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RESEARCH ARTICLE

Evaluation of community pharmacists' knowledge and awareness of food–drug interactions in Palestine

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Abstract

Background Food–drug interactions can produce undesirable outcomes during the therapy process. The pharmacist is responsible for providing patients counseling about common food-drug interactions. Knowledge of such interactions is important to avoid their occurrence. *Objective* This study aimed to assess the knowledge and awareness of community pharmacists about common food-drug interactions. *Setting* Pharmacists working in community pharmacies across Northern Palestine. *Method* This is a cross-sectional study, which involved a convenience sample of 259 pharmacists working in community pharmacies in Palestine. A self-administered questionnaire consisted of 29 questions (mainly yes/no questions) was used to assess pharmacists' knowledge towards the most common and clinically significant interactions between food and medicines. *Main outcome measure* Pharmacists' issues related to the knowledge of food drug interactions were evaluated. *Results* A total of 320 questionnaires were distributed of which 259 were completed providing a response rate 80.9%. One pharmacist from each community pharmacy was asked to complete the questionnaire. The overall knowledge score of food-drug interactions for the pharmacists was 17.9 (61.7%) out of a possible maximum of 29. The pharmacists surveyed in this study have demonstrated good knowledge of some interactions; but poor knowledge of others. *Conclusion* Pharmacists' knowledge about common food–drug interactions is inadequate. These findings support the need for training and educational courses for pharmacists regarding food–drug interactions.

Keywords Community pharmacists · Drug interactions · Food–drug interactions · Knowledge · Palestine

Impacts on practice

- Pharmacists are responsible for providing counseling to patients about clinically significant food–drug interactions and inadequate knowledge may result in adverse medical outcomes
- Efforts should be made to provide training and continuous education for community pharmacists' to raise their awareness about potential food–drug interactions

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Introduction

Food may have positive or negative effects on the drug bioavailability, which may lead to therapeutic failure or drug toxicity. Food–drug interactions (FDIs) are of important concern in the medical practice; they may adversely affect the drug's effectiveness and prolong the patient's hospitalization and be life threatening [1]. The prevalence of potential FDIs in different countries varies in the range from 6 to 70% [2–4]. However, the incidence of clinically relevant FDIs in the population of patients in Palestine has not been assessed so far.

Food can alter drug's bioavailability by introducing changes in the GI physiology such as; gastric emptying, gastric pH, GI motility, the activity of the metabolizing enzymes and the transport proteins such as P-glycoprotein. Furthermore, food components may bind or chelate to the active pharmaceutical ingredient [5].

Several studies have reported the evidence of interactions between certain types of food and medications.

Grapefruit juice has many drug interactions and is known for its ability to inhibit the cytochrome P450 3A4 enzyme, thereby reducing the metabolism and increasing the bioavailability of drugs metabolized by this pathway [6]. Ingestion of large quantities of vitamin K rich vegetables (broccoli, parsley, spinach) may interfere with the effectiveness and safety of warfarin therapy [7]. Dietary fiber, such as wheat bran may reduce the absorption of digoxin [8]. Consumption of large amounts of tea and coffee while taking theophylline could increase the risk of drug toxicity [9]. Milk and other dairy products intake may reduce the bioavailability of tetracycline due to the formation of insoluble chelates [10].

Timing of the medications intake with respect to food does affect the therapeutic effectiveness of drugs especially those with low bioavailability, which results in a profound effect on their GI absorption. A previous study suggested that taking clodronate with food could reduce the absorption of this drug to up 10% of the optimal compared to taking it 2 h before meal [11]. It is recommended to take some medications, such as NSAIDs, with food in attempt to reduce possible GI irritation such as dyspepsia and nausea. Therefore, the knowledge of the appropriate timing of drug consumption in relation to food could help in avoiding possible adverse effects and interactions.

Knowledge of these interactions can help in the prevention of food–drug interactions. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has established standards that require medical professionals to be aware of food–drug interactions and to provide appropriate counseling about them [12]. Pharmacists are responsible for providing adequate counseling for patients about types of food that should be avoided when taking their medications. Therefore, pharmacists' knowledge of food–drug interactions is essential and may have a great impact on the effectiveness of drug therapy.

The abilities of community pharmacists to accurately identify potential food–drug interactions are limited. Some previous reports have attempted to assess health care professionals' knowledge about common food drug interactions. The first study involved 200 doctors [Professors, Post Graduates (PGs) and Interns]. The mean knowledge scores were reported to be 26, 22.89, 21.35 for professors, PGs and interns respectively, out of 31 as the maximum score [13]. The second report included a sample of 278 nurses divided into five groups with different levels of experience: (0–4, 5–9, 10–14, 15–19 and ≥ 20 years). The questionnaire consisted of 35 questions to test participants' knowledge of the common FDIs. The results showed a low level of knowledge of FDI among nurses with a significant difference depending on their levels of working experience. The mean knowledge score percentages were as follows: 0–4 (60.9%), 5–9 (65.8%), 10–14 (60.8%), 15–19 (67.5%) and ≥ 20 years (60.7%) [14].

Ingestion of large amounts of vitamin K rich vegetables (broccoli, parsley, spinach) may interfere with the safety and efficacy of warfarin therapy [7]. The knowledge of warfarin interaction with vitamin K involving food among pharmacists, physicians, dietitians and nurses was assessed. The mean scores on the overall test were 72.5 for pharmacists, 62.5 for physicians, 56.9 for dietitians and 50.2 for nurses, with 100 being the best score. Pharmacists had higher knowledge toward drug interactions compared to other health care professionals [15]. Lasswell et al. [16] have examined the knowledge about drug–nutrient interaction in a sample of 834 family medicine residents. The physicians' knowledge score was 61% for fourteen drug–nutrient interaction items. Moreover, a slight increase in physicians' knowledge was shown as years of residency increased [16]. The knowledge of community pharmacists about alendronate interactions with food was assessed. The mean score was 10.5 with 14 being a perfect score [17].

Aim of the study

The main objective of this study was to evaluate the extent of knowledge and awareness that the community pharmacists in Palestine have towards the most common food–drug interactions.

Ethics approval

The protocol of this study was approved by the Institutional Review Board (IRB) committee at An-Najah National University. A verbal consent was obtained from the community pharmacists who participated in the study.

Method

Study design

This study is a cross sectional study that was conducted, using an anonymous validated self-administered questionnaire with the focus on the most common food–drug interactions. The questionnaires were filled in the presence of the researcher, which results in less chance for bias during the answering of the questions. The survey included a convenience sample of 259 pharmacists working in community pharmacies in the Northern area of Palestine, which consists of five governorates: Nablus, Qalqiliah, Jenin, Tubas and Tulkarem. The pharmacies were recruited from different districts of Palestine in order to ensure the representation of the sample. The study was carried out during the time period between December 2016 and March 2017.

Sample size

The sample size required for this study was estimated using a sample size calculator (www.raosoft.com). The total number of community pharmacies in the northern area of Palestine is approximately 430. Using a confidence interval of 95% and a margin of error of 5%, a sample size of about 204 pharmacies was required for this study. The target sample size was increased to 259 in order to minimize erroneous results and increase the study reliability, therefore, 60.2% of the total community pharmacies in the northern area of Palestine were included.

The tools of the study

The questionnaire, which consisted of 29 questions, was designed based on a previous survey instrument used in the published paper of Benni et al. [13] with some modifications. The used FDIs in this assessment were selected based on their prevalence and clinical significance. The medications included were the commonly prescribed drugs in the Palestinian market. The questionnaire was validated (face validity and content validity) by three lecturers from Pharmacy Department at An-Najah National University. It consisted of five sections.

The first section included questions concerning the socio demographic data of the pharmacists, such as: age, gender, workplace, education level, graduation place and years of experience.

The second section was designed to measure the extent of knowledge and awareness of pharmacists about drug interactions with foods, as well as to examine the sources of information used to obtain the knowledge about these interactions. In this part, there were (11) dichotomous questions (yes/no) asking about the possibility of co-administration of some medications with certain types of beverages or food. E.g.: May milk and other dairy products be taken with tetracycline? Does caffeine increase the symptoms of Diazepam poisoning? The third section included seven questions to test knowledge of the timing of some medications with respect to meals. The fourth section included 6 questions regarding food interactions with specific classes of medications (antihypertensive and antiretroviral drugs), while the fifth section consisted of 6 questions to test the knowledge of the interactions of some drugs with alcohol. One point was given to each question answered correctly while incorrect answers were given zero points. The summation of the points was labeled as food–drug interaction knowledge score for each participant. The overall test score was calculated by summation of all sections scores. The overall maximum score for the knowledge questions was 29.

Statistical analysis

The Statistical package for social sciences program version (16) (SPSS) was used for data analysis. Continuous variables were expressed as mean ± SD, while categorical variable were expressed as frequency. Mann–Whitney *U* and Kruskal Wallis tests were used to assess the significance among the study variables. These non-parametric tests were applied due to non-normal distribution of data. Statistical analysis was conducted to determine the association between the knowledge of FDIs and pharmacist's socio-demographic characteristics with a priori level of less than 0.05 ($P < 0.05$) set as significant.

Results

Socio-demographic of the pharmacists

The total number of surveys distributed was 320, of which 259 were returned (response rate 80.9%). One pharmacist from each community pharmacy was asked to complete the questionnaire. The age category of the pharmacists (23–29 years) was the highest in frequency 46.7% (n = 121). The majority of participants 88.8% (n = 230) indicated that a Bachelor's degree of pharmacy was the highest degree completed. About 62.9% (n = 163) of the pharmacists were working in pharmacies located in urban areas. The summary of socio-demographic characteristics of the pharmacists in this study is shown in Table 1.

Knowledge of the pharmacists about drug interactions with foods

In this section, the knowledge of the pharmacists about most common drug interactions with foods was assessed. The results demonstrated that 74.9% (n = 194) of participants believed that they have sufficient knowledge about common food–drug interactions, while 20.5% (n = 53) were unsure, and 4.6% (n = 12) responded negatively. The main sources of their knowledge were shown to be from their university studies (83%, n = 215), followed by the practice experience (58.7%, n = 152), drug leaflets (29.3%, n = 76), media (23.2% = 60), whereas, drug sales representatives as a source of information represented only 12.4% (n = 32). Elderly people were identified by 63.7% (n = 165) of the pharmacists as the most susceptible age group for FDIs. The knowledge of participants was assessed based on their responses to 29 questions related to food drug interactions. The mean

Table 1 The socio-demographic characteristics of the pharmacists

Variable	Subcategory	Frequency	Percent
Gender	Male	141	54.4
	Female	118	45.6
Age (year)	23–29	121	46.7
	30–39	70	27.0
	40–49	46	17.8
	50	22	8.5
Education level	Bachelor of pharmacy	230	88.8
	Doctor of pharmacy	22	8.5
	Post graduate	7	2.7
Experience year	Less than 5 years	92	35.5
	6–10 years	51	19.7
	More than 11 years	116	44.8
Graduation year	1970–1979	24	9.3
	1980–1989	47	18.1
	1990–1999	5	1.9
	2000–2009	97	37.5
	2010–2017	86	33.2
Work locality	City	163	62.9
	Village	88	34.0
	Camp	8	3.1
District	Nablus	98	37.8
	Tulkarem	51	19.7
	Jenin	65	25.1
	Tubas	13	5.0
	Qalqiliah	32	12.4
Employment status	Pharmacy owner	119	45.9
	An employee of pharmacy	140	54.1
Graduation university	Palestine	160	61.8
	Non Palestinian	99	38.2

scores on the individual sections and overall test score are presented in Table 2. The overall score of the study sample was 17.9 out of 29 as a maximum score, which is equivalent to 61.7% of the total score. The pharmacists surveyed in this study have demonstrated high knowledge scores of some interactions; but low knowledge scores in others. Table 3 shows the knowledge for each question represented as the frequency of the correct answers in each of the groups.

The majority of the participants (94.2%) were aware of the interaction of tetracycline antibiotics with dairy product. Over 74% (n = 192) of the pharmacists correctly identified the interactions of theophylline with tea and coffee as well as, the interaction of warfarin with vitamin K rich food, such as broccoli and spinach.

On the other hand, the knowledge score of the pharmacists was 71.8% regarding the interaction of MAO inhibitors with cheese, and fermented products. Furthermore, little less than one third (31.3%) were able to identify the interaction of ketoconazole with fatty food. Similarly, only 21.6% of the pharmacists answered correctly about the interaction of caffeine and diazepam. About half of the participants answered correctly about the interaction of digoxin with fiber containing foods (e.g.: wheat bran and oats) and the interaction of thyroid medications with foods such as cauliflower, and cabbage.

Timing of drug intake with respect to food

In this study, pharmacists' knowledge about the timing of some drugs with regards to food intake was evaluated (Table 4). The results indicated that all the pharmacists were able to correctly identify the intake time of omeprazole and metformin with respect to meals. However, there was lack of knowledge about the timing for other drugs such as levothyroxine, NSAID, griseolfulvin and glipizide.

Food interaction with antihypertensive and antiretroviral medications

In this section, the knowledge of pharmacists about food interactions with specific classes of medications such as, anti-hypertensive and antiretroviral medications was assessed (Table 5). About 86.5% of pharmacists answered that hypertensive patients require a low salt diet. However, only 36.3% answered correctly that Angiotensin converting enzyme (ACE) inhibitors must be taken on an empty stomach.

Table 2 Pharmacists' total score on the knowledge and awareness about drug interactions with foods

	Mean score	Maximum score	%
Pharmacists' knowledge of drug interactions with foods	6.6	11	60
Timing of food intake and drugs	3.8	6	63.3
Food and antihypertensive drugs and antiretroviral drugs	2.8	6	46.7
Drugs and alcohol	4.6	6	76.7
Total knowledge	17.9	29	61.7

Table 3 The knowledge on food–drug interactions among pharmacists expressed as percentage of correct answers for each question

Question	Frequency of correct answers N (%)
Theophylline with excessive coffee and tea	192 (74.13)
Tetracyclin with milk and dairy products	244 (94.21)
MAOI with cheese and fermented food	186 (71.81)
Diazepam with caffeine	56 (21.62)
Antibiotics with grapefruit juice	143 (55.21)
Ketoconazole with fatty food	81 (31.27)
Digoxin with wheat bran	148 (57.14)
Levodopa with protein-rich food	164 (63.32)
Coumadin with green vegetables	192 (74.13)
Levothyroxine with cauliflower	136 (52.51)

Table 4 Pharmacists' knowledge on timing of drug intake with respect to food

Drug	Correct answers frequency (N), %
Griseofulvin	100 (38.6)
Levothyroxine	116 (44.8)
NSAID	117 (45.2)
Glipizide	126 (48.6)
Omeprazole	259 (100.0)
Metformin	259 (100.0)

Table 5 Pharmacists' knowledge on food with anti-hypertensive and retroviral medications

	Correct answers frequency (%)	
Anti-hypertensive medications		
ACE Inhibitors must be taken on an empty stomach	94	36.3
Spironolactone must be avoided with potassium rich foods	158	61.0
Hypertensive patients require a low salt diet	224	86.5
Anti-Retroviral medications		
Lopinavir/Ritonavir must be taken with food	81	31.3
Didanosine and Indinavir must be taken on an empty stomach	92	35.5
Zidovudine can be taken without relation to food intake	108	41.7

Regarding Food interactions with antiretroviral drugs: 35.5% of the participants were able to identify the correct way of taking Lopinavir/Ritonavir (with food) and Didanosine and Indinavir (empty stomach).

Drugs and alcohol

The results for the knowledge of pharmacists about some drugs with alcohol interactions were as follows: Warfarin received the highest correct answer (91.9%) followed by methotrexate (83.4%), isoniazid (76.8%), paracetamol (68.3%), antihistamine (75.7%) and the last in rank, metformin received the lowest with 65.6% of correct answers.

Relationship between the socio-demographic characteristics of the pharmacists and their knowledge scores

The association between the socio-demographic characteristics of the participants and their knowledge score of FDIs is shown in Table 6.

Factors such as: age, work experience years, graduation year and employment status had a significant effect (P value <0.05) on the extent of knowledge and awareness of pharmacists about FDIs.

Discussion

The purpose of this study was to evaluate the knowledge of community pharmacists about the potential food–drug interactions. In the current study, the most common FDIs were included as items in the knowledge section of the collection data tool and the pharmacists were asked to identify them. The majority of the pharmacists believed that they have sufficient information regarding this subject. Unfortunately, they did not appear to have the appropriate knowledge to recognize a number of these interactions. University education was identified as the main source of information about drug interactions with food, followed by the practice experience. Other sources of information such as, drug leaflets, media and drug sales representative were less reliable sources.

In this study, pharmacists' knowledge was shown to be inadequate. The overall score of the study sample was 17.9 out of 29 as a maximum score, which is equivalent to 61.7% of the total score. These findings are in agreement with previous reports on the knowledge of health care professionals regarding food drug interactions [14–17].

The pharmacists included in this study have demonstrated adequate knowledge of some interactions; but inadequate knowledge in others. Of all the listed food drug interactions, only one was recognized correctly by > 94% of the respondents, that is; tetracycline's interaction with milk and dairy foods. The respondents had better knowledge about antibiotics food interactions, since they are commonly prescribed medications. Therefore, pharmacists have more opportunities to come across the FDIs in this class of drugs.

Table 6 The association between the socio-demographic characteristics of the pharmacists and their knowledge scores

Variable	Level	Median (Q1–Q3)	Mean ± SD maximum score (29)	*P* value
Gender	Male	18.0 (15.0–21.0)	18.0 ± 3.8	0.618
	Female	18.0 (15.0–20.0)	17.7 ± 3.3	
Age	23–29 years	17.0 (15.0–19.0)	17.2 ± 3.3	0.048
	30–39 years	19.0 (15.0–21.0)	18.3 ± 3.6	
	40–50 years	18.0 (16.0–22.0)	18.6 ± 4.0	
	50 years++	18.0 (15.75–21.0)	18.2 ± 4.1	
Location	City	18.0 (15.0–20.0)	17.8 ± 3.8	0.376
	Village	18.0 (16.0–20.0)	17.9 ± 3.3	
	Camp (refugee)	17.0 (13.75–21.0)	17.8 ± 4.5	
Education level	Bsc. of pharmacy	18.0 (15.7–20.25)	17.9 ± 3.6	0.212
	Doctor of pharmacy	18.0 (14.0–20.0)	17.5 ± 3.1	
	Post graduate	16.0 (13.0–21.0)	16.4 ± 4.6	
Employment status	Pharmacy owner	18.0 (16.0–21.0)	18.3 ± 3.9	0.047
	Employee of pharmacy	18.0 (15.0–20.0)	17.5 ± 3.3	
Expert years	less than 5 years	18.0 (15.0–20.0)	17.3 ± 3.2	0.032
	6–10 years	19.0 (16.0–21.0)	18.4 ± 3.6	
	more than 10 years	18.0 (15.25–21.0)	18.1 ± 3.9	
Graduation year	1970–1979	16.0 (15.0–21.0)	18.0 ± 4.4	0.043
	1980–1989	18.0 (16.0–22.0)	18.2 ± 4.2	
	1990–1999	19.0 (14.0–21.0)	17.8 ± 4.6	
	2000–2009	18.0 (16.0–21.0)	18.3 ± 3.4	
	2010–2017	17.0 (15.0–19.0)	17.0 ± 3.1	
District	Nablus	18.0 (15.7–21.0)	18.1 ± 3.7	0.770
	Tulkarem	18.0 (15.0–20.0)	17.5 ± 3.5	
	Jenin	18.0 (15.5–21.0)	18.0 ± 3.5	
	Tubas	18.0 (16.0–19.0)	17.5 ± 2.0	
	Qalqiliah	17.0 (14.25–19.0)	17.5 ± 4.2	
University	Palestine	18.0 (15.0–20.0)	17.6 ± 3.4	0.160
	Non Palestinian	18.0 (16.0–21.0)	18.3 ± 3.9	

The majority of respondents were not aware of the interactions involving diazepam and caffeine containing beverages. Caffeine intake with diazepam results in a 22% reduction in plasma diazepam levels [18]. Similarly, lack of knowledge about the interaction of fatty foods with ketoconazole was shown. Ketoconazole has low oral bioavailability due to its poor solubility. Co-administration of this drug with fatty meals was shown to increase its absorption as a result of the enhanced solubility by fatty meals. However, the intake of carbohydrate rich meal had significantly reduced the bioavailability of ketoconazole [19]. The participants scored low in knowledge about the interaction of digoxin with fibers containing foods such as wheat bran. Co-administration of digoxin with fiber rich meals can decrease the absorption of digoxin by 16–32%, which may lead to therapeutic failure [8]. The participants provided incorrect answers pertaining FDIs related to drugs that have mostly been replaced by safer/more effective drugs e.g. ketoconazole, MAOIs, griseofulvin and digoxin. This could be attributed to infamiliarity of pharmacists about potential FDIs of these medications due to the lower rate of prescribing these agents.

Similarly, 63.3% answered correctly the knowledge question about the interaction of levodopa with protein rich meals. The bioavailability of levodopa was shown to decrease with co-administration of dietary amino acids due to competition for the transporters in the small intestine and the blood–brain barrier [20]. About 71.8% of the respondents were aware of the interaction of monoamine oxidase inhibitors (MAOIs), used in the treatment of depressive disorders, with tyramine-containing food (cheese and fermented products), which may produce hypertensive crisis in these patients [21].

Timing of meal administration with respect to drug intake is an important parameter controlling food–drug interactions. The knowledge score of pharmacists about FDIs regarding the time interval between drug and food intake was 3.7 from 6. All pharmacists were aware of the correct intake time of commonly prescribed drugs e.g. omeprazole and metformin with respect to food. Omeprazole is a proton pump inhibitor that should be taken 30 min before food for maximal activity [22]. Lack of knowledge about timing for drugs such as, griseofulvin, levothyroxine, NSAID, and glipizide was shown. NSAIDs are recommended to be administered with meal to prevent stomach upset [23]. Glipizide should be taken 30 min before meals and Griseofulvin with meal.

Pharmacists have adequate knowledge regarding the interactions of antihypertensive agents and food. Angiotensin-converting enzyme (ACE) inhibitors must be taken on empty stomach. Propranolol serum levels may be increased if taken with protein rich food. The absorption of ACE inhibitors is increased when taken in fasted state. Excessive potassium intake should be avoided in patients taking ACE inhibitors or potassium-sparing diuretic (e.g. spironolactone), since these agents already elevate potassium levels in the body. Patients placed on anti-hypertensive drugs will benefit from low sodium restricted diets [24, 25].

It is evident that there is lack of knowledge about antiretroviral drug's interactions with food. Lopinavir/Ritonavir must be taken with food while Didanosine and Indinavir should be taken on an empty stomach [26–28].

Regarding alcohol interactions with drugs, alcohol should not be taken with many drugs such as, warfarin, sulfonylureas, isoniazid, acetaminophen and antihistamines. Pharmacists did perform well regarding the knowledge about alcohol interaction with warfarin. 68.3% of participants identified correctly that acetaminophen should not be taken with alcohol. High doses of acetaminophen with alcohol intake may increase the risk of hepatotoxicity. Ingestion of alcohol with drugs such as, sulfonylureas, or isoniazid can produce disulfiram reaction (facial flushing, vomiting, tachycardia). Antihistamines intake with alcohol may intensify its sedative effect which can lead to accidents, falls, and injury and increase the risk of somnolence, ataxia and respiratory depression [29].

Knowledge of food drug interactions was not associated with gender, university degree, locality, and graduation place of the pharmacists. However, there was a significant effect for the experience level, employment status and age on the knowledge level. The higher the working experience and the older the pharmacist's age resulted in a higher knowledge levels. Older pharmacists might have more concern about FDIs than younger ones. Pharmacists with longer years of working experience may have encountered more FDIs compared to the others with less experience and able to identify the potential FDIs. These findings are in agreement with the study by Benni et al. [13] who revealed that the working experience level is strongly correlated to the medical professional's knowledge of FDIs. Similarly, in the study by Enwerem et al. [15] there was a significant difference in the knowledge of FDIs among five groups of nurses depending on their levels of working experience.

Pharmacists' knowledge and awareness regarding common FDIs was not adequate. Continuing education and training for medical professionals about potential FDIs can help in reducing their incidence. The rate of drug–food interactions significantly decreased in a teaching hospital in Iran after a training course given by clinical pharmacists for nurses. The total incorrect drug administration decreased from 44.6 to 31.5% [30].

The pharmacist is responsible for counseling patients about the types of food to avoid when taking certain medications. Inadequate knowledge of FDIs may lead to inappropriate patient counseling and result in adverse medical outcomes. Integration of knowledge about clinically significant FDIs among pharmacists is essential for the effectiveness of the therapeutic process. Therefore, efforts should be made to improve community pharmacists' knowledge about potential FDIs and to identify the reasons behind the knowledge gaps as well as to implement strategies for overcoming them. In order to achieve these goals, continuing education programmes on common FDIs should be provided to the pharmacists. Moreover, community pharmacies should have access to evidence-based references on most common food–drug interactions.

The limitations of the study

The validity of the survey instrument as a research tool is questionable, since it was based on Benni et al. questionnaire [13], which seems to be not validated and was constructed by the authors. Because of time constraints in some community pharmacies, participants were allowed to complete the questionnaire and return it later. In such cases, a few of questionnaires were not completed in the presence of the researcher and the respondents may have looked up the answers to increase their knowledge scores.

Despite these limitations, the present work lays a foundation for selecting the appropriate measures to improve pharmacists' knowledge on FDIs. Further research to evaluate the knowledge gaps among other healthcare professionals on FDIs is required. Future plans may involve evaluation of the effect of an educational intervention on the knowledge base of community pharmacists.

Conclusion

In conclusion, the community pharmacists' knowledge towards food–drug interactions was inadequate. Lack of knowledge of nutrient drug interactions may lead to inappropriate patient counseling and the occurrence of adverse effects. There is a need to improve the knowledge and to raise the level of awareness of community pharmacists about the potential food drug interactions that are clinically relevant. Therefore, pharmacists still need more education and training campaign about food–drug interactions in order to be more qualified to provide better pharmaceutical care and improve their patient's therapeutic outcome. This requires regulatory bodies to include FDIs themes for pharmacy students as part of the undergraduate curriculum and more structured training schedule for practicing pharmacists.

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Conflicts of interest The authors declare no conflict of interest.

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