ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

Evaluation of the Nurses' Knowledge Levels of Food-Drug Interaction and Some Other Influencing Factors: A Cross-Sectional Study

Hemşirelerin Besin-İlaç Etkileşimi Bilgi Düzeyleri ve Etkileyen İlişkili Diğer Faktörlerin Değerlendirilmesi: Kesitsel Bir Çalışma

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ABSTRACT Objective: To determine the knowledge levels of nurses on food-drug interaction (FDI) at a university hospital and to identify other relevant variables that affect their knowledge of FDI. **Material and Methods:** This cross-sectional study was conducted on 243 nurses working at a university hospital between November 2019 and January 2020. "A scale to determine the level of FDI knowledge in health care professionals" was used to determine the nurses' knowledge level of FDI. For statistical analysis, descriptive statistics, t-test and one-way ANOVA test were used. **Results:** Among the nurses, 21.4% had low, 39.5% medium, 31.7% good, and 7.4% very good knowledge level of FDI. There was no significant relationship between the nurses' FDI knowledge levels and nurses' gender, age groups, education level, total working duration in the profession, whether they chose the profession willingly, participation in any training after graduation, and whether they know the person who is legally responsible for this situation when an FDI occurs (for each; p>0.05). Nurses who do not put the drug hours at the same time with the foods that may interact to avoid FDI and who use academic databases on FDI had higher knowledge of FDI (for each; p<0.05). **Conclusion:** In conclusion, 78.6% of the nurses had a moderate or higher level of knowledge on FDI. In practice, it was seen that not giving the drugs and foods that may interact at the same time and using academic databases increase the knowledge level of the nurses' FDI.

Keywords: Food and drug interactions; knowledge; nurses; nurse's role

ÖZET Amaç: Bir üniversite hastanesinde çalışan hemşirelerin besin-ilaç etkileşimi (BİE) bilgi düzeylerinin saptanması ve BİE bilgi düzeylerini etkileyen ilgili diğer değişkenlerin belirlenmesidir. **Gereç ve Yöntemler:** Bu kesitsel çalışma, Kasım 2019-Ocak 2020 tarihleri arasında bir üniversite hastanesinde çalışan 243 hemşire üzerinde gerçekleştirilmiştir. Hemşirelerin BİE bilgi düzeylerini saptamak üzere "Sağlık çalışanlarında BİE bilgi düzeyini saptama ölçeği" kullanılmıştır. İstatistiksel analizler için tanımlayıcı istatistikler, t-testi ve ANOVA testi kullanılmıştır. **Bulgular:** Hemşirelerin %21,4'ünün BİE bilgi düzeyi düşük, %39,5'i orta, %31,7'si iyi, %7,4'ü çok iyi düzeyde BİE bilgi düzeyine sahiptir. Hemşirelerin BİE bilgi düzeyleri ile hemşirelerin cinsiyetleri, yaş grupları, eğitim düzeyleri, meslekte toplam çalışma süreleri, mesleği isteyerek seçme, mezuniyet sonrası herhangi bir eğitime katılma durumları, BİE gerçekleştiğinde bu durumdan yasal olarak sorumlu olan kişiyi bilme durumları arasında anlamlı bir ilişki yoktur (her biri için; p>0,05). BİE ile karşılaşmamak için ilaç saatlerini etkileyebilecek besinlerle aynı zaman dilimine koymayan ve BİE ile ilgili akademik veri tabanlarını kullanan hemşirelerin BİE bilgi düzeyleri daha yüksektir (her biri için; p<0,05). **Sonuç:** Sonuç olarak hemşirelerin %78,6'sı, orta veya üst düzeyde BİE bilgisine sahiptir. Uygulamada etkileşebilecek besinlerle ilaçları aynı zaman diliminde vermeme ve akademik veri tabanlarını kullanmanın hemşirelerin BİE bilgi düzeylerini artırdığı görülmektedir.

Anahtar Kelimeler: Besin ilaç etkileşimleri; bilgi; hemşireler; hemşirelik rolleri

Drugs are defined as "substances intended to be used in diagnosis, healing, treatment, alleviation or prevention of the disease" and "products aim to affect any function or structure of the bodies of human or other animals (other than food)", regarding its intended use.[1] Food-drug interactions (FDI) include all interactions that affect the stability or arrangement of food or drug ingredients in vitro (in food or drug products) or

in vivo (in the body), regardless of whether they affect the physiological function or health measurably.[2] There is a bidirectional interaction between food and drug. Some drugs may cause a decrease or increase in the absorption of nutrients, change in their metabolism, deficiencies of some nutrients such as vitamins and minerals, and even change the taste perception and body weight related to nutrition, while some foods change the absorption, distribution, elimination, pharmacokinetic and/or pharmacodynamic properties of drugs, thus they can affect the bioavailability of drugs.[3,4] At the intersection point where genetic variation shapes the individual responses to combination of food and drug, pharmacogenetics takes place.[5]

The optimal drug concentration range, that is, the therapeutic range that, allows drugs to be effective while avoiding side effects, maybe narrow for some pharmacological agents, making the dosing of the pharmacological agent very precise.[5] Due to physiological changes such as partial dysfunction in kidneys, hepatic blood flow, liver function, lean body mass, or increase in body fat mass and volume of distribution, especially elderly people who take more than one drug, use complementary and alternative therapies, are at risk in terms of FDI.[6,7] FDI negatively affects the treatment of patients by increasing the costs of pharmacotherapy and prolonging the duration of hospitalization, and may cause the loss of the expected effect in the treatment (loss of therapeutic efficacy) or the emergence of toxic effects and unwanted adverse effects of drugs.[3,6-8]

Various studies in the literature show that the knowledge levels of the society about FDI are inadequate.[7,9] According to Levy et al., approximately one-fourth of hospitalized patients are at risk of FDI, which could compromise the efficacy and safety of the treatment. Moreover, 47% of the patients, who consume diet and herbal supplement products, use at least one dietary and herbal supplement product that has a potential interaction with drugs during their hospitalization.[10] Nurses, within the scope of their duties, powers and responsibilities, have to evaluate the treatments such as drugs, herbs, alternative therapies, vitamins or dietary supplements used by individuals. Furthermore, they have to monitor the effects of medical diagnosis and treatment procedures (drug applications) on the patient, assess the patient's response

or compliance with the treatment and, take necessary measures if undesirable situations occur.[11] In the future, it is stated that to achieve better results in the prevention and treatment of diseases, the focus will be on individualized therapies by adapting nutritional and pharmacological interventions to the treatments in a coordinated manner.[5] It is seen that courses such as pharmacology, rational drug use, and drug use in special cases are involved in the curriculum of various stages of nursing education (secondary education and undergraduate education). Besides, special courses on FDI are also included within the scope of master and doctoral programs in nursing.[12-14] Educating patients on FDI is a responsibility that is shared by physicians, pharmacists, dietitians, and nurses, also requires the need for an interdisciplinary approach.[15] Nurses can realize 80% of preventive factors required to avoid the unintended effects of drug interactions.[16] In this context, nurses' level of pharmacological knowledge and awareness of potential FDI play an important role in preventing adverse drug reactions involving FDI, ensuring patient safety, and reducing morbidity and mortality.[17,18] However, in previous studies, it is seen that FDI come first among the subjects that nurses define themselves as inadequate about drugs.[19-21]

Inadequate knowledge of nurses on FDI may affect the success of treatment effectiveness and threaten patient safety.[22,23] Moreover, nurses should have sufficient knowledge levels of FDI to adequately handle and process this issue, which allows nurses to implement their educational roles. However, in studies conducted in Iran and Colombia, the knowledge level of nurses on FDI has been found as low.[17,24] On the other hand, in Türkiye, no studies have been found evaluating the knowledge level of nurses on FDI, hence, making the present study was needed to fill the gap in the field. This study aimed to determine the knowledge levels of nurses working at a university hospital about FDI and to identify other relevant variables that affect their knowledge of FDI.

MATERIAL AND METHODS

STUDY DESIGN

This cross-sectional study was conducted between November 2019 and January 2020 with the nurses

working at Eskişehir Osmangazi University Health Application and Research Hospital.

SAMPLE

The universe of the study consisted of 654 nurses working in the hospital. The sample size consisted of 243 nurses who were determined by using "sample calculation formula with a known universe" with a confidence interval of 95%, an error margin of 5%, and an incidence of 50%.[25] The data of the study were collected from a total of 243 nurses who were selected by a simple random sampling method. In the sampling procedure, 640 nurses were listed because 14 nurses were not around during the enrollment period. The sample selection process continued until 243 nurses were reached by using a random numbers table. During the study, 312 nurses were invited to the study, 40 nurses did not return the survey, 3 nurses returned incomplete and/or unusable the survey, and 26 nurses refused to participate in the study. As a result, the study was completed with 243 nurses. The participation rate was 100%. The inclusion criteria for participation in the study were: (a) being a registered nurse; and (b) approving to participate in

the study. Exclusion criteria included: (a) being on unpaid leave or maternity leave during the period of study. Sample recruitment and enrollment process are presented in Figure 1.

DATA COLLECTION

Within the scope of the study, "a scale to determine the level of food and drug interaction knowledge in health care professionals" was used to determine the nurses' knowledge level of FDI with the 20 questions to determine the socio-demographic characteristics and variables affecting FDI knowledge of nurses.

SOCIO-DEMOGRAPHIC CHARACTERISTICS AND DATA FORM

To determine the socio-demographic characteristics and variables affecting FDI knowledge of nurses, 20 questions prepared by the researchers in line with the research purpose were used. Socio-demographic characteristics and data form consisted of questions about gender, age, marital status, perception of total income level, an education level (graduated school/university, graduation department, graduation
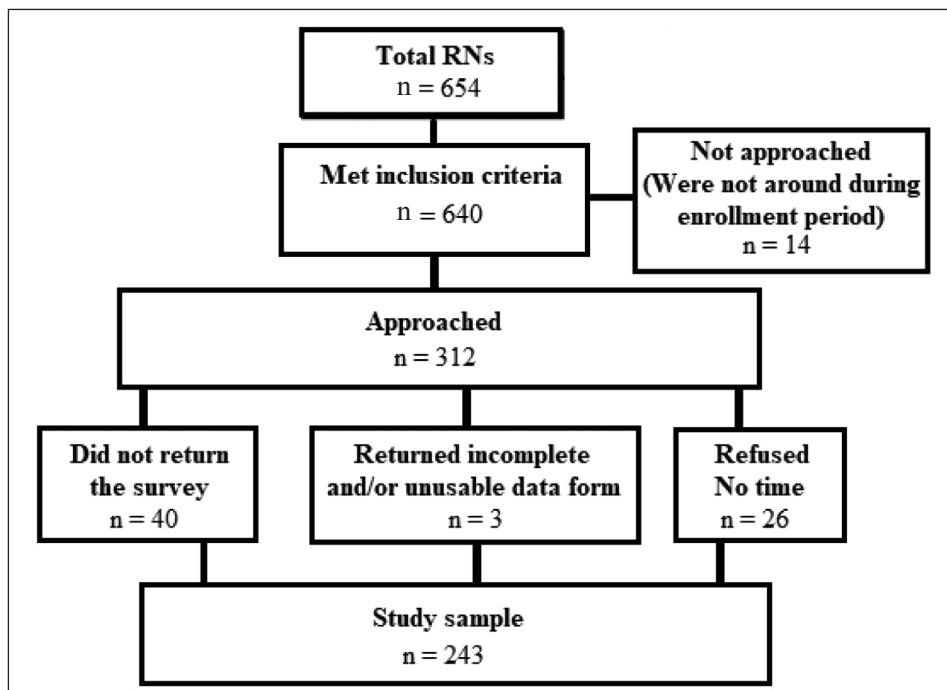

FIGURE 1: Sample recruitment and enrollment process.
RNs: Registered nurses.

year), participation situation in any training after graduation, choosing the occupation willingly, working unit/department, working shift, total working time in the profession, total working time in the unit, weekly working time, taking courses on FDI before graduation, thinking that training on FDI is necessary after graduation, participating in any training related to FDI after graduation (course, congress, seminar, etc.), an encounter with FDI in the patient provided cared, interventions to prevent FDI, individuals who are considered to be legally responsible for a FDI when it occurs, and information resources on FDI.

DETERMINING THE LEVEL OF FOOD AND DRUG INTERACTION KNOWLEDGE IN HEALTHCARE PROFESSIONALS SCALE

The scale was developed by Karagöz et al in 2022 to determine the knowledge level of healthcare professionals on FDI. There are 21 items with answer options "right", "false" and "I don't know". Correct answers are given "(1)" point, while false and unknown answers are given "(0)" point. The lowest score that can be obtained from the scale is 0 and the highest score is 21. The knowledge level of healthcare professionals on FDI is evaluated as "low (0-5 points)", "moderate (6-10 points)", "high (11-15 points)" and "very high (16-21 points)" according to the score obtained from the scale. The Cronbach's alpha reliability coefficient of the scale is 0.79.[25] Cronbach alpha reliability coefficient of the scale for this study is 0.81.

ETHICAL CONSIDERATIONS

First of all, permission to use the scale was obtained from the authors who developed the scale to use the "Determining the level of food and drug interaction knowledge in health care professionals scale" in this study. This study was approved by Eskişehir Osmangazi University Non-interventional Clinical Research Ethics Committee (24.09.2019/17) and institutional approval was obtained from Eskişehir Osmangazi University Health Application and Research Hospital (22.10.2019/120649). Moreover, nurses were informed about the study and verbal informed consent was obtained from the participants. All participants voluntarily agreed to participate in the study, which was carried out in accordance with the Helsinki Declaration principles.

STATISTICAL ANALYSIS

Before starting analysis, skewness and kurtosis coefficients of scale scores obtained from the "level of food and drug interaction knowledge in healthcare professionals scale" were checked as the assumption of normality, and it was found that skewness and kurtosis coefficients were between -1 and +1, and their absolute values were not greater than twice their standard errors.[26] Besides, the normal distribution curve on the histogram was evaluated by the visual method. The absence of extreme values in the box plot, a symmetrical graph, and the median line passing through the middle were in favor of the normal distribution. The normal quantile-quantile graph showed that the points were lined up on a 45-degree line, while the detrended quantile-quantile graph showed a random distribution of the points above and below the horizontal line, which showed that there was no contradiction to the normal distribution. Therefore, it was seen that the FDI data obtained from the scale fit the normal distribution. In the analysis of the data, in addition to descriptive statistics such as frequency, mean, standard deviation etc., two independent samples t-tests in groups with parametric two independent variables and one-way analysis of variance (ANOVA) in groups with more than two independent variables were used. The statistical significance level was determined as $p<0.05$.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

In the study group, 81.1% (n=197) were female and the mean age was 30.32±7.31 (minimum 20.00; maximum 55.00) years. Among the nurses, 51.4% (n=125) worked in the department of surgical medicine, and 58.0% (n=141) had a Bachelor's degree.

PREVALENCE OF KNOWLEDGE LEVELS AND OTHER RELATED FACTORS ABOUT FOOD-DRUG INTERACTION

The scores received by the nurses on the "Determining the level of FDI knowledge in health care profes-

sionals scale" ranged from 0.00 and 20.00 with a mean score of 9.18±4.42. Among the nurses, 21.4% (n=52) had a low, 39.5% (n=96) had a moderate, 31.7% (n=77) had a high, and 7.4% (n=18) had a very high knowledge level of FDI. Among the nurses, 17.3% (n=42) stated that they encountered a FDI in a patient they previously provided care. The sources that the nurses stated that they got information about the FDIs were; drug package insert (79%), web search engines (77%), physician (59.3%), other nurses (52.7%), vademecum, etc. drug guides (24.3%), academic databases (21.8%), pharmacist (21.8%), FDI list on the service (19.3%), dietician (15.2%), interactive drug information source/drug information software programs (15.2%), respectively.

The practices that the nurses stated that they did to prevent FDI were; not putting the drug hours at the same time with the foods that may interact (77%), observing the patient's reaction to the drug (73.7%), reading the warnings and precautions about the interaction in the drug package insert (70.4%), educating patients or their relatives about nutrients that need to be stopped, reduced or increased in drug use (68.3%), not mixing drugs with enteral or parenteral formulations in case of enteral nutrition (55.6%), and temporarily taking a break for drugs that are not urgently needed (41.6%), respectively.

Among the nurses, 71.2% (n=173) did not take any courses on FDI before graduation. Among the nurses, 54.3% (n=132) stated that they received a

TABLE 1: Distribution of nurses' knowledge level of FDI according to some socio-demographic characteristics.			
		Knowledge level of FDI	
Variables	n (%)	Mean±SD	t value/F; p value
Gender			
Female	197 (81.1)	9.07±4.42	-0.764; 0.446
Male	46 (18.9)	9.63±4.51	
Age group			
20-24	62 (25.5)	9.69±4.48	
25-29	65 (26.7)	8.86±4.30	1.383; 0.248
30-34	47 (19.3)	9.93±4.11	
≥35	69 (28.4)	8.50±4.65	
Marital status			
Married	134 (55.1)	8.83±4.43	-1.349; 0.647
Single	109 (44.9)	9.60±4.40	
Perception of total income level			
Income more than expenses	34 (14.0)	9.35±4.25	
Income meets expenses	147 (60.5)	9.06±4.42	0.120; 0.887
Income less than expenses	62 (25.5)	9.35±4.59	
Education level			
High school	59 (24.3)	9.49±4.48	
Two year college	22 (9.1)	9.68±5.71	
Undergraduate	141 (58.0)	8.98±4.14	0.282; 0.839
Master graduate	21 (8.6)	9.09±4.84	
Participation situation in any training after graduation			
Regularly	38 (15.6)	3.86±1.35	
Sometimes	201 (82.7)	3.48±1.41	1.818; 0.165
Never	4 (1.6)	2.75±0.95	
Total	243 (100.0)	9.18±4.42	

FDI: Food-drug interaction; SD: Standard deviation.

TABLE 2: Distribution of nurses' knowledge level of FDI according to some occupational characteristics.			
		Knowledge level of FDI	
Variables	n (%)	Mean±SD	t value/F; p value
Choosing the occupation willingly			
Yes	189 (77.8)	9.21±4.40	
No	54 (22.2)	9.05±4.55	0.453; 0.502
Working unit/department			
Internal medical sciences	104 (42.8)	9.31±4.97	
Surgical medical sciences	125 (51.4)	9.11±3.97	0.119; 0.888
Chief physician unit etc. other units	14 (5.8)	8.78±4.22	
Working shift			
Daytime working	64 (26.3)	8.28±4.69	
Shift working	172 (70.8)	9.54±4.19	1.969; 0.142
Night working	7 (2.9)	8.57±8.82	
Total working time in the profession (months)			
0-12	29 (11.9)	10.75±4.23	
13-36	39 (16.0)	8.76±4.21	
37-60	31 (12.8)	9.54±4.47	1.253; 0.289
61-120	61 (25.1)	8.72±4.17	
≥121	83 (34.2)	9.02±4.72	
Total working time in the unit (months)			
0-12	69 (28.4)	9.02±4.55	
13-36	77 (31.7)	8.90±4.11	
37-60	39 (16.0)	9.38±4.42	0.310; 0.818
61-120	58 (23.9)	9.58±4.75	
Weekly working time			
40 hours	114 (46.9)	8.85±4.46	
≥45 hours	129 (53.1)	9.47±4.39	0.004; 0.952
Total	243 (100.0)	9.18±4.42	

FDI: Food-drug interaction; SD: Standard deviation.

training (in-service training, course, seminar, congress, etc.) about FDI after graduation, while 96.3% (n=234) of them thought that postgraduate training program for nurses on drug interactions was necessary.

VARIABLES RELATED TO FOOD-DRUG INTERACTION

It was determined that variables in Table 1 and Table 2 had no significant difference in the knowledge level of nurses on FDI. According to that, no difference was found between nurses' gender, age groups, marital status, perception of total income level, graduation, and participation situation in any training after graduation (Table 1; for each, p>0.05).

Moreover, no difference was found between nurses whether they chose the profession willingly, working unit or department, working shift, total working time in the profession, total working time in the unit, and weekly working time (Table 2; for each, p>0.05).

Furthermore, no difference was found between nurses' taking courses on FDI before graduation, thinking that training on FDI is necessary after graduation, participation in any training after graduation, an encounter with FDI in the patient provided cared, and interventions to prevent FDI apart from not putting the drug hours at the same time with foods that may interact (Table 3; for each, p>0.05). There was no difference between whether they know the person

who is legally responsible for this situation when an FDI occurs with their knowledge levels of FDI (Table 4; for each, p>0.05).

The knowledge levels were higher among the nurses who do not put the drug hours at the same time with the foods that may interact to avoid FDI and who use academic databases on FDI (Table 3 and Table 4; for each, p<0.05).

DISCUSSION

Previous studies have shown that 57% of patients who received chemotherapy used herbal supplements, the rate of geriatric patients who were chronically prescribed 5 or more drugs in 2018 was 14.3%, and the cumulative percentage of geriatric patients who were prescribed at least one prescription per

TABLE 3: Distribution of nurses' knowledge level of FDI according to their educational and occupational characteristics and interventions to prevent FDI.			
		Knowledge level of FDI	
Variables	**n (%)**	**Mean±SD**	**t value/F; p value**
Taking courses on FDI before graduation			
No	173 (71.2)	9.12±4.69	-0.364; 0.716
Yes	70 (28.8)	9.32±3.70	
Thinking that training on FDI is necessary after graduation			
No	9 (3.7)	8.00±4.50	0.815; 0.416
Yes	234 (96.3)	9.22±4.43	
Participating in any training related to FDI after graduation (course, congress, seminar, etc.)			
No	111 (45.7)	9.09±4.46	-0.264; 0.792
Yes	132 (54.3)	9.25±4.41	
Encounter with FDI in the patient provided cared			
No	201 (82.7)	9.32±4.37	-1.096; 0.274
Yes	42 (17.3)	8.50±4.65	
Interventions to prevent FDI			
Observing the patient's reaction to the drug			
No	64 (26.3)	9.81±4.64	1.331; 0.184
Yes	179 (73.7)	8.95±4.34	
Taking a temporary break for drugs that are not urgently needed			
No	142 (58.4)	8.82±4.32	-1.494; 0.136
Yes	101 (41.6)	9.68±4.54	
Not putting the drug hours at the same time with foods that may interact			
No	56 (23.0)	8.01±4.28	-2.259; 0.025
Yes	187 (77.0)	9.52±4.42	
Educating patients or caregivers about nutrients that need to be stopped, reduced or increased at drug use			
No	77 (31.7)	8.88±4.78	-0.713; 0.476
Yes	166 (68.3)	9.31±4.26	
Not mixing drugs in enteral or parenteral formulations in case of enteral nutrition			
No	108 (44.4)	9.13±4.72	-0.133; 0.895
Yes	135 (55.6)	9.21±4.19	
Reading interaction related warnings and precautions in the drug insert			
No	72 (29.6)	8.73±5.02	-1.016; 0.311
Yes	171 (70.4)	9.36±4.15	
Total	243 (100.0)	9.18±4.42	

FDI: Food-drug interaction; SD: Standard deviation.

TABLE 4: Distribution of nurses' knowledge level of FDI according to individuals considered to be legally responsible for FDI and to information sources about FDI.

| Variables | n (%) | Knowledge level of FDI | |
		Mean±SD	t value/F; p value
Induviduals who are considered to be legally responsible for a FDI when it occurs			
Physician			
Not responsible	75 (30.9)	9.21±4.79	
Responsible	168 (69.1)	9.16±4.27	0.076; 0.940
Nurse			
Not responsible	97 (39.9)	8.71±4.70	
Responsible	146 (60.1)	9.49±4.22	-1.350; 0.178
Pharmacist			
Not responsible	174 (71.6)	9.21±4.49	
Responsible	69 (28.4)	9.10±4.29	0.176; 0.860
Nutritionist			
Not responsible	173 (71.2)	9.32±4.60	
Responsible	70 (28.8)	9.05±3.99	0.277; 0.782
Information resources on FDI			
Medication package insert			
No	51 (21.0)	9.31±4.74	
Yes	192 (79.0)	9.14±4.35	0.240; 0.810
Search engines			
No	56 (23.0)	9.71±4.32	
Yes	187 (77.0)	9.02±4.46	1.027; 0.305
Academic databases			
No	190 (78.2)	8.85±4.42	
Yes	53 (21.8)	10.35±4.28	-2.206; **0.028**
Interactive drug information resource /drug information software			
No	206 (84.8)	9.03±4.36	
Yes	37 (15.2)	9.97±4.74	-1.182; 0.238
Vademecum etc. medication guide			
No	184 (75.7)	8.94±4.23	
Yes	59 (24.3)	9.93±4.95	-1.385; 0.170
Nurse			
No	115 (47.3)	9.22±4.65	
Yes	128 (52.7)	9.14±4.23	0.150; 0.881
Physician			
No	99 (40.7)	8.93±4.72	
Yes	144 (59.3)	9.34±4.22	-0.704; 0.482
Pharmacist			
No	190 (78.2)	9.11±4.30	
Yes	53 (21.8)	9.41±4.88	-0.434; 0.664
Nutritionist			
No	206 (84.8)	9.18±4.29	
Yes	37 (15.2)	9.16±5.19	0.028; 0.978
List of FDI in the unit			
No	196 (80.7)	9.18±4.45	
Yes	47 (19.3)	9.14±4.35	0.055; 0.956
Total	243 (100.0)	9.18±4.42	

FDI: Food-drug interaction; SD: Standard deviation.

month containing 5 or more drugs ranged between 16.4% and 20.7%.[27,28] The high use of various nutritional supplements and common polypharmacy dur- ing the treatment of patients are worrisome in terms of showing that nurses are at a high risk of encountering FDI. These also emphasize the need for in-

creased efforts to avoid preventable FDI and the importance of awareness of nurses. In our study, it was found that 78.6% of the nurses had a moderate or high level of knowledge on FDI. However, unlike our study, in a study conducted in Egypt, it was reported that 74% of the nurses had low awareness of FDI.[29] Besides, in various previous studies, it has been stated that the knowledge level of nurses on FDI was low, and the frequency of nurses with the low knowledge level of FDI has been reported between 79.2% and 83%.[17,24,30,31] The fact that the study was conducted in a tertiary health institution and that approximately 2 out of 3 of the nurses (66.6%) had undergraduate and graduate education may have had an impact on determining the nurses' knowledge level on FDI as high in our study.

The need to employ the graduate nurses in different departments according to requirements of different sections, and not being appointed according to their areas of expertise in Türkiye, prevents them from specializing in the pharmacology of drugs in their clinical study areas.[32] However, the role of nurses' routine awareness and training have a great role in reducing medication errors and improving patient safety outcomes.[18,30] In our study, 71.2% of the nurses reported that they did not take any lessons on FDI before graduation, while the rate of those who reported that they received training on FDI after graduation was 54.3%. In the aforementioned study conducted in Egypt, it was reported that approximately 2 out of 3 nurses did not receive any training on FDIs after graduation.[29] An intervention study conducted in Iran showed that the incidence of FDIs decreased by 13.1% after the training given to nurses.[33]

According to Abdollahi et al., although only 33.2% of the patients were educated by nurses about using their medications with the meal, these patients were also at high risk of potential FDI.[34] In our study, it was found that 17.3% of the nurses encountered FDI in a patient who previously was provided care. In previous studies, the rate of encountering FDIs during clinical interventions of nurses has been reported between 28% and 56%.[24,29] Since the drug administration under the control of a physician and the diet list under the control of a dietician fall into the dependent functions of nurses, the nurses' high level of knowledge on FDI in routine practice remains dysfunctional due to legal limitations. It is expected that nurses with more experience are more likely to encounter FDIs in proportion to their working time. In our study, it was determined that 24.1% of the nurses who encountered FDIs consisted of people with 12 years or more of experience. This finding coincides with the results of Enwerem and Okunji's study in which nurses with ≥20 years of experience observed more FDI during their clinical practice, thus, nurses' awareness levels of FDI increased with experience.[24]

The theoretical knowledge level of newly graduated nurses is expected to be higher. El-Lassy and Ouda reported in their study that nurses with less than 10 years of professional experience had higher levels of knowledge on FDI.[31] In our study, no difference was found between the total working time of the nurses in their profession or their units and their level of knowledge on FDI. This finding was consistent with other studies showing that professional experience did not provide expertise at the knowledge level of FDI.[17,18,24] Similarly, Enwerem and Okunji did not detect a difference between the knowledge levels of nurses working in different units on FDI.[30] The fact that more than half of the nurses (54.3%) participating in any training related to FDI after graduation (course, congress, seminar, etc.) in our study may have had an impact on this situation.

Genetic variation in enzymes responsible for the biotransformation of drugs in the body can alter drug exposure in the body. This variation appears to be an important factor that should be combined with variants important in nutritional and pharmacological interventions and should be taken into account in the drug prescription or administration process.[5] In our study, the first two interventions most frequently used by nurses to prevent FDI were not putting drug hours at the same time with the foods that could interact, and observing the patient's response to the drug. Similarly, Oğuz et al. stated that 66.7% of the nurses questioned both food-drug and drug-drug interactions before drug administration, and only 42% of the nurses reported side effects that developed in the patient after drug administration.[32] It is seen that

nurses act in accordance with the principles of safe administration of medicine and the rational use of medicine.

In order to identify potential problems in optimizing patient prescriptions and drug dosing on an individual basis and increasing the benefit-risk ratio of the treatment, in addition to a comprehensive and detailed health history, the individual's diet should also be considered.[8] In our study, nurses who do not put the drug hours at the same time with the foods that may interact in order to avoid FDI and who use academic databases on FDI had higher knowledge of FDI. Jarosz and Wolnicka reported in their study that 47.6% of the patients were unaware that the time of taking medication according to meals may affect their treatment.[7]

LIMITATIONS

It is important to point out some possible limitations of this study. The most obvious one is that nurses participating in the study work in a university hospital. The fact that the study results can not be compared with nurses working in private hospitals, other public hospitals or primary health care institutions limits the generalizability of the study results.

CONCLUSION

The findings of the study showed that the nurses' knowledge level of FDI was satisfactory, and that only 2 of the 10 nurses had a low knowledge level of FDI. In practice, it is observed that not giving drugs and foods that may interact at the same time and using academic databases increased nurses' knowledge level of FDI. This study has implications in several aspects. First of all, the study findings can be used to design appropriate educational interventions to increase nurses' knowledge level of FDI. Secondly, training programs and clinical guidelines to be developed on this subject into clinical-decision support systems can help nurses in the correct management of FDI in the prognosis of diseases and in ensuring patient safety by preventing risks. In this context, it may be beneficial to include courses on FDI in the pregraduate curriculum and to keep the information up-to-date with in-service training after graduation. Moreover, nurses' awareness of potential FDI will increase with the increase of their knowledge level of FDI, and their constant caution will increase the possibility of encountering FDI and intervening early when encountered.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Pınar Duru, Özlem Örsal, Hilal Çelik; *Design:* Pınar Duru, Özlem Örsal, Hilal Çelik; *Control/Supervision:* Pınar Duru, Özlem Örsal; *Data Collection and/or Processing:* Hilal Çelik; *Analysis and/or Interpretation:* Pınar Duru; *Literature Review:* Pınar Duru, Hilal Çelik; *Writing the Article:* Pınar Duru; *Critical Review:* Özlem Örsal, Hilal Çelik; *References and Fundings:* Pınar Duru, Özlem Örsal, Hilal Çelik.

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