

Knowledge and attitude of adolescents on probiotic foods and their consumption

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Abstract

The steady increase in awareness on healthy nutrition today coupled with the wish to keep the immune system strong has seen individuals turn to nutritional supplements and functional foods. Even though there has been a rapid increase in the production of probiotic products, no study has examined what adolescents know about probiotic dairy products, their attitude, or their consumption of the product. The present work therefore aimed to examine the consumption of probiotic foods among adolescents, and to investigate their knowledge of probiotics. The present work was conducted in four secondary schools located in three central districts of Ankara, and one central district of Istanbul in Turkey, involving 2,369 students attending the sixth, seventh, and eighth grades. The scores of female and male adolescents who wanted to add probiotics into beverages were 44.4 and 55.6%, respectively. A statistically significant difference was observed in the demand for the addition of probiotics by gender ($p < 0.01$). The mean scores of sixth, seventh, and eighth grade students for the statement “*probiotic foods are rich in nutrients*” were $M = 4.08, 3.97, \text{ and } 3.90$, respectively, with a statistically significant difference ($p < 0.05$). Recent studies also have proven the positive effect of probiotics consumption on diseases specifically seen in children such as infectious diarrhoea, antibiotic-associated diarrhoea, necrotising enterocolitis in very low birth weight infants, and childhood atopy.

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Keywords

adolescent,
probiotics,
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probiotics and health

Introduction

Indiscriminate use of antibiotics and drugs has increased the requirement for probiotics. Under the pandemic conditions, consumption of probiotics has become more important in order to strengthen the immune system of individuals. Therefore, the use of probiotics has varied such as their addition in the foodstuff (milk, cereal, and vegetable products), vegetable juices, food supplements (liquid, tablet, capsule, and powder), or in the form of drugs (Di Lena *et al.*, 2015). As another alternative, foods such as probiotic yogurt enriched with almond milk have also been developed (Jeske *et al.*, 2018; Rööös *et al.*, 2018; Yılmaz-Ersan and Topçuoğlu, 2019; Grom *et al.*, 2019; Rasika *et al.*, 2021).

The effect of probiotics on health depends on the type of probiotic culture used, and the dairy product consumed. Whey dairy beverages display health benefits associated with the bioactive peptides, antioxidant activity, and essential amino acids (Coutinho *et al.*, 2019; Turkmen *et al.*, 2019). Both kefir and koumiss are generally probiotic products.

But probiotic is a technical concept, and when microorganisms or associated products do not meet all the requirements for probiotics including health impacts based on science evidence, they cannot be called as probiotic (Turkmen *et al.*, 2019).

FAO and WHO define probiotics as “live microorganisms which confer a health benefit on the host when administered in adequate amounts”. In 2002, this definition was strengthened as relevant and adequately accommodating for current and anticipated applications (FAO and WHO, 2002; Hill *et al.*, 2014). New definitions related to probiotics have been made such as ‘paraprobiotics’ (dead/inactivated cells of probiotics) and ‘postbiotics’ (healthful metabolites of probiotics), since studies have indicated that dead (intact or ruptured) cells are also likely to confer significant health impacts on consumers (Fonden *et al.*, 2000; Fazilah *et al.*, 2018). However, the latest classification for probiotics gives three terminology; (a) ‘true probiotic’ which is viable and active probiotic cell, (b) ‘pseudo-probiotic’ which is viable and inactive cell in the forms of vegetative or spore, and (c) ‘ghost probiotic’ which is

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dead/non-viable cell in the forms of intact or ruptured cells. The groups also have two sub-groups based on internal (*in vivo*) or external (*in vitro*) site of action/impact. Based on the existing well-designed clinical trials, systematic reviews, and meta-analyses, consensus panel asserted that certain effects may be associated with probiotics as a general class (Zendeboodi *et al.*, 2020).

The most widely known and used microorganisms (Ranadheera *et al.*, 2017; Kerry *et al.*, 2018) include *Lactobacillus* (*L. plantarum*, *L. paracasei*, *L. acidophilus*, *L. casei*, *L. rhamnosus*, *L. crispatus*, *L. gasseri*, *L. reuteri*, and *L. bulgaricus*); *Bifidobacterium* (*B. adolescentis*, *B. animalis*, *B. bifidum*, *B. infantis*, *B. lactis*, *B. longum*, and *B. catenulatum*); *Propionibacterium* (*P. jensenii* and *P. freudenreichii*); *Peptostreptococcus* (*P. productus*); *Pediococcus* (*P. acidilactici*); *Leuconostoc* (*Lc. lactis* subsp. *Cremoris* and *Lc. mesenteroides*); *Enterococcus* (*E. faecium*); *Streptococcus* (*S. oralis*, *S. uberis*, *S. rattus*, *S. salivarius*, *S. sanguis*, *S. mitis* and *S. thermophilus*); *Bacillus* (*B. coagulans*, *B. subtilis* and *B. laterosporus*); *Bacteroides* (*B. uniformis*); *Akkermansia* (*A. muciniphila*); and *Saccharomyces* (*S. cerevisiae* and *S. boulardii*).

Based on several benefits of probiotic strains in clinical trials, they should be viable in the food product in order for probiotic cultures to exert their health benefits (Gomand *et al.*, 2019). *Lactobacillus casei* is a known probiotic strain associated with several health benefits such as anti-hypertensive (Sperry *et al.*, 2018), anti-hyperglycaemic (Grom *et al.*, 2019), hypocholesterolaemic (Sperry *et al.*, 2018), and anti-carcinogenic (Liu *et al.*, 2011). Furthermore, *L. casei* is associated with the mitigation of inflammation caused by rheumatoid arthritis (Alipour *et al.*, 2014). The mechanisms of action include the improvement of the serum antioxidant activity, regulation of the immune system, improvement of disease status and inflammation (Alipour *et al.*, 2014), decrease in serum cholesterol (Sperry *et al.*, 2018), allergic reactions, and treating atopic eczema, celiac disease, irritable bowel syndrome, treatment of acute diarrhoea in children, as well as contributing to oral, bone, urogenital, and vaginal health (Roberfroid *et al.*, 2010; Tok and Aslim, 2010; Derin and Keskin, 2013; Khalighi *et al.*, 2016; Sánchez *et al.*, 2017; Cremon *et al.*, 2018); and anticarcinogenic activity (Liu *et al.*, 2011).

Based on probiotics' health benefits, the adolescents' awareness on their use should start at an early age to increase the use of probiotics and to provide continuity in healthy nutrition habits.

Therefore, in the present work, we examined the knowledge and attitude of adolescents on probiotic foods and their consumption. This would provide a significant contribution particularly to schools and parents in menu-planning of children. It is also important to determine what young people know about probiotics so that their awareness can be raised, and they can be informed about the health-related effects of probiotics.

Materials and methods

Study model

The present work utilised a survey model which is a research approach aiming to identify a past or present situation as it exists (Creswell, 2016). To this end, a survey form was carefully developed and used to assess the adolescents' knowledge on probiotic foods, their attitude towards probiotic foods, and their consumption levels of probiotic foods.

The cross-sectional design was participated by 2,369 students studying at secondary schools (sixth, seventh, and eighth grades) affiliated with the Ministry of National Education from three central districts of Ankara (Çankaya, Gölbaşı, Keçiören,) and one central district of Istanbul (Gaziosmanpaşa).

Study sample

Using the G* Power Version 3.1.9.6 program, the sample size was determined from the population size of 9,977 students (sixth, seventh, and eighth grades' students studying in the aforementioned four secondary schools). The sample size was calculated as 2,146 at the smallest effect size of 0.10, the alpha margin of error of 0.01, and the power of 0.99 (Faul *et al.*, 1992), thus giving 2,369 sample size; sufficient to represent the population. The sampling method, which can be easily found among the sampling types, was adopted to reach the determined sample. As convenience sampling, the sample consisted of adolescent students aged between 10 and 16 years (Erkuş, 2013). In this method, the sample that can be found easily consisted of individuals (volunteers) who were in the immediate vicinity, easy to reach and available, and willing to participate in the survey.

Data collection

A questionnaire carefully developed by us to investigate the adolescents' attitude and knowledge towards probiotics, and the scale developed by Balkis (2011) were used to collect the data. A pilot study was conducted with 55 participants before the

actual study. Following the pilot study, minor changes were made on the questionnaire. The first part of the questionnaire included four questions about the students and their families, such as the student's gender, grade, and parents' education. The second part included 12 questions about their probiotic food consumption including: *What are probiotic foods? Do you eat probiotic foods? What are the factors affecting the consumption of probiotic foods? Do you read the nutritional facts on probiotic food packages? Would you recommend eating probiotic foods to your friends and family? Does consumption of probiotic foods contribute to eliminating health problems?* The third part consisted of the 20-item Likert-type scale developed by Balkis (2011) to evaluate knowledge of adolescents on probiotic foods which included "strongly agree", "moderately agree", "neither agree nor disagree", "disagree", and "strongly disagree" (Table 1).

The present work was conducted between 5 February and 8 March 2019. Ethical considerations: prior to the study, we obtained ethical approval from Gazi University Institute of Health Sciences in Turkey (date: 11.12.2018 – approval no: 77082166-604.01.02). Necessary permissions were obtained from the Ministry of National Education (date: 21.01.2019 - E.3883, No: 14588481-605.99-E.765058).

The students who agreed to participate voluntarily were informed about the purpose of the study, and signed the informed consent forms. They were then asked to complete the data collection tools. The questionnaire was administered under our supervision by conducting face-to-face interview with the students. The students completed the questionnaire on their own following the necessary explanation. Each interview lasted for approximately 15 min. The participants were informed that their information would be kept confidential, and used only for scientific purposes. We assumed that the respondents had given true and unbiased answers.

Statistical analysis

The data were digitised and analysed through SPSS-21 (Armonk, NY) statistics software. Frequency distributions of the demographic information of the students and their parents were calculated. The students' probiotic foods' knowledge, their opinions about the non-consumption of probiotic foods and foods requiring probiotic supplements, their opinions on probiotic foods by attending a class on nutrition, and distribution of probiotic dairy product consumption were analysed

with chi-square tests. Knowledge on probiotic foods based on student gender was analysed by *t*-test. Knowledge on probiotic foods based on student grade was analysed by one-way analysis of variance. Knowledge on probiotic foods based on attendance to nutrition class was analysed by *t*-test.

Results

In the present work, 51.1% of the adolescents were female, and 48.9% were male. The sixth, seventh, and eighth grades' adolescents accounted for 29.0, 35.4, and 35.6%, respectively. For parents, 31.3% of the mothers and 31.6% of the fathers were high school graduates, while 26.2% of the mothers and 30.6% of the fathers were university graduates (Table 2).

How the adolescents characterised probiotic foods displayed a statistically significant difference. 55.2% of female adolescents and 44.8% of male adolescents consumed probiotic foods, while the rest reported that they did not consume probiotic foods. When probiotic food consumption and reading labels on probiotic foods were examined based on gender, it was revealed that female adolescents had higher scores in both cases as compared to the male adolescents, and this difference was statistically significant ($p < 0.01$). 47.6% of male adolescents and 52.4% of female adolescents reported not consuming probiotic foods because they were not knowledgeable about these foods. The reasons for not consuming probiotic foods did not differ significantly based on gender ($p > 0.05$). 60.1% of female adolescents and 39.9% of male adolescents wanted probiotics to be added into cookies, confectioneries, and chocolates. Female and male adolescents who wanted to add probiotics into beverages were 44.4 and 55.6%, respectively. A statistically significant difference was observed in the demand for the addition of probiotics based on gender ($p < 0.01$) (Table 3).

Table 4 reveals the limited consumption of probiotic foods by the adolescents, and the lack of any significant difference with respect to attending a class on nutrition ($p > 0.05$). The adolescents who consumed probiotic products listed reasons such as recommendations of friends and relatives, health problems, the effect of advertisements, desire to be healthy, consumption by own choice, and good taste. Results indicated a significant difference in the factors effective in consumption of probiotics with respect to attending a class on nutrition ($p < 0.05$).

Table 5 shows a statistically significant difference in probiotic dairy product consumption

Table 1. Questionnaire to assess the knowledge and attitude of adolescents on the use of probiotics.

Section I: Demographic information		
1) Child's gender		
a) Female	b) Male	
2) Child's grade		
a) 6 th	b) 7 th	c) 8 th
3) Mother's education		
a) Illiterate	c) Primary school	e) High school
b) Literate	d) Secondary school	f) Master's/doctoral degree
4) Father's education		
a) Illiterate	c) Primary school	e) High school
b) Literate	d) Secondary school	f) Master's/doctoral degree
Section II		
1) Opinions on probiotic foods		
a) The name for the foods that help to maintain microbiological balance in the intestines.		
b) The general term for foods that contain all the proteins the body requires.		
c) Foods that are risky due to their microbial content.		
2) Consumption of probiotic foods		
a) Yes	b) No	
3) Benefiting from probiotic foods		
a) Yes	b) No	
4) Reading food labels on probiotic foods		
a) Yes	b) No	
5) Recommendation of probiotic food consumption		
a) Yes	b) No	
6) Reasons for consuming probiotic foods		
a) To strengthen the immune system	d) To be healthy	g) To strengthen bones
b) To avoid gastrointestinal problems	e) To promote body development	h) All of the above
c) To avoid circulatory system problems	f) None of the above	
7) Reasons for not consuming probiotic foods		
a) Lack of knowledge	c) Tasteless	e) Expensive
b) Having no need	d) Unnatural	
8) Foods requiring addition of probiotics		
a) Cookies, confectioneries, and chocolates	c) Pastas, pastries	
b) Beverages	d) Other (hamburgers, pizzas, potato chips, dairy products)	
9) Consumption of probiotic dairy products		
a) Yes	b) No	
10) Factors in probiotic food consumption		
a) Recommendation	c) Effect of advertisement	e) By choice
b) Health problems	d) Being healthy	f) Good taste

Probiotic food consumption frequency by attendance to a nutrition class.

	Once daily	2-3 times daily	Once weekly	Once biweekly	Once monthly	Not consume
Yogurt						
Milk						
Kefir						
Section III						
Statement regarding probiotic foods				Strongly disagree	Disagree	Neither agree nor disagree
						Moderately agree
						Strongly agree
1) Probiotic foods can make us feel good						
2) Probiotic foods are rich in nutrients						
3) Probiotic foods help to strengthen the immune system						
4) Yogurt contributes to the regulation of the digestive system						
5) Probiotic foods contain high numbers of microorganisms						
6) Probiotic foods help to prevent diseases						
7) Probiotic foods increase the risk of contracting cancers						
8) Microorganisms in probiotic foods always retain their activity						
9) Probiotic foods have therapeutic effects						
10) Probiotic foods can cause diarrhoea						
11) Probiotic foods help to prevent cancer						
12) Probiotic foods help to prevent the reproduction of pathogenic microorganisms						
13) Probiotic foods are resistant to antibiotics						
14) Probiotic foods contribute to eye health						
15) Probiotic foods have a positive effect on skin health						
16) Probiotic foods help to lose weight						
17) Probiotic foods increase the appetite						
18) Probiotic foods are produced without fermentation						
19) Probiotic foods decrease the need for vitamins and minerals						
20) Probiotic foods are generally produced by natural methods						

Table 2. Distribution of the adolescents' demographic ($n = 2,369$).

Variables		f	%
Child's gender	Female	1.211	51.1
	Male	1.158	48.9
	Total	2.369	100.0
Child's grade	6 th	686	29.0
	7 th	839	35.4
	8 th	844	35.6
	Total	2.369	100.0
Mother's education	Illiterate	53	2.2
	Literate	68	2.8
	Primary school	431	18.2
	Secondary school	367	15.5
	High school	741	31.3
	University	620	26.2
	Master's/doctoral degree	89	3.8
	Total	2.369	100.0
Father's education	Illiterate	18	0.8
	Literate	55	2.3
	Primary school	294	12.4
	Secondary school	381	16.1
	High school	748	31.6
	University	724	30.6
	Master's/doctoral degree	140	6.3
Total	2.369	100.0	

with respect to attending a class on nutrition ($p < 0.01$). 23.0 and 30.0% of the students who attended a class on nutrition ate yogurt once and 2 - 3 times daily, respectively. Those who did not consume any probiotic dairy product were higher in number among the students who did not attend a class on nutrition. 29.6 and 21.1% of the students who had attended a class on nutrition, drank milk twice a day and once a month, respectively, while 78.8, 70.4, and 78.9% of the students who did not attend a class on nutrition drank milk once a day, twice a day, and once a month, respectively. 22.9% of the students who attended a class on nutrition and 77.1% of the students who did not attend the nutrition class reported that they did not consume any kefir.

There were statistically significant differences in consumption of yogurt ($\chi^2 = 18.029$, $SD = 5$, $p < 0.01$) and probiotic milk ($\chi^2 = 18.496$, $SD = 5$, $p < 0.01$) based on gender. Results revealed no statistically significant difference in the consumption of kefir based on gender ($p > 0.05$).

Table 6 presents the probiotic food knowledge scores of the adolescents. Female adolescents scored higher scores than male adolescents for some statements with a statistically significant difference: "probiotic foods can make us feel good" $M = 3.54$, "probiotic foods are rich in nutrients" $M = 4.03$, "probiotic foods help to strengthen the immune system" $M = 4.10$ ($p < 0.05$), "probiotic foods are resistant to antibiotics" $M = 3.40$, and "probiotic foods have a positive effect on skin health" $M = 3.52$ ($p < 0.01$). The difference between female and male adolescents' scores in the statement "probiotic foods can cause diarrhoea" $M = 2.80$ was statistically significant in favour of male adolescents ($p < 0.05$). On the other hand, male adolescents scored higher for several statements as well: "probiotic foods increase the risk of contracting cancers" $M = 2.30$, "microorganisms in probiotic foods always retain their activity" $M = 3.02$, "probiotic foods have therapeutic effects" $M = 3.62$, "probiotic foods increase the appetite"

Table 3. Distribution of the adolescents' opinions on probiotic foods by gender.

Opinions on probiotic foods	Female		Male	
	f	%	f	%
Characterisation of probiotic foods				
The name for the foods that help to maintain microbiological balance in the intestines	766	56.2	597	43.8
The general term for foods that contain all the proteins the body requires	387	49.2	399	50.8
Foods that are risky due to their microbial content	19	42.2	26	57.8
Total	1.172	53.4	1.022	46.6
	$\chi^2 = 12.03$	SD = 2	$p = 0.02^*$	
Consumption of probiotic foods				
Yes	1.043	55.2	848	44.8
No	177	39.7	269	60.3
Total	1.220	52.2	1.117	47.8
	$\chi^2 = 34.61$	SD = 1	$p = 0.00^*$	
Benefited from probiotic foods				
Yes	919	54.7	762	45.3
No	173	46.5	199	53.5
Total	1.092	53.2	961	46.8
	$\chi^2 = 8.16$	SD = 1	$p = 0.04^*$	
Reading labels on probiotic foods				
Yes	784	57.3	584	42.7
No	309	45.8	366	54.2
Total	1.093	53.5	950	46.5
	$\chi^2 = 24.16$	SD = 1	$p = 0.00^*$	
Recommendation of probiotic food consumption				
Yes	863	55.5	691	44.5
No	216	46.3	251	53.7
Total	1.079	53.4	942	46.6
	$\chi^2 = 12.43$	SD = 1	$p = 0.00^*$	
Reasons for consuming probiotic foods				
To strengthen the immune system	752	56.7	575	43.3
To avoid gastrointestinal problems	107	48.0	116	52.0
To avoid circulatory system problems	34	39.5	52	60.5
To be healthy	27	56.3	21	43.8
To promote body development	16	8.3	11	91.7
To strengthen bones	14	51.9	13	48.1
All of the above	1	8.3	11	91.7
None of the above	17	54.8	14	45.2
Total	968	54.6	805	45.4
	$\chi^2 = 31.32$	SD = 7	$p = 0.00^*$	

Reasons for not consuming probiotic foods				
Lack of knowledge	187	47.6	206	52.4
Having no need	136	44.9	167	55.1
Tasteless	84	52.8	75	47.2
Unnatural	54	49.5	55	50.5
Expensive	25	39.7	38	60.3
Total	486	47.3	541	52.7
	$\chi^2 = 4.36$	SD = 4	$p = 0.36^*$	
Foods requiring addition of probiotics				
Cookies, confectioneries, and chocolates	596	60.1	396	39.9
Beverages	229	44.4	287	55.6
Pastas, pastries	167	44.9	205	55.1
Other (hamburgers, pizzas, potato chips, dairy products)	176	7.8	178	8.0
Total	1.168	52.3	1.066	47.7
	$\chi^2 = 61.02$	SD = 4	$p = 0.00^*$	

Table 4. Distribution of factors effective in probiotic food consumption based on attendance to a nutrition class.

Variable	Attending to nutrition class		Not attending nutrition class	
	f	%	f	%
Consumption of probiotic dairy products				
Yes	429	24.4	1,331	75.6
No	93	22.9	314	77.1
Total	522	24.1	1.645	75.9
	$\chi^2 = .42$	SD = 1	$p = 0.52$	
Factors in probiotic food consumption				
Recommendation	195	23.4	637	76.6
Health problem	84	30.2	194	69.8
Effect of advertisement	71	27.7	185	72.3
Being healthy	40	22.1	141	77.9
By choice	17	16.3	87	83.7
Good taste	15	27.8	39	72.2
Total	422	24.8	1.283	75.2
	$\chi^2 = 11.35$	SD = 5	$p = 0.04^*$	

* $p < 0.05$.

M = 3.16, "probiotic foods are produced without fermentation" M = 2.98, and "probiotic foods decrease the need for vitamins and minerals" M = 2.94. However, this difference between genders

was not significant ($p > 0.05$).

Opinions of the students regarding probiotic foods were investigated with respect to grade. The mean scores of sixth, seventh, and eighth grades'

Table 5. Frequency of probiotic food consumption based on attendance to a nutrition class.

Variable	Frequency	Attending nutrition class		Not attending nutrition class	
		f	%	f	%
Yogurt	Once daily	238	23.0	797	77.0
	2-3 times daily	169	30.0	394	70.0
	Once weekly	91	21.8	327	78.2
	Once biweekly	14	26.9	38	73.1
	Once monthly	14	25.0	42	75.0
	Not consuming	11	13.4	71	86.6
	Total	537	24.3	1,669	75.7
		$\chi^2 = 17.89$	SD = 5	$p = 0.00^*$	
Milk	Once daily	194	21.2	719	78.8
	2-3 times daily	201	29.6	477	70.4
	Once weekly	77	21.2	287	78.8
	Once biweekly	24	28.9	59	71.1
	Once monthly	15	21.1	56	78.9
	Not consuming	24	24.7	73	75.3
	Total	535	24.3	1,671	75.7
		$\chi^2 = 18.50$	SD = 5	$p = 0.00^*$	
Kefir	Once daily	31	27.2	83	72.8
	2-3 times daily	21	34.4	40	65.6
	Once weekly	67	26.5	186	73.5
	Once biweekly	44	28.8	109	71.2
	Once monthly	60	22.0	213	78.0
	Not consuming	303	22.9	1,021	77.1
	Total	526	24.2	1,652	75.8
		$\chi^2 = 8.50$	SD = 5	$p = 0.13^*$	

* $p \leq 0.05$

students for the statement “probiotic foods are rich in nutrients” were M = 4.08, 3.97, and 3.90, respectively, with a statistically significant difference ($p < 0.05$). The mean scores of sixth, seventh, and eighth grades’ students for the statement “probiotic foods help to strengthen the immune system” were M = 4.20, 4.04, and 3.97, respectively, with a statistically significant difference ($p < 0.01$). Their mean scores for the statement “probiotic foods help to prevent diseases” were M = 3.92, 3.78, and 3.74, respectively, with a statistically significant difference ($p < 0.05$). The mean scores of sixth, seventh, and eighth grades’ students for the statement “microorganisms in probiotic foods always retain their activity” were M = 3.07, 3.00, and 2.96, respectively. The mean scores of sixth, seventh, and

eighth grades’ students for the statement “probiotic foods have therapeutic effects” were M = 3.70, 3.61, and 3.53, respectively, with a statistically significant difference ($p < 0.05$). The mean scores of sixth, seventh, and eighth grades’ students for the statement “probiotic foods can cause diarrhoea” were M = 2.66, 2.77, and 2.80, respectively, with a statistically significant difference ($p < 0.05$). The mean scores of sixth, seventh, and eighth grades’ students for the statement “probiotic foods contribute to eye health” were M = 3.40, 3.23, and 3.27, respectively, with a statistically significant difference ($p < 0.01$) (Table 7).

In addition, all the statements concerning probiotic foods were analysed with *t*-test with respect to attending a class on nutrition. Results indicated that the difference between the scores of students

Table 6. Scores for knowledge on probiotic food in terms of gender.

Statements regarding probiotic foods	Gender	n	M	SD	t	p																																																																																																																																																																													
Probiotic foods can make us feel good	Female	1.220	3.62	0.92	2.04	0.04*																																																																																																																																																																													
	Male	1.119	3.54				Probiotic foods are rich in nutrients	Female	1.218	4.03	0.93	2.60	0.01*	Male	1.120	3.92	Probiotic foods help to strengthen the immune system	Female	1.219	4.10	0.89	2.24	0.02*	Male	1.119	4.01	Yogurt contributes to the regulation of the digestive system	Female	1.220	4.06	0.89	1.85	0.06	Male	1.123	3.99	Probiotic foods contain high numbers of microorganisms	Female	1.213	3.34	0.95	0.28	0.77	Male	1.112	3.34	Probiotic foods help to prevent diseases	Female	1.212	3.84	0.92	1.58	0.11	Male	1.111	3.77	Probiotic foods increase the risk of contracting cancers	Female	1.220	2.21	1.06	1.89	0.06	Male	1.116	2.30	Microorganisms in probiotic foods always retain their activity	Female	1.207	2.99	0.79	0.69	0.48	Male	1.107	3.02	Probiotic foods have therapeutic effects	Female	1.213	3.59	0.91	0.88	0.37	Male	1.109	3.62	Probiotic foods can cause diarrhoea	Female	1.210	2.70	0.96	2.26	0.02*	Male	1.112	2.80	Probiotic foods help to prevent cancers	Female	1.215	3.41	0.94	1.60	0.10	Male	1.115	3.34	Probiotic foods help to prevent the reproduction of pathogenic microorganisms	Female	1.210	3.38	1.02	0.03	0.97	Male	1.115	3.38	Probiotic foods are resistant to antibiotics	Female	1.214	3.40	0.90	3.44	0.00*	Male	1.109	3.27	Probiotic foods contribute to eye health	Female	1.213	3.33	1.00	1.60	0.10	Male	1.109	3.26	Probiotic foods have a positive effect on skin health	Female	1.213	3.52	1.01	4.53	0.00*	Male	1.109	3.33	Probiotic foods help to lose weight	Female	1.217	3.25	1.12	1.53	0.12	Male	1.113	3.18	Probiotic foods increase the appetite	Female	1.212	3.13	1.06	0.68	0.49	Male	1.111	3.16	Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57	Male	1.100	2.98	Probiotic foods decrease the need for vitamins	Female	1.216
Probiotic foods are rich in nutrients	Female	1.218	4.03	0.93	2.60	0.01*																																																																																																																																																																													
	Male	1.120	3.92				Probiotic foods help to strengthen the immune system	Female	1.219	4.10	0.89	2.24	0.02*	Male	1.119	4.01	Yogurt contributes to the regulation of the digestive system	Female	1.220	4.06	0.89	1.85	0.06	Male	1.123	3.99	Probiotic foods contain high numbers of microorganisms	Female	1.213	3.34	0.95	0.28	0.77	Male	1.112	3.34	Probiotic foods help to prevent diseases	Female	1.212	3.84	0.92	1.58	0.11	Male	1.111	3.77	Probiotic foods increase the risk of contracting cancers	Female	1.220	2.21	1.06	1.89	0.06	Male	1.116	2.30	Microorganisms in probiotic foods always retain their activity	Female	1.207	2.99	0.79	0.69	0.48	Male	1.107	3.02	Probiotic foods have therapeutic effects	Female	1.213	3.59	0.91	0.88	0.37	Male	1.109	3.62	Probiotic foods can cause diarrhoea	Female	1.210	2.70	0.96	2.26	0.02*	Male	1.112	2.80	Probiotic foods help to prevent cancers	Female	1.215	3.41	0.94	1.60	0.10	Male	1.115	3.34	Probiotic foods help to prevent the reproduction of pathogenic microorganisms	Female	1.210	3.38	1.02	0.03	0.97	Male	1.115	3.38	Probiotic foods are resistant to antibiotics	Female	1.214	3.40	0.90	3.44	0.00*	Male	1.109	3.27	Probiotic foods contribute to eye health	Female	1.213	3.33	1.00	1.60	0.10	Male	1.109	3.26	Probiotic foods have a positive effect on skin health	Female	1.213	3.52	1.01	4.53	0.00*	Male	1.109	3.33	Probiotic foods help to lose weight	Female	1.217	3.25	1.12	1.53	0.12	Male	1.113	3.18	Probiotic foods increase the appetite	Female	1.212	3.13	1.06	0.68	0.49	Male	1.111	3.16	Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57	Male	1.100	2.98	Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69						
Probiotic foods help to strengthen the immune system	Female	1.219	4.10	0.89	2.24	0.02*																																																																																																																																																																													
	Male	1.119	4.01				Yogurt contributes to the regulation of the digestive system	Female	1.220	4.06	0.89	1.85	0.06	Male	1.123	3.99	Probiotic foods contain high numbers of microorganisms	Female	1.213	3.34	0.95	0.28	0.77	Male	1.112	3.34	Probiotic foods help to prevent diseases	Female	1.212	3.84	0.92	1.58	0.11	Male	1.111	3.77	Probiotic foods increase the risk of contracting cancers	Female	1.220	2.21	1.06	1.89	0.06	Male	1.116	2.30	Microorganisms in probiotic foods always retain their activity	Female	1.207	2.99	0.79	0.69	0.48	Male	1.107	3.02	Probiotic foods have therapeutic effects	Female	1.213	3.59	0.91	0.88	0.37	Male	1.109	3.62	Probiotic foods can cause diarrhoea	Female	1.210	2.70	0.96	2.26	0.02*	Male	1.112	2.80	Probiotic foods help to prevent cancers	Female	1.215	3.41	0.94	1.60	0.10	Male	1.115	3.34	Probiotic foods help to prevent the reproduction of pathogenic microorganisms	Female	1.210	3.38	1.02	0.03	0.97	Male	1.115	3.38	Probiotic foods are resistant to antibiotics	Female	1.214	3.40	0.90	3.44	0.00*	Male	1.109	3.27	Probiotic foods contribute to eye health	Female	1.213	3.33	1.00	1.60	0.10	Male	1.109	3.26	Probiotic foods have a positive effect on skin health	Female	1.213	3.52	1.01	4.53	0.00*	Male	1.109	3.33	Probiotic foods help to lose weight	Female	1.217	3.25	1.12	1.53	0.12	Male	1.113	3.18	Probiotic foods increase the appetite	Female	1.212	3.13	1.06	0.68	0.49	Male	1.111	3.16	Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57	Male	1.100	2.98	Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69																
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Probiotic foods help to lose weight	Female	1.217	3.25	1.12	1.53	0.12																																																																																																																																																																													
	Male	1.113	3.18				Probiotic foods increase the appetite	Female	1.212	3.13	1.06	0.68	0.49	Male	1.111	3.16	Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57	Male	1.100	2.98	Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69																																																																																																																																																		
Probiotic foods increase the appetite	Female	1.212	3.13	1.06	0.68	0.49																																																																																																																																																																													
	Male	1.111	3.16				Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57	Male	1.100	2.98	Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69																																																																																																																																																												
Probiotic foods are produced without fermentation	Female	1.211	2.96	1.04	0.56	0.57																																																																																																																																																																													
	Male	1.100	2.98				Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69																																																																																																																																																																						
Probiotic foods decrease the need for vitamins	Female	1.216	2.92	1.10	0.39	0.69																																																																																																																																																																													

* $p \leq 0.05$

Table 7. Comparison of knowledge scores by student grades.

Statements regarding probiotic foods	Grade	n	M	SD	F	p
Probiotic foods can make us feel good	6 th	667	3.64	1.06	1.649	0.19
	7 th	822	3.57	.95		
	8 th	811	3.55	.97		
Probiotic foods are rich in nutrients	6 th	667	4.08	1.00	6.162 (6-8)	0.02*
	7 th	821	3.97	.97		
	8 th	810	3.90	.97		
Probiotic foods help to strengthen the immune system	6 th	667	4.20	.94	10.975 (6-8)	0.00*
	7 th	822	4.04	.97		
	8 th	810	3.97	.94		
Yogurt contributes to the regulation of the digestive system	6 th	669	4.08	.96	1.968	0.14
	7 th	819	3.98	.94		
	8 th	816	4.02	.92		
Probiotic foods contain high numbers of microorganisms	6 th	661	3.30	1.08	1.349	0.26
	7 th	815	3.38	.98		
	8 th	809	3.32	.95		
Probiotic foods help to prevent diseases	6.	658	3.92	1.00	6.772 (6-8)	0.00*
	7.	819	3.78	.98		
	8.	807	3.74	.96		
Probiotic foods increase the risk of contracting cancers	6 th	664	2.20	1.20	2.196	0.11
	7 th	820	2.23	1.07		
	8 th	813	2.32	1.09		
Microorganisms in probiotic foods always retain their activity	6 th	660	3.07	.94	3.411 (6-8)	0.03*
	7 th	809	3.00	.81		
	8 th	805	2.96	.81		
Probiotic foods have therapeutic effects	6 th	659	3.70	1.01	5.674 (6-8)	0.03*
	7 th	818	3.61	.93		
	8 th	805	3.53	.95		
Probiotic foods can cause diarrhoea	6 th	653	2.66	1.12	3.839 (6-8)	0.02*
	7 th	820	2.77	.99		
	8 th	809	2.80	.95		
Probiotic foods help to prevent cancers	6 th	664	3.51	1.06	9.509 (6-8)	0.00*
	7 th	817	3.35	.98		
	8 th	809	3.29	.93		
Probiotic foods help to prevent the reproduction of pathogenic microorganisms	6 th	661	3.44	1.14	1.424	0.21
	7 th	815	3.38	1.02		
	8 th	809	3.34	.99		
Probiotic foods are resistant to antibiotics	6 th	659	3.43	1.01	5.348 (6-8)	0.05*
	7 th	817	3.27	.90		
	8 th	807	3.32	.94		
Probiotic foods contribute to eye health	6 th	660	3.40	1.08	5.204 (6-8)	0.05*
	7 th	815	3.23	.96		
	8 th	807	3.27	1.00		
Probiotic foods have a positive effect on skin health	6 th	658	3.50	1.05	3.223 (6-8)	0.04*
	7 th	815	3.37	1.01		
	8 th	809	3.44	.98		
Probiotic foods help to lose weight	6 th	662	3.23	1.15	0.177	0.87
	7 th	816	3.20	1.07		
	8 th	812	3.23	1.08		
Probiotic foods increase the appetite	6 th	660	3.32	1.14	12.825 (6-8)	0.00*
	7 th	817	3.05	1.06		
	8 th	806	3.08	1.06		
Probiotic foods are produced without fermentation	6 th	652	3.10	1.12	6.534 (6-8)	0.01*
	7 th	815	2.93	1.02		
	8 th	804	2.91	1.03		
Probiotic foods decrease the need for vitamins and minerals	6 th	659	2.86	1.25	2.360	0.10
	7 th	819	2.91	1.10		
	8 th	810	2.99	1.05		
Probiotic foods are generally produced by natural methods	6 th	663	3.62	1.10	8.597 (6-8)	0.00*
	7 th	821	3.47	1.04		
	8 th	812	3.39	1.04		

* $p \leq 0.05$

who attended nutrition class and those who did not was not statistically significant ($p > 0.05$).

Discussion

The present work was carried out with secondary school students to investigate their attitude, knowledge, and consumption of probiotic foods. The adolescents involved aged between 10 and 16 years ($M = 12.67 \pm 1.03$), attended the sixth, seventh, and eighth grades, and more than half of them were females. Both female and male adolescents characterised probiotic foods as “*foods are risky due to their microorganism content,*” and “*the name for foods help to maintain microbiological balance in the intestines,*” with a statistically significant difference based on gender. Results also revealed a statistically significant difference in probiotic food consumption among adolescents in terms of gender, in favour of the females. Recently, the production of yogurt by traditional methods have increased, and people have begun to make their own yogurt at home, which might have contributed to the high rate of probiotic food consumption.

Yogurt, obtained by fermenting the milk, has been used for intestinal health and as an essential nutrient for many years. In recent years, the microbiota of yogurt has been enriched by adding external microorganisms such as probiotics, prebiotics, and synbiotics to increase its nutritional value (Champagne *et al.*, 2018).

The most prominent findings regarding the factors that affected the consumption of probiotic foods were that female adolescents consumed probiotic products with advertisement effect at higher rate, and male adolescents consumed probiotic products due to health problems at higher rate. However, the difference in the adolescents' reasons for consumption of probiotic food in terms of gender was not statistically significant. This finding might be associated with lack of female and male students' knowledge about probiotic foods. In addition, female adolescents obtained higher scores as compared to male adolescents for the statement “*probiotic foods help to strengthen the immune system.*” In their studies, Hill *et al.* (2014) highlighted the strengthening effect of probiotics on the immune system. Cetinbas *et al.* (2017) explained that one of the effects of probiotic foods was to maintain immune balance by strengthening barrier function on the intestinal surface. There was a significant difference based on gender in the adolescents' reports regarding whether or not they benefited from probiotics. Additionally, it was found

in the present work that female adolescents were more accustomed to read the labels on probiotic foods.

Neither female nor male adolescents were knowledgeable about probiotic products. Both female and male adolescents reported that they did not consume probiotic foods because they considered probiotic foods tasteless. There was no statistically significant difference in probiotic food consumption in terms of gender. de Simone (2019) reported that probiotic products were not easily embraced in terms of storage conditions and packaging, and also active and dormant bacteria added into the products often affected the taste. Another remarkable result was the demand reported by the adolescents in the present work for the addition of probiotic products into cookies, confectioneries, and chocolates. Majority of the participants reported that they consumed probiotic foods. The factors affecting consumption of probiotic foods displayed a statistically significant difference in terms of attending a class on nutrition. Milk and yogurt consumption were higher among the adolescents who did not attend a class on nutrition as compared to those who attended a class on nutrition, with a statistically significant difference. This finding might be associated with the fact that the adolescents lived with their parents, and the parents might have been more informed and conscious about milk and yogurt consumption. Grom *et al.* (2019) stated that the blood glucose level increased 15 and 30 min after the consumption of probiotic-rich milk products. Eser (2017) reported yogurt as the most commonly consumed probiotic food. Furthermore, the present work indicated that the probiotic dairy product least consumed by the students was kefir. Vandenplas (2016) also reported a low tendency of kefir consumption, and recommended promoting the consumption of kefir for its nutritiousness. In the present work, female adolescents had a higher score as compared to male adolescents for the statement “*probiotic foods are rich in nutrients,*” with a statistically significant difference, which might indicate that female students attached greater importance to healthy nutrition than male students. Cremon *et al.* (2018) highlighted the necessity of doctor and nutritionist supervision for probiotic consumption despite their numerous benefits on human health. There was a statistically significant difference in the scores concerning the statement “*probiotic foods can cause diarrhoea*” by student grade, which revealed the presence of an important misconception among the students. The study conducted by Li *et al.* (2019a) with children and adolescents indicated that probiotics and probiotic

foods decreased diarrhoea. A significant difference was observed in the mean scores of the sixth, seventh, and eighth grades' students for the statements "*probiotic foods are rich in nutrients*" and "*probiotic foods help to strengthen the immune system*". Liu *et al.* (2019) mentioned about the assistance of probiotic foods in strengthening the gastrointestinal and immune systems. There was also a significant difference in mean score by student grade for the statements "*probiotic foods contain high numbers of microorganisms*" and "*probiotic foods have therapeutic effects*". The studies by Yabancı and Şimşek (2007), Parker *et al.* (2016), and de Simone (2019) stressed the high number of active microorganisms in probiotic foods and drinks. Cremon *et al.* (2018) reported that consumption of probiotics reduced stress and irritable bowel syndrome, prevented food allergies, obesity, and type 2 diabetes mellitus in children, and had therapeutic effects on autism patients. In the previous studies, it was specified that the consumption of probiotics was effective in the prevention of conditions such as inflammatory bowel disease, colorectal cancer, obesity, and diabetes (Jones *et al.*, 2018; Li *et al.*, 2019b). The sixth grade students had significantly higher scores than the seventh and eighth grade students for the statement "*probiotic foods help to prevent cancers*" ($F = 9.509$). Abatenh *et al.* (2018) and Hendler and Zhang (2018) suggested that regular consumption of probiotics could reduce the incidence of colon cancer. Additionally, Cremon *et al.* (2018) reported about reduced constipation with regular consumption of probiotics, as well as lack of evidence about the effectiveness of probiotic consumption in preventing colonic diverticulosis and diverticular disease. The sixth grade students had higher scores than seventh and eighth grade students for the statement "*probiotic foods are resistant to antibiotics*," with a statistically significant difference between the groups ($F = 5.348$, $p < 0.05$). Mizock (2015), Khalighi *et al.* (2016), and Guimarães *et al.* (2019) reported that the consumption of probiotic products decreased number of feverish days, improved academic activity, and increased bowel movements. Yabancı and Şimşek, (2007), Soltani *et al.* (2018), and Guimarães *et al.* (2019) highlighted that probiotic, having the ability to strengthen the immune system, were alternatives to antibiotics. It is also possible to strengthen the immune system and to prevent Covid-19 in adolescents through the consumption of probiotic foods (Baud *et al.*, 2020). In addition, investigation on probiotic food knowledge scores by attending a class on nutrition revealed no significant difference for any statement

between the students who attended a class on nutrition and those who did not.

Limitations

The limitation of the present work was that the sample was limited to state schools in only one metropolitan city since we were located in the same city. While calculating the knowledge scores, the adolescents were grouped based on their gender, but not whether they received nutritional education or not, and the classes they attended. The present work was carried out with adolescents because there was no previous studies on knowledge of adolescents about probiotics, their attitudes toward them, and their consumption. The probiotic products in the present work were limited to dairy products.

Another limitation of the present work was that the adolescents had the lack of knowledge about probiotics. It may be suggested to conduct future studies using multiple variables such as gender, different cultures, and adolescents' participation in classes on nutrition. The results obtained in the present work cannot be generalised for all adolescents in Turkey since it was conducted only in four districts.

It is therefore recommended to raise awareness of adolescents in this age group on probiotic dairy products. It is also recommended to raise awareness of families in order to make probiotic consumption a habit. It is suggested for children to make probiotic consumption a habit from early ages.

Conclusion

In conclusion, there is no independent nutrition class in Turkish schools within the body of the Ministry of National Education. However, science classes incorporate subjects concerning nutrition. Results of the present work indicated the insufficiency of these lessons. Obesity and diabetes caused by lack of nutritional knowledge have become serious contemporary health problems. Therefore, a systematic and continuous nutrition education must be provided at every stage of education, starting from preschool, and nutrition classes must be incorporated into the curriculum. Furthermore, social media and other media tools can also be utilised to raise awareness on probiotic foods, as well as their sources and health benefits.

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