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Association of The Healthy Eating Index and Body Composition Among Iran's Paralympic Athletes with Hemodialysis and Hemophilia

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Abstract

Background: Essential parameters of athletes that enhancing their fitness and success rate in sports career are body composition and anthropometric indices, additionally perfect performance of athletes with a prolonged and intensive season is significantly influenced by dietary intake and training.
Objective: To determine the association between the healthy eating index (HEI) and body composition among Iran's Paralympic athletes with hemodialysis and hemophilia.
Patients and Methods: A study with a cross-sectional design was carried out, which recruited 100 athletes with hemodialysis and hemophilia who participated in the 2020 competitive pre-season tests. Sociodemographic, anthropometric, physical activity, sleep pattern, and dietary intake were used in the analysis. The quality of the diet was assessed using the HEI score, with a range of 0 to 100, based on information obtained using food frequency questionnaire. Body components parameters were assessed using Bio impedance analyzer BIA (TANITA BC- 418 (TANITA, Japan) and 7-points skinfold measures, linear regression model was used for finding the associations between HEI and body composition.
Results: The overall HEI score was 67.81 (grade D) and there was a significant difference for the mean body fat percent (P=0.001) and mean fat free mass percent (P=≤0.001) between 7-points skinfold measurements and BIA. No significant association had been found between the resulting HEI of the participants with the components of their body composition including, body mass index BMI (P=0.57), waist circumference WC (P=0.53), waist hip ratio WHR (P=0.18), fat percent (P=0.76) and fat free mass percent (P=0.76).
Conclusion: It can be concluded that the dietary intake need more improvement, we did not find any significant associations between HEI (diet quality) with the parameters of body composition.
Keywords: Healthy Eating Index, body composition, Dietary Intake.

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Introduction

Physical fitness and sport performance are the most priority of sport athletes, as such, optimal performance of athletes with a prolonged and intensive season is significantly influenced by dietary intake and training[1]. Additionally, anthropometric indices and body composition in athletes are substantial measures in determining the rate

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of success in sports career [2]. As well, an important and critical component of health status and nutrition assessment is the body composition where it differentiates the determined percentages of soft tissue body mass, fat mass, and bone mass [3]. A two-compartment model separates the body into fat-free mass (FFM) and fat mass (FM), considering that fat free mass and fat mass are the typical components of body composition [4]. The FFM proportions from person to person are relatively constant. As a body weight percentage, the average total body fat for an individual is between 25% and 31% for females and18% and 24% for males. On the other extreme, "elite fit" women are as low as 10% to 13% body fat and men 2% to 5% [5], indicating that fat percentage is usually lower in bodies of athletes in comparison to general population [2]. As a result, a perfect exercise performance is strongly a body composition factor dependent contributing to improved athlete's capacity making it an important factor affecting athlete's agility, strength and appearance [6]. For this, it could be considered that body composition changes may affect the athletic performance. Several parameters which are the age, sex, inheritance or ethnicity considered as a constant important variables having an essential leverage on body composition, but the effect is highly dependent on exercise training, nutritional status and eating pattern [2, 7]. Additionally, the variety of food intake including all groups of food is not only imperative for performance in sport; it is often a reference of micronutrient consumption and as such linked to deficiency prevention and chronic disease risk reduction [8].

Hemodialysis (HD) patients are predisposed to protein–energy malnutrition/protein–energy wasting (PEM/PEW) which is usually documented in end stage kidney diseases due different factors including a decreased dietary intake, increased nutrient losses, chronic inflammation, increased nutritional needs, simultaneous acute or chronic conditions or illnesses, physical inactivity, and the dialysis catabolic stimulus itself, as a result a decreased fat mass (FM) and fat-free mass (FFM) and affected bone mass in final stages [9, 10 ,11 ,12]. Wasting of muscle mass is the main clinical finding of malnutrition for dialysis patients, so distinguishing fat and muscle mass when performing nutritional assessment is essential.

Hemophilia is a rare genetic bleeding disorder with an X-linked recessive pattern inheritance that is characterized by a lack of or insufficient clotting factor in the blood, So the nutrition status among patients with hemophilia is important criteria for keeping them healthy, preventing patients from getting extra weight to avoid vulnerable joints bleeding and muscle strains [13, 14]. Dietary patterns have a link with body composition, as several studies indicated that unhealthy and healthy dietary index is associated with body composition or anthropometric measures [15, 16, 17, 18, 19, 20].

Moreover, according to the best of our knowledge, No published studies about the association between the HEI and body composition in athletes with hemodialysis and hemophilia. Therefore, this study seeks

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to determine the association between the HEI with body composition among Iran's Paralympic athletes with hemodialysis and hemophilia.

Patients and Methods

Study Design

A study with a cross-sectional design has been conducted among 100 Iranian Paralympic athletes (hemophilic and dialysis patients) in Iran's Paralympic medical center, during the stage of the competitive pre-season test on 2020, using a convenient sampling method including all of the participants except individuals with pacemakers or individuals that do not wish to participate in the study. Data collection has been carried out by trained interviewers and it has been extended for seven days. sociodemographic information including (age, sex, occupation, education, smoking, marital status) were collected using a general sociodemographic questionnaire form.

Anthropometric measurements

Anthropometric parameters measurements were done including height, weight, BMI, WC, hip circumference, WHR, and skinfold thickness at seven points in the body (pectoral, axillary, abdominal, suprailiac, subscapular, thigh, and triceps) by using Harpenden caliper. where 7-Site Skinfold Equation for men is:

Body Density = 1.112 - (0.00043499 x sum of skinfolds) + (0.00000055 x square of the sum of skinfold sites) - (0.00028826 x age), where the skinfold sites (measured in mm) are: Chest, Axilla, Tricep, Subscapular, Abdominal, Suprailiac and Thigh [21].

And 7-Site Skinfold Equation for women is:

Body Density = 1.097 - (0.00046971 x sum of skinfolds) + (0.00000056 x square of the sum of skinfold sites) - (0.00012828 x age), where the skinfold sites (measured in mm) are: Chest, Axilla, Tricep, Subscapular, Abdominal, Suprailiac and Thigh [22].

Moreover, body compositions have been measured using Bio impedance analyzer BIA (TANITA BC- 418 (TANITA, Japan) [23].

Dietary assessments

Information on food intake have been collected using The 147 questions Food Frequency Questionnaire FFQ, this questionnaire designed for and validated against the population of Iran containing a list specific food and beverage items [24].

Data on 11 food categories were obtained including fruits, vegetables, dairy products, cereals and grains, meat, legumes, nuts, fast-food, oils and fats, salty snacks, sweets and beverages. Participants asked to report their frequency of intake for each item of food consumed during the past year on a daily, weekly, or monthly basis. The portion sizes of the foods were converted to grams per day using household measures [25]. Nutritionist IV software were used to estimate energy and nutrients intake (www.worldcat.org), based on the US Department of Agriculture food composition database modified for Iranian foods [26].

Physical activity

Questions on the physical activity level in the last seven days divided as vigorous activities, moderate activities, walking and sitting time on a week days have been collected using the validated international physical activity questionnaire (the short one) (IPAQ) [27]. In addition to that, sleep pattern questions also collected including the total number of sleeping hours during the day (24 hours), total number of hour during the day

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time, time of getting to bed and time of getting up from bed.

Calculations of HEI 2015

The HEI 2015 contains 9 adequacy components (components to increase) i.e. total fruits, whole fruit, whole grains, dairy, total vegetables, total protein foods, greens and beans, seafood/plant proteins, fatty acids and 4 moderation components (components to decrease) i.e. sodium, refined grains, saturated fats and added sugars. Every component has a maximum score of 5 or 10 and a minimum score of 0.

Concerning the adequacy components, their scoring is based on density, which means individuals who take at the recommended level receive the maximum score, while for the moderation components, increasing intake levels receive decreasingly lower scores. This means that, for all of the dietary components, higher scores indicating closer correspondence with dietary guidance. following scoring each component, summation of the scores were done to obtain the final individual's score (ranging between 0 and 100). The lowest score is 0, while the highest score was 100 [28].

Statistical Analysis

Data was transformed into a computerized data base component. Analysis was done using SPSS version [25] computer software (Statistical Package for Social Sciences) (SPSS Inc. Chicago, IL, USA). Statistical analyses were considered significant if P value was less or equal to 0.05. The main features of the data were obtained using the descriptive statistics (frequencies and cross tabulations). Paired-Samples T-test was used for comparing body composition parameters by the two methods (skinfold measurements and BIA). For finding the associations between HEI with the measures of body composition the linear correlation statistics was performed using the linear regression model in the crude and adjusted models for age, sex, energy intake, physical activity level, job, smoking, marital status and disease status.

Results

Description of demographic characteristics of study participants

One hundred Paralympic athlete participants were surveyed in this study. 48 of them were hemodialysis patients and 52 were hemophilia ones. Table (1) summarizes the main characteristics of these participants. They were on average 34.75 years old, had a total daily physical activity of 775.52 minutes per week which included (light 306.20 minutes per week, moderate 221.01 minutes per week and heavy ones 251.30 minutes per week). 67 participants were men, 33 were women. Mean body weight 68.6 kg and a BMI of 24.19 kg/m^2 with mean waist circumference 84.66 centimeter and mean waist hip ratio 0.87. Mean total caloric intake was 3036. Mean percent fat mass (FM) and percent fat free mass (FFM) measured by BIA were 19.84% and 80.15% respectively. However, according to 7-points skinfold measurements, mean percent fat mass (FM) and percent fat free mass (FFM) were 17.70% and 82.29% respectively. There was a statistically significant difference for the mean FM and FFM percent between the two methods (P=0.001) and (P=≤0.001) respectively Table (1).

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Table (1): Participants demographic characteristics

		Total	P value	Hemodialysis	Hemophilia	P value
Variables		Mean±SD		Mean±SD	Mean±SD	
Age (Years)		34.75±10.13		38.42±10.26	31.37±8.83	
Sex	Male	67		30	37	
	Female	33		18	15	
Marital status	married	46		19	33	
	single	54		29	19	
Education	University	41		20	21	
	Diploma or lower	59		28	31	
Smoking	Smoker	18		7	11	
	Non-smoker	82		41	41	
Disease status	hemodialysis	48				
	hemophilia	52				
Weight (Kg)		68.65±16.14		66.40±19.29	70.65±13.25	0.20
BMI (Kg/m²)		24.19±4.89		23.77±5.42	24.56±4.40	0.42
Waist Circumference (cm)		84.66±14.86		85.51±16.10	83.88±13.77	0.61
Waist Hip Ratio		0.87±0.09		0.89±0.09	0.86±0.08	0.15
Physical activity total (min/week)		775.52±956.51		653.44±918.55	900.38±988.66	0.22
Light Physical Activity (min/week)		306.20±433.43		330.66±434	281.18±436.43	0.59
Moderate Physical Activity (min/week)		221.01±450.17		116±186.82	328.40±596.39	0.02*
Heavy Physical Activity (min/week)		251.30±577.77		204.89±502.31	297.71±646.80	0.44
Sleep period (hour)		8.48±1.91		8.7±1.89	8.26±1.93	0.28
Energy intake (Kcal)		3036.29±970.41		2871.62±909.27	3194.24±1009.67	0.10
Fat percent % (BIA)		19.84±9.50*	0.001*	17.51±9.26	22.44±9.02	0.01*
Fat percent % (Skin fold Measures)		17.70±6.86*		15.81±6.97	18.60±6.57	0.06
FFM %(BIA)		80.15±9.50*	≤0.001*	82.48±9.26	77.55±9.02	0.01*
FFM % (Skin fold Measures)		82.29±6.86*		84.18±6.97	81.39±6.57	0.06

* means a statistically significant test

All values are reported as mean ± SD except for gender physical activity level sex, marital status, education, smoking and disease status which are reported as number of participants. Paired-Samples T-test was used for comparing fat free mass and fat mass between skinfold measurements and BIA methods.

BIA, Bio Impedance Analysis; FFM, fat free mass

HEI Score among participants

Diet quality of participants as assessed by the HEI-2015 lied in the category D according to the HEI score classification, with total points of 67.81 from the overall 100 points score as shown in Figure(1). The scores for the HEI components were as follow: total fruits 3.59 from 5, whole fruits 4.45 from 5, total vegetables 3.51 from 5, green and been 4.38 from 5, whole grains 5.19 from 10, dairy 3.60 from 10, total protein food 3.66 from 5,

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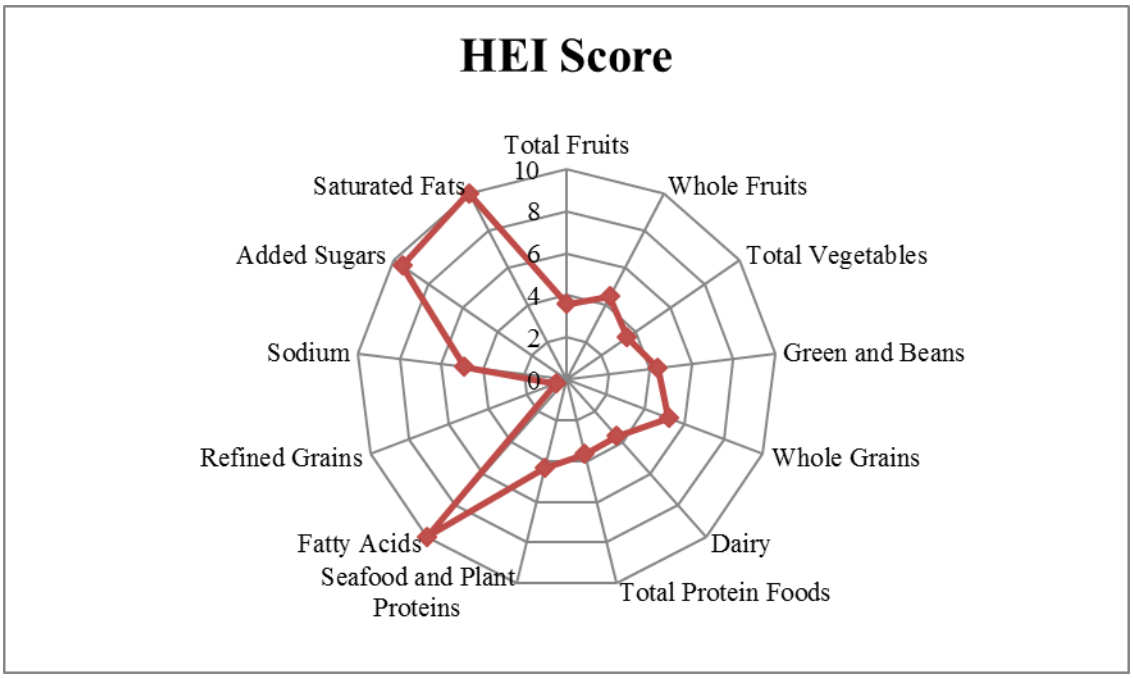
seafood and plant based protein 4.35 from 5, fatty acids 10 from 10, refined grains 0.54 from 10, sodium 4.9 from 10, added sugars 9.51 from 10, and saturated fat percent from total energy 10 from 10, Figure (1).



Figure(1): Radar graph depicting a (67.81 points) score pattern of HEI according to HEI-2015 component score

Association of HEI with anthropometric measures: Results revealed that the crude linear association of the HEI with the components of body composition for the participants BMI (Beta= 0.09, P=0.16), WC (Beta= 0.04, P=0.83), WHR (Beta=-0.001, P=0.58), percent fat mass PFM (Beta=0.14, P=0.30) and percent fat free mass PFFM (Beta= -0.14, P= 0.30) was statistically not significant as shown in Table (2).

The results remained unchanged even after controlling for the sex, age and caloric intake in the first model BMI (Beta= 0.07, P=0.25), WC (Beta= -0.03, P=0.88), WHR (Beta=-0.001, P=0.32), fat mass percent (Beta= 0.15, P=0.22) and fat free mass percent (Beta= -0.15, P= 0.22) and for sex, age, caloric intake, disease status, physical activity, smoking, marital status and job in the second model, BMI (Beta= 0.04, P =0.57), WC (Beta= -014, P=0.53), WHR (Beta= -0.002, P =0.18), fat mass percent (Beta=0.04, P=0.76) and fat free mass percent (Beta= -0.04, P= 0.76),Table (2).

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Table (2): Linear association of HEI with anthropometric measures among participants

		HEI score		
		Beta	95% CI	P
BMI				
	Crude	0.095	-0.041−0.231	0.169
	Model 1	0.078	-0.057−0.213	0.256
	Model 2	0.04	-0.11–0.20	0.57
WC				
	Crude	0.045	-0.391−0.482	0.837
	Model 1	-0.031	-0.437−0.376	0.881
	Model 2	-0.14	-0.60–0.31	0.53
WHR				
	Crude	-0.001	-0.003−0.002	0.584
	Model 1	-0.001	-0.004−0.001	0.325
	Model 2	-0.002	-0.005–0.001	0.18
PFFM				
	Crude	-0.14	-0.41−0.12	0.30
	Model 1	-0.15	-0.42−0.10	0.22
	Model 2	-0.04	-0.31–0.23	0.76
PFM				
	Crude	0.14	-0.128−0.411	0.30
	Model 1	0.159	-0.103−0.421	0.229
	Model 2	0.04	-0.23–0.31	0.76

A linear regression model was carried out with adjustment for sex, age, energy intake in the first model and adjustment for sex, age, energy intake, sickness, smoking, marital status, job and physical activity in the second model, P value set at 0.05. BMI, body mass index; WC, waist circumference; WHR, waist to hip ratio; PFFM, percent fat free mass; PFM, percent fat mass.

Association of HEI with percent fat mass and percent fat free mass according to 7 points skinfold measures: Results showed that the association of the HEI with the components of body composition according to 7 points skinfold measures for the participants was not significant in the crude model where percent fat mass (Beta= 0.12, P=0.19) and percent fat free mass (Beta= -0.12, P=0.19), as shown in Table (3).

The linear association is also not significant after adjustment for the sex, age and caloric intake in the first model, percent body fat (Beta= 0.12, P =0.20), percent fat free mass (Beta= -0.12, P=0.20), and in the second model after adjustment for sex, age, caloric intake, disease status, physical activity, smoking, marital status and job, percent body fat (Beta= 0.03, P =0.76), percent fat free mass (Beta= -0.03, P=0.76), Table (3).

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Table (3): Association of HEI with Percent body fat and percent fat free mass according to 7 points skinfold measures

		HEI scores		
		Beta	95% CI	P
PFM				
	Crude	0.12	-0.06−0.32	0.19
	Model 1	0.12	-0.07−0.31	0.20
	Model 2	0.03	-0.17–0.23	0.76
PFFM				
	Crude	-0.12	-0.32−0.06	0.19
	Model 1	-0.12	-0.31−0.07	0.20
	Model 2	-0.03	-0.23–0.17	0.76

A linear regression model was carried out with adjustment for age, sex, energy intake in the first model and adjustment for age, sex, energy intake, sickness, smoking, marital status, job and physical activity in the second model, P value set at 0.05. PFM, percent fat mass; PFFM, percent fat free mass.

Discussion

The present cross-sectional study explored the assessment of HEI and body composition in Iranian Paralympic athletes with hemodialysis and hemophilia, as well as, the association between the identified HEI with body composition in those Paralympic athletes. The overall HEI score was 67.81 which indicates a grade D level. No significant association had been found between the resulting HEI of the participants with the components of their body composition (BMI, WC, WHR, Fat percent and Fat Free Mass Percent) in the present study. The achieved results between diet quality as HEI-2015 and body composition parameters were inconsistent with previous studies [29,20]. These results were found associations between diet quality and body composition in National Health and Nutrition Examination Survey conducted on a United State population, and also with a study conducted by Gao, [19]. On the other hand, our results were in line with some other studies [30] with no association of HEI with BMI, WC, and body fat percent was seen, but it was associated with categories of body fat percent; while in a study by Asghari, [31] no association has been found between diet quality indices with BMI and WC. Another study [32] found that higher score of HEI was not related to overweight/general obesity in women but only in men. Additionally, Zagarins, [33] reported no association of HEI-2015 with BMI or body fat percent.

Some of the inconsistencies in the findings of the studies could be due to the inapplicability or limited utility of the dietary indices in populations where the specific healthful foods and food groups ascertained by the index are not widely consumed. Furthermore, different populations could have different applicability, as dietary scores assessed the conformance to dietary guidelines for United State populations; additionally, populations may be ignorant for measuring the overall quality of diet until more is known about consumption patterns of diet, putting in front of us that specific indices can be assessed only in specific population groups. Also, behavioral factor of nutrition and different food choice, in addition to cultural and economic factors and

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ethnicity determinants, play important roles, making people less able to conform their dietary intake patterns to US nutritional guidelines.

The healthy dietary options that are followed by obese individuals for getting a more ideal healthy weight could make a difficulty for detecting the effect of the healthy diet as assessed by scores on the obesity status that they have.

The design of the study could also has an effect, as the cross-sectional design including the present study cannot reveal the causal effects of conforming to dietary indices on the status of the weight, and only explain an association. Additionally what is considered in the present study is the special entity of the studied participants as they are sick subjects, as well as they can't engage in heavy physical activity like the professional athletes or they could be on a special diet like in hemodialysis, these factors could affect the dietary association with body anthropometric measurements.

Higher scores of HEI are indicative of a healthy diet, Adherence to a healthy diet and dietary guidelines with macronutrient balance are significant mechanisims for the regulation of different biological procedures associated with cardiovascular disease risk and body composition [34]. Evidence indicate that, high fat and sodium consumption are associated with higher risk for overweight/obesity [35, 36]. Considering the association of quality of the diet as HEI and obesity, it may be mandatary to set a better dietary guideline recommendations adherence.

Conclusions

The present study is the first to evaluate the association of HEI with components of body composition in Paralympic athletes with hemodialysis and hemophilia. We observed that the overall HEI score was 67.81 classified as a grade D. No association was found between (diet quality as HEI) with the parameters of body composition in Iranian Paralympic athletes with hemodialysis and hemophilia. More studies are warranted to confirm the present association.

Recommendations

Different scores diet quality observed in different populations indicated that future dietary guidelines should be developed and updated to address the dietary needs of different specific population groups.

Coaches and nutritionist should regulate and control Paralympic athletes' diet and also educate them to be self-responsible for their health.

Further research using longitudinal studies and field trials to confirm dietary pattern with body anthropometric parameters

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Ethical clearance: Tehran University of Medical Sciences Ethics Committee approved this study (Ethic number IR.TUMS.MEDICINE.REC.1400.524).

Before signing an approval consent form, all of the participants were given a detailed verbal and written explanations about the study, in addition to that, assurance of the subjects about the confidentiality of the information that were given to the researcher.

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No harm or complain to any of the study participants was present, so the study was totally safe.

Conflict of interest: Nill

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تقييم العلاقة بين مؤشر التغذية الصحية وتركيب الجسم في رياضيي البارالمبياد الايرانيين المبتلين بغسل الكلى الدموي والهيموفيليا

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الملخص

خلفية الدراسة: من العوامل المهمة بالنسبة للرياضيين لتحقيق اللياقة البدنية والنجاح في الميدان الرياضي هي تركيب الجسم والقياسات الانثروبومترية او بيانات القياسات البشرية، بالاضافة الى ذلك فان قابلية الاداء بالنسبة للرياضيين في المباريات التنافسية تعتمد بصورة مباشرة على الغذاء المتناول والتمرين الرياضي.

اهداف الدراسة: لتقييم العلاقة بين مؤشر التغذية الصحية وتركيب الجسم في رياضيي البارالمبياد الايرانيين المبتلين بغسل الكلى الدموي والهيموفيليا.

المرضى والطرائق: تم اجراء دراسة مقطعية والتي تضمنت مشاركة مئة رياضي مبتلين بغسل الكلى الدموي والهيموفيليا والذين شاركو في المباريات التنافسية لعام ٢٠٢٠. اجري الاستبيان بصورة مباشرة مع الأشخاص الذين تمت جمع المعلومات منهم وشملت معلومات ديموغرافية، قياسات تركيب الجسم، مستوى النشاط البدني، نمط النوم، والغذاء المتناول. تم تحديد نوعية الغذاء المتناول باستخدام مؤشر الغذاء الصحي بمدى يتراوح بين الصفر والمئة عن طريق معلومات تم الحصول عليها باستخدام استبانة تكرار الغذاء (Food frequency questiommaire) ، كما وتم تحديد تركيب الجسم بطريقة تحليل المعاوقة الحيوية باستخدام جهاز تحليل تركيب الجسم TANITA BC-418 (TANITA, Japan) بالاضافة الى مقاسات سمك الجلد في سبعة نقاط معينة من الجسم.

النتائج: اظهرت النتائج ان مجموع النقاط الكلي لمؤشر الغذاء الصحي كانت ٦٧,٨١(المرحلة د) وان هناك فرق ملحوظ بين نسبة الكتلة الدهنية (P=0.001) ونسبة الكتلة الخالية من الدهون (P=≤0.001) بين طريقتي تحليل المعاوقة الحيوية ومقاسات سمك الجلد في سبع نقاط من الجسم . لا توجد علاقة بين نوعية الغذاء المتناول المتمثلة بمؤشر الغذاء الصحي و مؤشرات تركيب الجسم والمتمثلة بمؤشر كتلة الجسم (P=0.57)، محيط الخصر(P=0.53)، نسبة الخصر الى الورك(P=0.18)، كتلة الدهون (P=0.76)، والكتلة الخالية من الدهون(P=0.76).

الاستنتاجات: نوعية الغذاء المتناول تحتاج الى تحسين للافضل لا توجد علاقة بين مؤشر الغذاء الصحي و مؤشرات التركيب الجسمي.

الكلمات المفتاحية: مؤشر الغذاء الصحي، تركيب الجسم، الغذاء المتناول

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