

The Effect of Independent and Combined Exercises on Body Composition of Elite Squash Players

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Abstract- *Paper Physical capabilities and ideal body composition are considered as prerequisite for successful performance in sports. Measuring the individual body composition is one of the important, determining and effective factors in athletes' performance in every field of sports matches. Every exercise has its own specific effect on factors of body composition. This quasi-experimental research is aimed to consider the effect of eight weeks of squash exercises on athletes' body composition and compare it with that of combined exercises. Thirty 13 to 17 years old male athletes with at least three years experiences in playing squash were selected and then randomly divided in two 15-member groups. First, the body composition of every group was measured by the INBODY370, the model of JMW140. Then, they started doing exercises for eight weeks. The first group did squash exercises for five sessions a week (each one ninety minutes). The second group's exercise program was five sessions a week (each one ninety minutes) including three squash sessions and two sessions of the combined exercises. The combined exercises included one session of resistance-endurance exercise and one session of anaerobic power-agility exercise. The athletes' body composition was reassessed after eight weeks. The correlated t-test was used to compare intragroup characteristics and the independent t-test to compare intergroup characteristics. The data were analyzed by the SPSS software. The findings showed that while eight weeks of squash exercises had no effect on weight, Body Mass Index (BMI) and body fat percentage in squash players, eight weeks of the combined exercises significantly impacted on factors of body composition.*

Keywords: *Squash, body composition, Body Mass Index (BMI), body fat percentage, combined exercises.*

I. INTRODUCTION

Highlight a section that Body composition has impacted on physical performance and fitness quite considerably [1]. Body composition consists of elements such as weight, fat mass, muscle and BMI which play leading role in physical activities [2]. These factors, therefore, are of great significance in most researches carried out about the body composition. Studies carried out by Potvin et al. (1999) on Native North American Children showed that children's weight, BMI, subscapular and triceps skinfolds were of greater differences in older children [18]. Toriola (1987), also, indicated that lack of body composition would negatively impact on athletes' performance [19].

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To calculate body composition, we should measure fat mass and fat-free mass. Sport physiologists have mainly focused on the relationship between excessive fat and levels of physical activities due to the importance of aforementioned compartments [20]. Examination of body composition and relevant exercises provide coaches with accurate information about athletes' fitness, strengths, weaknesses and body weight regulation. In addition, coaches would be able to go ahead with a long-term plan for checking performances and provision of up-to-date exercise [3, 21]. Fat mass and fat-free mass are considered as the most important factors in calculating body composition. Sardar et al. (2008) have in their research- *the effectiveness of eight weeks of aerobic exercises on patients*- concluded that fat mass reduced and muscle mass increased significantly after treatment [4]. It is worthy of notice that excessive fat mass and lack of muscle mass can have damaging effect on athletes' performance.

As Wilmore (1994) stated there would be a reverse relationship between fat mass and performance in athletes (i.e., the more excessive fat an athlete has, the weaker his/her performance would be). This matter gets more important while we regard the sports in which the body activities are of high speed and acceleration. Smith et al. (1996) indicated that National Team Players were of higher speed, better performance and power compared to University Players. In conclusion, they stated that body composition including fat mass and fat-free mass would play a crucial role in determining the significant differences between players in University and National Team [23].

Fat is considered as an energy source in body, but excessive fat mass can have a devastating effect on athletes' performance. It is to be mentioned that there is a direct relationship between physical activity and energy consumption. Energy expenditure in body can reduce the proportion of fat mass to fat-free mass in two ways:

1. Using more fat stores as energy source in body and less carbohydrates expenditure
2. Increasing proteins synthesis (anabolism) and the level of body muscle mass through exercise adaptations, especially hormone binding [17].

Therefore, it is observable that the linkage between levels of physical activity and fat mass is significantly reverse. It means, an athlete with higher level of physical activity would possess lower level of fat mass in his/her body. Some studies have indicated that resistance training increase the fat-free mass and reduce fat mass in body. In addition, it is physical inactivity, rather than overeating, which is more likely to lead to obesity [4, 5].

Optimal body composition, therefore, is considered as a prerequisite to successfully physical performance for athletes. To reduce fat mass and have a healthy body composition, the young normally take up sports, among

which squash has become increasingly popular in recent years.

Although a squash court is a relatively small playing space when compared to other competitive areas such as a football pitch, the players will need to run at speed to reach certain shots. Many researchers have studied the impacts of various training program on body composition compartments [6, 7, 8, 24, 25 & 26] but the effectiveness of squash exercise program and combined exercise programs has not been well understood.

The present study is aimed at examining the independent and combined effects of eight weeks of training program in squash on body mass and composition in elite athletes.

II. METHODS

A. Population and sample of research

The present study is based on quasi-experimental design with practical results. Sample of study included 30 squash players, ranged 13-17, in Aran and Bidgol with 3 years experiences in playing the game. They were purposively selected and randomly divided into two 15-member groups. Their nutritional data were gathered through questionnaires; also the rate of calorie expenditure was calculated in them. They did not take any medicine. At first, the body composition of groups was measured by the INBODY370, model JMW140. It is worthy of notice that factors such as temperature and humidity in atmosphere, digestion and clothing were carefully examined during the measurement.

Then, they started doing their exercises for eight weeks. While the first group did squash exercises for five sessions a week (each of which lasting 90 minutes), the exercise patterns for the second group included five 90-minute training sessions (each of which lasting 90 minutes) in a week that consisted of three squash exercise sessions and two sessions of the combined exercises. The combined exercises included one session of resistance-endurance exercise and one session of anaerobic power-agility exercise in which factors such as maximum load, exercise order, intensities and rest intervals were taken into account [Appendix 1]. The athletes' body composition was reassessed after eight weeks. The physical characteristics of the subjects are displayed in Table 1.

Table 1 the average physical characteristics of subjects

Indexes	Age (years)	Height (cm)	Weight (kg)	BMI
Groups				
First Group	14.1 ± 2.05	152.67 ± 20.21	45.13 ± 12.06	17.19 ± 3.71
Second Group	14.4 ± 2.64	153.8 ± 21.09	48.2 ± 10.20	20.22 ± 3.17

III. DATA ANALYSIS

After the data were gathered, their normality was examined through Kolmogorov-Smirnov Normality Test and the variance homogeneity of posttest data in both groups was examined through Levene's Test for Equality of Variances. The correlated t-test and independent t-test were employed to compare intragroup characteristics and intergroup characteristics respectively. The data were analyzed by the SPSS software.

IV. RESULTS

As shown in table 2, eight weeks of squash program had no effect on athletes' weight. Conversely, there existed a significant relationship between eight weeks of combined exercise program and athletes' weight loss ($P \geq 0.05$).

Table 2 weight information in pre and posttest of control and experimental group

Group	Index	Mean	SD	N	SD of difference	df	P
First group	pretest	45.13	12.06	15	0.73	14	0.97
	Posttest	45.12	11.91				
Second group	pretest	48.20	10.21	15	1.158	14	0.008
	Posttest	47.28	10.13				

Although there existed no significant differences between BMI in pre- and posttest for the first group, it was revealed that the difference was significant for that in the second group. Therefore, eight weeks of exercises in squash has not altered the BMI but eight weeks of combined exercises have impacted on athletes' BMI ($P \geq 0.05$) (Table 3).

Table 3 BMI in pre- and posttest of control and experimental group

Group	Index	Mean	SD	N	SD of difference	df	P
First group	pretest	19.71	3.71	15	0.38	14	0.99
	Posttest	19.71	3.60				
Second group	pretest	20.22	3.17	15	0.48	14	0.002
	Posttest	19.74	3.22				

Furthermore, there would no significant differences between percentage body fat in pre- and posttest for the first group. However, results showed that the difference was significant for that in the second group. Therefore, eight weeks of exercises in squash has not changed the percentage body fat but eight weeks of combined exercises have impacted on athletes' percentage body fat ($P \geq 0.05$) (Table 4).

Table 4 body fat percentage in pre- and posttest of control and experimental group

Group	Index	Mean	SD	N	SD of difference	df	P
First group	pretest	10.28	6.69	15	0.15	14	0.24
	Posttest	10.32	6.63				
Second group	pretest	10.29	6.65	15	0.35	14	0.003
	Posttest	9.96	6.34				

V. DISCUSSION

Exercise Physiologists in addition to researchers and sports coaches have determined indexes for weight, BMI and percentage body fat. Physical performance and sports activities are considerably related to the weight, BMI and percentage body fat. In addition, researches have shown that various sports might differently impact on weight, BMI and percentage body fat in athletes [4, 9].

The findings of present study indicated that eight weeks of squash program had no effect on athletes' weight, which are in line with those of Tayebi et al. (2009) which showed that 3-month volleyball exercise pattern would not influence

weight loss and BMI [10]. However, eight weeks of combined exercises can significantly reduce athletes' weight and BMI, which is in line with that of Gayini et al. (2007) who proved the effectiveness of eight weeks of physical activities in losing weight and BMI [11]. Also, it is comparable to those of Rahmaninia et al. (2004) indicating that there exists a significant relationship between endurance exercises and weight loss [7].

Weight and BMI can negatively or positively impact the sports performance. When the physical activities are crucial in sport game, the high level of BMI and weight can positively influence the performance. However, low level of BMI and weight can be of positive effect in sports like squash in which speed and acceleration play the crucial roles [12, 13]. Considering findings of present study, it can be said that some combined exercises in addition to squash would help amateurs to lose weight.

Findings also represented that eight weeks of exercises in squash has not significantly changed the percentage body fat in athletes, which is line with those of Tayebi et al. (2009) indicating that 3 months of volleyball exercise program was ineffective in reducing athletes' fat percentage [10]. Another research, also, had showed that football players' body composition changed during the competitive season and their BMI increased due to growing fat-free mass rather than fat mass [27]. However, some studies have reported no change in body composition during the competitive season [28]. The present study has indicated that eight weeks of exercises in squash has not changed the percentage body fat, whereas eight weeks of combined exercises have impacted on athletes' percentage body fat. This finding is comparable to other studies which showed a kind of direct relationship between endurance exercises and weight loss.

Moreover, research results are in line with those of Sardar et al. (2008) which showed that eight weeks of aerobic exercises would significantly influence body composition and body fat percentage [4]. In addition, findings are comparable to those obtained by Rahmani Nia et al. (2004) which showed the significant effect of endurance exercises on losing weight in women [7].

There is, in fact, a reverse linkage between percentage fat body and physical performance in squash players. Chin et al. (1995) found that physical performances of Hong Kong National Squash Players were significantly related to their championship in Asia [29].

Other studies, however, demonstrated a positive effect of exercises and sports activities on body composition and body fat. For example, Marrin and Bampouras (2008) in their examination - *the anthropometric and physiological characteristics of elite female water polo players over the course of a periodized training year*- demonstrated that significant reductions in body fat percentage occurred as the training year progressed [30]. Results of present study along with those of Tayebi et al., [10] show that exercise programs have no effect on body fat reduction in volleyball and squash players, which generally indicate that sports variously impact on fat mass in athletes. Consequently, the sport-specific activities would play a crucial role in determining the body composition.

The effectiveness of combined exercises in reducing the fat mass and weight can be attributed to the circuit exercises

because they involve all levels of body muscles [2, Rahmani and Poursohrab] and as Wilmore & Costill state the fat mass is the energy source for circuit exercises. Circuit exercises are influential due to two functions: Firstly, due to increased enzyme activities of fat β -oxidation and secondly due to the elevation of free fatty acid levels for muscles [17, Rahmani and Poursohrab]. These functions lead to utilization of more fat masses by muscles through exercises [11, Rahmani and Poursohrab].

The hypothesis advanced by Issekutz et al. (1965) is that as exercise intensity increases (mild to moderate), it results in fuel substrate switching (or crossing over) from lipids to carbohydrates (increased carbohydrate and decreased fatty acid metabolism). Other studies, in addition, showed that increase in free fatty acid levels would save glycogen in blood, thus the combined exercise can play a crucial role in changes of body composition and reduction of fat mass in athletes.

The findings of present study are of great application in public sports, as squash can help people who want lose weight, fat mass and finally have a homogenous body composition. A game of squash can be a lot of fun but it requires high level of stamina, speed and strength. Also, it In order to play well during a squash match, arms, legs and core need to be extremely strong as strong legs will allow you to move quickly to the ball and execute an effective shot. Strong arms will enable you to control the squash racket and play powerful shots throughout the match, whilst a strong core will help your balance and general sense of body control [15]. Research findings showed that it was not squash per se that considerably changed the body composition and lose weight, but the combined exercises. This issue can be attributed to the fact that fat mass does not play a leading role in energy production in sports like squash [16]. Regarding findings of present and other related studies about losing weight and reducing fat mass, it is suggested that athletes do combined exercises along with squash.

VI. CONCLUSION

The past researches have mainly focused on the positive effect of aerobic exercises on weight loss, BMI and body fat mass [8] and considered the anaerobic exercises ineffective consequently [6]. Although research findings showed that eight weeks of squash exercises could not considerably impact on weight loss, BMI and fat percentage in athletes, it was revealed that combined exercises, along with squash, would dramatically decrease weight, BMI and body fat percentage in athletes. Balanced body composition is very essential in athletes and non-athletes fitness while lower level of fat mass and higher level of muscles have a considerable impact on athletes' physical performance and non-athletes' fitness. Finally, it can be claimed that the research findings pave the way for both squash players and non-athletes who intend to lose weight.

REFERENCES

- [1] T. W. Rowland. Developmental exercise physiology (A. A. Gaiyini, Trans.). Tehran: Danesh Afrouz (Original Work Published in 1996).
- [2] Gh. Sharifi. Azmounhaye Azmayeshgahi va Meidani [Laboratory and field researches]. Khouresegan Azad University Publication. (2007).
- [3] N. Behpour.; B. Yousefi, M. Faramarzi. Ertebate noue peykare bandi va tarkibbandi ba amalkard dar olgouhaye harekati paye va ejraye

- maharathaye payeye football [the relationship of body composition and performance in basic skill of football]. *The Journal of Harekat*, 2001. 7, 113-135.
- [4] M. A. Sardar, et al. Taisre faliathaye havazi 8 hafteyi bar ghande khoun, darsade charbi badan, hadeaksare oxigene masrafi va avamele khatarzaye bimarihaye ghalbi oroughi dar bimarane marde diabeti noe 1 [The effect of 8 weeks of aerobic exercises on blood glucose, body fat percentage, the maximum of oxygen uptake and detrimental factors of cardiovascular disease in male patients of type 1 diabetes, Iranian Journal of endocrinology and Metabolism, 2008, 10 (2), 91-97.
- [5] M. Shafizadeh. Karborde sanjesh va arzeshyabi dar tarbiyat badani va olume varzeshi, 2005. [The application of assessment in physical education and sports sciences]. Tehran: Bamdade Ketrab Publication Center.
- [6] E. Aljijani, R. Hayatgheybi. Barasiye tasire 8 hafte tamrine havazi va bi havazi bar mizane taghirate hormoune estrogen, LH va darsade charbi daneshjouiyan dokhtare gheyre varezhkar daneshgah Shahid Chmarane Ahvaz [The effect of 8 weeks of aerobic and anaerobic on change rates of Estrogen, LH and fat percentage in female students of Shahid Chamran University in Ahvaz], *The Journal of Harekat*, 2002, 13, 21-30.
- [7] F. Rahmani Nia, T. Saidi. Asare yek barnameye montakhab ba vazne bar tarkibe badani va charbi zir pousti zanan gheyre varezhkar [The effect of a selected program on female non-athlete body composition and underderm fat]. *Olympics*, 2004, 12 (1), 61-8.
- [8] A. Jafari, M. R., Moradi, A. Salime, E. Mohammadi. Moghayeseye tasire tedad jalasate peyade ravi dar hafte bar taghirate badani zanane kam taharrok [The study of the number of hiking sessions in a week on body composition of non-active women], *Olympics*, 2007, 15 (1), 27-36.
- [9] M. Namjou. Ertebat beyne tipe badani va vigegehaye peykar shenasi ba montakhabi az amdegi jesmani va harekati daneshjouiyan dokhtare moaseseye amouzeshe ali va olume ensani va tarbiyat badani Tehran [The relationship between physical characteristics and body composition with a selected exercises of physical fitness in female students in Tehran Institute for Humanities and Physical Education (Unpublished Master's Thesis), Tehran, Tarbiat Moallem University. (1996).
- [10] S. M. Tayebi, et al. Asare tamrine volleyball bar tarkibe badan, avamele montakhabe amadegi jesmani va hambastegi miyane anha dar noujavanan [The effect and relationship of volleyball exercises on body composition, factors of physical fitness in inexperienced teenagers]. *The Journal of Sport Sciences in Mazandaran University*, 2009, 5 (9), 41-5.
- [11] A. Gayini, et al. Tasire 8 hafte faliyate varzeshi montakhab va regime control shode bar avamele khatarzaye ghalbi oroughi va tarkibe badaniye zanane zayeman karde [The effect of 8 weeks of selected exercises and controlled diet on detrimental cardiovascular factors and body composition in women with childbirth], *Studies in Sports Sciences*, 2007, 14, 85-98.
- [12] R. Malina, C. Bouchard. Growth, maturation and physical activity (Abas Bahram et al., Trans.), Tehran: Omid Danesh (Original work published in 2005).
- [13] M. Kashef, F. Shalchi. Assessment in physical education. Tehran: Faratahlil Publication. (2006).
- [14] J. H., Wilmore, D. L. Costill. Physiology of sport and exercise (Z, Moini et al., Trans.). Tehran: Mobtakeran (Original Work Published in 1999).
- [15] M. Kashefi. Squash. Tehran: Ketab Sara Publication Co. (2003).
- [16] E. L. Fox, D. K. Mathews. The physiological basics of physical education and athletics (A, Khaledan, Trans.). Tehran: Tehran University Press (Original Work Published in 1993).
- [17] R. A. Rabegs, S. O. Roberts. Exercise physiology: Exercise, and clinical application (A, Gayini & V. Dehbidi Rowshan, Trans.). Tehran: SAMT (Original Work Published in 2009).
- [18] L. Potvin, S. Desrosiers, M. Trifonopoulos, N. Leduc, M. Rivard, C. Macaulay, G. Paradis. "Anthropometric Characteristics of Mohawk Children Aged 6 to 11 Years". *Journal of the American Dietetic Association*, 1999, 99 (8), 955-961.
- [19] A.L. Toriola, S.A. Adeniran, P.T. Ogunremi. Body composition and anthropometric characteristics of elite male basketball and volleyball players. *Journal of Sports Medicine*, 1987, 27, 235-238.
- [20] A. Schlemmer, C. Hassayer, J. Haarbo. Direct Measurement of abdominal fat body dual photon absorptiometry, *International of obesity*, 1996, 14, 603 – 611.
- [21] A. L. Classene. The role of Anthropometric characteristics in modern pentathlon performance in female athletes. *Journal of sports science*, 1994, 12 (13), 382-395.
- [22] M. Wilkinson, d. Leedale-Brown, E. Winter. Validity of a squash-specific fitness test. *International Journal of Sports Physiology and Performance*, 2009, 29-40.
- [23] D. Smith. Physiological and performance differences between Canadian national team and university volleyball players. *Journal of sports sciences*. 1996, 10, 131-138.
- [24] S. S. Bassuk, J. E. Manson. Physical activity and cardiovascular disease prevention in women: How much is good enough. *Exercise & Sport Science Review*. 2003, 31 (4), 176 – 181.
- [25] L. K. Cox, V. Burke, A. R. Morton, et al. The independent and combined effects of 16 weeks of vigorous exercise and energy restriction on body mass and composition in free – living overweight: A randomized controlled trail, *Metabolism*, 2003, 52 (1), 107 – 115.
- [26] H. O. Chambliss. Exercise duration and intensity in a weight loss program. *JAMA*. 2003, 10; 290 (10), 1323 – 30.
- [27] R. Silvestre, W. J. Kreemer, D. A. Chris West, B. A. Judelson, J. L. Spiering, D. L. Vingren, et al. Body composition and physical performance during a National collegiate athletic association division in men's soccer season. *J Strength Cond Res*, 2006, 20 (4), 962-970.
- [28] T. Metaxas, T. Sendelides, N. Koutlianos, K. Mandroukas. Seasonal variation of aerobic performance in soccer players according to positional role. *J Sports Med Phys Fitness*, 2006, 46, 520-5.
- [29] M. Chin, k. Steninger. Physiological profiles and sport specific fitness of Asian elite squash players. *Br J Sport Med*, 1995, 29, 158-164.
- [30] k. Marrin. Anthropometric and physiological changes in elite female water polo players during a training year, *Serbian Journal of Sport Science*, 2008, 2, 75-83.



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