



# IS DIET QUALITY AFFECTED BY NUTRITIONAL KNOWLEDGE AND PRACTICES IN INDIVIDUALS DOING REGULAR PHYSICAL ACTIVITY?: A CROSS-SECTIONAL STUDY

¿LA CALIDAD DE LA ALIMENTACIÓN EN INDIVIDUOS QUE REALIZAN ACTIVIDAD FÍSICA REGULAR, SE VE AFECTA POR CONOCIMIENTOS Y PRÁCTICAS NUTRICIONALES?: UN ESTUDIO TRANSVERSAL

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## ABSTRACT

**Background:** This study aimed to determine the relationship between diet quality and nutrition knowledge (CN) and nutrition practices (NP) of people who perform physical activity (PA) regularly. **Methods:** Two hundred healthy individuals who attended the gym at least three times a week were studied. The quality of the diet is calculated using the Healthy Eating Index-2015 (HEI-2015). Linear regression models were used multiplex to assess associations between NC and PN scores and dietary variables. **Results:** Of the participants, 47.0% had poor NC and 48.0% had poor NP. It was determined that the PN scores were significantly associated with whole grain, seafood, and herbal protein and quality total diet ( $p < 0.05$ ), while CN scores were not associated with the quality of the diet or its components ( $p > 0.05$ ). A one-unit increase in CN score resulted in a 26.7% increase in snack consumption adjusted for age, sex, educational level, body mass index (BMI), smoking, alcohol consumption, and activity physical (PA) ( $p < 0.001$ ). The evaluation of the PN score was related to the main meals ( $\beta = 0.065 \pm 0.013$ ; 95% CI 0.04–0.09;  $p < 0.001$ ), snack consumption ( $\beta = 0.029 \pm 0.014$ , 95% CI 0.01–0.06;  $p < 0.05$ ), and total quality of diet ( $\beta = 0.894 \pm 0.329$ ; 95% CI 0.24–1.54;  $p < 0.05$ ). Additionally, about 17% of the variability in the PN score could be explained by CN scores. **Conclusions:** Elevated NC was associated with an increase in BW scores and indirectly with an increase in diet quality. In order to see the beneficial effects of PA on health, people must rely on a healthy diet, increasing your CN.

**Keywords:** Diet quality, Physical activity, Eating habits, Nutritional knowledge, Nutritional practice. (Source: MeSH-NLM)

## RESUMEN

**Antecedentes:** Este estudio tuvo como objetivo determinar la relación entre la calidad de la dieta y el conocimiento sobre nutrición (CN) y las prácticas de nutrición (PN) de las personas que realizan actividad física (AF) con regularidad. **Métodos:** Se estudiaron 200 individuos sanos que acudían al gimnasio al menos tres veces por semana. La calidad de la dieta se calculó utilizando el Índice de Alimentación Saludable-2015 (HEI-2015). Se utilizaron modelos de regresión lineal múltiple para evaluar las asociaciones entre las puntuaciones de CN y PN y las variables de la dieta. **Resultados:** De los participantes, el 47,0% tenía CN deficiente y el 48,0% tenía PN pobre. Se determinó que las puntuaciones de PN se asociaron significativamente con los granos integrales, los mariscos y las proteínas a base de hierbas y la calidad total de la dieta ( $p < 0,05$ ), mientras que los puntajes CN no se asociaron con la calidad de la dieta o sus componentes ( $p > 0,05$ ). Un aumento en una unidad en la puntuación CN resultó en un aumento del 26,7% en el consumo de refrigerios ajustado por edad, sexo, nivel educativo, índice de masa corporal (IMC), tabaquismo, consumo de alcohol y actividad física (AF) ( $p < 0,001$ ). La evaluación del puntaje PN se relacionó con las comidas principales ( $\beta = 0,065 \pm 0,013$ ; IC 95% 0,04–0,09;  $p < 0,001$ ), consumo de refrigerios ( $\beta = 0,029 \pm 0,014$ , IC 95% 0,01–0,06;  $p < 0,05$ ) y la calidad total de la dieta ( $\beta = 0,894 \pm 0,329$ ; IC95% 0,24–1,54;  $p < 0,05$ ). Además, alrededor del 17% de la variabilidad en la puntuación PN podría explicarse por las puntuaciones CN. **Conclusiones:** CN elevada se asoció con un aumento en las puntuaciones de PN e indirectamente con un aumento en la calidad de la dieta. Para ver los efectos beneficiosos de la AF en la salud, las personas deben apoyarse en una dieta saludable, aumentando su CN.

**Palabras Clave:** Calidad de la dieta, Actividad física, Hábitos alimentarios, Conocimiento nutricional, Práctica nutricional. (Fuente: DeCS-BIREME)

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## INTRODUCTION

Balanced nutrition consists of taking different nutritional components and determining the correct proportions to meet the energy and nutrient needs of an individual. This diet is important for the improvement of exercise performance as well as health<sup>(1)</sup>. During exercise, glycogen stores may be exhausted in individuals; hence, dehydration and muscle damage may occur. Therefore, adequate nutrition can reduce the fatigue of an individual, help them exercise longer, and recover faster between workouts<sup>(2)</sup>. Although it has been determined that a balanced diet has beneficial effects on the health of athletes<sup>(1)</sup>, most athletes still have many nutritional deficiencies<sup>(3)</sup>.

Some researchers have reported that nutritional errors in athletes or individuals who do regular physical activity (PA) may be due to low nutritional knowledge (NK) and under-nutrition counselling<sup>(4)</sup>. However, many athletes are still unable to interpret adequate nutritional information on proper food intake<sup>(5)</sup>. Having inadequate education about healthy eating behaviors could result in an individual not making the right food choices.

Several components of the Healthy Eating Index-2015 (HEI-2015) are comprised of foods or nutrients associated with measures of physical performance or physical functioning in observational studies, including fruits and vegetables, protein, and whole grains. Fruits, vegetables, and whole grains can contribute to meeting carbohydrate and antioxidant intake recommendations, while animal, seafood, and plant proteins can contribute to meeting protein and iron intake recommendations<sup>(6)</sup>. A higher total score obtained from the HEI-2015 was found to be associated with physical performance measures in individuals who did regular PA, but the NK and NPs of participants were not investigated<sup>(7)</sup>.

A lack of correct information can lead to incorrect food selection and nutrient deficiencies, which can negatively affect diet quality and exercise performance<sup>(8)</sup>. Many studies have stated that athletes with higher NK scores had better diet quality<sup>(7,8)</sup>. However, Rash et al.<sup>(9)</sup> determined that a low NK score was significantly correlated with dietary intake<sup>(9)</sup>. In another study, there was no significant relationship between the NK

and NP scores<sup>(10)</sup>.

The European Health and Fitness Association has stated that fitness centers can be useful in the promotion of PA and prevention of chronic diseases<sup>(11)</sup>. In recent years, the attraction of fitness centers has increased due to socialization, the desire to increase PA, and body image anxiety<sup>(12)</sup>. However, the expected benefit of fitness centers on health by health professionals<sup>(13)</sup> has not been fully recognized<sup>(14)</sup>. Therefore, an evaluation of the diets and nutritional information of individuals who go to fitness centers is necessary.

It is still unknown whether the NK level has an effect on diet quality in regularly training individuals. Thus, it has often been reported that athletes have poor NK scores<sup>(4)</sup>. If it is proven that there is a relationship between NK and diet quality, it is thought that exercise performance will increase, as the dietary quality of individuals who do sports will improve with nutritional training intervention. This research was conducted to determine the relationship between dietary quality, and the NK and NPs of individuals who did the physical activity (PA) regularly.

## METHODS

### Study population

This was a cross-sectional study evaluating the relationship between NK, NPs, dietary intake, and quality of diet. Recruited into the study were 200 individuals, between 19 and 64 years of age, who did regular PA and applied to one of three chosen fitness centers between October 2017 and July 2018. The sample size was calculated using the GPower Analysis software. A minimum of 200 participants were necessary in order to achieve the Type I error ( $\alpha$ ) = 0.05, effect size 0.08, and power 80%.

Approval of the Ethics Committee was received from a University (56786525-050.04.04/82713) and the Helsinki Declaration principles were followed in the research. Participants who registered at three selected fitness centers and came to the fitness centers at least three times a week were accepted into the study. Participants with a history of diabetes and/or hypertension, previous glucose or lipid metabolism drug prescriptions, and pregnant women were excluded. Research data were collected using survey





forms and face-to-face interviews. The questionnaire consisted of questions about sociodemographic characteristics, dietary habits, anthropometric measurements, a NK and NP questionnaire, and 24-h dietary recall. The number of main meals, number of snacks, eating at night, and using dietary supplements were inquired about in the dietary habits section. Moreover, the individuals were asked from whom or where they learned about the nutritional information. Before the survey, each participant was verbally informed about the contents of the research and asked to sign an informed consent form indicating that they voluntarily agreed to participate in the research."

### Assessment of Sport Nutritional Knowledge and Practices

To evaluate the NK of the individuals, 29 questions were asked using a three-point Likert-type scale (I agree, I do not know, I do not agree). Scoring comprised 1 point for each correct answer and 0 points for the wrong answer. The lowest and highest NK scores that could be obtained were between 0 and 29, and as the score increased, the NK increased. The continuous variable of NK was categorized as poor (< 21 points) and good ( $\geq 21$  points). The Cronbach alpha of the NK questions was 0.841." To evaluate the NPs 18 questions were asked, with 1 point given for correct NPs and 0 points for wrong NPs. The lowest and highest NP scores that could be obtained were between 0 and 18, and as the score increased, the NPs increases. The total NP scores were categorized as poor (< 13 points) and good ( $\geq 13$  points). The Cronbach alpha of the NP questions was 0.639.

### Anthropometric Measurements

The bodyweight of the participants, wearing light clothing, and without shoes and socks, was measured to the nearest 0.5 kg using a digital scale. Height was measured to the nearest 0.1 cm using a calibrated stadiometer (Seca 217, Germany). Body mass index (BMI) was calculated for all of the individuals and classified as underweight for <18.5 kg/m<sup>2</sup>, normal for 18.5–24.9 kg/m<sup>2</sup>, and overweight/obese for  $\geq 25.0$  kg/m<sup>2</sup> <sup>(15)</sup>.

### Physical activity assessment

PA was assessed using the validated Turkish version of the International Physical Activity Questionnaire (IPAQ)-short form. Eleven PA items were used to define

the total minutes in the last seven days spent on inactivity, walking, and moderate- and vigorous-intensity PA. Responses were converted to metabolic equivalent task (MET) hours per week (MET-h/week): walking=3.3 METs $\times$ d $\times$ h, moderate PA=4 METs $\times$ d $\times$ h, and vigorous PA=8 METs $\times$ d $\times$ h. The total MET scores were calculated by summing up the weekly MET values for the three activity types. Participants of the study were classified in three different groups of PA considering the MET-min/week of the sum of walking, moderate-intensity PAs, and vigorous-intensity PAs: low active (< 600 MET-min/week), moderately active ( $\geq 600$  MET-min/week), and highly active ( $\geq 3000$  MET-min/week)."

### Dietary Intake

The one-day food intake records of the participants were obtained using the 24-h recall (24-HR) method. A photo catalog of foods and nutrients was presented to the participants to obtain accurate measures and amounts. The Photo Catalog of Foods and Nutrients: Measures and Amounts was used to determine the portion sizes of the consumed foods. The average energy and nutritional facts of the consumed foods were calculated using the Nutritional Information Systems Package Program."

### Diet Quality (HEI-2015)

The HEI-2015 reflects the 2005–2015 Dietary Guidelines for Americans (DGA) as an energy-adjusted measure of nutrients (i.e. scores per 1000 calories). This index consists of nine adequacy and three moderation components, with a maximum score of 100. Of the adequacy components, six include total fruits (fruit, juice and canned fruit), whole fruit (fruits excluding juice), total vegetables, seafood and plant proteins, greens and beans, and total protein foods; each scored at 5 points for the highest consumption and 0 points for the lowest consumption. A maximum of 10 points were given to the other adequacy components (whole grains, dairy, and fatty acids). The three moderation components (refined grain, sodium, empty calories) were scored in the range of 0–10, as a higher score indicated lower consumption. Higher scores for all of the components indicated a more healthy diet and greater adherence to the DGA recommendations.

### Statistical Analyses

Descriptive statistics for the sociodemographic and anthropometric characteristics were presented as the mean  $\pm$  SD or as a proportion of the total sample size. The mean intake of nutrients and the HEI-2015 components were also generated. Multiple-adjusted

linear regression models were used to assess associations between the NK and NP scores, and the diet variables. The outcome variables included total dietary, total fruit, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, added sugars, saturated fats scores, total energy, macronutrients, and fiber. Regression models were adjusted for confounding variables including age (years), BMI (kg/m<sup>2</sup>), smoking status (yes versus no), and PA (yes versus no). Statistical significance levels were evaluated at  $p < 0.05$

## RESULTS

The characteristics, and NK and NPs of the 200 participants are presented in Table 1. The mean age was  $25.9 \pm 7.6$  years. The mean BMI was  $23.5 \pm 2.9$  kg/m<sup>2</sup>, with a significant difference with regards to gender. More than half of the participants (69.5%) had a medium MET score. According to the MET score, 30.2% of men had high scores, while 10.8% of female had low scores ( $p < 0.05$ ). The mean NK and NP scores were  $19.9 \pm 3.8$  and  $12.5 \pm 2.3$ , respectively. Overall, there was no significant difference in the NK and NP scores in terms of gender ( $p > 0.05$ ).

**Table 1.** Sociodemographic characteristics of participants by gender.

Characteristics	Total (n=200)	Gender		p
		Female (n=74)	Male (n=126)	
Age (year)	25.9±7.6	25.2±6.6	26.3±8.1	0.320
Education level				
Collegiate	78 (39.0)	23 (31.1)	55 (43.7)	
Non-collegiate	122 (61.0)	51 (68.9)	71 (56.3)	0.099
Current smoker	39 (19.5)	9 (12.2)	30 (23.8)	0.013*
Consuming alcohol	86 (43.0)	22 (29.7)	64 (50.8)	0.005*
Body mass index	23.5±2.9	21.6±2.6	24.6±2.6	0.001**
Underweight	6 (3.0)	6 (8.1)	-	
Normal	135 (67.5)	63 (85.1)	72 (57.1)	0.001**
Overweight and Obese	59 (29.5)	5 (6.8)	54 (42.9)	
MET score	2350.7±1465.0	1890.0±1185.7	2621.3±1548.1	0.001*
Low	15 (7.5)	8 (10.8)	7 (5.6)	
Medium	139 (69.5)	58 (78.4)	81 (64.3)	0.005*
High	46 (23.0)	8 (10.8)	38 (30.2)	
Dietary supplement	16 (8.0)	-	16 (8.0)	
NK score	19.9±3.8	20.2±3.4	19.6±4.1	-0.279
Poor (<21 score)	94 (47.0)	33 (44.6)	61 (48.4)	0.661
Good (≥21 score)	106 (53.0)	41 (55.4)	65 (51.6)	
NP score	12.5±2.3	12.9±2.0	12.3±2.4	0.069
Poor (<13 score)	96 (48.0)	33 (44.6)	63 (50.0)	0.468
Good (≥13 score)	104 (52.0)	41 (55.4)	63 (50.0)	

NK: Nutrition knowledge; NP: Nutrition practice; MET: Metabolic Equivalent of Task

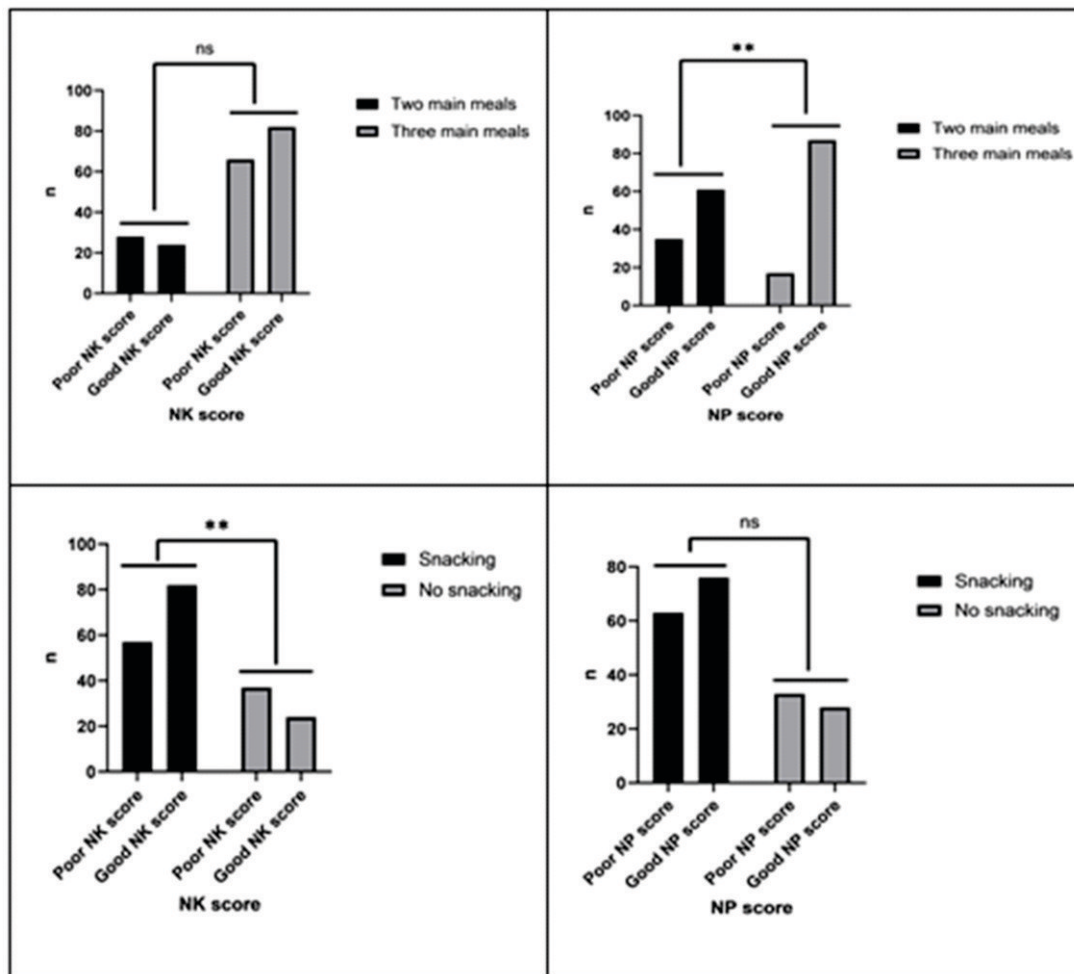
Data are presented as mean ± standard deviation values (independent t-test).

Other data are presented as n (%).

\* $p < 0.05$ , \*\* $p < .001$ .

It was determined that 70.2% of individuals with poor NK scores and 55.4% of those with good NK scores consumed three main meals, but no significant difference was found between the two groups. However, participants with good NP scores more

significantly consumed three main meals than those with poor NP scores ( $p < 0.001$ ). While individuals with poor NK scores consumed snacks more frequently ( $p < 0.05$ ), there was no difference in the NP scores ( $p > 0.05$ ).



Chi-square test was used.

\* $p < 0.05$ , \*\* $p < 0.001$ .

**Figure 1.** Meals pattern according to participants NK and NP Scores.

Average intakes for nutrients of interest for the individuals who completed the one-day 24-HR are shown in Table 2. The average energy intake of the participants was  $1886.6 \pm 810.8$  kcal/day. There were no significant differences between the total energy intake, and NK and NP scores ( $p > 0.05$ ). Intakes of protein,

riboflavin, iron, zinc, and potassium of individuals with good NK scores were higher than those with poor scores ( $p < 0.05$ ). However, there were no significant differences between the NP scores and intake of energy and nutrients ( $p > 0.05$ ).

**Table 2.** Assessment of energy and nutrients according to participants NK and NP scores.

Energía y nutrientes	CN Score			PNScore		
	Malo (n=94)	Bueno (n=106)	P	Malo (n=96)	Bueno (n=104)	P
Energía (kcal)	1700.4	1728.7	0.400	1686.8	1755.3	0.601
IQR	(1310.3-2158.6)	(1390.6-2396.3)		(1262.3-2271.4)	(1396.3-2280.6)	
Carbohidrato (g)	147.8	147.5	0.806	157.6	142.0	0.957
IQR	(110.3-208.0)	(108.5-206.4)		(108.9-202.5)	(108.7-217.9)	
Proteína (g)	75.6	89.1	0.045*	82.2	83.8	0.466
IQR	(52.7-103.3)	(62.8-121.9)		(54.7-108.6)	(59.4-121.5)	
Grasas totales (g)	82.9	87.5	0.290	90.9 (43.2)	91.4 (42.3)	0.978†
IQR	(59.9-108.1)	(62.8-121.4)				
Tiamina (mg)	0.78	0.83	0.148	0.74	0.85	0.145
IQR	(0.53-1.04)	(0.65-1.07)		(0.56-1.03)	(0.64-1.07)	
Riboflavina (mg)	1.3	1.6	0.046*	1.43	1.47	0.346
IQR	(0.87-1.77)	(1.14-1.97)		(0.95-1.84)	(1.10-1.96)	
Vitamina B12 (µg)	4.2	4.4	0.433	4.4	4.3	0.561
IQR	(2.40-7.01)	(2.20-7.58)		(2.70-7.07)	(2.5-7.4)	
Vitamina C (mg)	66.8	62.6	0.458	66.9	62.2	0.935
IQR	(42.8-116.0)	(38.1-112.0)		(42.8-98.2)	(40.4-113.9)	
Vitamin A (µg)	964.2	939.8	0.641	928.5	990.7	0.803
IQR	(574.5-1487.7)	(622.6-1602.4)		(673.5-1502.0)	(520.8-1551.8)	
Vitamin E (mg)	15.4	18.5	0.433	15.9	17.6	0.718
IQR	(11.3-22.9)	(10.5-25.7)		(11.2-24.6)	(10.5-24.3)	
Calcio (mg)	581.1	678.2	0.108	628.5	652.0	0.550
IQR	(462.4-831.6)	(491.0-899.7)		(477.2-867.6)	(491.9-885.4)	
Hierron (mg)	10.5	11.7	0.031*	10.8	11.6	0.252
IQR	(7.7-13.8)	(9.1-14.9)		(7.8-14.4)	(8.6-14.6)	
Zinc (mg)	9.3	10.9	0.046*	9.6	10.7	0.360
IQR	(6.6-12.9)	(7.4-14.4)		(6.7-13.6)	(7.3-13.7)	
Potasio (mg)	2.1	2.4	0.025*	2.2	2.3	0.316
IQR	(1.6-2.7)	(1.9-3.0)		(1.6-2.7)	(1.7-2.9)	
Sodio (mg)	3.5	3.0	0.850	3.4 (1.5)	3.6 (1.7)	0.764†
IQR	(2.1-4.2)	(2.3-4.6)				

NK: Nutrition knowledge; NP: Nutrition practice; IQR: Interquartile range.

†Data were presented as mean and standard deviation (SD), and Independent t-test was used.

Other data were presented as median (IQR), and Mann Whitney U test was used.

\*p<0,05



The total HEI scores are given in Table 3 for the evaluation of the dietary quality of the participants according to the NK and NP scores. The average diet quality score was  $60.9 \pm 10.7$  among the participants. There were no significant differences in the total diet

quality and component scores of the participants according to NK and NP scores ( $p > 0.05$ ). The total diet quality, whole grains, and seafood and herbal proteins scores of individuals with good NP scores were higher ( $p < 0.05$ ).

**Table 3.** Assessment of total HEI (2010) scores according to participants NK and NP scores.

HEI (2010)	CN Score			PN Score		
	Malo (n=94)	Bueno (n=106)	P	Malo (n=96)	Bueno (n=104)	P
Total fruits (5)	0.27 (0.0-2.94)	0.31 (0.0-2.69)	0.679	0.12 (0.0-2.81)	0.65 (0.0-2.87)	0.176
Whole fruit (5)	0.52 (0.0-5.0)	0.42 (0.0-4.89)	0.947	0.25 (0.0-5.0)	0.94 (0.0-5.0)	0.321
Total vegetables (5)	2.92 (1.48-4.15)	2.81 (1.27-4.11)	0.684	3.15 (1.88-4.05)	2.66 (1.28-4.25)	0.293
Dark green-leafy vegetables and legumes (5)	5.0 (3.10-5.0)	5.0 (1.88-5.0)	0.428	5.0 (2.53-5.0)	5.0 (2.0-5.0)	0.557
Whole grains (10)	3.02 (0.0-9.60)	3.34 (0.0-10.0)	0.924	1.33 (0.0-7.88)	5.97 (0.0-10.0)	0.023*
Milk group (10)	3.69 (1.87-6.13)	4.29 (2.02-6.74)	0.568	3.69 (1.86-5.73)	4.43 (2.01-7.13)	0.198
Total Protein (5)	5.0 (5.0-5.0)	5.0 (5.0-5.0)	0.586	5.0 (5.0-5.0)	5.0 (5.0-5.0)	0.585
Seafood and herbal protein (5)	3.14 (0.0-5.0)	2.63 (0.0-5.0)	0.683	2.39 (0.0-5.0)	2.99 (0.0-5.0)	0.032*
Fatty acids (10)	8.71 (4.38-10.0)	7.53 (4.23-10.0)	0.566	7.82 (4.48-10.0)	8.08 (4.31-10.0)	0.677
Refined grains (10)	3.27 (0.0-10.0)	4.67 (0.0-10.0)	0.476	3.10 (0.0-10.0)	4.82 (0.0-10.0)	0.402
Sodium (10)	0.0 (0.0-7.08)	2.08 (0.0-6.70)	0.416	0.94 (0.0-6.99)	0.01 (0.0-6.20)	0.521
Empty Calories (20)	20.0 (20.0-20.0)	20.0 (20.0-20.0)	0.324	20.0 (20.0-20.0)	20.0 (20.0-20.0)	0.354
Total diet quality (100)†	60.5 (10.6)	61.2 (10.9)	0.662	59.1 (10.9)	62.6 (10.4)	0.021*

NK: Conocimientos de nutrición; NP: Práctica de nutrición; IES: Índice de Alimentación Saludable. Los datos se presentaron como media y desviación estándar (DE) y se utilizó la prueba t independiente.

Otros datos se presentaron como mediana (RIC) y se utilizó la prueba U de Mann Whitney. \* $p < 0.05$

Higher NK scores were significantly associated with a higher consumption of snacks ( $B = 0.032 \pm 0.008$ ; 95% CI: 0.02–0.05;  $p < 0.001$ ), but were not significantly positively associated with main meals ( $B = 0.015 \pm 0.008$ ; 95% CI: –0.01–0.03;  $p > 0.05$ ) or total diet quality ( $B = 0.167 \pm 0.199$ ; 95% CI: –0.23–0.55;  $p > 0.05$ ) (Table 4).

A 1-unit increase in the NK score resulted in a 26.7% increase in the consumption of snacks adjusted for age, gender, educational level, BMI, smoking status, alcohol consumption, and PA. Assessment of the NP scores was related to main meals ( $B = 0.065 \pm 0.013$ ; 95% CI: 0.04–0.09;  $p < 0.001$ ), the consumption of snacks ( $B =$

0.029 ± 0.014, 95% CI: 0.01–0.06; p<0.05), and total diet quality (B = 0.894 ± 0.329; 95% CI: 0.24–1.54; p<0.05). As the NP scores of the participants increased, the number of main meals increased by 35.2%, snack consumption increased by 15.2%, and total diet quality increased by 19.4% (P < 0.05), adjusted for covariates.

Knowledge of nutrition significantly predicted attitudes toward the related measures in individuals who did PA regularly (B = 0.276 ± 0.118, 95% CI: 0.04–0.50; P < 0.05). Almost 17% of the variability in the NPs of individuals who did PA regularly could be explained by their NK scores.

**Table 4.** Multiple linear regression analysis of associations between NK, NP scores and nutritional behavior.

Predictors	Outcome	Models	B	SE	β	95% CI	p	
NK Score	Main meals	Crude	0.015	0.008	0.134	-0.01-0.03	0.059	
		Adjusted <sup>a</sup>	0.016	0.008	0.137	-0.01-0.03	0.058	
	Snack meals	Crude	0.032	0.008	0.266	0.02-0.05	<0.001*	
		Adjusted <sup>a</sup>	0.032	0.008	0.267	0.02-0.05	<0.001*	
	Total diet quality	Crude	0.167	0.199	0.060	-0.23-0.55	0.402	
			Adjusted <sup>a</sup>	0.102	0.201	0.036	-0.29-0.49	0.611
		NP Score	Crude	0.276	0.118	0.164	0.04-0.50	0.020*
			Adjusted <sup>a</sup>	0.282	0.120	0.168	0.05-0.51	0.019*
NP Score	Main meals	Crude	0.065	0.013	0.339	0.04-0.09	<0.001*	
		Adjusted <sup>a</sup>	0.068	0.013	0.352	0.04-0.09	<0.001*	
	Snack meals	Crude	0.029	0.014	0.144	0.01-0.06	0.042*	
		Adjusted <sup>a</sup>	0.031	0.014	0.152	0.03-0.06	0.031*	
	Total diet quality	Crude	0.894	0.329	0.189	0.24-1.54	0.007*	
		Adjusted <sup>a</sup>	0.916	0.330	0.194	0.26-1.57	0.006*	

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B: Unstandardized coefficient; SE: standard error; β: Standardized coefficient; 95% CI: 95% confidence interval; NK: Nutrition knowledge; NP: Nutrition practice.

†Lower scores indicate poorer NK.

Lower scores indicate poorer NP.

<sup>a</sup>Multiple linear regression analysis adjusted for age, gender, educational level, body mass index, smoking status, alcohol consumption and physical activity.

\*p<.05, \*\*p<.001.





## DISCUSSION

This study aimed to determine the relationship between dietary quality, and the NK and NPs of adults who did PA regularly. With the understanding of the increasing importance of PA, fitness centers have become very popular in recent years<sup>(11,16)</sup>. Exercise programs, especially due to concerns about body weight<sup>(16)</sup>, should be supported by a proper diet<sup>(8)</sup>. In this study, it was determined that the NP scores were significantly associated with whole grains, seafood and herbal proteins, and total diet quality, while the NK scores were not associated with diet quality and components.

The NK score was found to be positively associated with snacking frequency and NP scores. Moreover, as the NP score increased, the main meal and snacking frequency also increased. During consultation or nutrition education, the NK, NPs, food consumption, and diet quality of individuals should be taken into consideration<sup>(17)</sup>. To our knowledge, this study was the first to examine the effect of nutritional information on the diet quality of individuals who did regular PA. Previous studies have mostly focused on athletes<sup>(4,5,18)</sup>. However, although there is a large majority of individuals going to fitness centers, NK and behaviors are not emphasized.

PA together with proper nutrition is vital in the prevention and treatment of obesity and chronic disease, which is rapidly increasing, both in the world and in Turkey<sup>(19)</sup>. The World Health Organization stated that 39% of the world population is overweight and 13% is obese, while the Organization for Economic Co-operation and Development reported that 64.4% of adults are overweight and obese in Turkey<sup>(20)</sup>. In this study, 29.5% of the participants were overweight and obese. The fact that obesity was lower than the general population was thought to be due to the fact that the participants did regular PA. This situation was also predicted to be effective in preventing chronic diseases. For this reason, it would be beneficial to give a recommendation to increase physical activity. It has been argued that the diet and physical activities of an individual are affected by their knowledge and practices<sup>(21)</sup>. NK triggers healthy eating behaviors and plays an important role in meeting these requirements

throughout the lifetime of the individual<sup>(22)</sup>. Adequate nutrition, which can be achieved with sufficient NK, is important for individuals who do PA by optimizing the intake of energy and macro/micro nutrients<sup>(23)</sup>. While some studies have found a correlation between dietary intake and NK in athletes<sup>(4,18)</sup>, nutritional information has not always been associated with healthy food selection<sup>(10)</sup>.

It is difficult to examine the relationship between NK and diet<sup>(8)</sup>. Therefore, in this study, the evaluation was made on diet quality. Contrary to expectations, NK did not correlate with dietary quality components or total diet quality ( $p > 0.05$ ). In a systematic review examining the relationship between nutritional information and diet quality, no relationship was found in 10 of 29 studies, and a significant, positive, but weak relationship was found in the rest<sup>(8)</sup>. These results were not sufficient to say that NK is ineffective on food intake, correct food selection, or diet quality. NPs are affected by many factors, such as beliefs, culture, self-efficacy, and NK<sup>(24)</sup>.

It is aimed to achieve positive changes in food intake by increasing NK<sup>(25)</sup>. In this study, a one-unit increase in the NK score was found to be associated with a 16% increase in the NP score. There was a significant positive correlation between the NP score and whole grains, seafood and herbal protein, and total diet quality ( $p < 0.05$ ). It was thought that individuals who did regular PA turned to whole grains and protein foods to increase the feeling of fullness. The total diet quality also presented important results. In one study, a 0.45-unit decrease in the healthy dietary pattern score was associated with an approximately 500-kcal increase in daily energy intake and an increase in the consumption of chips, and fried and roasted potatoes<sup>(26)</sup>. Based on this study, it can mention that NK and NPs play a significant role in maintaining general health and healthy body weight.

The energy intake and meal frequency of physically active individuals play a role in achieving their goals and maintaining energy balance<sup>(27)</sup>. There are three main meal consumptions based on adequate and balanced nutrition. The consumption of three main meals a day is generally one of the recommendations in country-specific guidelines<sup>(28)</sup>. It has been claimed that the

consumption of three main meals a day facilitates the intake of the nutrients necessary for the body, the quality of the diet, and serving control<sup>(29)</sup>. It has been recommended by different authorities that individuals should snack 1–3 times a day<sup>(30)</sup>. In this study, it was determined that a one-unit increase in the NK score increased the snacking frequency by 26%, and this relationship remained significant after adjusted confounding variables. The increase in the NP score significantly increased the quality of diet, and main meal and snacking frequency ( $p < 0.05$ ). This showed the importance of nutritional information to meet the requirements of individuals who do PA.

### Strengths and limitations

Although this paper provided significant data on the relationship between the NK and NP scores, and diet quality, there were a few limitations. First, due to its cross-sectional design, the results may not have applied to the general population. Furthermore, the NK and NP scores, and dietary intake were self-reported, which may have over or underestimated the actual scores. Objective evaluation of the diet records may reveal more precise results. Finally, studies conducted on a wider range of individuals who do regular PA are required to confirm the findings. Despite all of these

limitations, this study provided new perspectives into the current literature on NK and NP scores, and diet quality, and was the first to determine the relationship between NK, NPs, and diet quality in individuals who did regular PA. Moreover, this data will provide insight into the potential factors influencing the dietary habits and diet quality that forms the basis of targeted education programs.

### CONCLUSIONS

In recent years, with emphasis on the importance of PA, the number of people going to fitness centers has increased. This study was the first to draw attention to the NK and diet quality of this population. Cross-sectional data from a sample of individuals who did regular PA found that poor NPs were associated with lower main meal and snack consumption, and diet quality. One of the important results of this study was that the NP score can be improved by increasing NK. Increasing NK may improve sports performance, and provide adequate and balanced nutrition education to individuals who are regularly PA, which may help them to develop better NPs and diet quality. Further studies investigating sports performance on NK and NPs in populations that are regularly PA may provide valuable data to better understand the relationship between dietary habits and diet quality.

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