The effect of intense endurance training with supplementation of egg white and wheat germ powder on cardiopulmonary function of endurance runners

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Abstract

The importance of protein and carbohydrate intake for endurance athletes has been shown. The most important healthy protein and carbohydrate supplements are egg white and wheat germ. The aim of this study was to determine the effect of intense endurance training with supplementation of egg white and wheat germ powder on cardiopulmonary function of endurance runners. Twenty four runners were randomly divided into exercise+supplement (ES) and exercise (E) group (n=12 in each group) (age: 18-30 years, MBI ≤ 25 kg/m2). Before and after training and supplementation, Echocardiographic and Spirometry characteristic were obtained. The results showed that supplementation of egg white and wheat germ powder have no effects on the indexes of PEF, FVC, stroke volume (SV) and ejection fraction (EF) ($p > 0.05$), but only a significant different was observed in the FEV1 index. According to the obtained results, it can be concluded that the supplementation of egg white and wheat germ powder has no beneficial effects on cardiopulmonary function of endurance runners.

Keywords: egg white powder, wheat germ powder, cardiopulmonary function, endurance runners

1. Background

After a few days of strenuous exercise, muscle glycogen stores may be depleted if proper attention is not paid to dietary carbohydrates, which can simultaneously affect several systems, including the immune and cardiovascular systems [1,2]. New studies have reported morphological changes and exercise- induced cardiac function as the cause of a marked increase in the risk of sudden death in young athletes during exercise. Since the cardiorespiratory system is one of the main parts of oxygen supply to the body, it is important in daily physical activities as well as sports activities [3] .

Scientific evidence shows that aerobic exercise can be beneficial in strengthening the respiratory system and improving ventilation performance [4] . Aerobic trainings reduce body fat percentage and improve the strength and endurance of the respiratory muscles as well as lung function [5]. In contrast, some studies have not shown significant changes in respiratory parameters after aerobic exercise [5,6].

Endurance athletes usually use nutritional supplements to ensure they get enough protein and carbohydrates[7]. One of them is egg white supplementation that has been investigated extensively in various studies, often due to the amount of protein consumed during recovery[8]. The importance of protein intake for endurance athletes has been well proven, because high energy consumption during exercise, in addition to the need to receive carbohydrates, requires protein intake so that the body is not in a catabolic state and can return to the restorative state and the anabolic state of damaged tissues during exercise[7]. Researchers have shown that the amount of muscle protein synthesis (MPS) increased with the consumption of egg white[13]. Therefore, the simultaneous consumption of carbohydrates and protein is very necessary for endurance athletes, especially those who train hard and one of the most important and widely consumed dietary supplements can be egg white with wheat germ, which in addition to restoring calories consumed during exercise, will also be accompanied by various amino acids, micronutrients and many vitamins. So maybe this will cause a higher effect, although in studies at the same time, not much attention has been paid to this part, and in the field of immune system function and its effects on the cardiovascular system, more studies are still needed.

According to the above and the need to study proper nutritional, this study aimed to investigate the effect of dietary supplements containing egg white and wheat germ powder on the level of immunity, respiratory and the heart electrocardiogram is designed for athletes with intense endurance training. The reason for using eggs and wheat germ as food supplements in this study is the presence of these two nutrients in the combination of different types of supplements available in the market, which studies have examined the various compounds in these foods and their effect on increasing the physical strength of athletes, but the study is not mentioned in this study.

2. Methods

2.1.General research method and design

The present study was a quasi- experimental study that after coordination with Saqez Athletics Board, among endurance runners with at least one year of experience in endurance training, 24 runners were randomly divided into exercise+supplement (ES) and exercise (E) group (n=12 in each group) (age: 18-30 years, MBI $\leq$ 25 kg/m^2). After completing the questionnaire (including personal information, history of sports activity, disease and family background) by athletes and

studying it, the conditions for participating in the test were explained to the athletes in question. Then, the subjects voluntarily announced their readiness to participate in their research, and written consent was obtained from the candidates to perform the test and draw blood. Inclusion criteria was include participation in endurance running exercises for one to three years, and no disease and physical- muscular complication, no history of smoking, alcohol and history of cardiorespiratory disease and the presence of diseases related to the immune system or certain diseases.

2.2.Body composition

To evaluate the body composition, the height of the subjects was measured with a gauge, hip and waist circumference with a tape measure with a sensitivity of 5mm and body fat percentage and weight with an in body device, respectively. All measurements were taken while the subjects had abstained from eating and drinking for 4 hours before the test and their bladder, stomach and intestines had been emptied as much as possible. Subjects were allowed to enter the project after a cardiovascular examination, blood pressure measurement, and electrocardiogram registration by a specialist physician[9].

2.3. Echocardiographic test

The method of working with a cardiograph device is that a small transducer is usually placed on a person's chest around the third and fourth spaces between the ribs near the lower left edge of the sternum. A copy of electrocardiogram is recorded on paper to obtain a graph of the findings[10]. The subject was explained about the purpose of the test, as well as its painlessness and complication. The test took 30 to 60 minutes to be completed. During the test, the subject leaned to the left and the subject's head was above its body level for 15 to 20 minutes. Since echocardiography does not cause any side effects, the subject could return to normal activities after the test.

2.4.Spirometry measurement method

Pulmonary function indices were measured by pressure method (Forced spirometry) using Sporadic S / NW 001125 model spirometer made by MIR company. The subjects sit on a chair and after attaching the nose clip, insert the mouthpiece into the mouth. After a deep breath, they immediately expelled the exhaled air through a mouth sensor at maximum-pressure. The experiment was repeated three times and the data for each step were displayed and stored separately on the monitor at the end. The monitor screen of the device, in the profile of each subject, the best result was recorded by the device and used for statistical analysis of the fourth row, which contains the best and most standard results.

2.5.Training Protocol

The training protocol included high-intensity endurance aerobic exercise for eight weeks, with three sessions per week and each session 60 minutes (total training session time including warm-up, main part and cool-down). Aerobic exercise program includes running on a treadmill for 21 minutes (main part of the exercise) with an intensity equivalent to 70 to 90% of the stored

heartbeat. The exercise was controlled by the pulse meter (POLAR/ Finland). After two days without exercise, on the morning of the training day, the resting heartbeat of the subjects was measured using a pulse meter. Training sessions were held in the afternoon around at 7:00 pm.

2.6.Supplementation

The E group received placebo. The placebo used in this study was starch powder [9]. But in the ES group, take the dietary supplement two days before the start of exercise. Protein supplements included 15g of dry white egg powder (75kc) and carbohydrates supplement containing 17/5g of wheat germ powder (78 kcal) with no added flavor. Each supplement as a dry powder was sealed in packages and delivered with a code number to ensure blinding of the study. The subjects were asked to take the supplements by mixing approximately 200 milliliter of mineral water (approximately two hours before the training session on training days). Otherwise, they were stored in the refrigerator until use. Each participant took the same supplements over an eight-week period and their adherence to the daily diet was monitored [8].

2.7.Statistical Methods

Descriptive statistics were used to determine the mean and standard deviation and the status of data distribution was assessed by Kolmogorov-Smirnov test. Analysis of covariance (ANCOVA) test was used in order to investigate the differences between the two groups. It should be noted that all findings were analyzed at a significant level 0/05 and by SPSS26 software.

3. Results

Individual anthropometric and physiological characteristics of the subjects are shown in Table 1.

Table 1. Mean and standard deviation of individual indexes.

	Variable (M ± SD)			
Groups	**Age (year)**	**Weight (kg)**	**Higth (cm)**	**Fat (%)**
E	22.30 ± 2.45	72.70 ± 10.13	175.00 ± 5.80	18.20 ± 3.72
ES	22.45 ± 2.65	73.00 ± 10.95	176.00 ± 6.10	18.50 ± 4.00

Also, the measured values of the studied are mentioned in Table 2.

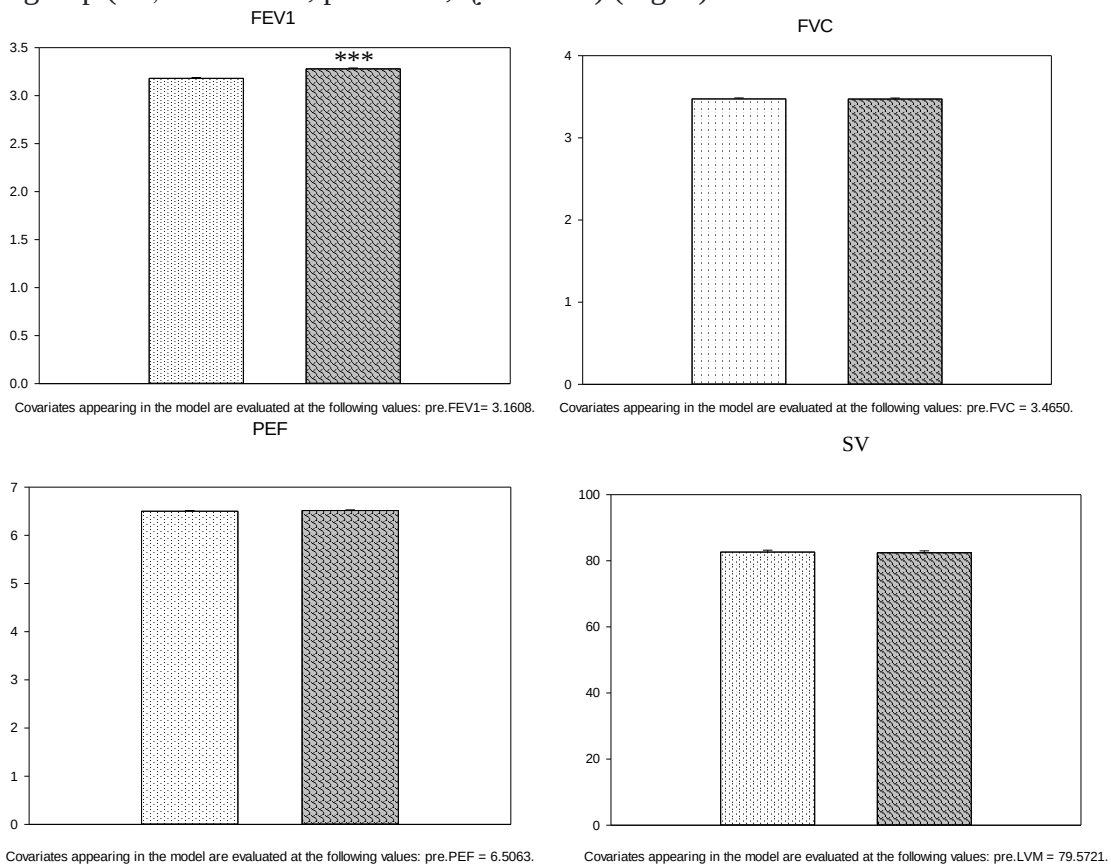
Table 2. Mean and standard deviation of depended indexes studied.

		Variable (M ± SD)				
Groups	**Condition (Test)**	**FVC (L)**	**FEV1 (L)**	**PEF (L/S)**	**SV (ml)**	**EF (%)**
E	Pre	3.52 ± 0.57	3.11 ± 0.49	6.55 ± 1.25	79.74 ± 3.48	69.52 ± 3.03

	Post	3.39 ± 0.63	3.01 ± 0.41	6.55 ± 1.36	82.67 ± 2.50	67.44 ± 3.77
ES	Pre	3.52 ± 0.62	3.11 ± 0.48	6.59 ± 1.15	80.97 ± 3.91	69.78 ± 3.21
	Post	3.60 ± 0.58	3.83 ± 0.54	6.89 ± 1.53	84.38 ± 3.15	66.07 ± 3.63

To determine the effect of eight weeks of intense endurance training with and without concomitant use of egg white and wheat germ supplement on FEV1, FVC, PEF, SV and EF indices in two groups, analysis of covariance test (ANCOVA) was performed.

The results from ANCOVA shown that there are no differences between groups about FVC, PEF, SV, and EF ($p > 0.05$). But, about FEV1 variable, values of ES group has significantly higher than E group ($F_{1, 21} = 60.308$, $p = 0.000$, $\eta^2 = 0.742$) (Fig. 1).



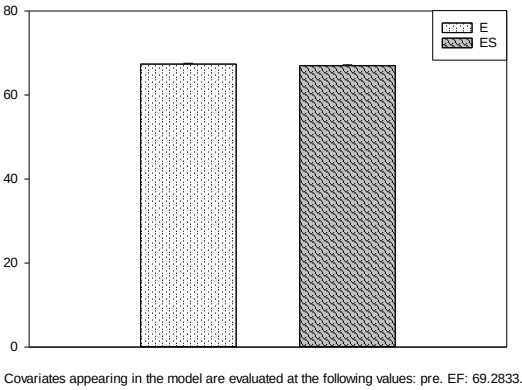


Fig. 1. The effects of supplementation on various indicators. * Show significantly different at p < 0.001. E: exercise group, ES: exercise+supplementation.**

4. Discussion

The results of the present study showed that there was no significant difference in FVC, PEF, SV, and EF between the two groups, but the FEV1 value in the exercise + supplement (ES) group is higher than the exercise (E) group.

Harrison et al (2002) observed different results from the present study. They observed a significant difference in FVC but did not observe such an increase in PEF and FEV1.

This study was performed using a treadmill on children aged 10 to 12 years with asthma. One of the differences between this study with the present study was in the type of sports activity. The important point in this study is that in children, due to the low baseline values, it is possible to be evident increases due to exercise. Because they start training with smaller amounts than experienced people.[11] These values will be especially evident when people have certain diseases such as asthma. However ,Helal et al (2017) In FEV1 index was consistent with the present study and inconsistent in the FVC index, the main reasons are smoking, young age and type of sports activity of the subjects in the study [12].

Participation in physical activity and sports is necessary to achieve better lung function. Attending a certain physical activity or exercise can help increase the strength of the respiratory muscles and consequently, the development of pulmonary function. Respiratory function depends on many factors, including the nervous system, nerve coordination, muscle, strength of respiratory muscles and lung size . Increasing respiratory muscle strength and decreasing airway resistance following physical activity is effective on improving lung function. By involving the muscles, it increases the amplitude and depth of respiration for improving FVC and consumption of oxygen and its release rate.It is said that increasing the strength of auxiliary respiratory muscles improves lung function.[13]

The researchers attributed the lack of enough duration and intensity of training to the cause of the findings. Fone and others have identified the intensity factor effective in making changes and also identified cortisol secretion due to high-intensity exercise as a dilating element due to increased surfactant secretion and decreased airway resistance, and have stated that the intensity of exercise may not have been sufficient in periodic exercise. Aerobics has also been introduced as another influential factor, as it has been stated that swimming and bodybuilding exercises, due to putting more pressure on the respiratory muscles, have an effect.**[14]**

On the other hand, the results of this study showed that the values of stroke volume index in both pre-test and post-test stages of the two groups are not statistically significant. Therefore, it can be concluded from this finding that Exercise and exercise+ supplementation have no significant effect on left ventricular mass values. Also, according to the results, a significant difference was observed in the two stages of measurement in the two groups of Exercise and Exercise + supplementation for the stroke volume index. Therefore, intense endurance training without supplementation leads to a significant difference between pre-test and post-test stroke volume values. According to these results, it can be stated that intense endurance training with simultaneous consumption of egg white and wheat germ supplementation has a significant effect on stroke volume.

In addition, according to the findings of the present study, no significant difference was observed in the values of the enjection fraction index in the two stages of pre-test and post-test between the two groups. In addition, according to the findings of the present study, no significant difference was observed in the values of the enjection fraction index in the two stages of pre-test and post-test between the two groups of Exercise and Exercise + supplementation.

In this study, we observed that both Exercise and exercise + supplement group was associated with an improvement in enjection fraction and stroke volume, but there was no difference between the two groups Adler et al. (2008) have also stated in their study that intense resistance training improved the enjection fraction percentage and performance of stroke volume both at rest and in exercise [15]. Enjection fraction is often used clinically as an indicator of the heart's ability to pump .[16] Studies have shown that the usual indicators of systolic function, namely the percentage of shortening fraction, the percentage of injection fraction are not affected by strength training, but has been reported that the fraction percentage of Shortness is significantly higher in trained strength athletes than in normal subjects.[17] In general, it can be said that periodic resistance exercise has the ability to increase and make significant changes in the important functional index of heart, i.e. the percentage of enjection fraction of the stroke volume, and probably due to the greater effectiveness of high-intensity periodic exercise in the training athletes. [15]

In relation to the impact volume variable, the result obtained is consistent with the results of Aaron Baggish (2009). In general, an increase in the volume of resting impact is considered as a positive adaptation to training. In highly trained strength men, the stroke values of the resting impact volume are normal or higher than normal. [18] Being above normal range of absolute amount of impact volume is due to a significant increase in left ventricular diastolic diameter, which causes that ventricle fill with more blood before each stroke.[19] The results of the research indicate that in order to increase the absolute amount of impact volume, rest is necessary for a long training period with a high volume or both [19], Zaidi et al, in his research states that endurance runners' stroke volume was larger than the resistance athletes and non-athlete groups.[20] James et al. (2004) also states that the greatest effect on stroke volume is due to long endurance training with high intense [21]. Hence the result obtained could probably be a reason for greater influence of nature of continuous training on the volume of stroke of research subjects that in order to study the effects of supplements used in the present study need further studies with a longer training period.

4.1.Conclusion:

Based on the findings of the present study, it can be concluded that the supplementation of egg white and wheat germ powder has no beneficial effects on cardiopulmonary function of endurance runners. Considering that only FEV1 was affected by supplementation, more extensive research is needed for any further conclusions.

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$$\sigma_r = \frac{E}{1-\upsilon^2}(\varepsilon_r + \upsilon\varepsilon_\theta - (1-\upsilon)\alpha\Delta T) \qquad (1)$$

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Tables must be numbered and the title of the table must be placed on the top of the table with the footnotes on the bottom. Tables must appear where (or as close as to) they are first mentioned in the text. They must be referred in the text as "Table 1".

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Table 1-major cities on the 21 routes to london

Route number	City 1	City 2	City 3	City 4	City 5	City 6
1	Halifax	Sheffield	Nottingham	Bedford		
2	Plymouth	Exeter	Salisbury			
3	Tiverton	Taunton	Frome			
4	Bristol	Bath	Reading			
5	Southampton	Winchester				
6	Portsmouth	Chichester				
7	Canterbury	Rochester				
8	Yarmouth	Ipswich	Colchester			
9	Norwich	Bury				
10	King's Lynn	Ely	Cambridge			
11	Berwick	Newcastle	South Shields	Sunderland	Durham	
12	Bradford	Leeds				
13	Whitby	Scarborough	York			
14	Manchester	Derby	Northampton	Leicester		
15	Hereford	Gloucester	Circenster			
16	Beverley	Hull	Lincoln	Boston		
17	Whitehaven	Liverpool	Macclesfield	Lancaster	Carlisle	Kendal
18	Shrewsbury	Birmingham	Wolverhampton	Coventry	Dudley	
19	Worcester	Oxford				
20	Kidderminster	Warwick	Banbury			
21	Chester	Lichfield	Coventry			

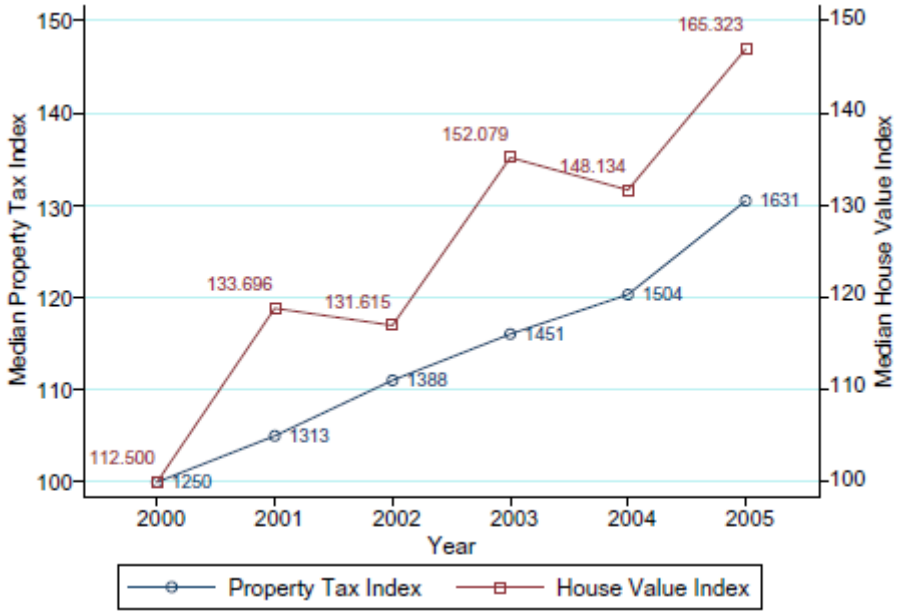

Figure (1) median property taxes and house valuse in the united states, 2000-2005

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