Cukurova Medical Journal
ÇUKUROVA ÜNİVERSİTESİ TIP FAKÜLTESİ

Cukurova Med J 2020;45(4):1428-1435
DOI: 10.17826/cumj.733444

ARAŞTIRMA / RESEARCH

Does protein adding to diet affect sportsmen's cardiovascular system?

Diyete protein eklenmesi sporcuların kardiyovasküler sistemini etkiler mi?

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Cukurova Medical Journal 2020;45(4):1428-1435

Abstract

Purpose: Arrhythmias are reproached for most of the sudden cardiac deaths in professional athletes. Also, performance-enhancing dietary supplements have been blamed in recent years. In this study, we aimed to investigate the effect of protein supplements (PS) on regular training athletes.
Materials and Methods: 70 male sportsmen (30.0 ± 7.3 year) who regularly train in the gym, were included in the study; 35 used approximately 40 grams of PS daily, while the other half regularly trained without additional PS. All participants underwent ECG, exercise test and results were evaluated by two independent cardiologists.
Results: There were no differences between two groups in terms of age, smoking and alcohol use, body mass index, baseline ECG results, effort capacity, heart rate, and blood pressure values. Correlation analyses showed a negative correlation between the age and maximum HR in an effort test.
Conclusion: This study showed that using PS in certain does not have any effect on ECG findings, heart rate at both rest and during exercise, effort capacity evaluated by a treadmill test, and blood pressure values of sportsmen.
Keywords:. Sportsmen, electrocardiography, exercise test, protein

Öz

Amaç: Profesyonel sporcularda aritmiler, ani kardiyak ölümlerin çoğundan sorumlu tutulmaktadır. Aynı zamanda, performansı artıran diyet takviyeleri de son yıllarda suçlanmaktadır. Bu çalışmada, protein takviyelerinin (PT) düzenli antreman yapan sporcular üzerindeki etkisini araştırmayı amaçladık.
Gereç ve Yöntem: Düzenli olarak antrenman yapan 70 (30.0 ± 7.3 yıl) erkek sporcu çalışmaya dahil edildi; 35 sporcu günde yaklaşık 40 gram PT kullanan, diğer yarısı PT kullanmadan egzersiz yapanlardı. Tüm katılımcılara EKG çekildi, efor testi yapıldı ve sonuçları iki bağımsız kardiyolog tarafından değerlendirildi.
Bulgular: İki grup arasında yaş, sigara ve alkol kullanımı, vücut kitle indeksi, başlangıç EKG sonuçları, efor kapasitesi, kalp atım hızı ve kan basıncı değerleri açısından fark yoktu. Korelasyon analizinde, yaş ile efordaki en yüksek kalp hızı arasında negative korelasyon görüldü.
Sonuç: Bu çalışma, sporcuların protein tozlarını belirli dozlarda kullandıklarında, kalp atış hızı, hem dinlenme hem egzersiz esnasındaki EKG bulguları, kan basıncı ve egzersiz kapasitesi üzerinde hiç bir etkiye sahip olmadıklarını göstermiştir.
Anahtar kelimeler: Spocular, elektrokardiyografi, efor testi, protein

INTRODUCTION

More than 100 years ago, Swedish clinician, Henschen concluded that heart enlargement in athletes could be normal when he was performed physical examinations on country skiers[1]. Since then, technological advancement, echocardiography, and cardiac MR imaging have provided more clues to the athlete's heart, and consensus reports have been published which interpreted both electrocardiographic and echocardiographic changes between normal individuals and athletes[2,3,4,5].

Sudden cardiac death (SCD) is the most common cause of death in athletes, and its estimated incidence varies greatly from 1 in 40,000 to 1 in 80,000, depending on the population[6]. A 12-lead ECG, 2-D echocardiography and treadmill tests are the main screening and diagnostic tools for the prediction of SCD and cardiovascular evaluation of the athletes[6,7,8].

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Geliş tarihi/Received: 07.05.2020 Kabul tarihi/Accepted: 31.08.2020 Çevrimiçi yayın/Published online: 30.10.2020

It is known that cardiac hypertrophy, valvular heart disease, coronary artery disease, and arrhythmic disorders are responsible for sudden cardiac death in the professional sportsmen. Also, performance-enhancing dietary supplements have been blamed in recent years since some case reports declared that such supplements have cardiovascular adverse effects[9,10,11].

In recent years, the number of people going to the gym has increased for being healthier and to look better. These products attract athletes because they ensure muscle development rapidly [12]. The prevalence of dietary supplement consumption ranges from 48% to 81% among of athletes worldwide, these supplements included carbohydrates, proteins, and amino acids components, anabolic steroids, carnitine, caffeine, creatine, glutamine, nitric oxide, prohormones, yohimbine and reserpine[13].

The effect of PS on athlete's cardiovascular system is controversial. We could not find large-scale studies investigating whether there is any change in the cardiovascular system of athletes who use PS and those who did not. We think that there will be a study demonstrate the effects of protein powders and contributing to the literature. Newly, this study aimed to investigate the cardiovascular effects of protein supplements (PS) on sportsmen who regularly train at the gym, by using ECG and treadmill test.

MATERIALS AND METHODS

Ethics committee approval (decision no: 2019/67-744, date: 28.03.2019) was obtained from the Non-Interventional Clinical Research Ethics Committee of Near East University Faculty of Medicine before the initation of study. Written and verbal consents were obtained from all participants. Declaration of Helsinki's was followed in the application of the ethical rules of the study.

Sample

A total of 70 male sportsmen who trained regularly at the gym were included in the study. All of the sportsmen regularly trained at the gym for at least 3 days a week and were performing both isometric and isotonic exercises for 1 to 2 hours per day. The duration of the exercise ranged from 6 months to 16 years. They were divided into 2 groups; the first group consisted of the ones who used PS and the second group included sportsmen who never used PS. To evaluate doses and type of PS use, the dietary habits were questioned by an experienced nutritionist. While some of the athletes used one type of protein, some of them used 2 or 3 different types of PS (ie. whey protein mixes, branched-chain amino acids (BCCA) based supplements, glutamine, creatine, arginine). The amount of PS consumed was an average of 30-40 grams of protein per day.

ECG and treadmill test data of both PS users and non-PS users were collected and the two groups were compared in terms of baseline ECG findings, heart rate, exercise capacity, systolic, and diastolic blood pressure.

Only male sportsmen and who had been going to the gym regularly for at least 6 months were included in the study. Four sportsmen who did not sign the voluntary consent form to participate in the study were not included in the study. Patients with known hypertension, diabetes mellitus, coronary artery disease, cancer, ventricular arrhythmia, T wave inversion in contiguous leads, and complete right bundle branch block (RBBB) or left bundle branch block (LBBB) on ECG were excluded from the study.

Measures

Electrocardiography

All sportsmen received a 12-lead ECG in the supine position after resting for at least 15 minutes (GE Marquette Mac 1200). Each ECG was interpreted by two different cardiologists independently and according to the "International consensus statement" [14]. The PR interval was defined the time from the onset of the P wave to the start of the QRS complex. QRS duration was reffered the time interval from the onset to the end of the QRS complex. QT interval was measured from the onset of the QRS complex to the end of the T-wave. The QTc interval was measured using the Bazett's formula. QT dispersion was measured as the difference between the longest (QT max) and shortest (QT min) QT intervals. QTc dispersion was measured as the difference between the longest (QTc max) and shortest (QTc min) QTc intervals. The interval from the peak of the T wave to the end of the T wave was defined to as the Tpe interval. Tpe / QT ratio values were calculated from these measurements[7,8]. Exercise stress test: The test was performed and supervised by trained medical staff (GE Case Stress System 6.7 & T2100 Treadmill).

Resting ECG, heart rate, and blood pressure were obtained before starting the exercise regimen. The sportsmen were placed on the treadmill using a designed Bruce protocol during exercise[15]. During exercise, blood pressure and heart rate were monitored by experienced staff and patients were closely monitored for symptoms such as chest pain, shortness of breath, dizziness, or excessive fatigue.

Blood pressure measurement

The patient rested in a quiet room with his back laid on the chair for at least 5 minutes. An appropriate size cuff was placed directly over the patient's left upper arm, and the patient's arm was supported at heart level towards the center of the cuff. Blood pressure was measured by the auscultation method, and the Korotkoff sounds were evaluated (phase I systolic BP, phase V diastolic BP).

Statistical analysis

The sample size was calculated in this study by taking into account the young population, gender and specific time period using the "simple random sampling method". Power analysis was calculated by using post hoc analysis method and G power 3.1 package. The study sample size was 70 patients, the margin of error was 0.05, the power of the study was 0.73 %, and the standard effect power was 0.52 %.

Statistical analysis was performed using SPSS 20.0 (IBM Corporation, Armonk, NY, USA). Continuous variables are expressed as mean and SD or median interval interquartile (IQR), and categorical variables are expressed as proportions. Shapiro-Wilk and Kolmogorov-Smirnov tests were used to determine whether the data conformed to normal distribution. Mann-Whitney U test was used to compare two independent groups when data is not normally distributed (age, sports years, V1-3 S, V5-6 R, V1 S+V5 R, QRS axis, QRS, Tpe time, Tpe/QTc, QRS peak, QRS recovery values). The baseline characteristics of the PS users and non-PS users groups were compared using the Student's t-test for continuous variables and normal distrubition (BMI, bazal heart rate [HR], R wave in limbs, PR, QT, QTc, QTDs, QTcDs, Tpe/QT, basal Systolic BP, Diastolic BP, Max SBP, Max DBP, Exercise time, basal Pulse Pressure [PP], Max PP, Max MET, Max ST Depression, pre exercise basal HR, Max HR, Exercise Stage 1,2,3,4,5 HR and Recovery 1,2,3 HR) and the $\chi 2$ Pearson's test used for categorical variables (smokers, alcohol users, Right Atral Enlargement [RAE], Left AE, Early Repolarization convex type and concave type values). Pearson's correlation coefficient (r) was used to evaluate the strength of the relation between heart rate and age, sport years. For all statistics, a p-value below 0.05 was considered significant.

RESULTS

The mean age of PS users was 32 (18-43) years and the mean age of non-PS users was 30 (20-45) years (p=0.633). The amount of PS consumed was an average of 30-40 grams of protein per day (such as whey protein mixes, BCCA, glutamine, creatine, arginine).

For the type of PS used, 10 (28.57%) were using only whey protein, 2 (5.71%) were using the only BCCA, the remaining 23 (65.71%) sportsmen were using a different mixture of whey, BCCA, glutamine, creatine or arginine PS (Figure 1, Table 1).

There was no difference between the two groups in terms of Body Mass Index (BMI) (25.3 ± 2.3 vs 25.7 ± 2.4 kg/m^2, p=0.618), sports years (4.5 [0.5-16] vs 4.0 [0.5-15], p=0.878), smoking (31.4% vs 37.1 %, p=0.615), alcohol consumption (54.3 % vs 40.0 %, p=0.231) (Table 1).

Table 1. Baseline characteristics of sportsmen

Variables	Non-Protein supplement users (n=35)	Protein supplement users (n=35)	p-value
Age (year)	30 (20-45)	32 (18-43)	0.633*
Height (cm)	178.3 ± 5.50	176.8 ± 6.69	0.156
Weight (kg)	80.6 ± 7.91	80.4 ± 8.73	0.326
BMI (kg/m^2)	25.3 ± 2.30	25.7 ± 2.43	0.618
Sport year	4.5 (0.5-16)	4.0 (0.5-15)	0.878*
Smokers (%)	11 (31.4)	13 (37.1)	0.615
Alcohol (%)	19 (54.3)	14 (40.0)	0.231
Amount of protein supplement (g/day)		± 18.9	

*: Mann-Whitney U test; cm=centimeter, kg=kilogram, g=gram, m^2= square meters

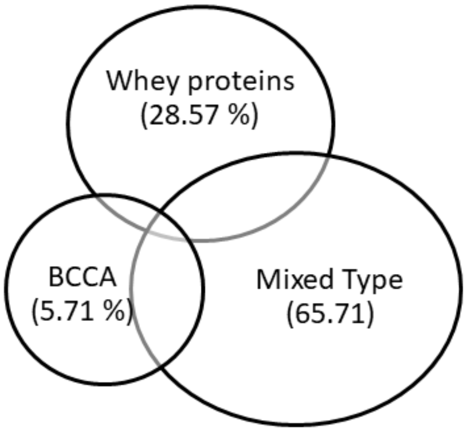

Figure 1. Types and rates of of protein supplements that used by our sportsmen

Baseline ECG characteristics of both groups were similar in terms of heart rate (67.1 ± 11.4 vs 69.1 ± 10.8 bpm), right (5.7 % vs 2.9 %) and left (8.6 % vs 5.7 %) atrial enlargement (RAE, LAE), early repolarization convex type (%0 vs 5.7%) and concave type (11.4 %vs 11.4 %), highest S wave amplitude in leads V1-3 (11.0 [5-18] vs 12.0 [5-22] mV), R wave in leads V5-6 amplitude (15 [9-25] vs 13 [4-32] mV), the sum of V1 S and V5 R wave voltage indicating left ventricular hypertrophy according to Sokolow-Lyon criteria (25 [15-40] vs 25 [14-52] mV), longest R wave in extremity leads (22.1 ± 4.7 vs 21.4 ± 6.1 mV), QRS axis (70 [20-105] vs 80 [5-105]) , PR duration (149.7 ±21.9 vs 150.4 ± 22.9 ms), QRS duration (98 [84-116] vs 100 [65-124] ms), QT interval (389.9 ± 36.4 vs 390.9 ± 30.1 ms), QTc interval (410.2 ± 22.2 vs 417.7 ± 21.1 ms), QT dispersion (38.8 ± 12.5 vs 42.4 ± 14.4 ms), QTc dispersion (40.5 ± 13.4 vs 45.2 ± 15.4 ms), Tpe time (90 [60-120] vs 85 [60-10] ms), Tpe / QT ratio values (0.229 ± 0.02 vs 0.222 ± 0.025 ms), Tpe / QTc ratio (0.213 [0.15-0.29] vs 0.204 [0.16-0.28] ms) values (p>0.05) (Table 2).

Table 2. Electrocardiographic findings of sportsmen

Variables	Non-Protein supplement users (n=35)	Protein supplement users (n=35)	p-value
Basal HR (bpm)	67.1 ± 11.4	69.1 ± 10.8	0.820
RAE (%)	2 (5.7)	1 (2.9)	0.555
LAE (%)	3 (8.6)	2(5.7)	0.643
ER (convex type) (%)	0 (0)	2 (5.7)	0.151
ER (concave type) (%)	4 (11.4)	4 (11.4)	1.000
V1-3 S (mV)	11.0 (5-18)	12.0 (5-22)	0.299*
V5-6 R (mV)	15 (9-25)	13 (4-32)	0.831*
V1 S +V5 R (mV)	25.0 (15-40)	25.0 (14-52)	0.685*
R wave in limbs (mV)	22.1 ± 4.7	21.4 ± 6.1	0.875
QRS axis	70 (20-105)	80 (5-105)	0.101*
PR (ms)	149.7 ± 21.9	150.4 ± 22.9	0.865
QRS (ms)	98 (84-116)	100 (65-124)	0.593*
QT (ms)	389.9 ± 36.4	390.9 ± 30.1	0.571
QTc (ms)	410.2 ± 22.2	417.7 ± 21.1	0.987
QT Ds (ms)	38.3 ± 12.5	42.4 ± 14.4	0.187
QTc Ds (ms)	40.5 ± 13.4	45.2 ± 15.4	0.246
Tpe time (ms)	90 (60-120)	85 (60-110)	0.291*
Tpe/QT	0.229 ± 0.02	0.222 ± 0.025	0.815
Tpe/QTc	0.213 (0.15-0.29)	0.204 (0.16-0.28)	0.073*

*: Mann-Whitney U test; Ds=Dispersion, ER=Early repolarization, HR= Heart Rate, LAE= Left atrial enlargement, RAE=Right atrial enlargement, QTc=corrected QT interval, ms=miliseconds

There was no difference between baseline systolic (119.7 ± 13.1 vs 123.5 ± 13.8 mmHg) and diastolic blood pressures (SBP and DBP) (74.7 ± 11.4 vs 73.4 ± 13.0 mmHg), maximum (max) SBP (164.4 ± 23.0 vs 171.6 ± 18.7 mmHg), max DBP during exercise (73.0 ± 13.0 vs 71.9 ± 13.6 mmHg), exercise time (12.0 ± 0.9 vs 11.9 ± 0.7 min), basal pulse pressure (45.0 ± 12.1 vs 50.1 ± 12.5 mmHg), max pulse pressure (91.4 ± 24.5 vs 99.6 ± 21.0 mmHg), the max metabolic equivalent term (MET) (14.4 ± 1.7 vs 14.2 ± 1.1), QRS duration (96 [84-114] vs 96 [82-118] ms), QRS peak duration (96 [83-115] vs 94 [78-114] ms), QRS recovery duration (96 [85-117] vs 96 [82-120] ms), max ST depression (0.14 ± 0.12 vs 0.12 ± 0.10 mm), pre-exercise basal heart rate (HR) (80.1 ± 12.4 vs 78.5 ± 13.1 bpm), max HR (in exercise) (168.0 ± 13.3 vs 166.4 ± 15.9 bpm), exercise step 1, 2,3, 4, 5 HR, Recovery HR step 1, 2, 3 between the two groups (p>0.05) (Table 3).

Table 3. Cardiovascular findings in sportsmen during the treadmill test

Variables	Non-Protein supplement users (n=35)	Protein supplement users (n=35)	P-value
Basal SBP (mmHg)	119.7 ± 13.1	123.5 ± 13.8	0.544
Basal DBP (mmHg)	74.7 ± 11.4	73.4 ± 13.0	0.468
Max SBP (mmHg)	164.4 ± 23.0	171.6 ± 18.7	0.114
Max DBP (mmHg)	73.0 ± 13.0	71.9 ± 13.6	0.879
Exercise Time (min)	12.0 ± 0.9	11.9 ± 0.7	0.515
Basal PP (mmHg)	45.0 ± 12.1	50.1 ± 12.5	0.800
Max PP (mmHg)	91.4 ± 24.5	99.6 ± 21.0	0.366
Max MET	14.4 ± 1.7	14.2 ± 1.1	0.434
QRS (ms)	96 (84-114)	96 (82-118)	0.551*
QRS peak (ms)	96 (83-115)	94 (78-114)	0.586*
QRS recovery (ms)	96 (85-117)	96 (82-120)	0.556*
Max ST Depression (mm)	0.14 ± 0.12	0.12 ± 0.10	0.940
Preexercise Basal HR	80.1 ± 12.4	78.5 ± 13.1	0.570
Max HR	168.0 ± 13.3	166.4 ± 15.9	0.212
ES 1 HR	93.8 ± 13.2	94.1 ± 11.7	0.433
ES 2 HR	107.8 ± 16.8	109.0 ± 13.7	0.176
ES 3 HR	129.0 ± 20.8	127.8 ± 17.2	0.194
ES 4 HR	158.3 ± 19.5	158.2 ± 18.8	0.697
ES 5 HR	161.7 ± 13.9	162.2 ± 16.5	0.295
R 1 HR	142.8 ± 18.3	143.8 ± 19.0	0.607
R 2 HR	118.6 ± 16.1	117.9 ± 20.8	0.093
R 3 HR	107.5 ± 15.8	109.1 ± 17.7	0.309

*: Mann- Whitney U test; DBP=Diastolic blood pressure, ES=Exercise step, MET= Metabolic equivalent Term , min=minute, ms= milisecond, HR= Heart rate, PP= Pulse Pressure, R=Recovery, SBP=Systolic blood pressure,

Pearson correlation analyses showed a negative correlation between the age and maximum HR (r=-0.475, p<0.001) (Figure 2).

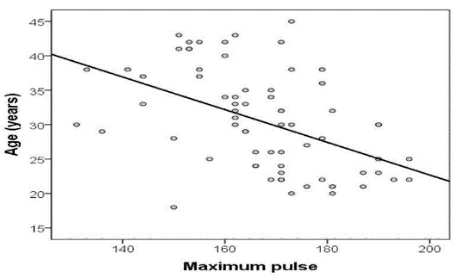

Figure 2. Relation between age and maximum heart rate (Pearson Coeffcient r= -475, p =0.000).

DISCUSSION

In our study, we could not find a difference between PS users and non-PS users regarding ECG findings, blood pressure values, heart rate, and effort capacity evaluated by a treadmill test. Another outcome of our study, showed that the basal and maximum heart rate results of all sportsmen negative correlation with age and sports duration in accordance with the literature[16].

ECG shows heart rhythm and heart rate accurately and it is the first choice diagnostic method used for cardiovascular disease screening by athletes. ECG changes in athletes vary depending on age, ethnicity, gender, sport type, and duration. In particular, these changes are prominent in older trained athletes who have done endurance sports for a long time[16,17].

Waase et al. examined ECG samples of 519 NBA basketball players and found that T wave inversion (6.2%) was the most pathological finding in athletes. Also, they found mean QRS duration was 99 ±13 ms, mean QTc interval 418±31 ms, the ratio of early repolarization 69.7%, convex ST elevation 4.4%, left atrial enlargement 13.3% right atrial enlargement 8.9% [18].

In the study conducted by Sharma et al. on 1000 junior athletes, sinus bradycardia and sinus arrhythmia were the most common ECG findings. They found QRS duration was 92 ms, QTc duration was 391±27, LAE was 14%, RAE was 16%, LVH was 45% in athletes [19]. In our study, QRS and QTc interval, LAE, RAE rates of sportsmen were lower than the literature. Because of the low number of sportsmen in our study, we thought that the number of athletes with abnormal ECG findings was less than the literature.

Another study investigating ECG changes in marathon runners with portable ECG, researches found that ST-segment deviation and arrhythmias (non-sustained ventricular tachycardia, atrial fibrillation) were more common abnormal findings in athletes[20]. In our study, arrhythmia was not observed during the exercise test, and mean ST-segment depression was less than 2 mm. In the aforementioned study, the average athlete age was 48 years, while the mean age was 30 years in our study.

To distinguish ECG changes in athletes' heart related to exercise, from the underlying pathological disease, various consensus reports have been presented. In our study, international consensus report criteria were taken into consideration when interpreting ECG's[14].

One of the important results of our study was that the baseline blood pressure in rest time and peak blood pressure during exercise were not different between the two groups. Fekete et al. followed mild hypertension and pre-hypertension patients who took Whey protein for 8 weeks. This study showed that consuming Whey proteins decrease blood pressure, improves both endothelial function and lipid biomarkers[21]. Fekete et al. attributed these effects of PS in the diet to their important role in vascular reactivity[21]. However, Kendal et al. showed that consuming a pre-workout supplement containing caffeine, creatine, β-alanine, amino acids, and B vitamins for use up to 28 days, had no observed adverse effects in terms of renal and hepatic blood markers, resting heart rate, or blood pressures. After all, they concluded that these supplements were safe for blood pressure and heart rate for up to 28 days in healthy, recreation-educated, college-age men[22]. In the literature, we did not find any study comparing the blood pressure of professional sportsmen using PS. According to our data, it can be considered that PS has no significant effect on arterial blood pressure.

Regular sports are known to have a favorable effect on patients with hypertension, due to the improvement of endothelial function[23]. In a large study investigating the prevalence of hypertension in athletes, the frequency was found 3% (n = 2 040; age 25 ± 6 years), concerning these results, hypertension appears to be seen less in athletes compared to the normal population[24]. In light of this information, the normal values of blood pressure during the resting phase of all of the sportsmen included in the study seem to be consistent with the results of previous studies.

Blood pressure measurement during exercise test provides important information about the hemodynamic response. The development of hypotension or hypertension during the test may be signs of certain diseases. The change of blood pressure during the test may be a precursor of cardiovascular disease or a new diagnosis of hypertension[24,25]. According to research conducted by Caselli et al. normotensive athletes with high blood pressure responses during exercise are under risk for incident hypertension over follow-up when compared with normotensive response athletes during exercise[25]. In our study, the maximum systolic and diastolic blood pressures of the sportsmen in both groups during the exercise test were high. However, further blood pressure monitoring could not be performed since no follow-ups took place.

Another aim of this study was to evaluate the effects of PS on exercise capacity and we found conflicting results in the literature. A study performed by Hansen et al. has demonstrated, that PS does not positively affect the athletic performance of elite cyclists[26]. Hulmi et al. observed that post-exercise supplementation with whey proteins did not show a significant impact on muscle strength compared to carbohydrates or a combination of protein and carbohydrates. They concluded that whey proteins can decrease abdominal fat and increase relative lean mass adaptations in response to resistance training compared to fast-acting carbohydrates[27]. In another study, D'Lugos et al. demonstrated that supplemental proteins during heavy cycling exercise were related to improved skeletal muscle and heart rate responses, but no effect on their performances[28]. As a result, they concluded the use of PS for muscle building and strength in daily life might not be a good idea as it is often used.

On the contrary, a systematic review conducted by Pasiakos et al. showed, that PS may support muscle hypertrophy and improve gain in muscle strength, accelerate capacity, frequency of resistance training[29].

The amount of PS taken by the sportsmen participating in our study was consistent with the doses recommended in the current sports nutrition consensus[30,31]. In line with this information, our study showed that the effects of PS on exercise capacity are not significant when used at certain doses.

Our study consisted of retrospective data and the number of sportsmen included in the study was limited. Although men with similar ages and sports years duration were included for homogenization, the sportsmen were using various types and durations of using PS. For this reason, the effect of PS on the cardiovascular system could not be determined clearly. It was questioned whether the athletes participating in the study were using anabolic steroids. Athletes who used drugs other than protein supplements were excluded from the study. Since there was no previous study on this topic, our data could not be accurately compared with other studies.

To the best of our knowledge, there is no prospective large-group study investigating the effects of PS on the cardiovascular system in the literature. This study showed that using PS in certain does not have any effect on ECG findings, heart rate at both rest and during exercise, effort capacity evaluated by a treadmill test, and blood pressure values of sportsmen. While studies emphasizing the positive effects of regular sports on the heart have been increasing day by day, unfortunately, publications on cardiovascular effects of PS are limited. Therefore, in future studies, these effects can be examined in athletes who have not used PS before and who will start using PS.

Yazar Katkıları: Çalışma konsepti/Tasarımı: SU, OA; Veri toplama: SU; Veri analizi ve yorumlama: OA; Yazı taslağı: SU; İçeriğin eleştirel incelenmesi: HD; Son onay ve sorumluluk: SU, HK, OA, LC, HD; Teknik ve malzeme desteği: -; Süpervizyon: HD; Fon sağlama (mevcut ise): yok.
Etik Onay: Bu çalışma için Yakın Doğu Üniversitesi Tıp Fakültesi Klinik Araştırmalar Etik Kurulundan 28.03.2019 tarih ve 2019/67-744 projesi etik onay amıştır..
Hakem Değerlendirmesi: Dış bağımsız.
Çıkar Çatışması: Yazarlar çıkar çatışması beyan etmemişlerdir.
Finansal Destek: Yazarlar finansal destek beyan etmemişlerdir.
Author Contributions: Concept/Design :SU, OA; Data acquisition: SU; Data analysis and interpretation: OA; Drafting manuscript: SU; Critical revision of manuscript: HD; Final approval and accountability: SU, HK, OA, LC, HD; Technical or material support: -; Supervision: HD; Securing funding (if available): n/a.
Ethical Approval: For this study, the ethical approval of the project 2019/67-744 dated 28.03.2019 was obtained from the Ethics Committee of Clinical Research of the Faculty of Medicine of the Near East University.
Peer-review: Externally peer-reviewed.
Conflict of Interest: Authors declared no conflict of interest.
Financial Disclosure: Authors declared no financial support

REFERENCES

1. Henschen S. Skilanglauf und skiwettlauf: eine medizinische sports studie. Mitt Med Klin Upsala (Jena). 1899;2:15-18.
2. Maron BJ, Pelliccia A, Spirito P. Cardiac disease in young trained in athletes: insights into methods for distinguishing athlete's heart from structural heart disease, with particular emphasis on hypertrophic cardiomyopathy. Circulation. 1995;91:1596-601.
3. Bonow RO, Nishmura RA, Thompson PD, Udelson JE. Eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities: Taskforce 5: valvular heart disease: a scientific statement from the American Heart Association and American College of Cardiology. Circulation. 2015;132:292-7.
4. Mont L, Pelliccia A, Sharma S, Biffi A, Borjesson M, Terradellas JB et al. Pre-participation cardiovascular evaluation for athletic participants to prevent sudden death: Position paper from the EHRA and the EACPR, branches of the ESC. Endorsed by APHRS, HRS, and SOLAECE. Eur J Prev Cardiol. 2017;24:41-69.
5. Maillot N, Guenancia C, Yameogo NV, A Gudjoncik, F Garnier, L Lorgis, et al. Impact of the dynamic and static component of the sport practiced for electrocardiogram analysis in screening athletes. Scand J Med Sci Sports. 2018;28:575-84.
6. Wasfy MM, Hutter AM, Weiner RB. Sudden cardiac death in athletes. Methodist Debakey Cardiovasc J. 2016;12:76-80.
7. Taşcanov MB, Güngören F, Erkuş ME. The relation between myocardial bridges and myocardial repolarization. Harran Üniversitesi Tıp Fakültesi Dergisi. 2018;15:221-5.
8. Tascanov MB, Tanriverdi Z, Gungoren F, Besli F, Yeşilay AB, Altıparmak Hİ et al. The effect of propofol on frontal QRS-T angle in patients undergoing elective colonoscopy procedure. J Clin Pharm Ther. 2020;45:185-90.
9. Prosser JM, Majlesi N, Chan GM, Olsen D, Hoffman RS, Nelson LS. Adverse effect associated with arginine alpha-ketoglutarate containing supplements. Hum Exp Toxicol. 2009;28:259-62.

10. Kammer RT. Lone atrial fibrillation associated with creatine monohydrate supplementation. Pharmacotherapy. 2005;25:762-4.
11. Liyanage CR, Kodali V. Bulk muscles, loose cables. BMJ Case Rep. 2014;2014:17.
12. Cermak NM, Res PT, de Groot LC, Saris WHM, Loon LJC. Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis. Am J Clin Nutr. 2012;96:1454-64.
13. Baltazar-Martins G, Brito de Souza D, Aguilar-Navarro M, Munoz-Guerra J, Plata MDM, Del Coso J et al. Prevalence and patterns of dietary supplements use in elite Spanish athletes. J Int Soc Sports Nutr. 2019;16:30.
14. Drezner JA, Sharma S, Baggish A, Papadakis M, Wilson MG, Prutkin JM et al. International Criteria for electrocardiographic interpretation in athletes: a consensus statement. Br J Sports Med. 2017;51:704-31.
15. Bruce RA, Blackmon JR, Jones JW, Strait G. Exercising testing in adult normal subjects and cardiac patients. Pediatrics. 1963;32:742–56.
16. Maron BJ, Pelliccia A. The heart of trained athletes: cardiac remodeling and the risks of sports, including sudden death. Circulation 2006;114:1633-36.
17. Maron BJ, Pelliccia A. The heart of trained athletes: cardiac remodeling and risk of sports, including sudden death. Circulation 2006;114:1633-44.
18. Waase PM, Mutharasan RK, Whang W, DiTullio MR, DiFiori JP, Callahan L et al. Electrocardiographic findings in National Basketball Association Athletes. JAMA Cardiol. 2018;3:69-74.
19. Sharma S, Whyte G, Elliott P, Padula M, Kaushal R, Mahon N et al. Electrocardiographic changes in 1000 highly trained junior elite athletes. Br J Sports Med. 1999;33:319-24.
20. Herm J, Töpper A, Wutzler A, Kunze C, Krüll M, Brechtel L et al. Frequency of exercise-induced ST-T-segment deviations and cardiac arrhythmias in recreational endurance athletes during a marathon race: results of the prospective observational Berlin Beat of Running study. BMJ Open. 2017;7:015798.
21. Fekete AA, Giromini C, Chatzidiakou Y, Givens DI, Lovegrove JA. Whey protein lowers blood pressure and improves endothelial function and lipid biomarkers in adults with prehypertension and mild hypertension: results from the chronic Whey2Go randomized controlled trial. Am J Clin Nutr. 2016;104:1534-44.
22. Kendall KL, Moon JR, Fairman CM, Spradley BD, Tai CY, Falcone PH et al. Ingesting a pre workout supplement containing caffeine, creatine, β-alanine, amino acids, and B vitamins for 28 days is both safe and efficacious in recreationally active men. Nutr Res. 2014;34:442-9.
23. Mazur M, Glodzik J, Szczepaniak P, Nosalski R, Siedlinski M, Skiba D et al.Effects of controlled physical activity on immune cell phenotype in peripheral blood in prehypertension-studies in a preclinical model and randomized crossover study. J Physiol Pharmacol. 2018;69:6.
24. Caselli S, Serdoz A, Mango F, Lemme E, Segui AV, Milan A et al. High blood pressure response to exercise predicts future development of hypertension in young athletes. Eur Heart J.2019;40:62-8.
25. Caselli S, Segui AV, Quattrini F, Gacinto BD, Milan A, Assorgi R et al, Upper normal values of blood pressure response to exercise in Olympic athletes. Am Heart J. 2016;177:120-8.
26. Hansen M, Bangsbo J, Jensen J, Krause-Jensen M, Bibby BM, Sollie O et al. Protein intake during training sessions has no effect on performance and recovery during a strenuous training camp for elite cyclists. J Int Soc Sports Nutr. 2016;13:9.
27. Hulmi JJ, Laakso M, Mero AA, Hakkinen K, Ahtiainen JP, Pelonen H. The effects of whey protein with or without carbohydrates on resistance training adaptations. J int Soc Sports Nutr. 2015;12:48.
28. D'Lugos AC, Ludden ND, Faller J, Akers JD, McKenzie A, Saunders MJ. Supplemental protein during heavy cycling training and recovery impacts skeletal muscle and heart rate responses but not performance, Nutrients. 2016;8:550.
29. Pasiakos SM, McLellan TM, Lieberman HR. The effects of protein supplements on muscle mass, strength, and aerobic and anaerobic power in healthy adults: a systematic review. Sports Med.2015;45:111-31.
30. Thomas DT, Erdman KA, Burke LM. American College of Sports Medicine Joint Position Statement. Nutrition and athletic performance. Med Sci Sports Exerc. 2016;48:543-68.
31. Maughan RJ, Burke LM, Dvorak J, Larson-Meyer DE, Peeling P, Phillips SM, et al. IOC consensus statement: dietary supplements and high-performance athlete. Int J Sport Nutr Exerc Metab. 2018;28:104-25.