IWNEST PUBLISHER

International Journal of Sport Sciences

(ISSN: 2077-4532)

Journal home page: http://www.iwnest.com/IJSS/

The Effect of Intense Warm up on Respiratory Function During Maximal Exercise in Women Basketball

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ARTICLE INFO

Article history:
Received 2 February 2015
Received in revised form 28 February 2015
Accepted 10 March 2015

Keywords:
heating, maximal exercise, pulmonary ventilation, respiratory equivalent

ABSTRACT

Warm-up exercise are designed to prepare the body for ensuring sporting activity They have two functions (i) to prevent injury and (ii) to enhance performance. The **purpose** of this study was to compare the total oxygen consumed during maximal exercise after both severe and moderate heat on Tehran's female basketball players. In this study seven elite female basketball players with an average age of 21 ± 25/1 years and mean height in centimeters and weight 166/8 ± 3/27& 60/85 ± 5/76 kg purposefully through a bunch of basketball teams Tehran province were selected. They participated in two separate sessions of the two protocols heating medium (with 65% of maximum heart rate) and extreme heat (with 85% of maximum heart rate) were performed for six minutes before exercise, After maximal exercise protocols based on the balk and Weber performed until exhaustion. Respiratory indices by gass analysis system was used to measure respiratory 600ZAN model and assessment of body composition Body Composition meter Body In 5/5 Venus model was used. The **results** showed that the amount of oxygen ventilation during maximal exercise after severe heat score significantly higher than average after heating at zero, 3, 6 and 9, respectively.

To Cite This Article: Mansoureh karimi, Hamid AghaAlinejad and Mojtaba Kashani., The Effect of Intense Warm up on Respiratory Function During Maximal Exercise in Women Basketball. Int. J. Sport Sci**.,** ***2(2),*** *7-12, 2015*

INTRODUCTION

Athletics believe that warm up during exercise and match help them to act with better physical and mental readiness and it also prevents injury during activities. Warm up will increase body central temperature, increase performance of circulation of blood and respiratory systems and increase speed of metabolism processes(1). Athletic exercises improve athletes' perseverance and power of respiratory muscles; it also decrease resistance of respiratory canal, increase lung elasticity and develop alveolar. Other studies show that lung capacity and volume will be increased during exercises. Maximum sport is performed by 100% vo² max [2]. According exercise plan of Bulk and Ware [2], maximum exercise means running on spinning strip until fatigue [3].

By increasing blood circulation, warm-up exercises before starting main exercise cause increasing muscle temperature and stimulating mitochondrial respiration, and by body ability to response sport activities cause decreasing oxygen shortage [4]. However, those mechanisms that change intercellular processes and whole body metabolism through warm-up are still unknown largely. By considering numerous achievements about warm-up effects on how execute sport activities and due to concentration of the researches on physiological and metabolic changes and lack of enough attention to its effects on sport performance, necessity of warm-up before main activity and what kind of program is suitable to warm-up improve oxygen distribution to the exercised muscles, which it is the considered subject of researchers and more importantly, coaches and athletes.

On the other hand, heavy warm-up delay starting metabolic acidosis, improving activity implementation and decreasing fatigue in increasing exercise. Oxygen ventilation (VO/VE) equals with volume of ventilation air and amount of the consumed oxygen. This ratio is usually measured according amount liters of breathing air to every liter of the consumed oxygen. In resting state, this ratio may be 23-28 liters air for every liter of the consumed oxygen. Ventilation oxygen equivalent will be slightly changed during light sports such as hiking, but this can be more than 30 liters of air for every liter of the consumed oxygen during heavy sports. In physiology science, this factor is used to determine athlete readiness, respiratory efficiency, aerobic threshold and non-offensive estimation of lactate threshold. When increasing sport intensity moves toward maximum,

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disproportionate ventilation with oxygen consumption will be increased at a point, which it is called defeat point. When activity exceeds from 55% to 70% maximum oxygen consumption, the delivered oxygen to muscles will not be enough for oxidation needs. To compensate, more energy is provided by glycolysis process. This increases acid lactic production and gathering. Lactic acid is composed with sodium bicarbonate and creates sodium lactate, water and carbon dioxide. Increasing carbon dioxide stimulates chemical receptors; the receptors send messages halituous center to increase ventilation. Therefore, point of ventilation defeat is a reflective of respiratory reaction to increasing amount of carbon dioxide, as which pulmonary ventilation is significantly increased after point of ventilation defeat. Although there are different ways to warm-up before race, but it seems that warm-up affects oxygen dynamics generally. Grebino *et al* [7] reported that heavy intensity warm-up (above lactate threshold) can significantly accelerate dynamics of the consumed oxygen during heavy sports. Grebino *et al* [7] were first researchers who studied dynamics of the consumed oxygen and respiratory indexes during each under-maximum and intense exercises after intense warm-up. They assumed that the phenomenon is caused by metabolic acidosis because of intense warm-up. Also Arren *et al* and Mark Brounley *et al* showed intense warm-up results to more rapid oxygen dynamics for next exercises. This in turn helps in the transmission of nervous impulse faster. The duration and intensity of warm-up should be adjusted according to the environmental temperature and the amount of clothing. With regard to duration of warm-up, In their investigations, Hagburg *et al* (1947) showed that athletes can obtain better results, if they warm-up themselves 15 minutes before race. When Group II and III warmed-up themselves for 25-30 minutes, there was no change in the obtained results, and even their records was reduced.

Methodology:

a) Subjects:

In the present study, there were selected seven female basketball players with of 21±52.1 years old, 166.8±72.3 cm, 85.60±76.5 kg, 71.21±72.1 kg/m^2 and 44.1±40.3 ml/kg for mean of age, height, weight, body mass index and VO^2 peak respectively. They have played basketball for six years averagely. They were selected from active basketball teams in Tehran Basketball League 1.

Table 1: General characteristics of the subjects.

	Mean	Minimum	Maximum
Calendar age (years)	21±52.1	20	24
Body Mass (kg)	85.60±76.5	50.7	65.8
Height (cm)	166.8±72.3	150	178
Body mass index (kg/m^2)	71.21±72.1	18.60	23.70
VO^2 peak (ml/kg/m)	44.1±40.3	37.9	48

b) Research tools:

To ensure the athletes' health, there was provided and distributed a questionnaire among them. Respiratory indexes were measured by machine of decomposing respiratory gas model ZAN-600 made by Germany. There was used machine of measuring body compounds, In Body, model Venus 5.5 made by South Korea to evaluate body compounds.

c) Method of gathering information:

After preliminaries, i.e. the questionnaire codification, the research objective and its execution manner were described in a separate meeting for the athletes. Each subject referred to the Research Center Physical Education and Sports Sciences during three separate sessions. In the first session, all subjects performed increasing test on spinning strip until fatigue, in order to identify VO^2 peak.

In two next referrals, after seven minutes tensional exercises, each subject performed two warm-up protocols (middle and severe warm-up) before maximum sport in two different days:

1. *protocol of middle warm-up:* six minutes running on spinning strip with 65% maximum heart rate;
2. *protocol of severe warm-up:* six minutes running on spinning strip with 85% maximum heart rate.

There was used from maximum protocol of Bulk and Ware on spinning strip to performed maximum activity. Between warm-up and maximum sport, the subjects walked in spinning strip with speed of 3 km/h for 3 minutes to prevent increasing effect of heart rate on major sport. All activities were done spinning strip connected to the machine of decomposing respiratory gases. During exercise, all breathing and heart rate indexes of the subjects were gathered in all times. In all three stages, there were measured active recovery and maximum sport of all the considered variables including the consumed oxygen, pulmonary ventilation, oxygen ventilation equivalent, oxygen pulse and ratio of respiratory exchange. During maximum sport, the related variables were recorded and compared at intervals 3 minutes.

The Research Statistical Method:

There were used descriptive statistics and twisted t-test to analyze data statistically and compare averages respectively. The considered meaningful level for all calculations was $p< 0.50$.

Findings:

Describing pulmonary ventilation variable in different times of activity

Time zero means time of beginning warm-up protocol with the considered intensity. In fact, to access the considered intensity, subjects began their activity on spinning strip and they started warm-up protocol when their heart rate achieved the considered rate.

Table 1: Descriptive statistics of pulmonary ventilation variable in different times of activity after middle and severe warm-up.

	Statistic Time	VE (l/min	
		middle warm-up	severe warm-up
Warm-up	0	23.14 ± 4.59	46.28 ± 12.07
	3	26.42 ± 6.32	55.85 ± 9.51
	6	28.57 ± 6.60	49.28 ± 5.90
Active recovery	9	20.00 ± 4.04	23.57 ± 3.20
Maximum sport	12	29.00 ± 3.26	27.85 ± 3.48
	15	35.57 ± 8.03	33.28 ± 5.28
	18	41.00 ± 8.50	40.28 ± 8.45
	21	46.42 ± 9.05	46.14 ± 7.90
	24	59.57 ± 12.94	54.85 ± 9.75
	27	83.57 ± 20.46	73.75 ± 17.05
	Peak	87.01 ± 19.89	73.83 ± 11.89

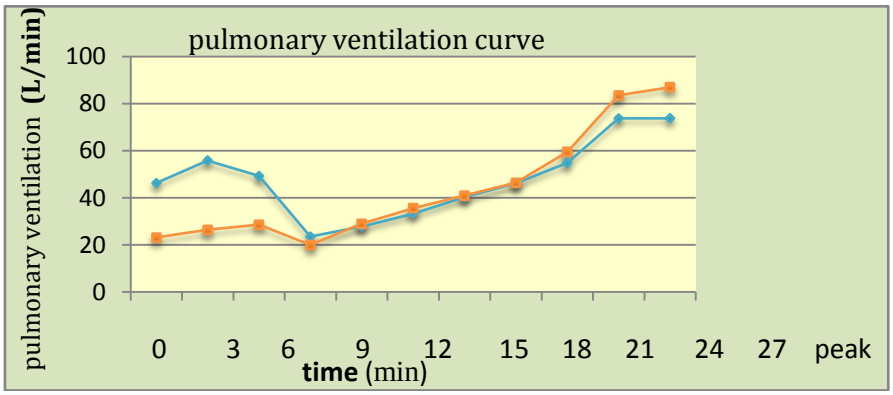

Chart 1: Difference between pulmonary ventilation in different times after middle and severe warm-up.

Describing ventilation oxygen equivalent variable in different times of activity.

Table 2: Descriptive statistics of ventilation oxygen equivalent in different times of activity after middle and severe warm-up.

	Statistic Time	VE (l/min	
		middle warm-up	severe warm-up
Warm-up	0	22.28 ± 1.70	25.71 ± 1.97
	3	23.42 ± 2.22	27.85 ± 2.60
	6	25.14 ± 2.41	27.85 ± 2.60
Active recovery	9	25.42 ± 20.07	28.85 ± 3.28
Maximum sport	12	23.85 ± 1.77	24.42 ± 1.90
	15	24.14 ± 2.19	24.71 ± 2.75
	18	24.57 ± 2.50	26.00 ± 3.16
	21	25.24 ± 2.34	27.00 ± 4.00
	24	28.42 ± 3.15	29.00 ± 4.32
	27	32.28 ± 3.72	31.28 ± 4.82
	Peak	33.49 ± 3.46	32.05 ± 3.42

Time zero means time of beginning warm-up protocol with the considered intensity. In fact, to access the considered intensity, subjects began their activity on spinning strip and they started warm-up protocol when their heart rate achieved the considered rate.

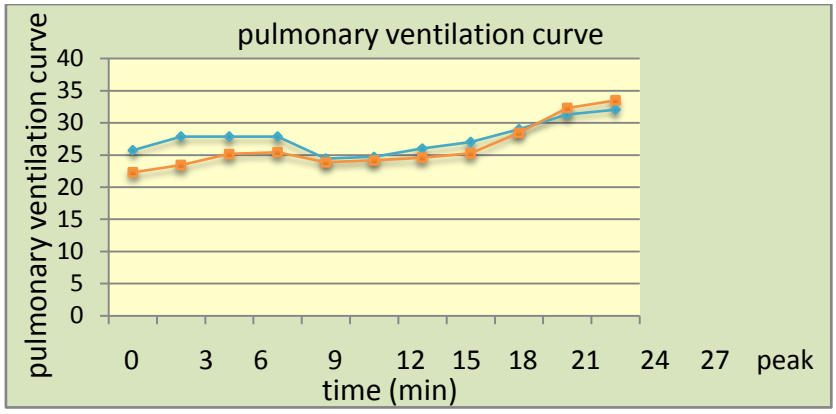

Chart 2: Difference between ventilation oxygen equivalent in different times after middle and severe warm-up.

H: There is no meaningful difference between changes of pulmonary ventilation of (VE) during maximum sport after middle and severe warm-up among women basketball players.

Table 3: Changes of the consumed VE during maximum sport after middle and severe warm-up.

Statistic / Time		middle warm-up	severe warm-up	DF	t	p
Warm-up	0	23.14 ± 4.59	46.28 ±12.07	6	-97.9	0.001
	3	26.42 ± 6.32	55.85 ± 9.51	6	-2.13	0.001
	6	28.57 ± 6.60	49.28 ± 5.90	6	-56.2	0.043
Active recovery	9	20.00 ± 4.04	23.57 ± 3.20	6	1.039	0.339
Maximum sport	12	29.00 ± 3.26	27.85 ± 3.48	6	1.100	0.314
	15	35.57 ± 8.03	33.28 ± 5.28	6	0.358	0.733
	18	41.00 ± 8.50	40.28 ± 8.45	6	0.880	0.933
	21	46.42 ± 9.05	46.14 ± 7.90	6	1.492	0.186
	24	59.57 ± 12.94	54.85 ± 9.75	6	2.711	0.350
	27	83.57 ± 20.46	73.75 ±17.05	6	2.385	0.054
	Peak	87.01 ± 19.89	73.83 ±11.89	6	-69.5	0.001

* shows meaningfulness

Considering P value and t amount Table 3, there is a meaningful difference between times 0, 3, 6, 9 and 27 in the consumed VE changes during maximum sport after middle and severe warm-up among women basketball players; while there was no meaningful difference between changes VE during maximum sport after middle and severe warm-up among women basketball players. In other words, in times 3, 6 and 9, there was observed higher average meaningful for VE during maximum sport after severe warm-up in comparison with middle warm-up. However, in time 24, there was observed higher average meaningful for VE during maximum sport after middle warm-up in comparison with severe warm-up.

Table 4: Changes of the consumed ventilation oxygen equivalent during maximum sport after middle and severe warm-up

Statistic / Time		middle warm-up	severe warm-up	DF	t	p
Warm-up	0	22.28 ± 1.70	25.71 ± 1.97	6	-4.94	0.003
	3	23.42 ± 2.22	27.85 ± 2.60	6	-3.53	0.015
	6	25.14 ± 2.41	27.85 ± 2.60	6	58.2	0.041
Active recovery	9	25.42 ± 20.07	28.85 ± 3.28	6	-1.33	0.231
Maximum sport	12	23.85 ± 1.77	24.42 ± 1.90	6	-0.001	0.356
	15	24.14 ± 2.19	24.71 ± 2.75	6	-1.98	0.094
	18	24.57 ± 2.50	26.00 ± 3.16	6	-1.12	0.304
	21	25.24 ± 2.34	27.00 ± 4.00	6	-0.795	0.457
	24	28.42 ± 3.15	29.00 ± 4.32	6	1.025	0.350
	27	32.28 ± 3.72	31.28 ± 4.82	6	2.385	0.345
	Peak	33.49 ± 3.46	32.05 ± 3.42	6	1.151	0.294

* shows meaningfulness

Considering P value and t amount Table 4, there is a meaningful difference between times 3, 6 and 9 in changes of ventilation oxygen equivalent during maximum sport after middle and severe warm-up among women basketball players; while there was no meaningful difference between changes of ventilation oxygen equivalent during maximum sport after middle and severe warm-up among women basketball players. In other words, in times 3, 6 and 9, there was observed higher average meaningful for ventilation oxygen equivalent during maximum sport after severe warm-up in comparison with middle warm-up.

Discussion and Conclusion:

Middle and severe warm-up before sport activities are necessary for better record and optimal performance, but it should be implemented as which it has no damage for execution. The conducted researches by Kesawachandran, Indian researcher, showed that there was obtained a meaningful progress in pulmonary ventilation of athletes after warming-up for 15-25 minutes before sport competition; it indicated that increasing pulmonary volume disturbs the consumed oxygen during warm-up. While warm-up for 45 minutes showed no improvement in pulmonary volume. In fact, in the carried out activities with maximum severity, pulmonary volume moves toward reduction and normal level. It should be noted that there are several factors affecting pulmonary function including physical size, age, sex, weight and height. Pulmonary function will be peak at 18 years old, it will be stable for a short time then will be decreased. In their research, Woolcook *et al* showed that 15 minutes warm-up before race will have the best result for athletes.

Results of the above-mentioned research showed that there is a meaningful difference between times 0, 3, 6, 9 and 27 in the consumed VE changes during maximum sport after middle and severe warm-up among women basketball players; while there was no meaningful difference between changes VE during maximum sport after middle and severe warm-up among women basketball players. In other words, in times 3, 6 and 9, there was observed higher average meaningful for VE during maximum sport after severe warm-up in comparison with middle warm-up. However, in time 24, there was observed higher average meaningful for VE during maximum sport after middle warm-up in comparison with severe warm-up. In Table 4, there is a meaningful difference between times 3, 6 and 9 in changes of ventilation oxygen equivalent during maximum sport after middle and severe warm-up among women basketball players; while there was no meaningful difference between changes of ventilation oxygen equivalent during maximum sport after middle and severe warm-up among women basketball players. In other words, in times 3, 6 and 9, there was observed higher average meaningful for ventilation oxygen equivalent during maximum sport after severe warm-up in comparison with middle warm-up.And researches found a respiratory warm-up (RWU) can improve exercise performance in able-bodied athletes, its effects in paraplegic individuals are unknown, In the comparison intervention (INT) trial and the control (CON) trial, no RWU was conducted. Time to exhaustion was reduced following the RWU (CON vs. INT: 497 ± 163 vs. 425 ± 126 s, $P = 0.02$). Pulmonary ventilation was increased in the middle (74.8 ± 18.0 vs. 78.3 ± 19.6 L min^{-1}, $P = 0.01$) and end (86.1 ± 20.4 vs. 95.4 ± 23.3 L min^{-1}, $P = 0.01$) phase of exercise following the RWU. Forced expiratory volume in 1 s (FEV1) was reduced following the RWU (3.44 ± 0.45 vs. 3.27 ± 0.54 L, $P = 0.02$). The decrease in FEV1 following the RWU and the higher pulmonary ventilation during the INT trial suggest that the RWU fatigued the respiratory system, and hence reduced performance capacity. It is possible that the RWU used in this study is not suitable for paraplegic individuals, as their respiratory system is limited due to their disability conclude that a RWU impaired exercise performance in a group of active paraplegic individuals as a result of respiratory muscle fatigue.

The conducted researches in this field show that heavy intensity warm-up (above lactate threshold) can significantly accelerate dynamics of the consumed oxygen during heavy sports because of the remained acidosis after early heavy activity that results to vascular expansion, muscular release, improve deliverying oxygen and oxygen deficit reduction.

Altogether, according the conducted research by Jonathan & Luis *et al*, respiratory system, respiratory canal and volume of the breathed air will be increased by physical growth, which the highest capacity is in 12-18 years old. As subjects of the research were averagely 21 years old, i.e. in heyday, it is clear that their capacity will be increased by warming-up for 30 minutes; but sprot performance and pulmonary function during warm-up more than 15 minutes damage optimal implementation of athlete.

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