European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1164390 Volume 4 | Issue 2 | 2018

EFFECTS OF TRAINING MASK ON HEART RATE AND ANXIETY DURING THE GRADED EXERCISE TEST AND RECOVERY

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Abstract:
The aim of this study is to examine the effect of training mask on heart rate (HR) and related anxiety during Graded Exercise Exercise (GXT). Six volunteer participants (age 20,5 ± 0,5 yrs, height 181,8 ± 5,5 cm, weight 74,5 ± 7 kg, BMI 22,51 ± 0,81) have been included in the study. PARQ and ACSM (American College of Sports Medicine) risk factor analysis have been made to all of the participants before the tests. Only healthy experimental subjects have been included in the study. The participants have been randomly separated into two groups (A, B) including 3 people. On the first day of the test, Group A completed the test with the training mask (TM) while the Group B completed it without training mask (NTM). Two days later, the groups were changed and they repeated the tests (Crossover Design). GXT have been applied to the participants on the treadmill until they got exhausted. During the 5-minute recovery time given after the end of GXT, HR variables have been measured. At the end of recovery, Becks Anxiety Inventory (BAI) has been implemented. In order to determine the differences came out at the measurements made after TM and NTM exercises, non-parametric t-test has been used and the confidence interval has been taken as $p<0,05$. At the end of GXT and the following 5-minute recovery time, a significant difference has been found in HR variables between both groups (p<, 005). The termination process of the test with TM has been 2.45% earlier (from 15.02 sec. to 14.49 sec.) than the NTM group and HR average at the end of recovery period has been found 9.12% lower than NTM group. In addition to this, there is no significant difference between anxiety total scores of the two groups (p>, 005). As a conclusion, while low HR averages of TM group can be explained as CO_2 diaspora, it can be figured that the similarity in terms of anxiety levels between the groups has resulted from the fact that the running test has been finished up to the participation own decision.

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Keywords: exercise, mask, anxiety, circulation

1. Introduction

Hypoxia and aerobic exercise are independent metabolic stress factors which composes impulse, adaptation, transmit and use of oxygen to all body tissues (Bailey, Davies &Young, 2001; Maher and Figueroa, 2016). Due to this reason, training in hypoxic conditions is commonly used in order to increase aerobic performance that is related to peripheral adaptation. Method such as hypoxia hoops, hypoxia tents, hypoxia rooms, hypoxia circles have been used by athletes for years in order to improve aerobic performance. Several studies have focused on individual adaptations of life both in training and altitude in the first periods of altitude researches. Later, these researches have given place to the methods including hypoxic stress composed over reducing O_2 content such as hypoxic gas respiration, oxygen filtering or nitrogen rarefaction that has been prepared during the exercise such as "live low, train high" (Cheung, 2010). In addition to these methods, training mask is effective on inspiration resistance with its adjustable structure to variable resistances which simulates high altitude training. Thus, it is considered that using training mask may have positive contribution on ventilation, lung endurance and lung capacity.

In high intensity training charges, (90% of VO_{2max}) breathing muscle endurance is seen as one of the most important determinants of the performance (Queslati, 2016). On the condition of dyspnea in spite of the increase in ventilation frequency and depth, muscles which give support to respiration take charge in for supplying O_2 deficit (Sönmez, 2002; Ergen, 2007).

Cardiac output increase during exercise is principally related with the increase in HR. the average arterial pressure during the exercise increases depending upon cardiac output. Systolic pressure increases generally more than diastolic pressure. This results in the increase in pulse rate. The more pulse rate you have, the more stroke volume is. Arterial pressure starts to increase at the beginning of the exercise and increases in parallel with the intenseness of the exercise performance (Katch et. al, 2011)

Compulsion in breathing resistance created by training mask generates an increase in HR (Granados, 2014). Training mask is used for designing an altitude training environment that is simulated by limiting air flow. It has been reported in several studies that the complicating effect that training mask creates in breathing resistance stands out mostly respiratory muscles (Porcari et.al, 2016, Biggs et.al, 2017, Motoyama et.al, 2016). For this reason, training models made with training mask are also called respiratory muscle training. On the other hand, it has been reported that hypoxemia at low level is generated by re-inspiring CO_2 remained inside the mask (Granados et.al, 2014). Considering all these, the effect of training mask on HR variable during exercise and recovery period has been an issue of concern.

In this study, the effect o0f training mask on heart rate (HR) and related anxiety during GXT until getting exhausted has been examined.

2. Method

Six experimental subjects having some features such as 20,5 ± 0,5 years, height 181,8 ± 5,5 cm, weight 74,5 ± 7 kg, VKI 22,51 ± 0,81 have been included in the study. The facts that the participants do not smoke, do not use drug and do not have chronic diseases (diabetes, asthma, chronic obstructive lung disease, hypertension, metabolic syndrome) in the past medical history have been determined and they have been included in the study. PARQ test evaluation has been implemented to the research group before the study and ACSM (American College of Sports Medicine) risk factor analysis evaluation has been implemented after the study. Only healthy experimental subjects have been included in the study.

The participants have been randomly separated into two groups (A, B) including 3 people. On the first day of the test, Group A completed the test with the training mask (TM) while the Group B completed it without training mask (NTM). Two days later, the groups were changed and the tests were repeated (Crossover Design).

The participants wore training masks before TM tests and by the way, they got familiar to training masks. Valve openings of training mask have been adjusted to the altitude of 2.743 m and HR has been recorded by the device Polar V800. Recovery period has been planned as 5 minutes at 4 km speed. TM test participants have not been allowed to take out their masks during recovery period. Bruce protocol which is one of the graded exercise tests until getting exhausted on treadmill has been implemented to the participants. Averages of HR values taken at 1 second-intervals during running and 5- minute recovery period have been recorded. Running and recovery period HR averages have been used for calculations. At the end of both tests, BAI has been used in order to identify anxiety conditions that the participants experience during the tests.

Nonparametric T-test has been used for determining the difference between two tests and the confidence interval has been taken as p= 0,05.

Diagram 1: Visual Plan of the Study

<table>
<tr><td>Grup A n:3</td><td>TM</td><td rowspan="2">GXT
It starts with a 10% slope, continues with 2% increase every 3 min. When the person is exhausted, the test ends</td><td rowspan="2">Recovery
4 km/h, 5min.</td><td rowspan="2">BAI</td><td rowspan="2">2 days Break</td><td>NTM</td><td rowspan="2">GXT
It starts with a 10% slope, continues with. 2% increase every 3 min. When the person is exhausted, the test ends</td><td rowspan="2">Recovery
4 km/h, 5min.</td><td rowspan="2">BAI</td></tr>
<tr><td>Grup B
n:3</td><td>NTM</td><td>TM</td></tr>
</table>

Recording of HR for each sec.

3. Results

Table 1. Age, Height, Weight and BMI Statistics of Participants

	N	Minimum	Maximum	The Mean
Age / years	6	19	22	20,5 ± 0,5
Height / cm	6	172	186	179 ± 5,2
Weight / kg	6	64	84	73,33 ± 6,88
BMI	6	21,36	24,28	22,81

The mean age of the participating athletes is 20,5, the mean height is 181,8 cm, the mean weight is 74,5 kg and the mean BMI is 22,51.

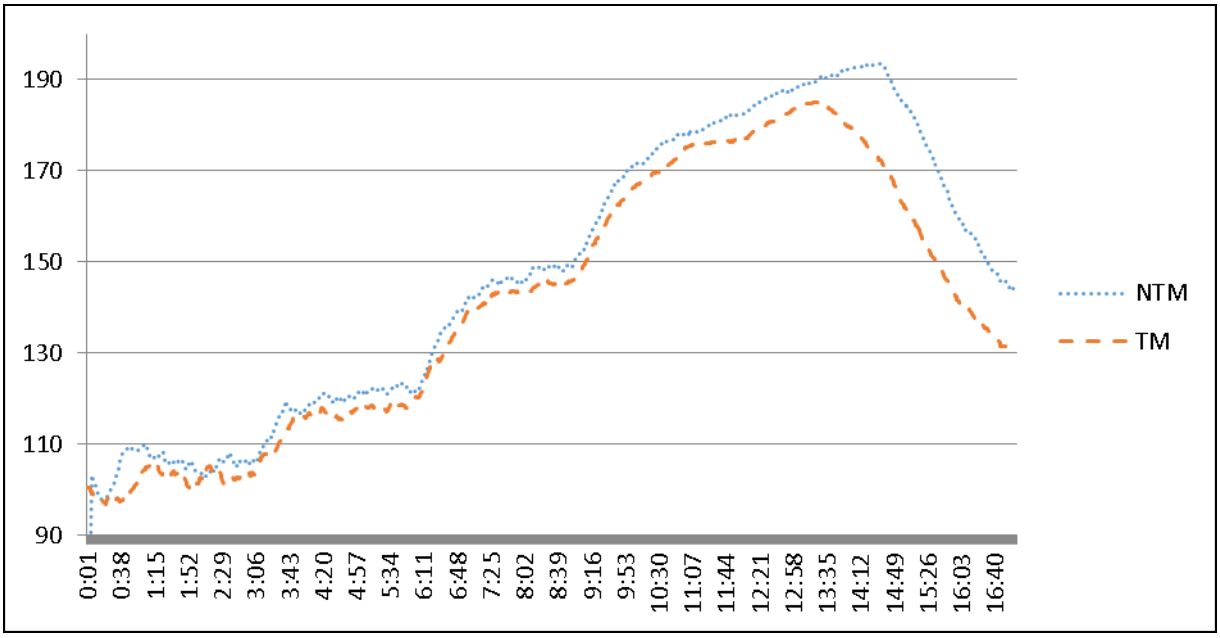

Table 2: Heart Rate Data of TM and NTM Bruce Protocol Test

		N	*Mean*	*SD*	Max	*Min*	P
HR	TM	6	135,31	31,64	184,67	96,83	,000
	NTM	6	144,42	28,55	193,33	97,83	

A significant difference has been found in view of HR values in graded running tests carried out in TM and NTM conditions (p<,005). According to the mean of terminating time of both tests, tests carried out with TM has been finalized 2.45 % earlier than the tests with NTM and the finishing time has been found lower (14,49 min.) than NTM condition (15,02 min.).

Considering maximum heart rates of the participants of TM and NTM tests (HR_{max}); TM Test (184,6 min/beat) is lower than NTM test (193,3 min/beat). In view of mean HR values of TM and NTM Tests, TM Test (135 min/beat) has lower HR mean than NTM test (144 min/beat).

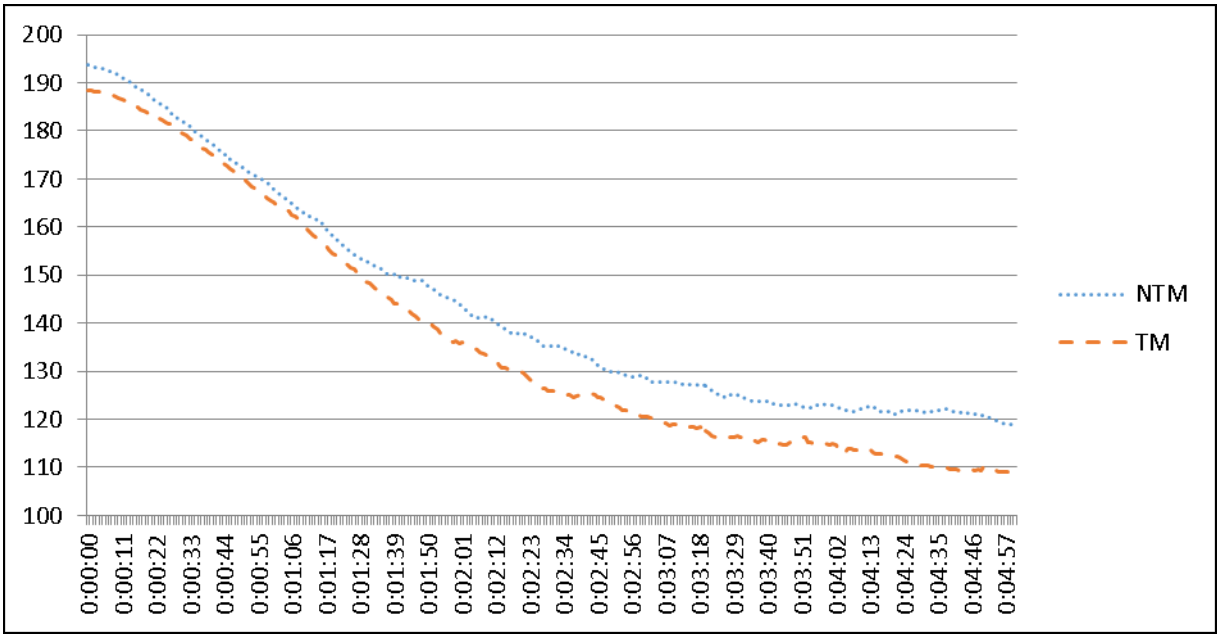

Table 3: HR Recovery Data at TM and NTM Condition

		N	*Mean*	*SD*	Min	Max	P
Recovery-HR	TM	6	136,7	23,0456	109	188,5	,000
	NTM	6	143,6	25,4873	118,6	193,6	

HR mean during recovery period after GXT has been recorded as 136,7 min/beat at TM Test and 143,6 min/beat at NTM Test.

Accordingly, a significant difference has been found statistically between TM and NTM tests (p<,005). Considering HR mean in every 60 seconds during 5-minute recovery period; while the recovery difference has been found as 1,7 % between TM and NTM tests in the first second, it has been observed that this difference has improved increasingly on behalf of TM respectively at the rate of 3,32%, 6,26%, 8,11%, 9.12%.

Table 4: Becks Anxiety Inventory

		N	***Mean***	***SD***	**Min**	**Max**	**p**
Total Score	TM	6	27,16	0,90982	24	34	,625
	NTM	6	28,16	1,58465	26	32	

Total point means of BAI implemented after TM and NTM tests have been found as 27,1667 for TM test and 28,1667 for NTM test. Accordingly, there is no significant difference between two groups in view of anxiety condition (p>,005).

4. Discussion and Conclusion

Graded exercise test (GXT) has been implemented to TM and NTM groups. During the test, HR has been recorded momentarily and the anxiety level generated by training mask has been measured by Becks Anxiety Inventory (BAI).

Considering maximal HR means at GXT, the fact that HR value reached at the exercises carried out with TM (184,6 min/beat) is lower than the NTM test (193,3 min/beat) gives rise to the idea that using TM creates bradycardia effect. Thus, in a similar study made by Özel (2016) on soccer players, it has been found that maximum HR values of the participants in the group using TM (192 min/beat) is lower than the participants without training mask (195 min/beat).

In the study carried out by Granados on TM, it has bene stated that CO_2 exhaled in wide dead spaces existing in the training mask is approximately 100 ml and CO_2 is respired back by inspiration. Therefore, it has been reported that respiring CO_2 expired back causes an increase at the rate of CO_2 and so the bradycardia effect resulted from $paCO_2$ ratio that is increasing in the blood can be observed. As Granados stated the bradycardia effect resulted from cumulated CO_2 may clarify the fact that tests practiced with TM has been finalized earlier. In our study, it is observed that GXTs carried out with TM has been terminated 2.45 % earlier.

The effect that the training mask creates over bradycardia occurrence continues at the recovery period. This situation causes the condition that HR values at the end of 5-minute recovery period carried out with TM is 9.12 % lower than the recovery carried out with NTM. HR value that is low during the recovery period practiced with TM leads a paradox which is seen as a positive effect of the recovery.

At the end of BAI implemented to the participants after finishing both tests, no significant difference has been found between total anxiety score and subtitles. At this stage, it is impossible to say that the mask stimulates an anxiety situation. However, a participant who has experienced a high anxiety situation the minute that the training mask is worn has been removed from this study according to the criteria of exclusion from the experimental study. This situation makes think that it cannot be possible to continue the performance when the training mask arises anxiety. On the other hand, graded exercise is a test that goes on until exhaustion. Evaluating the exhaustion criteria according to the person executes that the person thinks that the test has finished without experiencing anxiety. The fact that running time taken at TM test is shorter than the running time taken at NTM test supports this idea. For these reasons, it can be thought that there is no significant difference at anxiety total scores. Nevertheless, it is important to carry out the test again by increasing the number of the sample group.

It has been observed that using TM stimulates high CO_2 accumulation rate however there is no idea whether this rate is graded or at what rate at the end of the test. It is going to be helpful in respect of obtaining more information about using mask if the effect of training mask is tested by using different valve openings.

References

1. Buchheit M, Richard R, Doutreleau S, Lonsdorfer-Wolf E, Brandenberger G, Simon C. (2004). Effect of acute hypoxia on heart rate variability at rest and during exercise. Int J Sports Med. 25(4):264–269.
2. Naeije R, Mélot C, Mols P, Hallemans R. (1982). Effects of vasodilators on hypoxic pulmonary vasoconstriction in normal man. 82(4):404–410.
3. Faulhaber M, Gatterer H, Haider T, Linser T, Netzer N, Burtscher M. (2015). Heart rate and blood pressure responses during hypoxic cycles of a 3-week intermittent hypoxia breathing program in patients at risk for or with mild COPD. Int J Chron Obstruct Pulmon Dis. 10: 339–345
4. Granados J, Gillum T.L, Castillo W, Christmas K.M, Kuennen M.R. (2016). 'Functional' respiratory muscle training during endurance exercise causes modest hypoxemia but overall is well tolerated. Journal of Strengh and Conditioning Research. 30(3):755-762
5. Cheung S.S. (2010). Advanced environmental exercise physiology. Human kinetics. USA:127-143
6. Maher M.T, Figueroa M.A. (2016). The effects of simulated altitude training on aerobic capacity and function. İnternational Journal of Applied Science and Technology. 6(2): 11-15
7. Biggs N.C, England B.S, Turcotte N.J, Cook M.R, Williams A.L. (2017). Effects of Simulated altitude on maximal oxygen uptake and inspiratory fitness. İnternational Journal of Exercise Science. 10(1): 128-136
8. Warren B.G, Spaniol F.J, Bonnette R.A. (2017). The effects of an Elevation Training Mask on VO_{2max} of male reserve officers training corps cadets. . İnternational Journal of Exercise Science. 10(1): 37-43
9. Sellers J.H, Monaghan T.P, Schnaiter J.A, Jacobson B.H, Pope Z.K. (2016). Effecacy of a ventilator training mask to improve anaerobic and aerobic capacity in reserve officers training corps cadets. Journal of Strength and Conditioning Research. 30(4): 1155-1160
10. Granados J, Jansen L, Harton H, Gillum T, Christmas K, Kuennen M. (2015).''Elevation Training Mask'' Induces hypoxemia but utilizes a novel feedback signaling mechanism. İnternational Journal of Exercise Science.
11. Porcari J, Probst L, Forrester K, Doberstein S, Foster C, Cress M.L, Schmidt K. (2016). Effect of wearing the Elevation Training Mask on aerobic capacity, lung function and hematological variables. Journal of Sports Science And Medicine 15: 379-386
12. Brocherie F, Girard O; Faiss R, Millet G.P. (2015) High – intensity intermittent training in hypoxia: A double – blinded placebo – controlled field study in youth football players. Journal of Strength and Conditioning Research. 29(1): 226-237
13. Motayama Y.L, Joel G.B, Pereira P.E.A, Esteves G.J, Azevedo P.H.S.M. (2016). Airflow-restricting in resistance exercise. MDPI. 4-46

14. Illi S.K, Held U, Frank1 I, Spengler1 C.M. (2012). Effect of respiratory muscle training on exercise performance in healthy individuals. Sports Med; 42 (8): 707-724
15. Berne R.M, Levy M.N, Koeppen B.M, Stanton B.A Textbook of Physiology, Trans: Türk Fizyoloji Bilimler Derneği. Fizyoloji. 5th ed. Güneş Tıp Kitapevi. Ankara, 433-437
16. Katch VL, McArdle WD, Katch FI, (2011) Essentials Exercise Physiology. 4th ed. Lippicott Williams & Wilkins. Philadelphia, PA 19103, 265 - 377