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Investigating the Relationship Between Nutritional Knowledge and Microbiota Awareness: A Cross-Sectional Study Among University Students

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ABSTRACT

Aim: This study aims to evaluate the relationship between nutritional knowledge and microbiota awareness among students at Istanbul Bilgi University.

Material and Methods: The sample of this cross-sectional study consists of 415 university students. The general characteristics of the participants were obtained through a questionnaire, while their nutritional knowledge and microbiota awareness were assessed using the Nutrition Knowledge Level Scale for Adults and the Microbiota Awareness Scale, respectively.

Results: The students had a mean age of 22.6±4.29 years, and a median BMI of 22.14 [5.13] kg/m². Median scores were 51 [11] for NKLSA-NK, 38 [9] for NKLSA-FP, and 69 [15] for microbiota awareness. There was a statistically significant positive correlation between nutritional knowledge and microbiota awareness (r=0.658; p<0.001). Age also showed a statistically significant positive correlation with nutritional knowledge, particularly with food preferences (r=0.131; p<0.05). Statistically significant negative correlations were found between BMI and both nutritional knowledge (r=-0.192) and microbiota awareness (r=-0.191), as well as between body weight and both variables (r=-0.242 and r=-0.274, respectively; p<0.001).

Conclusion: Our results show that the study population has fair nutritional knowledge in the NKLSA-NK and good nutritional knowledge in the NKLSA-FP sub-section, alongside a good level of microbiota awareness. The Education, lifestyle choices, and guidance are important for nutritional knowledge and microbiota awareness of the population. To our knowledge, this is the first study examining the relationship between nutritional knowledge level and microbiota awareness scores, and further studies are needed.

Keywords: Microbiota awareness; nutritional knowledge; university student.

Beslenme Bilgisi ile Mikrobiyota Farkındalığı Arasındaki İlişkinin İncelenmesi: Üniversite Öğrencileri Arasında Kesitsel Bir Çalışma

ÖZ

Amaç: Bu çalışma, İstanbul Bilgi Üniversitesi öğrencilerinde beslenme bilgisi ile mikrobiyota farkındalığı arasındaki ilişkiyi değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntemler: Bu kesitsel çalışmanın örneklemi 415 üniversite öğrencisinden oluşmaktadır. Katılımcıların demografik özellikleri anket yöntemiyle elde edilmiş; beslenme bilgi düzeyleri ile mikrobiyota farkındalıkları ise sırasıyla Yetişkinler İçin Beslenme Bilgi Düzeyi Ölçeği ve Mikrobiyota Farkındalık Ölçeği kullanılarak değerlendirilmiştir.

Bulgular: Öğrencilerin yaş ortalaması 22,6±4,29 yıl ve medyan beden kütle indeksi (BKİ) 22,14 [5,13] kg/m² olarak saptanmıştır. Temel beslenme ve beslenme sağlık bilgisi (NKLSA-NK) için medyan puan 51 [11] ve besin tercihi alt bölümü (NKLSA-FP) için 38 [9] olarak bulunmuştur. Mikrobiyota farkındalık puanının medyanı ise 69 [15] olarak belirlenmiştir. Beslenme bilgisinin alt boyutları ile mikrobiyota farkındalığı arasında istatistiksel olarak anlamlı pozitif yönlü bir korelasyon bulunmuştur (r= 0,658; 0,259; p<0,001). Ek olarak, yaş ile beslenme bilgisi arasında, özellikle de besin tercihi alt boyutunda istatistiksel olarak anlamlı pozitif yönlü bir korelasyon mevcuttur (r=0,131; p<0,05). Ayrıca, BKİ ile beslenme bilgi düzeyi ve mikrobiyota farkındalığı arasında istatistiksel olarak anlamlı negatif yönlü bir korelasyon (sırasıyla r=-0,192; r= -0,191; p<0,001) ve vücut ağırlığı ile beslenme bilgi düzeyi ve mikrobiyota farkındalığı arasında istatistiksel olarak anlamlı negatif yönlü bir korelasyon olduğu (sırasıyla r=-0,242; r=-0,274; p<0,001).

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Sonuç: Sonuçlarımız, çalışma popülasyonunun NKLSA-NK'de orta düzeyde beslenme bilgisine ve NKLSA-FP alt bölümünde iyi beslenme bilgisine sahip olduğunu ve iyi düzeyde mikrobiyota farkındalığına sahip olduğunu göstermektedir. Eğitim, yaşam tarzı seçimleri ve rehberlik, popülasyonun beslenme bilgisi ve mikrobiyota farkındalığı için önemlidir. Bu çalışma, beslenme bilgi düzeyi ile mikrobiyota farkındalık arasındaki ilişkiyi inceleyen ilk çalışmadır ve daha fazla çalışmaya ihtiyaç vardır.

Anahtar Kelimeler: Mikrobiyota farkındalığı; beslenme bilgisi; üniversite öğrencisi.

INTRODUCTION

The human body has about 1.3 times more bacterial cells and various microorganisms than human cells. Collectively called "microbiota" or "microflora", these microorganisms have a symbiotic relationship with human cells, mutually dependent on each other for survival. The microbiota plays an essential role in the physiology and health of the host. The human gut microbiota acts as a physical barrier against pathogens and provides immunity to various diseases. Among the factors influencing the development of the microbiota, the mode of birth, the mother's microbiota, breast milk consumption, antibiotic/probiotic use, and diet are important (1).

The microbiota plays an essential role in the development of host immunity, nutrient digestion, regulation of intestinal endocrine function and neurological signals, modification of xenobiotic and drug metabolism, elimination of toxins, maintenance of intestinal barrier integrity, structure and function of the gastrointestinal tract, regulation of the immune system, and synthesis of specific vitamins. Dysbiosis is defined as a disruption of the normal composition of the microbiota or the ratio of beneficial and harmful bacteria in the microbial composition and is caused by a wide range of internal and external factors, such as antibiotic use, dietary changes and environmental exposure, pollutants. Dysbiosis has been closely linked to many non-communicable diseases, such as obesity, type 2 diabetes, allergies, atopic diseases, asthma, inflammatory bowel diseases, metabolic syndrome, necrotizing enterocolitis, and atherosclerosis, and is thought to play a role in their pathogenesis Age, sex, nutrition, cleanliness, environment, and antibiotic use are some variables that affect an individual's microflora composition, which is host-specific and varies throughout their life. Studies have shown that the consumption of probiotics and prebiotics is important for the health of the microflora (2). Probiotics are live microorganisms that protect human health when administered in appropriate doses. They compete and inhibit harmful microorganisms at attachment sites, directly kill harmful microorganisms by producing various antimicrobial compounds, and reduce intestinal inflammation by increasing serum IgA levels while protecting the intestinal mucosal barrier. Prebiotics affect the microbiota species already present in the large intestine, increasing the production of short-chain fatty acids and decreasing pH (1).

Nutritional knowledge is among the factors that affect individuals' dietary habits and diet quality. While high nutritional knowledge promotes adequate and balanced nutrition by enabling healthier food selection, individuals with inadequate nutritional knowledge have been reported to show poorer nutritional patterns independent of their socioeconomic status (3). When a study conducted with university students were examined, it was found that students generally had low levels of nutritional knowledge, but students from the Faculty of Health Sciences had higher levels of nutritional knowledge than students from other departments (4). Considering other factors that shape the microbiota, it has been stated that one of the most interesting topics in recent years is related to the nutritional status of the individual because it is a modifiable factor in modulating the microbiota. Since there is a positive relationship between nutritional status and nutritional knowledge level, it is thought that nutritional knowledge level has important effects on microbiota as well as various chronic diseases (5).

To the best of our knowledge, no study has examined the nutritional knowledge level and microbiota awareness of individuals. Therefore, the current study aimed to evaluate the nutritional knowledge levels and microbiota awareness of university students studying undergraduate education in various faculties at Istanbul Bilgi University.

MATERIAL AND METHODS

Study Population and Design

This cross-sectional study was conducted to determine the nutritional knowledge levels and microbiota awareness of 415 students studying at Istanbul Bilgi University aged 18-35 years. For the study sample, power analysis was performed using the G-Power analysis program with a 95% confidence interval and an effect size of 0.8.

Data Collection

Within the scope of the study, the demographic characteristics of the students were obtained by applying the questionnaire; for assessing nutritional knowledge level and microbiota awareness, we used the Nutrition Knowledge Level Scale for Adults (NKLSA) and Microbiota Awareness Scale (MAS), respectively. We used Google forms to collect the data from March to July 2023. Anthropometric measurements of height and body weight were obtained from participants' self-reports. The Level of Nutrition Knowledge for Adults scale was developed by Batmaz and Güneş, and a validity and reliability study was conducted (6). This scale has two sub-dimensions, Basic Nutrition and Food Health Knowledge (NKLSA-NK) and Food Preference (NKLSA-FP) and consists of 32 propositions. In the 5-point Likert-type scale, correct propositions are scored as "0: Strongly disagree, 1: Disagree, 2: Neither agree nor disagree, 3: Agree, 4: Strongly agree", while the answers given in the wrong propositions were scored as "0: Strongly agree, 1: Agree, 2: Undecided, 3: Disagree, 4: Strongly disagree". The maximum score for basic nutrition is 80, and the maximum score for food preferences is 48. Participants rate the relationship between nutrition and health and the accuracy of their food choices in daily life on a separate Numerical Analog Scale (NAS) ranging from 0 to 10. The scores obtained from the evaluation criteria of NKLSA are evaluated as poor, moderate, good, and very good. Participants with a basic nutrition score of less than 45 points had poor knowledge, those with 45-55 points had fair knowledge, those with 56-65 points had good knowledge, and those with >65 points had very good

knowledge. Participants with a food preference score less than 30 had poor knowledge, those with a score between 30 and 36 had fair knowledge, those with a score between 37 and 42 had good knowledge, and those with a score above 42 had very good knowledge.

To determine the microbiota awareness levels of adults, the Microbiota Awareness Scale (MAS), developed and validated by Külcü in 2020, was used (7). This scale is a five-point Likert-type scale consisting of 20 questions and four subscales, including "General Information" (questions 1,2,4,5,6,13), "Product Information" (questions 17,18,19,20), "Chronic Disease" (questions 8,10,12,14,16) and "Probiotics and Prebiotics" (questions 3,7,9,11,15) ("1=strongly disagree, 2=disagree, 3=decided, 4=agree, 5=strongly agree"). Questions 17 and 18 of the scale are five-choice information questions; each correct answer is evaluated as one point, and each incorrect answer is assessed as one point. Questions 19 and 20 are open-ended questions, and they are evaluated in such a way that one point for no answer, two points for one answer, three points for two answers, four points for three answers, and five points for four or more answers. A score between 18 and 100 points is obtained from the scale. High scores obtained from the scale, which does not have any cut-off point, are interpreted as a high level of microbiota awareness.

Before the study was started, written permissions were obtained from the Istanbul Bilgi University Ethics Committee with 2023-10160-048 number on 30/03/2023. All study participants signed an online informed consent form using Google Forms.

Statistical Analysis

The Kolmogorov-Smirnov test was used to determine the normality of the data. Mean ± standard deviation (SD) was used to report normally distributed variables, median and interquartile range (IQR) for non-normally distributed variables, and frequency (n) and percentage (%) for categorical variables. Kruskal-Wallis, Mann-Whitney U, and independent student-t tests were employed for comparisons between and among groups of continuous data. To evaluate the differences between categorical variables, the Chi-square test was used. To evaluate the associations between the variables, Spearman's correlation coefficient was used. To interpret the correlation coefficients, conventional values 0.01 to 0.20 were very weak, 0.20 to 0.40 weak, 0.40 to 0.60 moderate, and ≥0.60 high (8). Statistical significance was set at $p< 0.05$.

RESULTS

The general characteristics of the study participants are shown in Table 1. The average age of the subject was 22.6 ± 4.29 years. Of the participants, 96.1% were single, and 3.9% were married. Half of the male students (51.2%) reported smoking, whereas 57.6% of the female students did not smoke (p=0.005). Of the students who participated in the study, 62.2% used alcohol, 37.8% did not use alcohol, and there was no statistically significant difference between the genders (p>0.05).

It was determined that 93.4% of the participants who had information about healthy eating were female and 82.4% were male, and there was a statistically significant difference between males and females (p=0.001). Participants who had information about healthy eating stated that they received this information from dieticians (37.7%), the Internet (34.0%), family and friends (12.8%), TV/media (9.6%), and doctors (5.9%). In this study, 44.6% of female students received information from a dietician, while 47.6% of male students received nutritional information from the Internet and this difference was found to be statistically significant (p<0.001). Most of the students (37.6%) who took a course related to nutrition were female, while only 16.8% were male, and this difference was found to be statistically significant (p<0.001). The majority of female students (66.6%) consumed two meals, while 42.4% of males reported two meals, and 52.0% reported three meals and this difference was found to be statistically significant (p<0.001). When the frequency of eating out was questioned, 11.1% of the students ate out every day, 22.4% ate out 3-4 times a week, 34.9% ate out 1-2 times a week, 22.4% ate out every 2 weeks, and 9.2% ate out once a month or less frequently. Notably, 35.5% of female students ate out 1-2 times per week, while 33.6% of male students exhibited a similar eating-out frequency. This difference was found to be statistically significant (p=0.017). When their probiotic use status was questioned, 41.20% of the students used probiotic supplements, while 58.79% did not use probiotic supplements. In contrast, 54.8% of female students did not use probiotic supplements, whereas this percentage was higher among male students at 68.0%. This difference was statistically significant (p=0.013). Approximately 42.0% of female students received the recommendation to use probiotics from a dietitian, while the majority of male students (62.5%) stated that they received this recommendation from the media and Internet. This difference was found to be statistically significant (<0.001). Of the participants, 42.9% stated that they exercised regularly and 57.1% stated that they did not exercise regularly. Of the students who exercised regularly, 34.5% were female and 62.4% were male. This difference was found to be statistically significant (p<0.001).

The median body weight and height of the female students were 57 [11] kg and 165 [0.09] cm respectively, and the median body weight and height of male students were 80 [18] kg and 180 [0.1] cm respectively. The median BMI of female students and male students were 20.89 [3.86] kg/ m^2 and 24.83 [4.86] kg/m2, respectively. The nutritional knowledge score was statistically significant higher in females (NKLSA-NK; 53 [11], NKLSA-FP; 39 [8]) than in males (NKLSA-NK; 49 [12], NKLSA-FP; 37 [8]) (p<0.001). The median food preference score of females was 39 [8] and this score was found to be statistically significant higher compared to males (37 [8]) (p<0.001). When the microbiota awareness of the students was analyzed, the median score was found to be 72 [15] for females and 64 [14] for males, indicating that females had a higher microbiota awareness than males (p<0.001) (Table 2).

Table 1. Genaral characteristic of the students (n=415)

	Female (n=290)	Male (n= 125)	Total (n= 415)	p
	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)	
Age (years)	22.6±4.66	22.59±0.29	22.6±4.29	0.977
Marital Status				
Single	276 (95.2)	123 (98.4)	399(96.1)	0.165
Married	14 (4.8)	2 (1.6)	16 (3.9)	
Smoking				
Yes	100 (34.5)	64 (51.2)	164 (39.5)	**0.005**
No	167 (57.6)	52 (41.6)	219 (52.7)	
Stop smoking	23 (7.9)	9 (7.2)	32 (7.7)	
Alcohol				
Yes	172 (59.3)	86 (69)	258 (62.2)	0.078
No	118 (40.7)	39 (31)	157 (37.8)	
Healthy eating knowledge				
Yes	271 (93.4)	103 (82.4)	374 (90.1)	**0.001**
No	19 (6.6)	22 (17.6)	41 (9.8)	
Source of healthy eating knowledge				
Doctor	17 (6.3)	5 (4.9)	22 (5.9)	
Dietitian	121 (44.6)	20 (19.4)	141 (37.7)	**<0.001**
TV/Media	31 (11.4)	5 (4.9)	36 (9.6)	
Internet	78 (28.8)	49 (47.6)	127 (34.0)	
Family/friends	24 (8.9)	24 (23.3)	48 (12.8)	
Receiving education about nutrition				
Yes	109 (37.6)	21 (16.8)	130 (31.3)	**<0.001**
No	181 (62.4)	104 (83.2)	285 (68.6)	
Number of meals consumed				
1	13 (4.5)	2 (1.6)	15 (3.6)	
2	193 (66.6)	53 (42.4)	246 (59.2)	**<0.001**
3	82 (28.3)	65 (52.0)	147 (35.4)	
>3	2 (0.7)	5 (4.0)	7 (1.6)	
Skipping meals				
Yes	243 (83.8)	97 (77.6)	340 (81.9)	0.164
No	47 (16.2)	28 (22.4)	75 (18.1)	
Frequency of eating outside				
Everyday	26 (9.0)	20 (16.0)	46 (11.1)	
3-4 times a week	59 (20.3)	34 (27.2)	93 (22.4)	
1-2 times a week	103 (35.5)	42 (33.6)	145 (34.9)	**0.017**
Once every 2 weeks	76 (26.2)	17 (13.6)	93 (22.4)	
Once a month or infrequently	26 (9.0)	12 (9.6)	38 (9.2)	
Probiotic supplements use status				
Yes	131 (45.2)	40 (32.0)	171 (41.2)	**0.013**
No	159 (54.8)	85 (68.0)	244 (58.8)	
Source of recommendation for using probiotic supplements				
Doctor	28 (21.4)	1 (2.5)	29 (16.9)	
Dietitian	55 (42.0)	11 (27.5)	58 (33.9)	
Media/Internet	37 (28.2)	25 (62.5)	62 (36.2)	**<0.001**
Family/friends	5 (3.8)	2 (5.0)	7 (4.1)	
Education	6 (4.6)	1 (2.5)	7 (4.1)	
Exercising regularly				
Yes	100 (34.5)	78 (62.4)	178 (42.9)	**<0.001**
No	190 (65.5)	47 (37.6)	237 (57.1)	

n: Count, %: Column percentage, SD: Standard Deviation

Table 2. Anthropometric measurement, nutritional knowledge score and microbiota awareness score (n=415)

	Female	Male	Total	p
	Median [IQR]	Median [IQR]	Median [IQR]	
Height (cm)	165 [0.09]	180 [0.10]	169 [0.13]	**<0.001**
Weight (kg)	57 [11]	80 [18]	63 [20]	**<0.001**
BMI (kg/m2)	20.89 [3.86]	24.83 [4.86]	22.14 [5.13]	**<0.001**
NKLSA-NK	53 [11]	49 [12]	51 [11]	**<0.001**
NKLSA-FP	39 [8]	37 [8]	38 [9]	**<0.001**
Microbiota Awareness Score	72 [15]	64 [14]	69 [15]	**<0.001**

BMI: Body Mass Index, NKLSA-NK: Basic Nutrition and Nutrition-Health Knowledge, NKLSA-FP: Food Preferences, IQR: Inter Quantile Range

The relationship between the general characteristics of the students participating in the study and their nutritional knowledge levels and microbiota awareness is presented in Table 3. The microbiota awareness score of married students (74.5 [18]) was statistically significantly higher than that of single students (69 [16]) (p=0.042). Non-smokers had statistically significantly higher basic nutrition knowledge (53 [10]) and microbiota awareness (71 [16]) than smokers, and those who quit smoking (p values respectively 0.004 and 0.009) (Table 3). Women who were knowledgeable about healthy nutrition had higher basic nutrition scores (52 [11] vs. 47 [10]) and microbiota awareness (70 [16] vs. 61 [14]) than those who lacked such knowledge.The basic nutrition score (55 [15]), food preference score (41 [8]), and microbiota awareness score (75 [15]) of the students who obtained information about healthy eating from a dietitian were statistically significantly higher than those of the students who obtained information from other sources (p values respectively p=0.001, p=0.003, p<0.001). Besides, nutrition knowledge, food preference score (58 [12], 42 [9]) and microbiota awareness scores (77 [15]) of students who received nutrition education were statistically significantly higher in compared to those who did not (all p values <0.001). Students who eat out once every two weeks have been found to have higher microbiota awareness compared to others, and this difference has been determined to be statistically significant (72 [12], p=0.029). Students who used probiotic supplements had statistically significantly higher nutrition knowledge (53 [13]), food preference score (39 [8]) and microbiota awareness scores (74 [14]) than those who did not use probiotic supplements (p values respectively <0.001, 0.013 and <0.001). Students who received probiotic supplement use advice from a dietitian had statistically significantly higher microbiota awareness (77 [12]) than other students, and this difference was statistically significant (p= 0.018).

In Table 4, the correlations between students' nutrition knowledge scores, microbiota awareness, age, BMI, and body weight were analyzed. When the correlation matrix was examined, a weak, positive and statistically significant correlation was found between the basic knowledge sub-dimension of nutritional knowledge level and the food preference sub-dimension (r=0.257, p<0.001). When the relationship between both sub-dimensions and microbiota awareness was examined, a high, positive and statistically significant correlation was found between the basic nutrition and nutrition health knowledge sub-dimension and microbiota awareness (r=0.658, p<0.001), and a weak, positive and statistically significant correlation was found between food preference and microbiota awareness (r=0.259, p<0.001). There was a very weak, negative and statistically significant correlation between the basic nutrition knowledge score with BMI (r=-0.192, p<0.001) and body weight (r=-0.242, p<0.001). The correlation between the food preference subscale of the nutritional knowledge score and age was very weakly positive and statistically significant (r=0.131, p=0.008). We did not find any correlation between students' microbiota awareness and age (p>0.05); however, we found a very weak negative correlation between body mass index and microbiota awareness, and this correlation was statistically significant (r=-0.191, p<0.001). Similarly, a negative, weak, but statistically significant correlation was found between body weight and microbiota awareness (r=-0.274, p<0.001). A positive, very weak and statistically significant correlation was found between the age of the students and their BMI (r=0.183, p<0.001) and body weight (r=0.168, p<0.001).

Table 1. Relationship between general charestristics and nutritional knowledge and microbiota awareness (n=415)

	NKLSA-NK	p	NKLSA-FP	p	Microbiota Awareness Score	p
	Median (IQR)		Median (IQR)		Median (IQR)	
Marital Status						
Single	51 [11]	0.515	38 [10]	0.148	69 [16]	**0.042**
Married	50 [12]		41.5 [9]		74.5 [18]	
Smoking						
Yes	50 [12]	**0.004**	38 [9]	0.647	68 [18]	**0.009**
No	53 [10]		38 [10]		71 [16]	
I quit	50 [12]		39 [12]		68 [15]	
Alcohol						
Yes	50 [11]	0.149	38 [9]	0.954	69 [17]	0.313
No	52 [10]		36 [10]		69 [16]	
Healthy eating knowledge						
Yes	52 [11]	**<0.001**	38 [10]	0.348	70 [16]	**<0.001**
No	47 [10]		38 [8]		61 [14]	
Source of healthy eating knowledge						
Doctor	53.5 [13]		38 [8]		69.5 [20]	
Dietitian	55 [15]	**0.001**	41 [8]	**0.003**	75 [15]	**<0.001**
TV/Media	50 [9]		37 [10]		69 [20]	
Internet	50 [10]		38 [9]		68 [12]	
Family/friends	50 [14]		36 [11]		67.5 [18]	
Receiving education about nutrition		**<0.001**		**<0.001**		**<0.001**
Yes	58 [12]		42 [9]		77 [15]	
No	49 [9]		38 [8]		66 [14]	
Number of meals consumed						
1	49 [10]		37 [12]		71 [21]	
2	52 [12]	0.121	38.5 [8]	0.687	70 [17]	0.144
3	50 [12]		38 [11]		68 [14]	
>3	49 [16]		38 [8]		62 [28]	
Skipping meals						
Yes	51 [11]	0.106	38 [9]	0.531	69 [16]	0.557
No	50 [11]		38 [11]		68 [14]	
Frequency of eating outside						
Everyday	50.5 [13]		37 [8]		68 [19]	
3-4 times a week	50 [10]		38.5 [6]		66 [16]	
1-2 times a week	51 [11]	0.177	38 [10]	0.238	69 [16]	**0.029**
Once every 2 weeks	53 [12]		40 [8]		72 [12]	
Once a month or infrequently	49 [10]		39 [10]		69 [15]	
Probiotic supplements use status						
Yes	53 [13]	**<0.001**	39 [8]	**0.013**	74 [14]	**<0.001**
No	50 [11]		38 [9]		65 [16]	
Source of recommendation for using probiotic supplements						
Doctor	53 [13]		39 [11]		74 [11]	
Dietitian	56.5 [15]		41 [7]		77 [12]	
TV/Media/Internet	52 [11]	0.068	37 [11]	0.068	71.5 [13]	**0.018**
Family/friends	52 [13]		36 [14]		75 [11]	
Education	56 [14]		42 [8]		74 [24]	
Exercising regularly						
Yes	50 [10]	0.075	38 [10]	0.196	69 [14]	0.393
No	53 [12]		39 [9]		70 [16]	

NKLSA-NK: Basic Nutrition and Nutrition-Health Knowledge, NKLSA-FP: Food Preferences, IQR: Inter Quantile Range

Table 4. Correlation between nutritional knowledge, microbiota awareness scores, age, body weight and body mass index

	NKLSA-FP		Microbiota Awareness Scores		Age		Body Mass Index		Body Weight	
	r	**p**	**r**	**p**	**r**	**p**	**r**	**p**	**r**	**p**
NKLSA-NK	0.257	**<0.001**	**0.658**	**<0.001**	-0.009	0.857	-0.192	**<0.001**	-0.242	**<0.001**
NKLSA-FP	1	-	0.259	**<0.001**	0.131	**0.008**	-0.051	0.299	-0.078	0.114
Microbiota Awareness Scores			1	-	0.034	0.495	-0.191	**<0.001**	-0.274	**<0.001**
Age					1	-	0.183	**<0.001**	0.168	**<0.001**
Body Mass Index							1	-	0.887	**<0.001**
Body Weight									1	-

NKLSA-NK: Basic Nutrition and Nutrition-Health Knowledge, NKLSA-FP: Food Preferences

DISCUSSION

This study investigated the factors associated with nutritional knowledge level and microbiota awareness among university students at Istanbul Bilgi University. Approximately 70.0% of the 415 study participants were female, and 30.0% were male. The mean age of the students was 22.6±4.29 years, and the median BMI was 22.14 [5.13] kg/m2. 31.3% of the students had received previous education about nutrition, and had a moderate level of basic nutrition, food health knowledge (median: 51 [11]), and a good level of food preference knowledge (median: 38 [9]) ($p<0.001$).

In the current study, 41.2% of the students stated that they took probiotic supplements, and most of the women who took the supplements received advice from a dietitian, while men declared that the media/Internet was effective in their use of supplements, and a statistically significant difference was found between genders ($p<0.05$). Studies have shown that students who consume probiotic products list the factors that influence their consumption, including advertisements, health problems, advice, and education received at school (9-11).

In the current study, NKLSA-NK, NKLSA-FP, and microbiota awareness of students who took probiotic supplements were found to be higher than those who did not, and this difference was found to be statistically significant ($p<0.05$). The microbiota awareness score of students who took probiotic supplements and received this advice from a dietitian was found to be high and this difference was statistically significant ($p<0.05$). In a study of adults similar to ours, people who used probiotic supplements said that they mostly heard about the concept of probiotics from a doctor or nutritionist (12). It is increasingly necessary for health professionals to give informed and objective advice regarding probiotics, and it is essential that patients receive advice based on scientific evidence. Khalesi et al. (13), in a study investigating attitudes and awareness of probiotic use in Australian adults, found that participants using probiotics were more aware of gut health and generally showed healthier lifestyle behaviors (fruit consumption, physical activity, risk of alcohol consumption). Most non-probiotic users said that they would only use probiotics if they were available and recommended by a health professional. In our study, receiving advice from a dietitian on the use of probiotics can be associated with higher microbiota awareness scores, increasing individuals' knowledge of healthy eating and microbiota.

In this study, when comparing the levels of nutrition knowledge between the sexes, it was found that women had a higher level of nutrition knowledge than men in the two sub-dimensions of the level of nutrition knowledge, NKLSA-NK and NKLSA-FP, and this difference was statistically significant ($p<0.001$). Similar to this study, a study conducted on university students has shown that women have a higher level of nutritional knowledge than men (14). In addition, a study has shown that women are more interested in food, diet and body weight management than men (15). It was concluded that women are more concerned about their health and physical appearance than men, and therefore are more informed about nutrition and healthy eating than men.

In this study, women had a significantly higher microbiota awareness score than men ($p<0.001$). Similarly, in a study conducted by Kocaadam Bozkurt et al. (16) among university students in Turkey, women's microbiota awareness scores were significantly higher than men's. In another study conducted in Turkey that assessed the awareness of the microbiota and gut health of adults, it was determined that women have a higher microbiota awareness score than men, and this difference was statistically significant (17). In a study conducted among Kırklareli University students, women's microbiota awareness scores were found to be higher than those of men, and a statistically significant difference was detected (18). However, in a study conducted by Hamurcu et al. (19) among university students, males were found to have better microbiota awareness than females, but this gender difference was not statistically significant. In a cross-sectional study conducted on university students in Jordan, the microbiota knowledge of students was questioned, and it was reported that men had higher microbiota knowledge than women, but this difference was not statistically significant (20).

The current study detected a positive, statistically significant correlation between age and the NKLSA-FP sub-dimension of the nutrition knowledge level scale ($p<0.05$). Similarly, another study conducted on university students, positive and statistically significant correlations were found between students' nutritional knowledge level and age (21). A study examining the level of nutrition knowledge in adult female individuals stated that as the age group increased, the average essential nutrition knowledge score was significantly higher than that in other groups. However, there was no significant difference in the food preference score between the age groups (22).

The current study found that married students had a higher microbiota awareness ($p<0.05$). Although there are limited studies on microbiota awareness in the literature, a study

on probiotic use awareness reported that married individuals exhibit similarly high awareness of probiotic products (23). Furthermore, another study found that married individuals tend to have higher nutritional knowledge levels compared to their single or divorced counterparts (24). In this context, our study found a significant relationship between the level of nutritional knowledge and microbiota awareness, and we can predict that this situation can have an impact on married individuals. We can assume that this situation can be related to the adoption by married people of a more regular and healthy lifestyle.

In the present study, the NKLSA-NK subdimension of nutritional knowledge score and microbiota awareness of non-smoking students was found to be higher than that of smoking students ($p<0.05$). In accordance with these results, the majority of non-smoking students in this study were female, and females were more susceptible to NKLSA-NK and microbiota than males ($p<0.001$). Similarly, a study has shown that people who adopt a more health-friendly lifestyle, including physical activity, sleep duration, smoking and alcohol consumption, are characterized by higher nutrition knowledge (25). Contrary to these results, no statistically significant association was found between the level of nutritional knowledge and smoking in a study conducted differently (26).

In the current study, most women exercised regularly, and this result was statistically significant ($p <0.05$). In a study conducted by Bird et al. (27) on the nutrition knowledge level of young athletes, no significant gender difference was observed in the total scores of nutrition knowledge. However, it was noted that female athletes provided more accurate answers than males, particularly in the nutrient's subcategory. This difference was found to be statistically significant, highlighting a trend where female athletes displayed a higher level of accuracy in their understanding of nutrients compared to their male counterparts. Nowadays, people may be concerned about having a physically fit body as well as being healthy. Women especially attach more importance to physical appearance, and for reasons such as their concerns about having a healthy and fit physical appearance, it can be said that female students have a healthier lifestyle than men, and, as a result, their knowledge and awareness are higher.

The current study detected a positive and statistically significant relationship between the NKLSA-NK and NKLSA-FP subscales ($p<0.05$). Similarly, another study indicated that the higher the level of basic nutritional knowledge, the more likely it is to make healthy food choices (28). According to this result, students with good nutrition knowledge had better food preferences because they transferred this knowledge to their daily lives.

In our study, the microbiota awareness scores of students with high NKLSA-NK and NKLSA-FP scores were also high ($p<0.001$). In particular, a strong positive correlation exists between the NKLSA-NK score and microbiota awareness score. Similar to our study results, in a study evaluating the relationship between gut microbiota and systemic health of dietitians and students of the nutrition and dietetics department across Europe, it was stated that professional background and environment play an important role in shaping knowledge of gut microbiota and nutrition, and registered dietitians had a higher level of knowledge related to intestinal microbiota and healthy nutrition (29). In a study conducted among university students in Turkey, students with high levels of nutritional knowledge stated that there were significant differences between their use of probiotics and healthy nutrition choices (30). Considering these results, having a high level of nutritional knowledge enables healthy food choices and increases awareness of the microbiota. Increasing training on this subject can help students acquire healthier lifestyle habits and increase their awareness of microbiota. To the best of our knowledge, our study is the first study to evaluate the relationship between nutritional knowledge level and microbiota awareness. Therefore, further studies are needed, as there is no possibility of a comparison with similar results.

In the current study, students with higher levels of NKLSA-NK had lower BMIs and body weights ($p<0.001$). Although other study did not find a statistically significant association between NKLSA-NK and BMI and body weight, it was hypothesized that this could be related to the fact that the study population was generally overweight/obese or inactive (4). In accordance with this result, it is believed that increased nutritional education may be more effective in controlling BMI and preventing chronic diseases.

In our study, participants with a high microbiota awareness score were shown to have a lower BMI and body weight, and this negative correlation was statistically significant ($p<0.05$). Similar to the results of our study, in a study that examined the microbiota awareness of pregnant women, the level of microbiota awareness of women who gained weight according to the guidelines was found to be higher than women who had insufficient or excess weight gain during pregnancy (31). In a study conducted by Hamurcu et al. (19) among the nutrition and dietetics students in Turkey, it was determined that the level of microbiota awareness score was lower in overweight individuals. According to these results, insufficient awareness of the microbiota and insufficient nutritional knowledge can lead to inadequate and unbalanced dietary habits and, consequently, to body weight.

CONCLUSION

According to our results, our study population has fair nutritional knowledge in the NKLSA-NK and good nutritional knowledge in the NKLSA-FP sub-section, alongside a good level of microbiota awareness. Furthermore, a significant association was found between the level of nutritional knowledge and microbiota awareness scores. This relationship supports the idea that if the level of nutritional knowledge is increased, microbiota awareness may also increase. Additionally, it was concluded that microbiota awareness can have an impact on healthy nutrition and contribute positively to public health. This study is one of the first studies on the subject and reveals the need for more comprehensive studies. In this context, it is recommended that educational programs should be organized, and measures taken to protect public health in order to increase the level of nutrition knowledge and microbiota awareness in society.

Future studies may benefit from larger sample sizes and intervention-based studies evaluating the effectiveness of educational programs aimed at improving nutrition knowledge and microbiota awareness may provide valuable contributions to public health.

Conflict of Interest

Authors declared that there is no conflict of interest.

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