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Assessment of Awareness and Knowledge of Food-Drug Interactions Among Medical Students from Different Faculties at Benghazi University, Libya: A Cross-Sectional Comparative Study

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Abstract:
Food and drug interactions can greatly affect the effectiveness of the drug and its mode of action and may lead to reduced drug effectiveness or serious and fatal side effects, which affects the patient's condition Evaluate the knowledge and awareness of medical students in medical colleges in the final and pre-final year. A descriptive cross-sectional study was conducted in 2025 ، The study included 771 students from Benghazi Medical University in the final years of the faculties (Medicine, Nutrition, Pharmacy and Dentistry) to assess knowledge, face-to-face interviews were conducted, and the data were statistically analyzed using SPSS. Most of the participants were above the age of 23 years and (75.9%) were female, and the highest percentage (47.3%) were humanities students, followed by dental (21.19%), pharmacy (17.8%) and nutrition (13.7%), of whom (38.1%) were in the penultimate year and (61.9%) in the last year. The results showed a disparity and difference in knowledge between medical specialties, where pharmacy students excelled, followed by medicine, nutrition, and dentistry, due to the pharmacy curriculum's focus on better interactions, as well as the greater awareness of final year students due to their more experience and greater reliance on self-effort. The study found a significant disparity in knowledge among medical students, where final year students and pharmacy students were more knowledgeable about this topic, and these results reflect the need to focus on curricula and workshops to raise the level.

Keywords: Food-Drug Interactions, Medical Students, Knowledge Assessment, Awareness, Knowledge Gap Knowledge.

تقييم الوعي والمعرفة بتفاعلات الغذاء والدواء بين طلاب الطب من مختلف الكليات بجامعة بنغازي، ليبيا: دراسة مقارنة مقطعية

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الملخص
يمكن أن تؤثر التفاعلات بين الأغذية والأدوية بشكل كبير على فعالية الدواء وطريقة عمله، وقد تؤدي إلى انخفاض فعالية الدواء أو آثار جانبية خطيرة ومميتة، مما يؤثر على حالة المريض .تقييم معرفة ووعي طلاب الطب في كليات الطب في السنة النهائية والسنة قبل النهائية .أجريت دراسة وصفية مستعرضة في عام 2025، وشملت الدراسة 771 طالبًا من جامعة بنغازي الطبية في السنوات النهائية للكليات (الطب والتغذية والصيدلة وطب الأسنان) لتقييم المعرفة، وأجريت مقابلات وجهًا لوجه، وتم تحليل البيانات إحصائيًا باستخدام SPSS كان معظم المشاركين فوق سن 23 عامًا و(75.9٪) منهم من الإناث، كانت النسبة الأعلى (47.3٪) من طلاب العلوم الإنسانية، يليهم طلاب طب الأسنان (21.19٪)،

والصيدلة (17.8٪) والتغذية (13.7٪)، منهم (38.1٪) في السنة قبل الأخيرة و(61.9٪) في السنة الأخيرة .أظهرت النتائج تباينًا واختلافًا في المعرفة بين التخصصات الطبية، حيث تفوق طلاب الصيدلة، يليهم طلاب الطب والتغذية وطب الأسنان، وذلك بسبب تركيز منهج الصيدلة على التفاعلات الأفضل، فضلاً عن الوعي الأكبر لدى طلاب السنة النهائية بسبب خبرتهم الأكبر واعتمادهم الأكبر على الجهد الذاتي.
الاستنتاج: وجدت الدراسة تباينًا كبيرًا في المعرفة بين طلاب الطب، حيث كان طلاب السنة النهائية وطلاب الصيدلة أكثر دراية بهذا الموضوع، وتعكس هذه النتائج الحاجة إلى التركيز على المناهج الدراسية وورش العمل لرفع المستوى.

الكلمات المفتاحية: التفاعلات بين الأغذية والأدوية، طلاب الطب، تقييم المعرفة، الوعي، فجوة المعرفة.

Introduction

Food-Drug Interactions (FDIs) refer to the physical, chemical, physiological, or pathological interactions between pharmaceutical agents and nutrients, general food intake, or specific nutritional states. Food is broadly defined as any substance consumed to provide energy and essential nutrients such as carbohydrates, fats, proteins, vitamins, and minerals to an organism. According to the World Health Organization (WHO), a drug is any substance or product intended to modify or treat physiological functions or pathological conditions for therapeutic benefit [1]. FDIs can profoundly influence drug efficacy and safety. Food intake may alter a drug's pharmacodynamics or pharmacokinetics, potentially enhancing or diminishing its therapeutic effects. In certain cases, these interactions can also modulate the intensity and occurrence of side effects. Moreover, medications can impact nutrient metabolism ,absorption, or excretion, potentially leading to clinically significant nutritional deficiencies or toxicities [2] Food-drug interactions are influenced by several factors that may increase or decrease the effect of the drug within the body. Among these factors are age, as the body's ability to absorb and metabolize drugs changes with age, as well as general health status that can affect how the body processes drugs, and biological factors such as gender, drug dosage, and the presence of other drugs or dietary supplements, including vitamins and herbs, play a large role in these interactions. In addition to that, genetic differences in transporter proteins, enzymes, or receptors may affect the body's response to drugs, so it is necessary to consider these factors to ensure the safe and effective use of drug therapies. [3]

Several clinical examples illustrate the significance of FDIs. ACE inhibitors can increase potassium levels in the body, which can lead to irregular heartbeats and palpitations, so it is recommended to minimize the intake of potassium-rich foods such as bananas, oranges, and leafy vegetables, in addition to avoiding salt substitutes that contain potassium. Anticoagulants such as warfarin interact with vitamin K-rich foods such as spinach and broccoli, which in large quantities can reduce the effectiveness of the drug, and garlic and ginger should be avoided as they can increase the risk of bleeding. Thyroid medications are best taken on an empty stomach, and cabbage and cauliflower should be avoided, as they may affect the absorption of the medication and reduce its effectiveness. Asthma medications may interact with caffeine, leading to side effects such as jitteriness and increased heart rate. Most statins can be taken with or without food, but some are more effective when taken with dinner. In the case of atorvastatin, lovastatin, or simvastatin, it is advised to avoid consuming more than one liter of grapefruit juice per day, as it can increase the levels of the drug in the body and increase the likelihood of side effects; however, there are some statins that do not interact with grapefruit juice and In some cases, food-drug interactions may reduce a drug's toxicity or improve its tolerability in the gastrointestinal tract. For example, albendazole, an antiparasitic drug that works against tapeworms, is more effective when taken with a high-fat meal, increasing its bioavailability fivefold compared to taking it on an empty stomach [4]. Given the importance of the topic, the SAFER model was designed to help healthcare providers give effective dietary advice to patients who might be at risk of food-drug interactions. This model aims to improve the quality of dietary counseling and reduce the health risks associated with these interactions. The name of the model is derived from the initial letters of the basic steps, which are Source (at this stage, the healthcare provider must identify reliable sources to understand the nature of food-drug interactions), followed by Assessment (the patient's medical history, medications, dietary habits, nutritional status, and the importance of this step in recognizing that each patient has unique needs), and Plan (a dietary plan). (medical history, medications, dietary habits, nutritional status, and the importance of this step is that each patient has unique needs) and F is a dietary plan (at this stage, a personalized dietary plan is created based on the patient's health status and medication regimen) Then E stands for evaluation and encouragement (after providing dietary recommendations, it is important to ensure that the patient understands the instructions and Is prepared to adhere to them). Finally, R stands for review and reinforcement (the work does not stop after the consultation session; rather, the patient must be followed up regularly to ensure that they are adhering to the plan and adapting to any health changes) [5]. Given the advances in science and the increased focus on food-drug interactions in 2024, Jinhang Wei and his team developed a new model known as the Enhanced Representation Model for Food-Drug Interactions (ERM-FDI). This model is a modern tool that helps to understand the effect of food on drugs more accurately, which is a step forward because studying these interactions was complicated due to the diversity of food components and their different effects on individuals. It is based on four analysis units. This was the first model to accurately show the effect of food on drugs using complex computational methods. Studies have shown that

the use of artificial intelligence and data analysis can improve the accuracy of predictions, thereby improving dietary guidelines and reducing the risk of adverse interactions between food and drugs [6,7].
So far, no research has been done to evaluate the awareness of medical students (medicine, pharmacy, dental, and public health nutrition), making this the first study to examine Libyan medical students' understanding of food-drug interactions across different disciplines.This study aims to assess the level of knowledge and awareness regarding food-drug interactions among final-year and penultimate-year students in the fields of medicine, dentistry, pharmacy, and nutrition. To evaluate the knowledge of medical students in various specialties regarding the most important interactions and clinical examples related to food-drug interactions. To examine the association between academic level and students' understanding of food-drug interactions. To identify the primary sources of information students, rely on to acquire knowledge about food-drug interactions.

Methods

Study Design and Participants: A cross-sectional descriptive comparative study was conducted between January and April 2025 among final- and penultimate-year students enrolled in various medical and health-related programs at Arab Medical University in Benghazi, Libya's second-largest city. A total of 771 students were randomly selected from disciplines including medicine, dentistry, pharmacy, and public health with a focus on nutrition. The primary objective was to assess participants' knowledge of food-drug interactions and their clinical implications using a validated questionnaire administered at a single point in time. The study underscored the importance of maintaining strict confidentiality and privacy of participant data. Additionally, the research highlights the critical role such investigations play in informing and enhancing the scientific curricula across all healthcare disciplines.

Sampling Size Calculation:

The researchers use Steven k. Thompson equations to calculate the sample size, from this formula:

$$n = \frac{N \times p\,(1-P)}{[[(N-1x\,(d^2 / Z^2)] + P(1-P)]}$$

To ensure that we have reliable and representative results, the sample was selected from four medical colleges based on the total number of students for each academic year, and the sample was selected according to the number of students enrolled in each faculty as reported by the Registrar's Office.

Results Table1. Number of students enrolled in each faculty as reported by the Registrar's Office.

Faculty	Year	Number of Students Participated	Total Number of Students
Faculty of Medicine	Fourth year	300	1352
	Fifth year	293	1218
Faculty of Public ealth (Nutrition Department)	Third year	25	25
	Fourth year	84	104
Faculty of Pharmacy	Third year	148	239
	Fourth year	159	270
Faculty of Dentistry	Fourth year	219	503

The total representative sample was 771 students, and they were carefully selected to represent the colleges in terms of academic specialization and academic year.

Questionnaire: In this study, the data collected through interviews was verified to ensure accuracy. The researchers relied on a validated questionnaire from previous studies, with some modifications such as repeated questions and additional information not related to the scope of our study. The questionnaire consisted of four main sections. The first section covered demographic data (such as gender, age, specialization, health, and social status). The second section focused on general knowledge of food-drug interactions. The third section addressed interactions associated with common foods. The final, fourth section emphasized the sources students rely on for information about the topic. The data were processed and analyzed using appropriate statistical programs.

Inclusion and Exclusion Criteria:

The study criteria included medical students at the University of Benghazi. The research involved final and penultimate-year students from the Faculties of Medicine, Pharmacy, and Nutrition, as well as students from the Faculty of Dentistry. First- and second-year students from the four faculties, and third-year students from the

Faculty of Medicine were excluded. Third- and fourth-year students from the Faculty of Public Health departments (Environmental Health, Health Administration, Health Education, Health Informatics, and Medical Laboratories) were also excluded because the research topic was not related to their academic specialization.

Ethical Approval Statement: The research is conducted in compliance with ethical principles and regulations. Before data collection, approval from the Institutional Review Board (IRB) is secured. To guarantee the confidentiality and anonymity of participants, everyone is given a unique identification code. All data are kept secure and can only be accessed by authorized personnel.

Statistical Analysis: The data was entered into a Microsoft Excel sheet and analyzed using SPSS Version 23 software. The data will be presented as descriptive statistics such as frequencies and percentages. The chi-square test and Pearson's correlation coefficient were used to compare groups of students based on college and year of study, and to identify significant relationships between variables. Statistical significance was assessed at a 95% confidence level ($p < 0.05$).

Results

Socio-demographic characteristic of the study population:

This is a descriptive cross-sectional study results that included 771 medical and health-related programs at Arab Medical University in Benghazi, Libya's. The data showed that (67.2%) of the participants were older than 23 years old while (32.8%) were between 21 and 23 years old. According to gender, most participants were female (75.9%) and male (24.1%). In terms of marital status, the majority were unmarried (92.2%). In terms of health status, only (7.4%) were suffering from chronic diseases. In terms of the stage of study (61.9%) in the final year (38.1%) in the penultimate year finally, the distribution by specialty was highest for medical (47.3%), dental (21.1%), pharmacy (17.8%) and nutrition (13.7%) students.

Table 2. Demographic characteristics of the participants (N = 771).

		Frequency (n)	Percent (%)
Age Groups (years)	21-23	253	32.8
	>23	518	67.2
Gender	Female	585	75.9
	Male	186	24.1
Marital status	Married	59	7.7
	Single	712	92.3
Complain of chronic diseases	Yes	57	7.4
	No	714	92.6
Year of studies	The year before last	294	38.1
	Final Year	477	61.9
Specialty	Dentistry	163	21.1
	Dietitian	106	13.7
	Medicine	365	47.3
	Pharmacy	137	17.8

The results of Table 3 show that most of the participants were from Benghazi (92.8%), while a small percentage came from other cities such as Al-Marj, Tripoli, Ajdabiya, etc.

Table 3. Geographical Distribution of Students at the University of Benghazi (N771).

Country	Frequency (n)	Percent (%)
Benghazi	716	92.8
Tobruk	2	.3
Sirte	3	.4
Misurata	1	.1
Darna	2	.3
Tripoli	11	1.4
Almarj	25	3.3
Alkafra	1	.1
Ajdabiya	10	1.3
Total	771	100

Figure (1) shows the distribution of students by specialization and year of study, medical students in the final and penultimate years represent the highest percentage (23.1%-24.3%) respectively, followed by dental students for the final year (20%), nutrition in the final year (10.9%) and penultimate year (2.9%), pharmacy (7.9%) for the final year (9.9%) for the penultimate year

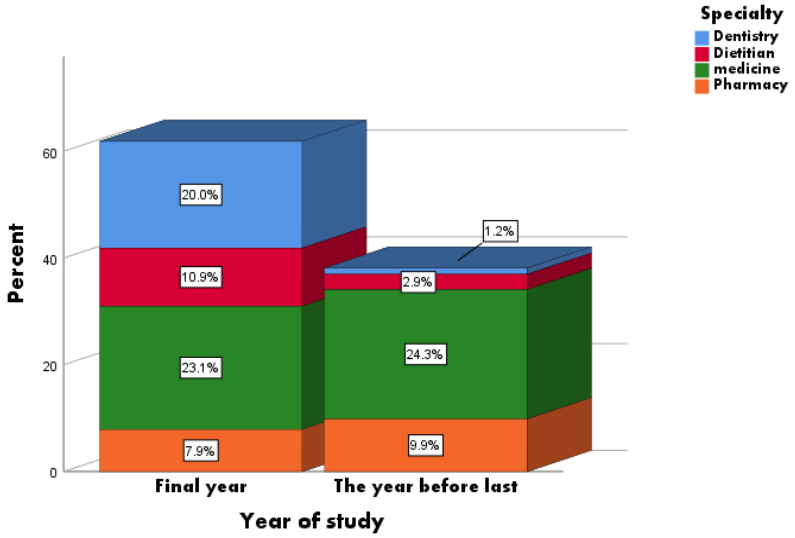

Figure 1. Distribution of the Sample by Specialty (Field of Study) and Academic Year N (771).

This figure represents the level of students' knowledge of interference before dispensing medications by specialty, it was found that medical students had the highest percentage of knowledge (37.2%) while nutrition students had the lowest percentage of knowledge (6.2%), and there was a varying percentage between specialties for the option (No and Don't know).

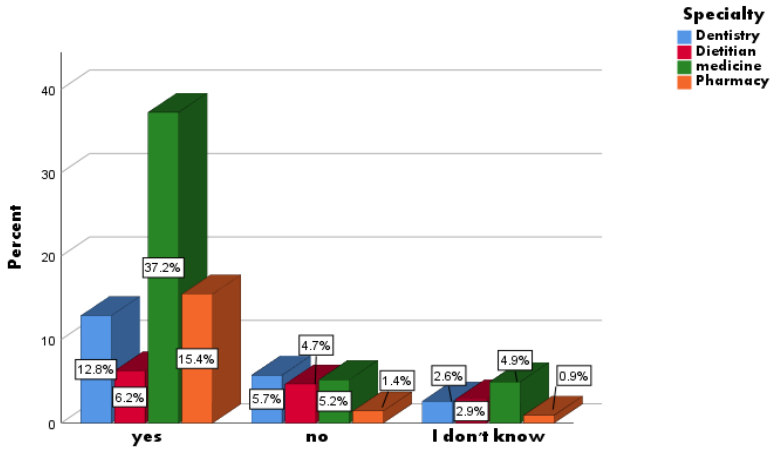

Figure 2. Students' knowledge of food-drug interactions before dispensing medication according to specialty.

As illustrated in Figure shows a noticeable improvement with progress in the years of study. Students in their final year showed the highest level of knowledge, while the level of knowledge was lower in the penultimate year. The results showed that a small percentage of students still admit that they do not know or do not have sufficient information .

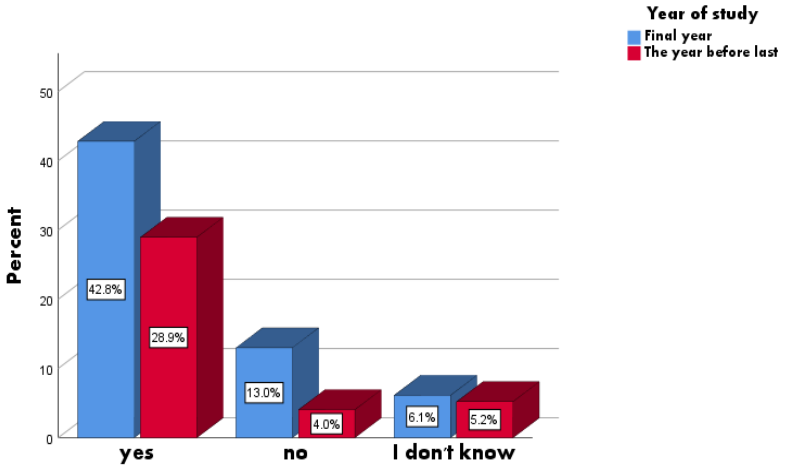

Figure 3. Students' knowledge of food-drug interactions before dispensing medication according to year of the studies.

Sources of information:

The figure represents the distribution of students' sources of knowledge according to their specialties, the results showed that medical students relied the most on personal effort as a source of information (32.9%), followed by dental and nutrition students (12.3% and 11.2% respectively) and finally pharmacy students (5.2%), where they relied the most on the curriculum.

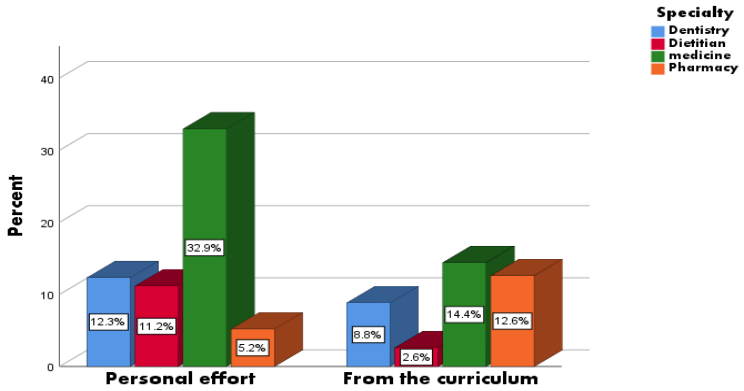

Figure 4. Students' knowledge source of food-drug interactions according to the specialty N (771).

This figure shows the students in the final year are the most likely to rely on personal effort (37.9%), while students in the pre-final year are the least likely (23.7%)

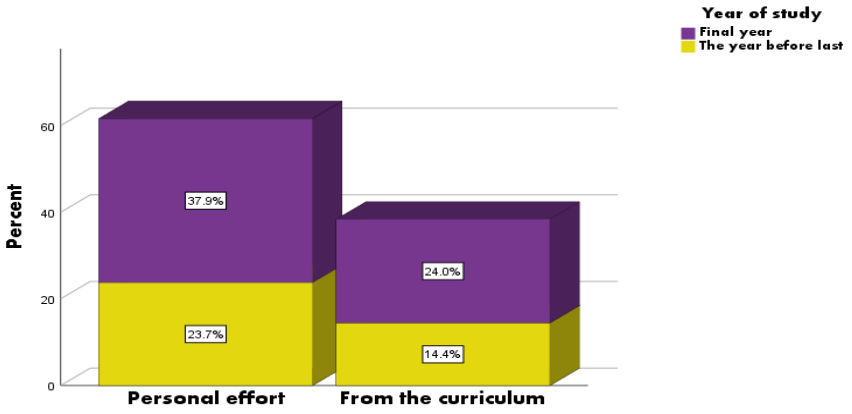

Figure 5. Students' knowledge source of food-drug interactions according to the year of studies N (771).

Students' Self-Evaluation and Objective Knowledge of Food–Drug Interactions:
The results in Table 4 show statistically significant differences between different specialties regarding self-awareness of drug-food interactions, according to the chi-square test.Note: The highest percentage of pharmacy students who agreed with the importance of prescribing medications was 86.3%, followed by medical students (68.7%), and those who did not understand specific nutrition were the highest (14%).Regarding the impact of slow drug action, according to their specialties, the majority of pharmacy students had a clear understanding of the effects of slow drug action, with the response rate remaining "yes" (99.3%).The participants who participated in the study, age, and health, reported the highest percentage of food interactions (97.1%), while nutrition students reported a lower percentage (85.8%-85.9%).Clear results regarding the percentage of these interactions were evident specifically among pharmacy students, with the lowest percentage of lack of knowledge compared to dental students (33.3%).Regarding the importance of taking medication, most students agreed with varying degrees of importance.Given that most participants rejected the belief that medication in a specific container always leads to better outcomes, particularly in the nutrition and pharmacy specialties,
The results showed that pharmacy students recorded the highest acceptance rate regarding their favorite beverage with food or beverages such as coffee, tea, and juices (47.4%), and the lowest percentage if they had experience in dentistry and nutrition (19%-20% on the toilet). The remaining results were summarized regarding students' verification of drug interactions before prescribing medication. Research and medical students were the most likely to check for drug interactions before prescribing (59.1%-57.3%, right), compared to dental students, who recorded the lowest percentage (13.3%), with significant differences. However, regarding students' assessment of community awareness of food interactions with blood pressure-lowering medications, pharmacy students recorded the highest agreement (50.4%), and nutrition students the lowest (21.7%-21.5%). The results showed that students' expectations that prescription (OTC) medications might interact with food were highest (46.7%), with significant differences.

Table 4. Self-evaluation of food drug interaction knowledge depending on the field of study.

Question	specialization	Yes	No	I don't know	Pearson Chi-Square
Should you not prescribe medication to a patient until you know how food affects the medication	Dentistry	92.6%	4.9%	2.5%	.004
	Dietitian	85.8%	5.7%	8.5%	
	Medicine	93.2%	4.1%	2.7%	
	Pharmacy	98.5%	1.5%	0.0%	
Is a nutritionist consultation necessary when prescribing medication, particularly for chronic conditions?	Dentistry	68.7%	27.0%	4.3%	.
	Dietitian	74.5%	11.3%	14.2%	
	Medicine	86.3%	6.8%	6.8%	0.000
	Pharmacy	78.8%	11.7%	9.5%	
Do you think that food can speed up or slow down the action of a drug?	Dentistry	90.8%	3.1%	6.1%	
	Dietitian	84%	2.8%	13.2%	

	Medicine	97%	0.8%	2.2%	0.000
	Pharmacy	99.3%	0%	0.7%	
Do drug dosage, age, and health status affect food-drug interactions?	Dentistry	85.9%	5.5%	8.6%	
	Dietitian	85.8%	2.8%	11.3%	
	Medicine	90.7%	4.4%	4.9%	.008
	Pharmacy	97.1%	0.7%	2.2%	
Can food-drug interactions lead to serious side effects?	Dentistry	63.8%	12.9%	33.3%	0.000
	Dietitian	79.2%	4.7%	16%	
	Medicine	72.3%	15.3%	12.3%	
	Pharmacy	94.9%	5.1%	0.0%	
Do you think it's important to consider the timing of meals when taking certain medications?	Dentistry	88.3%	5.5%	6.1%	0.072
	Dietitian	94.3%	2.8%	2.8%	
	Medicine	90.7%	3%	6.3%	
	Pharmacy	93.4%	5.8%	0.7%	
Do you think it's best to take drugs on an empty stomach for better effects?	Dentistry	10.4%	71.8%	17.8%	0.000
	Dietitian	5.7%	84.9%	9.4%	
	Medicine	17%	80.8%	2.2%	
	Pharmacy	10.9%	89.1%	0%	
Antibiotics may be prescribed with acidic foods and drinks, such as tea, coffee, and citrus juices.	Dentistry	19%	39.3%	41.7%	0.000
	Dietitian	20.8%	47.2%	32.1%	
	Medicine	35.9%	31.5%	32.6%	
	Pharmacy	47.4%	33.6%	19%	
Do you check for drug interactions before prescribing medication?	Dentistry	12.3%	81.6%	6.1%	0.000
	Dietitian	36.8%	48.1%	15.1%	
	Medicine	57.3%	30.1%	12.6%	
	Pharmacy	59.1%	31.4%	9.5%	
Do you think people are aware of the interaction between food and blood pressure-lowering medications?	Dentistry	21.5%	36.8%	41.7%	0.000
	Dietitian	21.7%	56.6%	21.7%	
	Medicine	30.4%	55.9%	13.7%	
	Pharmacy	50.4%	34.3%	15.3%	
Do OTC medications interact with food?	Dentistry	22.7%	46%	31.3%	
	Dietitian	16%	36.8%	47.2%	0.021
	Medicine	42.2%	35.1%	22.7%	
	Pharmacy	46.7%	27.7%	25.5%	

Table 5 summarizes the data measuring medical students' knowledge of common food-drug interactions: Regarding over-the-counter medications, the highest percentage of correct knowledge was recorded in pharmacy (46.7%), while the lowest percentage was recorded in nutrition (16%). The highest percentage of "don't know" responses was recorded in nutrition (47.2%). Furthermore, when asked about the association of certain foods, such as spinach and broccoli, with the effectiveness of anticoagulant medications such as heparin and warfarin, dental students obtained the highest percentage of answers (43.6%). The highest percentage of "don't know" responses was recorded in nutrition and pharmacy (61.3%). Regarding students' awareness of the effect of certain vegetables, such as cabbage, cauliflower, and turnips, on thyroxine, the percentage of knowledge varied across disciplines, ranging from (24.5% to 30.4%.) The highest percentage of "don't know" responses was recorded in the Nutrition and Pharmacy majors (69.8% - 67.2%). Regarding the absorption of esomeprazole when taken with fatty meals, Pharmacy and Nutrition students (24.4% - 22.6%, respectively) reported that fatty meals affect esomeprazole absorption. In contrast, (21.2%) of Dental Medicine students reported that fatty meals do not affect esomeprazole absorption. A high percentage of "don't know" responses was recorded among Nutrition students, reaching (50.9%).

Table 5. Student's knowledge about food drug interaction with some common drugs and food.

Question	specialization	Yes	No	I don't know	Pearson correlation
Do OTC medications interact with food?	Dentistry	22.7%	46%	31.3%	0.000
	Dietitian	16%	36.8%	47.2%	
	Medicine	42.2%	35.1%	22.7%	

	Pharmacy	46.7%	27.7%	25.5%	
Patients on Heparin / Warfarin should avoid foods like Spinach, broccoli, cauliflower, chickpeas, and pork in large quantities	Dentistry	43.6%	11.0%	45.4%	0.100
	Dietitian	32.1%	6.6%	61.3%	
	Medicine	28.8%	19.2%	52.1%	
	Pharmacy	33.6%	5.1%	61.3%	
Patient on L-thyroxine must avoid turnips, cauliflower, and cabbage.	Dentistry	29.4%	16%	54.6%	0.000
	Dietitian	24.5%	5.7%	69.8%	
	Medicine	30.4%	17%	52.6%	
	Pharmacy	29.2%	3.6%	67.2%	
Esomeprazole absorption could be increased with fatty meals	Dentistry	9.8%	71.2%	19%	0.000
	Dietitian	22.6%	26.4%	50.9%	
	Medicine	16.2%	52.3%	31.5%	
	Pharmacy	24.8%	39.4%	35.8%	

The table shows self-Evaluation of medical students' knowledge of the appropriate timing for taking medication with food. According to the results obtained from a field study, students' knowledge varied depending on the type of medication. When asked about common medications such as (amberzole, antihistamines, and thyroid medications), their knowledge was high, ranging from (83.9% and 74.9%, respectively). Pharmacy and medical students obtained the highest percentages, while the percentage of knowledge gradually decreased when asked about medications that require a more accurate understanding of interactions in the question about medications (Glipizide, isoniazid, and antacids). They obtained a total knowledge percentage of (52.2%), with pharmacy students achieving the highest level of knowledge and nutrition students showing a clear weakness in this area (32%), unlike other colleges All students showed a clear weakness when asked about medications (NSAIDs, steroids) with a percentage of (16.4%).

Table 6. Students' knowledge of the time interval between food intake and drug intake, expressed as the number and percentage of correct answers.

Question	Specialty	No. of correct answers	Percent of correct answers (%)	Total of correct answering
When should omeprazole/ranitidine and antihistamines be taken before, within, or after meals?	Dentistry	130	79.7	647 83.9 %
	Dietitian	69	65.0	
	medicine	324	88.7	
	Pharmacy	124	90.5	
When should Glipizide, isoniazid, and antacids be taken before, within, or after meals?	Dentistry	89	54.6	403 52.2 %
	Dietitian	34	32.0	
	medicine	198	54.2	
	Pharmacy	82	59.8	
When should acarbose and valises be taken before, within, or after meals?	Dentistry	52	31.9	278 36.0 %
	Dietitian	43	40.5	
	medicine	140	38.3	
	Pharmacy	43	31.3	
When should NSAIDs, steroids are advised be taken before, within, or after meals?	Dentistry	26	15.9	127 16.4 %
	Dietitian	27	25.4	
	medicine	59	16.1	
	Pharmacy	15	10.9	
When should thyroid hormone are advised be taken before, within, or after meals?	Dentistry	118	72.3	578 74.9 %
	Dietitian	63	59.4	
	medicine	293	80.2	
	Pharmacy	104	75.9	

The table (6) indicates the degree of variation in awareness among students of different specializations regarding interactions between drugs and certain types of food. Students showed high awareness when asked about iron supplements and vitamin supplements related to metformin drugs, with correct answers accounting for (85.8% and 83%) respectively. When asked about tetracycline, dental students showed better knowledge with a percentage of (81.5%) When asked about grapefruit, pharmacy students showed the most knowledge (51.8%), unlike other colleges, where there was a clear general weakness. When asked about foods that increase blood fluidity and antibiotic absorption, nutrition students showed the highest level of knowledge.

Table 7. Students' knowledge of interactions between some drugs and different types of foods, expressed as the number and percentage of correct answers.

Question	Specialty	No. of correct answers	Percent of correct answers (%)	Total of correct answering
Asthma medications should not be a description with	Dentistry	112	68.7	314
	Dietitian	31	29.2	44.2
	medicine	136	37.2	
	Pharmacy	62	45.2	
When a description an ACE Inhibitor (antihypertensive dugs) such as Captopril, avoid extensive amounts of	Dentistry	62	38.0	229
	Dietitian	42	39.6	29.7
	medicine	94	25.7	
	Pharmacy	31	22.6	
Iron supplements have their absorption reduced by	Dentistry	144	88.3	662
	Dietitian	85	80.1	85.8
	medicine	312	85.4	
	Pharmacy	121	88.3	
This fruit interacts with around 45 different medicines and can have lethal side effects	Dentistry	9	5.8	156
	Dietitian	31	29.2	20.2
	medicine	45	12.3	
	Pharmacy	71	51.8	
When using tetracycline, you should avoid:	Dentistry	133	81.5	536
	Dietitian	43	40.5	16.0
	medicine	252	69.0	
	Pharmacy	108	78.8	
Which of these foods increases the absorption of antibiotics	Dentistry	30	18.4	145
	Dietitian	29	27.3	18.8
	medicine	59	16.1	
	Pharmacy	27	19.7	
Which of these foods increases blood fluidity and should be avoided by patients using warfarin and aspirin	Dentistry	25	15.3	162
	Dietitian	36	33.9	21.0
	medicine	65	17.8	
	Pharmacy	36	26.2	
The vitamin most affected by the diabetes medication metformin and should always be monitored in diabetic patients is:	Dentistry	134	82.2	640
	Dietitian	77	72.6	83.0
	medicine	322	88.2	
	Pharmacy	107	78.1	

Correlation Between Students' Knowledge and Academic Characteristics:

The following table shows the relationship between students' knowledge of food-drug interactions ،The main findings were that there is a statistically significant correlation (p=0.001) between the year of study and the extent of students' knowledge of interactions, and showed a very strong correlation (p=0.000) between specialization and students' knowledge of food-drug interactions.

Table 8. The correlation between Students' knowledge of food-drug interactions before dispensing medication according to academic year and specialty.

	Mean square	F	P value*
Year of study	1.772	7.630	.001
Specialty	24.268	25.407	.000

The table presents the correlation coefficients (Pearson's r) between students' Subjective knowledge about food and drug interactions and a number of Demographic and knowledge variables. Highlights of the results Age showed a weak correlation with all other variables, noting that the strongest Correlation was with the academic year (0.190), as for the academic year, it was Very weakly correlated with most variables except for its relative correlation With specialization (0.384), and in contrast, academic specialization showed Significant relationships with knowledge before dispensing medication (0.243), Source of knowledge (0.179) and identification of at-risk groups (0.194), and One of the strongest relationships in the table was between

knowledge and Source of knowledge (0.370), while the relationship between the variables (Assessing at-risk groups and recognizing the level of common overlap) Weakly correlated with most variables.

Table 9. Pearson's r correlation coefficients between objective knowledge about food–drug interactions and the other variables.

	1	2	3	4	5	6
1. Age						
2. Year of studies	0.190					
3. Specialty	0.060	0.384				
4. knowledge of FDIs before dispensing the Drug to the patient	0.010	0.052	0.243			
5. FDI awareness (source of information)	0.136	0.010	0.179	0.370		
6. Which age group of patients do you think are at a greater risk for FDI	0.052	0.045	0.194	0.140	0.014	
7. At what level do the food/ beverages interfere with the drug commonly	0.039	0.026	0.090	0.089	0.022	0.056

Discussion

This chapter aims to discuss and interpret the results obtained to assess the knowledge of students at Benghazi Medical University regarding food-drug interactions, identify the factors influencing this knowledge, and elucidate differences across academic majors and years. A critical component of interpreting these results involves analyzing demographic variables such as age, specialization, geographical location, gender, and health status as these may significantly affect students understanding of such interactions. The study sample included final and pre-final year students from four medical faculties at the Arab Medical University of Benghazi. Analysis of demographic characteristics revealed several noteworthy trends. Regarding gender distribution, the majority of participants were female (75.9%), consistent with a previous study by Tahir Jameel (2019) conducted in Saudi Arabia, which highlighted a higher enrollment of females in medical disciplines compared to males (8). Additionally, most participants were over 23 years old, unmarried, and reported being in good health—findings aligned with a recent study conducted in Poland by Małgorzata Jeli (2024) (9). The Faculty of Medicine accounted for the highest proportion of participants, which reflects its status as the largest faculty within the university. Furthermore, most respondents (92.8%) were from Benghazi, an expected outcome given the location of the study.

In assessing students' knowledge about food-drug interactions before dispensing medications, differences emerged among faculties. Medical students reported the highest level of prior knowledge (37.2%), followed by students in pharmacy and dentistry, while nutrition students demonstrated the lowest awareness (6%), possibly due to insufficient integration of this topic into their curriculum. Regarding academic standing, final-year students exhibited a higher level of knowledge (42.8%) compared to pre-final year students (28.9%), suggesting a positive trend in knowledge acquisition as students advance through their academic training. The results of the questionnaire regarding the importance of understanding food effects prior to prescribing medications revealed that the majority of students across all faculties, particularly pharmacy students, recognized this as essential. A significant (98.5%) of pharmacy students agreed on the importance of knowing the effects of food before prescribing medication, reflecting a strong level of awareness. This outcome is expected given that pharmacy curricula typically emphasize drug properties and their interactions, including food-related effects. Medical students followed closely (93.2%), then dental students (92.6%), while nutrition students showed the lowest agreement (85%). This suggests that curricula in some disciplines, particularly nutrition, may insufficiently address the subject, despite its critical relevance in clinical practice. The observed differences between disciplines were statistically significant and are likely attributable to variations in curricular focus.

Furthermore, when evaluating perceptions regarding the importance of consulting a dietitian—especially in chronic cases—there was high consensus across all faculties. Medical students demonstrated the strongest agreement (86.3%), indicating heightened awareness of the need to integrate dietary considerations with pharmacological treatment. In assessing awareness of food's potential to delay drug action, pharmacy students again exhibited the highest level of understanding, with (99.3%)

acknowledging this effect and none selecting the "no" response. These findings are consistent with previous studies: one conducted in Yemen by Dr. Sadeq Al-Sharagi (2023), which reported a 99.6% awareness rate among pharmacy students (10), and another in Iraq (2025), where the rate was (94%) (11). These data confirm that this topic is comprehensively covered in pharmacy programs. In contrast, nutrition students demonstrated the lowest awareness (84%), with many selecting "don't know." This points to a knowledge gap, diverging from the results of a prior study in Portugal (2024) by Sofia Beirão, where nutrition students unanimously (100%) recognized that food influences drug efficacy (12).

When assessing students' awareness of the impact of dosage, age, and health status on food-drug interactions, pharmacy students demonstrated the highest level of knowledge (91.1%). This aligns with findings from a (2023) study in Yemen by Dr. Sadeq Al-Sharagi, which reported a similar awareness level of (92.9%) among pharmacy students (10). Medical students followed closely (90.7%), with slightly lower rates observed among dental (85.9%) and nutrition students (85.8%). Despite the relatively close percentages, the difference across disciplines was statistically significant ($p = 0.008$), suggesting that curricular structure plays a role in shaping students' knowledge in this area.

In evaluating students' understanding of the risks associated with food-drug interactions, pharmacy students again exhibited the highest level of awareness (94.9%), highlighting their strong grasp of the clinical consequences. In contrast, dental students showed the lowest awareness (63%), reflecting a potential gap in their educational training. This finding is consistent with a (2025) study by Bharghavi Latha (13), which identified a notable deficiency in knowledge among dental students, likely due to the limited emphasis placed on food-drug interactions within dental curricula. The study revealed a generally high level of awareness among students regarding the importance of medication timing, with agreement levels ranging from (88%) to (94%) across faculties. The absence of statistically significant differences ($p = 0.072$) suggests consistent understanding of the relevance of timing in relation to food intake across disciplines. Moreover, the majority of students, particularly in the pharmacy and nutrition faculties (84.0%–89.1%), rejected the misconception that medications are most effective when taken on an empty stomach. This demonstrates a sound cognitive understanding of this issue, likely reflecting effective curricular coverage. These results are consistent with findings from Soa Beirão's study at Lusófona University (12), which reported high awareness among nutrition students, and with the Yemen study by Dr. Sadeq Al-Sharagi (10), where pharmacy students similarly showed resistance to this misconception.

In the context of antibiotic administration with food, nutrition (47.2%) and dental students showed the highest awareness. This diverges from Beirão's study (12), which reported lower awareness (38.6%) among nutrition students, indicating a possible improvement in local curricula and instructional focus. This may reflect the applied nature of these faculties, where students frequently engage with prescription and dietary practices. Conversely, when assessing awareness of food interactions with antihypertensive medications, many students selected "No" or "Don't know," indicating insufficient knowledge in this area. Pharmacy (46.7%) and medical (42.2%) students showed higher awareness levels than other disciplines. These findings align with R. Lavanya's study in India (2022), where pharmacy students exhibited a similar knowledge level (50.8%) (14), though still lower than in Yemen (75.9%) (10), suggesting variability in curricular emphasis.

Knowledge of the interaction between leafy vegetables (e.g., spinach, broccoli) and anticoagulants such as warfarin and heparin was highest among dental students (43.6%), likely due to their clinical focus on oral bleeding. Pharmacy (33.6%) and nutrition (32%) students followed, reflecting similar awareness levels to studies in Saudi Arabia (40%) (15) and Portugal (34%) (12). Medical students showed the lowest awareness (28.6%), in contrast to higher knowledge (40.5%) found in an Iraqi study by Fika Megawati (16), underscoring the need for improved curricular focus.

Regarding knowledge of cruciferous vegetable (e.g., cabbage, kale) interactions with thyroxine, student awareness was low across all faculties (24.5%–30.4%), with high "Don't know" responses, especially among nutrition students (69.8%). This mirrors Beirão's findings in Portugal (18.18%) (12) and suggests the need for integrating this topic into pharmacology and clinical nutrition curricula. Pharmacy students showed (67.2%) "Don't know" responses, also falling short of awareness levels reported in Iraq (55.3%) (11). In relation to esomeprazole absorption and fatty meals, dental and medical students exhibited the most awareness, whereas (50.9%) of nutrition students responded with "Don't know." These results align with Jyoti M. Benni's (2012) study (17), which highlighted a general lack of training on such interactions across medical disciplines. Students demonstrated strong understanding of timing for medications like omeprazole and antihistamines, consistent with Indian findings by Lavanya (14). However, knowledge about NSAID timing was low, particularly among nutrition (15.9%) and pharmacy (10.9%) students, corroborating similarly low levels in Yemen (18%) (10). In contrast, 80.2% of medical students understood gland medication timing, outperforming peers in Iraq (37.9%) (16), indicating stronger curricular coverage locally. Across most topics, pharmacy and medicine students displayed higher levels of knowledge, suggesting a more robust academic foundation compared to nutrition and dentistry

students. Nonetheless, the general level of knowledge varied based on drug type. For instance, awareness of interactions involving iron and metformin was high across all faculties (85.8% and 83.0%, respectively), indicating strong curricular coverage.

Grapefruit-drug interaction awareness was notably low overall (20.2%), with pharmacy students demonstrating the highest knowledge (51.8%), followed by nutrition (29.2%), and dental (5.8%) and medical (12.3%) students showing the least awareness. These figures align with earlier studies in India (63.8%) (18), Iraq (73.3%) (38), and Libya (36.7%) (19), again emphasizing the curricular gap. Knowledge of tetracycline-milk interaction was relatively high (69.5%), with pharmacy students leading (78.8%), consistent with Indian data (80%) (18) but higher than Saudi findings (52%) (15). Medical students showed good awareness (69%) compared to Iraq (48.1%) (16), while nutrition students lagged (40.5%), similar to Libya (41.8%) (19) and Portugal (36.3%) (12).

When asked about foods that increase antibiotic absorption, knowledge was lowest (18.8%), though nutrition students performed best. This contrasts with Iraq (2024) findings, where medical students scored higher, revealing potential curriculum gaps locally. Regarding ACE inhibitors, overall awareness was low (29.7%), with nutrition and dental students scoring highest. This mirrored findings from Iraq (22.7%) (16). In contrast, awareness of anticoagulant interactions remained low, particularly among medical students (17.8%), compared to nutrition students (33%) and studies from Portugal (45.4%) (12) and Iraq (41.7%) (16).

Awareness of interactions between coffee and asthma medications was relatively strong, particularly among pharmacy and dental students, consistent with Indian data (2018) (14). This may reflect better clinical exposure in respiratory cases. Concerning sources of knowledge, pharmacy students relied heavily on curricula, which likely explains their higher performance. This differs from Saudi Arabia (15), where social media was more prominent. In contrast, students from medicine, dentistry, and nutrition relied more on self-directed learning. This differs from a prior Libyan study (19), where most nutrition students relied on curricular content. Academic major and year of study significantly influenced knowledge levels. As students progressed academically, knowledge improved, consistent with Saudi findings (15) and Polish data (9). Pharmacy students consistently demonstrated the highest knowledge levels in both studies. However, correlations between knowledge and demographic variables were generally weak. Although many students claimed prior knowledge, this did not always translate into accurate, practical understanding. This emphasizes the urgent need to integrate scientifically rigorous content on food-drug interactions into core curricula.

Conclusion:

This study offers valuable insights into the level of knowledge and awareness among medical students regarding food-drug interactions (FDIs). The findings revealed significant variability in knowledge across different medical disciplines, with pharmacy students demonstrating the highest level of awareness, followed by students of medicine, nutrition, and dentistry. Academic specialization and year of study were found to have a more substantial impact on FDI knowledge than demographic factors such as age. Notably, students in their final years exhibited greater understanding, particularly pharmacy and medical students who showed higher awareness of pharmacological principles, including the importance of meal timing in drug administration. Despite these strengths, considerable knowledge gaps were identified across all faculties. While nutrition students displayed relatively strong understanding of nutritional aspects of FDIs, dental students exhibited the lowest level of knowledge, highlighting a deficiency in curriculum content and a lack of interdisciplinary integration—particularly between nutrition and dentistry. Additionally, there was a general lack of awareness among all disciplines regarding interactions involving acidic foods or beverages, pointing to a need for enhanced curricular content and practical application. It is also noteworthy that the majority of respondents were female, a distribution likely influenced by higher attendance among female students during the data collection period. This demographic detail should be considered when interpreting the results. The research faced challenges in data collection and sample expansion: some students declined to participate due to exam stress, demanding lectures, or a lack of research interest, low lecture and clinical training attendance among targeted students, lack of access to third-year dental students due to vacation during sample collection, and the small third-year nutrition class resulted in insufficient sample representation.

Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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