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A Survey of Knowledge About the Interaction Between Food and Drugs Among the Syrian Population

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Abstract: ***This study aimed to evaluate the knowledge and awareness of food-drug interactions among the general public in Syria. A questionnaire was distributed at Tishreen University and published on social media between October and November 2023. A total of 419 responses were collected. 83.3% know that food can affect the effectiveness of medications. 85.2% think that food can increase or slow down the effects of medications. 77.6% believe that the effect of food-drug interactions varies depending on dose, age, and health status. 68.5% believe that food-drug interactions may lead to serious side effects. 45.8% believe that food-drug interactions can lead to death. 49.2% chose that the age group of patients at highest risk for food-drug interactions should be over 60 years of age. The questionnaire results showed that the level of knowledge and awareness of participants about food-drug interactions was good because the overall average of the number of participants who answered correctly was 63.34%.***

Keywords: Knowledge, Awareness, Food-drug Interactions, Survey.

I. INTRODUCTION

The increase in consumption of natural foods and plant-based dietary supplements over the past few decades has raised significant concerns about the potential interactions between food products and drugs[1][56][57]. Elderly patients taking several medications are at the highest risk of food-drug interactions, such as patients with diabetes, high blood pressure, and high blood cholesterol. Therefore, these patients need to be regularly monitored for food-drug interactions [2].

Food–Drug Interaction (FDI) is a change in pharmacokinetics or pharmacodynamics resulting from the simultaneous administration of a drug with food. Food-drug interactions are a source of therapeutic inefficiency or increased toxicity, sometimes endangering patients' lives [3].

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Foods change the rate of drug metabolism, leading to an increase/decrease in drug concentrations in the body and thus changing the drug's effectiveness. Food consumption leads to decreased plasma concentrations of isoniazid, rifampicin, ethambutol, and rosuvastatin, requiring fasting and administration away from meals to maintain the effectiveness of these medications [4]. Many ingredients found in foods change the pH of urine, ultimately decreasing or increasing the half-life of the drug when the patient is taking it. The half-life of acidic drugs is longer in acidic urine (urine becomes acidic due to consummating foods such as meat, fish, cheese, and eggs) because these acidic drugs remain in their unionized form in the acidic medium. Likewise, the half-life of acidic drugs is reduced in alkaline urine (urine becomes alkaline from consummating foods such as milk, vegetables, and citrus fruits), because they will become in their ionized form [3]. A prominent example of a food-drug interaction is the "cheese reaction" that occurs as a result of the interaction between tyramine, a component of raw cheese or sausage, and monoamine oxidase inhibitors (MAOIs) such as tranylcypromine, isocarboxazid, and selegiline [5].

Divalent and trivalent elements, especially calcium and iron, reduce the bioavailability of Thyroxine T4, making treatment less effective [6]. Some herbal-based medicines and juices may inhibit the cytochrome CYP enzymes, such as Mentha piperita oil, Eucalyptus globulus oil, Trifolium pratense, Punica granatum juice, and Grapefruit juice [7]-[8].

Many studies have been conducted to assess the level of knowledge and awareness about food-drug interactions among the general public and also among healthcare providers. Zaidi *et al.* (2021) [9], conducted a questionnaire-based survey to assess the level of knowledge and public awareness in the city of Jeddah, western Saudi Arabia, about food-drug interactions. The study showed that participants had a weak to moderate level of knowledge and awareness regarding food-drug interactions. Bagewadi *et al.* (2021) [10], surveyed second-year medical students at a government medical college in South India to assess knowledge and perceptions about food-drug interactions. It was found that the majority of students (82%) were aware of the interaction of foods and alcoholic beverages with medications in the body. Food-drug interactions play an important role in the pharmaceutical field, as they greatly influence the success of drug treatment [58]. Food-drug interactions are just as important as drug-drug interactions, but they are neglected due to a lack of awareness and knowledge.

This research aimed to assess the level of knowledge and awareness among the general Syrian public about food-drug interactions by conducting a questionnaire.

II. METHODS

The questionnaire was designed based on previous studies, especially including the study of Zaidi *et al.* (2021) [9], The questionnaire consists of two parts. The first part of the questionnaire included 10 questions in order to collect demographic characteristics. The second part of the questionnaire consisted of 15 questions to assess the level of knowledge about food-drug interactions.

The questionnaire was distributed and published at Tishreen University and on social media during October and November 2023. Statistical programs were used to analyze the data and reach results.

A. Calculating Results:

To assess the level of knowledge, this study has a total of 15 questions. The answer to some questions is "Yes/No/I don't know". Correct answers receive a score of 1, and incorrect answers receive a score of 0. Some questions are multiple-choice based, with correct answers receiving a score of 1, and other answers receiving a score of 0. Table-I ranks participants' scores according to their level of knowledge.

Table-I: Classification of Participants' Knowledge Level

Correct Answer (of 15 Questions)	Level of Knowledge
%30>	Weak
%59 -%31	Moderate
%60≤	Good

III. RESULTS

A. Demographic Characteristics of Participants:

A total of 419 people participated in the study. The demographic characteristics of the participants are summarized in Table-II. Most participants were between 18 and 24 years old, accounting for 61.8% (259 out of 419). The number of participants, by gender, was 28.6% (120) male and 71.4% (299) female. 58.5% (245) have a university degree. The occupations of 52.3% (219) of participants were not related to health care. 58% (243) of participants have no one in their family in a healthcare-related profession. Regarding whether participants had a chronic disease or not, a total of 85.4% (358) did not have any chronic disease. For the question of whether any of the participants had ever been at risk of drug-food poisoning, 24.6% (103) responded that they had experienced it personally or with someone they knew.

People have many different sources of information about food-drug interactions. Survey participants were asked a question (multiple-choice) about the sources of information they relied on regarding food-drug interactions (Figure 1). Social networking sites ranked first with 49.4% (207), followed by the academic study of a medical branch at 46.3% (194), trusted medical websites at 41.1% (172), Google search engine at 36.3% (152), television at 14.6% (61). Finally, paper newspapers and magazines 9.5% (40).

Table-II: Demographic Characteristics of Participants

Demographic Characteristics		Total Number of Participants (419)	Percentage
1. Age	18-24 years	259	61.8%
	25-34 years	90	21.5
	35-44 years	28	6.7
	45- 54 years	22	5.3
	>54 years old	20	4.8
2. Sex	Male	120	28.6
	Female	299	71.4
3. Educational level	Student	42	10
	Baccalaureate degree	22	5.3
	Bachelor's degree	245	58.5
	High education	110	26.3
4. University student	Not a student	189	45.1
	First	5	1.2
	Second	16	3.8
	Third	25	6.0
	Fourth	49	11.7
	Fifth	131	31.3
	Sixth	4	1.0
5. Graduate student	Not a student	370	88.3
	Master	44	10.5
	PhD	5	1.2
6. Is the participant's profession related to health care?	Yes	200	47.7
	No	219	52.3
7. Is a family member's profession related to health care?	Yes	176	%42
	No	243	%58
8. Chronic disease	Yes	61	%14.6
	No	358	%85.4
9. Previous exposure to the risk of drug-food poisoning	Yes	103	%24.6
	No	316	%75.4

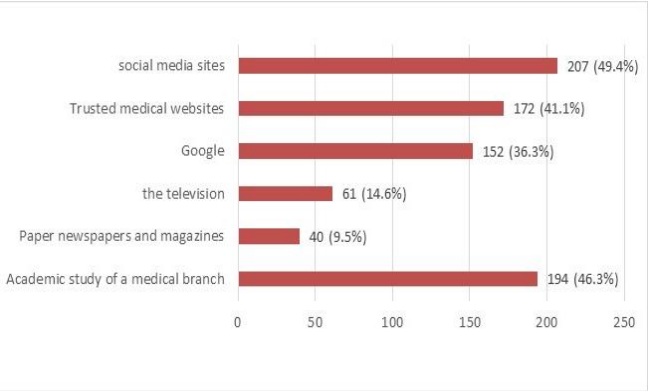

Fig. 1. Graphical Representation of Question 10: What are the Sources of Your Medical Knowledge About Food-Drug Interactions?

B. Level of Knowledge About Food-Drug Interactions

Assessment of knowledge level included asking a set of questions about food-drug interactions summarized in Table -III.

The results of the questionnaire showed that just over half of the participants 56.3% (236) knew the existence of interactions between drugs and foods, but 43.7% (183) were not aware of these interactions. Most participants (92.6% -388) believe that knowledge of food-drug interactions is essential.

For over-the-counter and prescription drugs, half of the participants (49.4% (207)) believe that they interfere with food. 83.3% (349) know that food can affect the effectiveness of medications, and 85.2% (357) reported that food can speed up or slow down the effects of medications. 77.6% (325) stated that food-drug interactions vary depending on the dose, age, and health status. When participants were asked about the possibility that food-drug interactions can cause side effects, 68.5% (287) believed that they could. 45.8% (192) believe that food-drug interactions can lead to death. Regarding the question: in your opinion, which age group of patients is most at risk for food-drug interactions? 206 people chose the answer: over 60 years old (accounting for 49.2% of the total number of participants).

Concerning the behaviors of taking medications with food to achieve better effects (during, before, or after): the majority of participants, 85.9% (360), believe that not all drugs should be taken with food. Additionally, 92.4% (387) responded that not all medications should be taken on an empty stomach to obtain better results.

C. Regarding the Possibility of Food Interactions with Medications

Only about half of the participants 51.6% (216) answered that it is better to avoid consuming milk and its derivatives, iron-rich foods, and nutritional supplements with some antibiotics. There was a question about which of the following drinks (alcohol, coffee, tea, milk) medical experts recommend avoiding when taking certain medications?. The percentages for the options are alcohol 81.4% (341), milk 28.9% (121), coffee 18.4% (77), tea 18.9% (79), and I don't know 11.5% (48). For the question about fruits, which overlaps with about 45 different medications, producing fatal side effects: the answers were: grapefruits 53.2% (219), watermelon 3.3% (14), kiwi 3.3% (14), I don't know 41.5% (174).

About the foods that reduce the absorption of iron supplements: the answers were: milk 49.6% (208), spinach 9.3% (39), watermelon 5.5% (23), oranges 3.6% (15), I don't know 36.5%. (153).

Table-III: Questionnaire Questions, Number, and Percentage of Answers for Each Question, in Addition to Assessing the Level of Knowledge

Question	Options	Number of answers	Percentage
11. Do you know that the food can interact with drugs?	Yes	236	%56.3
	No	183	%43.7
12. Is the knowledge about food-drug interactions necessary?	Yes	388	%92.6
	No	2	%0.5
	I don't know	29	%6.9
13. Do over-the-counter (OTC) and prescription medications interfere with food?	Yes	207	%49.4
	No	65	%15.5
	I don't know	147	%35.1
14. Do you think food can affect the effectiveness of medications?	Yes	349	%83.3
	No	13	%3.1
	I don't know	57	%13.6
15. Did you know that food can speed up or slow down the action of medicine?	Yes	357	%85.2
	No	62	%14.8
16. Does the effect of food-drug interactions depend on various factors such as the dose of the drug, the person's age, and health condition?	Yes	325	%77.6
	No	15	%3.6
	I don't know	79	%18.9
17. Can food-drug interactions lead to serious side effects?	Yes	287	%68.5
	No	26	%6.2
	I don't know	106	%25.3
18. Do you think that food-drug interactions can cause death?	Yes	192	%45.8
	No	80	%19.1
	I don't know	147	%35.1
19. What age group of patients do you believe are most at risk of developing food-drug interactions?	Younger than 15 years	174	%41.5
	15- 34 years	25	%6
	35- 60 years	58	%13.8
	Older than 60 years	206	%49.2
	years I don't know	80	%19.1
20. Is it permissible to take all medications with food?	Yes	10	%2.4
	No	360	%85.9
	I don't know	49	%11.7
21. Can all medicines be taken on an empty stomach to get a better effect?	Yes	9	%2.1
	No	387	%92.4
	I don't know	23	%5.5
22. Is it better to avoid consuming milk and dairy products, iron-rich foods, and nutritional supplements with some antibiotics?	Yes	216	%51.6
	No	43	%10.3
	I don't know	160	%38.2
23. Which of the following drinks do health experts recommend avoiding when taking certain medications?	Alcohol	341	%81.4
	Coffee	77	%18.4
	Tea	79	%18.9
	Milk	121	%28.9
	I don't know	48	%11.5
24. What is the fruit that interacts with about 85 different	Watermelon	14	%3.3
	Kiwi	14	%3.3
	Grapefruit	219	%53.2

medications and produces fatal side effects?	I don't know	174	%41.5
25. Absorption of iron supplements decreases with:	Spinach	39	%9.3
	Milk	208	%49.6
	Orange	15	%3.6
	Watermelon	23	%5.5
	I don't know	153	%36.5

Questions (19, 23-25): Participants can choose more than one answer.

Correct answers: Question 19: over 60 years old, Question 23: Alcohol, coffee, tea, milk, Question 24: Grapefruit, Question 25: Milk. Questions 20 and 21: No. Rest of the questions: Yes.

IV. DISCUSSION

Food-drug interactions have a significant impact on drug effectiveness and can worsen a patient's condition, cause drug concentrations to reach toxic levels, and lead to death. Food-drug interactions cause clear effects on drug absorption, distribution, metabolism, excretion, bioavailability, and therapeutic effectiveness [16]-[32]. As pharmacists, we must draw the public's attention to these interactions, and educate them about the need to be careful with foods that interfere with their medications [33]-[43]. On that basis, we have prepared a questionnaire to assess the level of knowledge and awareness about these interactions [44]-[55].

The first knowledge questions (questions 11 to 21) cover basic information about food-drug interactions. Some prescription medications and even over-the-counter medications interact with food. Food also affects the effectiveness of drugs, and the interaction depends on various factors such as the dose of the drug, the age of the person, health conditions, etc. Some food-drug interactions can be very dangerous, especially with repeated exposure, and can lead to death. Some medications act better if taken on an empty stomach, others act better if taken with food, and others remain unaffected by the presence or absence of food. The age group over 60 years has the highest risk of food-drug interaction. The answers to these questions show that the majority of participants have moderate to good basic knowledge and that they understand the importance of this topic (the correct answer rate is over 60%, except for questions 13, 18, and 19, which were about 50%) (Table-IV).

The other knowledge questions about food-drug interactions include more in-depth and complex questions (questions 22 to 25). The percentage of correct answers was low for two questions regarding the potential interaction between milk and its derivatives, iron-rich foods, nutritional supplements, acidic foods, and beverages with several drugs. Studies have reported that calcium in milk may bind with certain antibiotics and reduce their absorption [11].

The nature of interactions between alcohol and drugs is influenced by race, gender, environment, or genetic factors [12]. For Question 23, the answer was correct about the possibility of alcohol interfering with some drugs (81.4%), but surprisingly a very small proportion of participants answered correctly about the possibility of tea interfering with some drugs (18.9%). Drinking tea is known to reduce iron absorption and therefore interferes with iron supplements.

Currently, there are more than 85 drugs known or expected to interact with Grapefruits. This interaction increases drug concentrations by reducing drug metabolism [13]. Calcium in milk also reduces iron absorption [14]. Half of the participants chose grapefruit as a fruit that interacts with about 85 different medications and causes deadly side effects, and milk as a food that reduces iron absorption. For our study, it was found that the level of knowledge and awareness was good, as the percentage of correct answers was 63.34%. In a previous study, insufficient knowledge about food-drug interactions was found [9]. Jarab *et al.* found that participants had a moderate level of knowledge about food-drug interactions [15].

Table-IV: Level of Knowledge and Awareness Based on the Correct Answer to the Question.

Question	Assess the level of knowledge and awareness		
	Weak ≤30%	Moderate 31- 59%	Good ≥60%
11. Do you know that the food can interact with drugs?		+	
12. Is the knowledge about food-drug interactions necessary?			+
13. Do over-the-counter (OTC) and prescription medications interfere with food?		+	
14. Do you think food can affect the effectiveness of medications?			+
15. Did you know that food can speed up or slow down the action of medicine?			+
16. Does the effect of food-drug interactions depend on various factors such as the dose of the drug, the person's age, and health condition?			+
17. Can food-drug interactions lead to serious side effects?			+
18. Do you think that food-drug interactions can cause death?		+	
19. What age group of patients do you believe are most at risk of developing food-drug interactions?		+	
20. Is it permissible to take all medications with food?			+
21. Can all medicines be taken on an empty stomach to get a better effect?			+
22. Is it better to avoid consuming milk and dairy products, iron-rich foods, and nutritional supplements with some antibiotics?		+	
23. Which of the following drinks do health experts recommend avoiding when taking certain medications?			+
	+		
	+		
	+		
24. What is the fruit that interacts with about 85 different medications and produces fatal side effects?		+	
25. Absorption of iron supplements decreases with		+	

V. CONCLUSION

Foods interact with some medications, affecting their effectiveness. Considering the importance of food-drug interactions, a questionnaire has been published at Tishreen University and on social sites to assess the level of knowledge, including a set of questions related to this topic. The survey results showed that knowledge and awareness are at a good level, the correct answers rate of participants is 63.34%. In any case, the level of knowledge and awareness of the public should be raised, by healthcare providers regarding the possible interactions that occur when consuming food with drugs, especially in the elderly.

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Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material	Not relevant.
Authors Contributions	All authors have equal participation in this article.

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