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Assessment of Drug-Food Interactions Knowledge among Pharmacy Students at AL-Muthanna University in Iraq

Safa Azhar Razzaq
Dept. of Pharmacology and Toxicology/ College of Pharmacy-University of Al-Muthanna-Iraq
Safa_ Azhar@mu.edu.iq

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Annotation: Drug-food interactions (DFIs) are a critical yet often underrecognized factor in medication safety and therapeutic efficacy. Despite their significance, pharmacy students' knowledge regarding DFIs remains insufficiently explored, particularly in Iraq. This study aimed to assess the awareness and understanding of DFIs among undergraduate pharmacy students at Al-Muthanna University through a descriptive cross-sectional online survey conducted in August 2024. The questionnaire covered demographic data and evaluated knowledge across multiple DFI scenarios. Results from 94 participants revealed that while the majority demonstrated good awareness of common interactions—such as those involving tetracycline and dairy, or grapefruit and CYP3A4 substrates—knowledge gaps were evident in areas like warfarin and dietary vitamin K, or digoxin and fiber. These findings emphasize the necessity of integrating structured DFI education into the pharmacy curriculum to enhance future pharmacists' competency in reducing food-related medication errors and improving patient counseling.

Keywords: drug-food interaction, pharmacy education, pharmacology, bioavailability, medication safety, Al-Muthanna University, Iraq.

Introduction

Drugs used generally to either treat or prevent any disease condition so drugs used correctly to ensure safe and effective use. Once drugs dispensed by a pharmacist as OTC, herbal and dietary supplements usually the first issue related to drug use is that whether to take it with food or on empty stomach. Drug interaction is a condition in which any substance changes the effectiveness of drugs by either increasing or decreasing it. Drug- drug interaction is the most common one but also interaction occurred between drugs and foods as well as drugs and herbs (1).

Drug-food interactions are considered one of the most critical issues in the healthcare system defined as any food components or beverages that cause changes in the pharmacokinetics or dynamics of drugs, resulting in loss of their therapeutic benefits or increase their toxicity (2). Drug- food interactions occurred either due to accidental misuse or due to lack of information about the active constituents, which alter the bioavailability of drug (3). Drug-food interactions represent a widely unrecognized cause of medication errors that predispose patients to treatment failure due to decreased bioavailability or predispose them to drug toxicity due to increased bioavailability (4-6)

The content of certain foods interact with some drugs causing alteration in PKs and PDs of drugs. The complexity of the gastrointestinal tract represents a favorable site for DFIs and alters the bioavailability of drugs. Several factors affect absorption including alteration in gastric PH, alteration in gastrointestinal motility, chelation and presence of transport proteins such as P-glycoprotein (7).

PKs interaction occur when foods changing absorption, distribution, metabolism and excretion of drugs. Examples of PKs interaction include chelation of tetracycline in the presence of calcium in dairy products (changing absorption) (8). Several studies confirm drug interactions with grapefruit juice that occur through inhibition of CYP3A enzymes (changing metabolism) due to presence of furanocoumarins resulting in increased the bioavailability of CYP3A enzymes substrates like cyclosporine and midazolam (9). Naringenin and kaempferol are flavonoids present in grapefruit juice and considered as esterase inhibitors that mediate interaction with CCB and statins (10).

PDs drug-food interactions may predispose patients to life-threatening side effects for example when tyramine containing foods such as cheese and fermented food taken with MAOIs resulting in hypertensive crisis and MI because tyramine avoids degradation and accumulates in the circulation where it took by adrenergic neurons (11, 12). Another example vitamin K containing foods decrease therapeutic effectiveness of warfarin (13).

As thought previously, food in general decreases drugs absorption so drugs should give on empty stomach such as levothyroxine. However, recently some drugs showed increased bioavailability when given with food such as griseofulvin when given with high fat meal (14). In some cases, some drugs recommended to administer them with food to slow down its absorption such as carvedilol to decrease the incidence of hypotension (15). Ferrous sulfate and NSAIDS recommended to take with food to decrease GI irritation (16).

The most widely encountered population subjected to drug interactions is elderly patients due to several factors such as polypharmacy, prolonged treatment period and changes in kidney and liver functions (17). The incidence of FDIs according to previous studies range from 3% to 30% (18).

To our knowledge, no such study performed among pharmacy students to examine their awareness and knowledge about drug and food interactions so this study conducted to examine the awareness and knowledge of pharmacy students at AL-Muthanna University in Iraq.

Materials and Method

Design

A descriptive cross-sectional survey was conducted during August 2024 using an online-administered questionnaire. This study circulated using a social media among undergraduate pharmacy students at AL-Muthanna University in Iraq. This questionnaire carried out using online Google forms. Students of both genders aged ≥ 18 years who expressed willingness to complete the survey were included. The online Raosoft sample size calculator used to estimate the sample size of study that estimated at 95% CI with 50% response distribution and margin of error of 5%. Students informed that collected data used for research purposes. Various articles on assessment of students' knowledge on drug- food interactions taken into consideration for designing the present questionnaire (19-24).

The questionnaire consisted of two sections; the first section included questions concerning the socio demographic data of the students, such as: age, gender, year of study and general information about drug- food interactions. The second section consisted of 10 questions assessing the knowledge of pharmacy students about DFIs. The data analyzed and the results expressed in percentages.

Results

Total of (94) students enrolled in the study. 98.9% of students were in age group (18-25 years). Students, who participated, depending on gender, were 25% (23) male and 75% (69) female. About 46.7% (n=43) of students were from fourth stage and 53.3% (n= 49) were from fifth stage. According to study finding, 77.2 % of students knowing about DFIs, 94.6% of students knowing that food affecting the efficacy of drugs. Table 1 contains the demographics and general information about drug- food interactions.

Table 1. Demographics and general information about drug- food interactions.

Demographics and general information	Frequency (n)	Percentage (%)
Age		
18-25	93	98.9%
26-30	1	1.1%
Gender		
Male	25	26.6%
Female	69	73.4%
Stage		
Fourth	44	46.8%
Fifth	50	53.2%
Do you have knowledge about Drug-Food interactions?		
Yes	73	77.7%
No	5	5.3%
I do not know	16	17%
Food can decrease or increase the action of a drug, do you agree?		
Yes	89	94.7%
No	2	2.1%
I do not know	3	3.2%
I know the mechanism of how foods can interact		

with drugs		
Yes	66	70.2%
No	10	10.6%
I do not know	18	19.1%
I know food groups that commonly interfere with drugs.		
Yes	72	76.6%
No	14	14.9%
I do not know	8	8.5%
I would like to get more information regarding food and drug interactions.		
Yes	87	92.6%
No	2	2.1%
I do not know	5	5.3%
I know how to use online resources to get information about food and drug interactions.		
Yes	72	76.6%
No	12	12.8%
I do not know	10	10.6%
I can make recommendations to a patient on how to avoid a food and drug interaction.		
Yes	73	77.7%
No	9	9.6%
I do not know	12	12.8%

Table 2 describes the students' knowledge of FDIs. Regarding the pharmacy students' knowledge about FDIs, 76.6 % (n= 72) of students were aware that caffeine affect the efficacy of diazepam, while 59.6% (n= 56), knowing that long period consumption of garlic should be avoided when the patients taking coumarins. About three quarters of students knowing that grapefruit interact with many drugs causing serious and life threatening side effects.

Most students knowing that elderly age group is more susceptible to DFIs. Nearly 64.9% (n=61) of students knowing potassium rich foods should be avoided in patients taking spironolactone and about half of students being aware that digoxin absorption decreased with fiber rich diet. In addition, a large percent (55.3%) of students were aware that cauliflower consumption decreases levothyroxine efficacy. About half of students 45.7% (n=43) knowing that leafy green vegetables decrease the efficacy of warfarin. Nearly all students 90.4% (n=85) being aware that milk decreased tetracycline absorption. In addition, 47.9% (n=45) of students knowing that protein rich diet decreased levodopa efficacy.

Table 2 describes the students' knowledge of FDIs

Drug-Food interactions	Frequency (n)	Percentage (%)
Caffeine consumption affect the efficacy of diazepam.		
Yes	72	76.6%
No	4	4.3%

I do not know	18	19.1%
Long period consumption of garlic should be avoided along with coumarins.		
Yes	56	59.9%
No	9	9.6%
I do not know	29	30.8%
Fruit interacts with about 40 drugs and cause serious side effects.		
Mango	12	12.8%
Banana	13	13.8%
Grapefruit	69	73.4%
Patients at a greater risk for FDI		
Children	32	34%
Adults	15	16%
Elderly	47	50%
Patients should avoid taking spironolactone with food rich in		
Magnesium	8	8.5
Sodium	25	26.6
Potassium	61	64.9
The efficacy of digoxin when taken with wheat bran diet will be		
Increased	51	54.3%
Decreased	26	27.7%
Not affected	17	18.1%
The efficacy of levothyroxine when taken with cauliflower will be		
Increased	23	24.5%
Decreased	52	55.3%
Not affected	19	20.2%
If the patients eating more leafy green vegetables so the efficacy of warfarin will be		
Increased	36	38.3%
Decreased	43	45.7%
Not affected	15	16%
The efficacy of tetracycline will be decreased if concomitantly taken with:		
Milk	85	90.4%
Tea	5	5.3%
Soft drinks	4	4.3%
The efficacy of levodopa will be decreased if taken with:		
Fat-rich foods	30	31.9%
Carbohydrate-rich foods	19	20.2%
Protein-rich foods	45	47.9%

Discussion

Avoidance of DFIs is of great importance to ensure effective drug therapy and to decrease adverse effects of these interactions such as decreased drug bioavailability or increased drug side effects. The purpose of this study was to evaluate the awareness and knowledge of Pharmacy students at Al-Muthanna University about drug-food interactions. In this study, the responses to

DFIs survey summarized in Table 1 and 2. The students enrolled in this study have expressed adequate knowledge of some interaction but inadequate in others.

Regarding the awareness questions, 77.7 % of pharmacy students have knowledge of DFIs and 94.7% of them knowing that food either increase or decrease drug effect. About 70.2% of students know the mechanism of how food interact with drugs and 76.6% of them know food groups that commonly interact with drugs. 92.6% of students would like to receive further information about food drug interactions. 76.6% of students know how to use online resources to get information and 77.7% of them know how to make recommendations to avoid DFIs. The results of this study in agree with previous studies (25, 26)

In this study, 76.6 % of students aware that caffeine-containing beverages affect diazepam as stated in previous study (27) that caffeine consumption reduces plasma levels of diazepam by 22% while about three quarters (73.4%) of students know that grapefruit juice causes the most well documented and clinically proven DFIs. Ingestion even one cup of grapefruit juice result in significant inactivation of CYP 3A4 enzymes within GIT resulting in increased drug toxicity as mentioned in another studies (28, 29).

In this study half (50%) of students being aware that elderly patients more susceptible to DFIs when compared to adults and children due to multiple factors such as taking more than one drug and deterioration of kidney and liver function with increasing age which result in decreased drug clearance (30, 31)

64.9 % of students scored moderate in knowledge about spironolactone that used with caution with potassium rich sources to avoid the risk of hyperkalemia while 54.3% of students showed low knowledge about interaction of digoxin when taken with wheat bran diet, which decreased digoxin absorption by 16-32% resulting in therapeutic failure. In contrast to Radwan et al who demonstrated that, half of community pharmacists answered correctly (32)

Students in this study showed low knowledge (45.7%) about interaction of warfarin with ingestion of more leafy green vegetables this result in agree with Syed Snr et al who find that 40.8% of students did not agree with statement "patients can eat more green leafy vegetables with warfarin" (33)

Students showed high knowledge (90.4%) about interaction of tetracycline with dairy products due to chelation between calcium and tetracycline. The results of this study in agree with study conducted among healthcare professionals in Ethiopia in which two thirds of them being aware (34)

In this study, 47.9 % of students recognized that levodopa efficacy decreased when taken with protein rich diet because levodopa competes with amino acids for absorption (35). The result of this study similar to another study in Jordan in which more than half of health care professionals being aware that protein rich diet decrease bioavailability of levodopa (36).

Study limitations

The study limited by its small sample size and fact that the study's population is confined to Pharmacy students in their fourth and fifth year at Al-Muthanna University making them non-representative of other academic institutions. This study based on online self-administered survey that increased risk of bias.

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