM and without ETM) on the dependent variable (physiological ability) by using HIIT method. In this research, the tested statistical hypothesis is as follows:

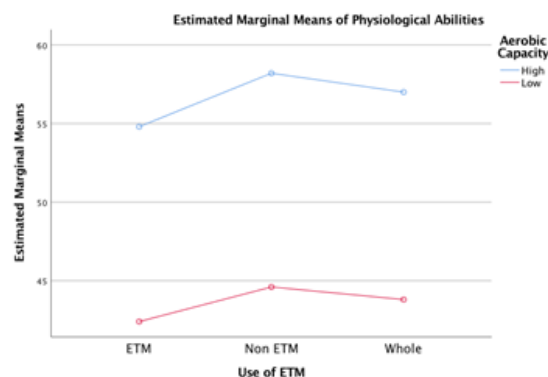


Figure 2. Normal probability plot

Figure 2 shows that the female futsal players with a high aerobic capacity, whether they used ETM or not, were more effective than female futsal players with low aerobic capacity, whether they used ETM or not. Besides that, there was not interaction between the groups. It is shown by the absence of intersection between the lines.

DISCUSSION

The new finding of this research is that the use of Elevation Training Mask (ETM) did not significantly give impact on the activities in the High Intensity Interval Training (HIIT) training method for 16 intensive meetings that might be influenced by the aerobic capacity of the players (Sartor et al., 2013). The initial requirements that should be acquired by the players before conducting the training program with HIIT method would have impacts on the readiness and the execution of the training process. The habit of using the ETM tool in the training process will be influential. A further research studying the oxygen level in blood before, during, and after training when using the Elevation Training Mask is required (Martin Buchheit, Sami Kuitunen, Sven C. Coss, Benjamin K. Williams, Alberto Mendez-Villanueva, 2012), thus the study will be deeper. It would be better if the size of the lung during exhalation and inhalation when using elevation training mask is measured. In Physiological exercise, further research is suggested to develop the science of a more effective and efficient training, thus this research can be developed through other training patterns, or the implementation on sports that specifically dominated by physical ability, such as sport that is dominated by speed, power, and endurance.

CONCLUSION

According to the results and discussion of the research, it concludes that no difference in the increase of physiological performance of the female futsal players with the use of ETM. There was difference of physiological performance improvement of female futsal players based on aerobic capacity. There was no interaction of the use of ETM with the aerobic capacity in improving the physiological performance of female futsal players.

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