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Original Research

Cross-Sectional Assessment of Pharmacy Students' Knowledge and Perception of Drug-Drug Interactions with Over the Counter Products

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Abstract

Background: Self-medication with over-the-counter products has dramatically increased following coronavirus disease of 2019 pandemic. For safe public use of these products, Pharmacy and Doctor of Pharmacy students are expected to have proper knowledge and perception towards these products dispensing and associated interactions. **Objectives:** A cross-sectional survey was developed to assess Pharmacy and Doctor of Pharmacy students' knowledge and perception towards drug interactions of over the counter products. **Methods:** Data were collected using a self-administered questionnaire and statistically analyzed. Descriptive statistics (frequency) were analyzed for participants' demographics. Multivariable logistic regression analysis was used to determine the association between over the counter products and relevant interactions with medications to treat chronic illnesses. A P value < 0.05 was used to determine statistical significance. **Results:** Responses were 411 and only 389 were included. 76.6% were studying Bachelor of Pharmacy and 86.1% were on a regular study program. Recipients of Pharmacy training were 65.3% and 62.0% of participants studied over the counter course. Orphenadrine muscle relaxant was the mostly identified over the counter product (n= 339, 87.1%). Majority of students (n= 345, 88.7%) consider that OTC products help improving conditions being dispensed for. Bridging students and those who studied over the counter course showed significant knowledge in drug interactions compared to regular-program students and those who did not complete the course (P= 0.004, P< 0.001, respectively). Of the 389 respondents, 79.9% and 79.2% considered hydrochlorothiazide and metformin as over the counter products, respectively, compared to 54.0% for amoxicillin. **Conclusion:** College of Pharmacy students showed moderate knowledge towards drug interactions of over the counter products. This warrant the necessity to shed the light on inclusion of drug interactions Pharmacy curriculum and to include reliable applications to help in checking drug interactions before dispensing and to emphasize on distinguishing in between prescription and non-prescription medications.

Keywords: over the counter drugs; drug interactions; pharmacy education

INTRODUCTION

Drug-drug interactions (DDIs) can be defined as an alteration in drug effect due to pharmacokinetic and/or pharmacodynamic changes by another co-administered perpetrator drug, supplement, herbal preparations, or device.[1] The possibility of DDI increases with age when individuals become in need for multiple drugs due to many health conditions, *i.e.* polypharmacy.[2] The effects of DDI might range from diminished therapeutic effects to potentially life-threatening conditions and adverse events (AEs).[2,3] Several factors play a substantial role in developing DDIs, such as impaired renal and/ or hepatic functions, wrong choice of the drug and/or route of administration, incorrect dose administration, and dispensing errors.[2-4]

Over-the-counter (OTC) drugs and pharmaceutical preparations, henceforth, OTC products are considered the ones dispensed without needing a medical prescription to treat minor symptoms such as seasonal allergy, rhinitis, fever, cough, heartburn, or to boost immunity *etc*.[5] According to Jordan Food and Drug Administration (Jordan FDA), drugs and pharmaceutical preparations at certain concentrations that act as analgesics, antipyretics, weight management, and herbal products could be dispensed without a prescription.[6] For instance, aacetaminophen (paracetamol), diclofenac, orlistat, loratadine, cetirizine, ambroxol, and herbal preparations of *Ginseng* or *Ginkgo biloba* are examples of the Jordan FDA approved OTC products.[6]

A systematic review conducted by *Jeremy Y. Ng* and colleagues demonstrated insufficient knowledge and confidence by pharmacists in herbal and dietary supplement counseling and dispensing, primarily due to lack of education in the field. [7] Conversely, pharmacists' intervention to minimize the possibility of DDI or drug-herb interaction proved efficient in a Hungarian study either by patient education, informing the general practitioner, or independently solving the interaction

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issue. [8]

In Jordan, Pharmacy programs such as the Bachelor of Pharmacy or Doctor of Pharmacy program curriculum include an obligatory module about dispensing OTC products. [9] However, this module might not cover all aspects of OTC medications in counseling, dispensing, and common DDI. Accordingly, this research aims to assess final year's students' knowledge and perception of potential DDI among commonly dispensed OTC products and drugs used to treat chronic illnesses. A cross-sectional survey was designed for this purpose, focusing on orally administered OTC products due to their systemic effects, especially analgesics, antipyretics, cough syrups, antacids, and antihistamines owing to their widespread use in Jordan and their interaction with commonly prescribed medications to treat chronic illnesses such as hypertension and diabetes. [9-11] This study aims to assess Pharmacy and Doctor of Pharmacy final years' students' knowledge and perception toward potential DDIs perpetrated by commonly dispensed OTC products. Another aim was to evaluate students' ability to identify prescription from non-prescription medications.

METHODOLOGY

A cross-sectional observational survey was developed to assess Pharmacy and Doctor of Pharmacy's knowledge and perception of students' knowledge and perception towards potential DDI perpetrated by commonly dispensed OTC products. Literature assessment was conducted for validated surveys and commonly dispensed OTC products and prescribed medications in Jordan.[9,12,13] The DDIs were assessed using Drug bank interaction checker tool® and relevant literature data.[14] Ethical approval to conduct the study was obtained from Zarqa University Ethics Committee for Scientific Research with approval number (2/4/2022). Informed consents were provided to study participants prior to data collection ensuring that participation is voluntary and participants can withdraw at any stage, with their answers being treated confidentially and anonymously.

The questionnaire was designed using Google forms® to collect data from students with a minimum target sample size of 385 subjects that was determined.[9,12] Using an online calculator with a margin of error (d) of 5%, confidence level of 95%, and a response distribution (P) of 50%, the sample size was determined after estimating the total number of Pharmacy and Doctor of Pharmacy students at Jordanian Universities.[15] The questionnaire covers the socioeconomic background of the participants to collect demographic. The collected data was statistically analysed for data interpretation. The questionnaire was designed to measure the perception of Pharmacy students' towards OTC products indications, knowledge of potential DDI among prescription and non-prescription medications.

The questionnaire was piloted to check for content validity and reliability *via* obtaining the feedback of academics (n= 5) expert in observational studies and students (n= 5). Then, the questionnaire was modified, taking into account the feedback received from the pilot sample. Experts commented on the wording, clarity, and comprehensiveness of the questionnaire items and whether each item was relevant to the study's aims and objectives. The academic experts' feedback and comments were reviewed by the authors and used to refine the questionnaire. Data used for piloting were not included in the final analysis. The questionnaire was translated from English to Arabic and back by two academics who are fluent in both languages. The questionnaire consists of six sections; the first one includes a brief introduction about the research objectives and research team in addition to the consent form to participate in this study. The second section consists of 12 questions and collects data about participants' demographics (gender, age, marital status, speciality, year of study, location and type of university (public or private), student status (regular or bridging), recipient of Pharmacy training, studied OTC module and if having OTC module in the curriculum. The third part consists of five questions and was designed to evaluate participants' knowledge of OTC products' types and indications, in addition to their source of knowledge about OTC products' interactions. The fourth part assessed students' knowledge of OTC products' interactions with commonly prescribed medications for chronic illnesses (*i.e.* warfarin, Angiotensin-converting enzyme (ACE) inhibitors, Angiotensin receptor blockers (ARBs), tricyclic antidepressants (TCA), Selective serotonin reuptake inhibitor (SSRIs), metformin, Sulfonylureas and Dipeptidyl Peptidase IV Inhibitors. A prototype drug from each class was mentioned to help students' recognize the class. Eleven OTC products were selected to evaluate the knowledge for their interactions (*i.e*. orlistat, diclofenac, paracetamol, ambroxol, pseudoephedrine-containing products, cetirizine, loratadine, famotidine, fish oil, *ginseng*, and *ginkgo biloba*). It is noteworthy that some of these OTC products are found only in combination with other medications such as pseudoephedrine. The fifth part evaluated students' perception of potential interactions perpetrated by OTC products and consisted of two questions with likert scale ranging from strongly agree to strongly disagree. The final part assessed students' practices to check DDIs and consisted of three questions. The questionnaire was distributed both in an online format on students' academic groups supervised by their academic institutions and in paper format disseminated in classrooms to ensure accessibility. Students were informed that it takes about 20 to 30 minutes to fill out the questionnaire. The data was collected between May and July 2022.

Statistical analyses

Data were analyzed using the statistical package for social science (SPSS) version 22 (SPSS Inc., Chicago, IL, USA). Frequency/percentage was utilized for qualitative variables. Univariate and multivariate linear regression analyses were conducted to screen for the independent factors affecting students' knowledge about DDIs. Following univariate linear regression, any variable with a P-value < 0.250 was considered eligible for entry in multivariate linear regression analysis. All variables were checked for any absence of multicollinearity before performing multivariate linear regression analysis (*i.e*., Pearson correlation coefficient <0.9 for any two variables). A P-value of ≤0.05 was deemed statistically significant when identifying factors affecting students' knowledge about DDIs.

RESULTS

During the study period, 411 responses were collected but only 407 students agreed to take part in this study. Only 389 responses were completed and included in the statistical analyses. Students have a median age of 22.0 years (interquartile range, IQR= 1.0), and around three-quarters of them were females (n= 298, 76.7%). The majority of students were single (n= 350, 90.0%), and most of them were classified as registering in a regular Pharmacy program (n= 335, 86.1%), whereas the rest were bridging who pursued their undergraduate studies following a two-year diploma degree in pharmaceutical studies. Additionally, around three-quarters of the students were studying bachelor of Pharmacy (n= 298, 76.6%), and more than half of them were in their fifth year of the study (n= 207, 53.2%). Furthermore, 59.4% of the students (n= 231) were from public universities. The full students' sociodemographic characteristics are described in Table 1.

Regarding the study curricula of the participating students (Table 2**),** results showed that around two-thirds of the students (n= 254, 65.3%) received pharmacy training as a requirement in their bachelor's degree until the time of conducting this study. Moreover, the majority of students (n= 387, 99.5%) reported that an OTC course is included within their study curricula. OTC course was classified to be compulsory in the studying curricula as reported by 95.3% of the students (n= 372). Moreover, 62.0% of the students (n= 241) have completed their OTC course at the time of the questionnaire filling.

With reference to participants' knowledge of OTC products 'indications (Figure 1), pain relief medications (n= 365, 93.8%), cough relief medications (n= 350, 90.0%), and nutritional supplements (n= 342, 87.9%) were the main indications identified correctly by the respondents for which OTC products are used.

Regarding Pharmacy students' ability to identify different OTC products and preparations (Table 4), muscle relaxants such as orphenadrine was the most commonly identified OTC product by the study participants (n= 339, 87.1%), followed by decongestants such as pseudoephedrine and triprolidine (n= 333, 85.6%), and herbal preparations (323, 83.0%). While weight management medications such as orlistat were the least identified OTC products (n= 162, 41.6%).

Participants were asked to identify the presence or absence of possible DDIs between certain prescription medications and OTC products (Table 5). The highest knowledge score was encountered in students' knowledge of paracetamol interactions, however, it did not exceed 53.5%.

Participants were asked about their opinion regarding OTC products and associated DDIs (Figure 1). Results showed that the majority of students (n= 345, 88.7%) consider that OTC products helped in improving conditions being dispensed for. In addition, most of the participants (n= 339, 87.1%) believed that OTC products can cause adverse drug events. Also, 85.9% of them (n= 334) believed that OTC products can cause DDIs or drug-herb interactions. Only 19.8% of the students (n= 77) agreed that patients should continue with the common doses of OTC products because there is no possibility of DDI, and 26.2% of them (n= 102) thought that OTC products are safe when used in combination with prescription medications.

Finally and most importantly, results revealed that bridging students, and those who have studied OTC course showed better knowledge score compared to other students (P ≤0.05) (Table 6**)**. The multiple linear regression model explained 7.5% (R^2) of students' awareness about OTC products DDIs.

Table 1. Sociodemographic characteristics of the study participants (n= 389)

Parameters	Median (IQR)	n (%)
Age (years)	22.0 (1.0)	
Gender		
○ Male		91 (23.4)
○ Female		298 (76.6)
Marital status		
○ Married		34 (8.7)
○ Single		350 (90.0)
○ Others		5 (1.3)
Specialty		
○ Bachelor of Pharmacy		298 (76.6)
○ Doctor of Pharmacy		91 (23.4)
Year of study		
○ Third		12 (3.1)
○ Fourth		150 (39.8)
○ Fifth		207 (53.2)
○ Sixth		15 (3.9)
Type of university		
○ Public		231 (59.4)
○ Private		128 (40.6)
Student status		
○ Regular		335 (86.1)
○ Bridging		54 (13.9)

IQR: Interquartile range

Table 2. Study curricula related information of the study participants (n= 389)

Parameters	n (%)
Have you received pharmacy training as one of the requirements for the Bachelor's degree?	
○ Yes	254 (65.3)
○ No	34 (8.7)
○ In progress	53 (13.6)
○ Not yet	48 (12.3)
Does your Bachelor of Pharmacy or Doctor of Pharmacy curriculum include an OTC course?	
○ Yes	387 (99.5)
○ No	2 (0.5)
In your curriculum, which category of courses is the OTC course classified?	
○ Compulsory	372 (95.6)
○ Optional	10 (2.6)
○ I don't know	5 (1.3)
○ Not applicable	2 (0.5)
Until the time of filling out this questionnaire, have you studied the OTC course?	
○ Yes	241 (62.0)
○ No	105 (27.0)
○ In progress	41 (10.5)
○ Not applicable	2 (0.5)

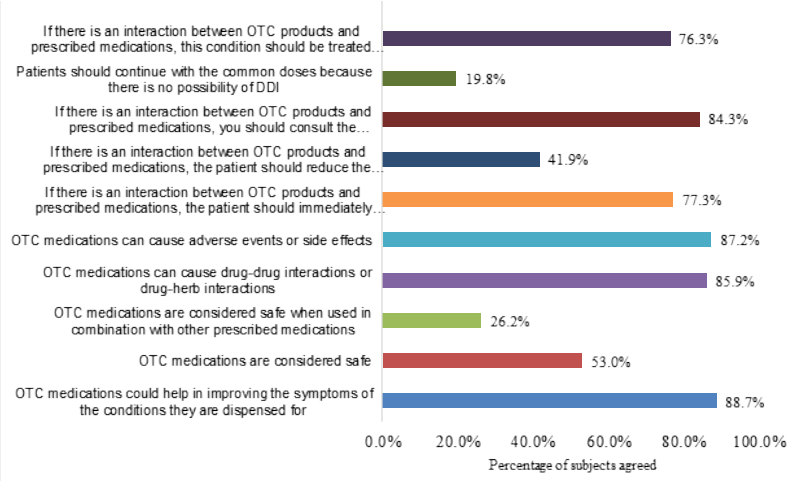

Figure 1. Pharmacy students' perception regarding OTC medications and associated DDIs (n= 389). OTC: over the counter medications. DDIs: Drug-drug interactions

Table 3. Assessment of pharmacy students' knowledge of OTC products' indications (n= 389)

Indication	Correct answer n (%)
Weight management[1]	234 (60.2)
Pain management[1]	365 (93.8)
Cough relief[1]	350 (90.0)
Allergy management[1]	326 (83.3)
Cold and flu symptoms alleviation[1]	336 (86.4)
Insomnia management[1]	211 (54.2)
Heartburn relief[1]	309 (79.4)
Diarrhea or constipation management[1]	338 (86.9)
Nutritional supplementation[1]	342 (87.9)
Muscle relaxation[1]	277 (71.2)
Treatment of infections[2]	203 (52.2)
Hypertension[2]	318 (81.7)
Diabetes[2]	317 (81.5)
Immunity boosting[2]	98 (25.2)

1: The answer is True, 2: The answer is false

Table 4. Assessment of pharmacy students' ability to identify the different OTC products and preparations (n= 389)

Preparation	Correct answer n (%)
Weight management medications such as orlistat[1]	162 (41.6)
Non-steroidal anti-inflammatory drugs such as diclofenac and ibuprofen[1]	298 (76.6)
Cough syrups such as ambroxol and bromhexine[1]	320 (82.3)
Anti-allergics such as cetirizine, loratadine and xylometazoline[1]	315 (81.0)
Herbal preparations such as ginseng extract, *Ginkgo biloba* extract, cranberry[1]	323 (83.0)
Heart burn medications such as famotidine[1]	311 (79.9)
Decongestants such as pseudoephedrine and triprolidine[1]	333 (85.6)
Muscle relaxants such as orphenadrine[1]	339 (87.1)
Antibiotics such as amoxicillin[2]	210 (54.0)
Anti-hypertensive agents such as hydrochlorothiazides[2]	311 (79.9)
Anti-diabetic agents such as metformin[2]	308 (79.2)

1: The answer is True, 2: The answer is false

Table 5. Pharmacists awareness of possible DDIs between certain prescription and OTC products (n= 389)

OTC products	Warfarin	ACEIs	ARBs	TCAs	SSRIs	Metformin	Sulfonylureas	DPP4 inhibitors
	Correct answers n (%)							
Orlistat	137 (35.2)[a]	95 (24.4)[b]	104 (26.7)[b]	84 (21.6)[b]	78 (20.1)[b]	90 (23.1)[b]	72 (18.5)[b]	66 (17.0)[b]
Diclofenac	178 (45.8)[a]	153 (39.3)[a]	144 (37.0)[a]	76 (19.5)[a]	62 (15.9)[a]	62 (16.2)[a]	66 (17.0)[a]	61 (15.7)[a]
Paracetamol	90 (23.1)[a]	208 (53.5)[b]	203 (52.2)[b]	46 (11.8)[a]	43 (11.1)[a]	204 (52.4)[b]	177 (45.5)[b]	138 (35.5)[b]
Ambroxol	94 (24.2)[b]	123 (31.6)[b]	119 (30.6)[b]	103 (26.5)[b]	104 (26.7)[b]	132 (33.9)[b]	105 (27.0)[b]	97 (24.9)[b]
Pseudoephedrine	153 (39.3)[b]	134 (34.4)[a]	123 (31.6)[b]	95 (24.4)[a]	86 (22.1)[a]	72 (18.5)[a]	56 (14.4)[a]	61 (15.7)[a]
Cetirizine	111 (28.5)[a]	134 (34.4)[b]	137 (35.2)[a]	87 (22.4)[a]	73 (18.8)[a]	57 (17.4)[a]	135 (32.1)[b]	102 (26.2)[b]
Loratadine	114 (29.3)[b]	189 (38.3)[b]	137 (35.2)[b]	75 (19.3)[a]	105 (27.0)[b]	151 (38.8)[b]	53 (13.6)[a]	111 (28.5)[b]
Famotidine	127 (32.6)[a]	74 (19.0)[a]	132 (33.9)[b]	68 (17.5)[a]	55 (14.1)[a]	66 (17.0)[a]	124 (31.9)[b]	103 (26.5)[b]
Fish oil	153 (39.3)[b]	67 (17.2)[a]	56 (14.4)[a]	46 (11.8)[a]	126 (32.4)[b]	59 (15.2)[a]	44 (11.3)[a]	44 (11.3)[a]

Ginseng	175 (45.0)[a]	96 (24.7)[b]	79 (20.3)[b]	97 (24.9)[b]	91 (23.4)[b]	119 (30.6)[b]	109 (28.0)[b]	100 (25.7)[b]
Ginkgo biloba	177 (45.5)[a]	103 (26.5)[b]	102 (26.2)[a]	85 (21.9)[a]	90 (23.1)[b]	122 (31.4)[b]	62 (15.9)[a]	89 (22.9)[b]

a: interaction present, b: interaction not present. ACEIs: Angiotensin Converting Enzyme Inhibitors, ARBs: Angiotensin Receptor Antagonists, TCAs: Tricyclic Antidepressants, SSRIs: Selective Serotonin Reuptake Inhibitors, DDP4: Dipeptidyl Peptidase IV inhibitors.

Table 6. Assessment of factors associated with pharmacy students' awareness about drug-drug interactions (n= 389)

Parameter	Beta	P-value#	Beta	P-value$
Age (years)	0.075	0.139^	-0.051	0.429
Gender ○ Male ○ Female	Reference -0.090	0.075^	-0.030	0.566
Marital status ○ Married ○ Others	Reference -0.086	0.089^	-0.033	0.575
Specialty ○ Bachelor of Pharmacy ○ Doctor of Pharmacy	Reference -0.230	<0.001^	-0.095	0.129
Year of study ○ Third or fourth ○ Fifth or sixth	Reference 0.057	0.262	----	----
Type of university ○ Public ○ Private	Reference 0.161	0.001^	0.028	0.623
Student status ○ Regular ○ Bridging	Reference 0.144	0.004^	0.134	0.028*
Received pharmacy training as part of the BSc curriculum ○ No ○ Yes	Reference -0.016	0.753	----	----
Studied OTC course ○ No ○ Yes	Reference 0.239	<0.001^	0.185	0.002*

using simple linear regression, $ using multiple linear regression, ^ eligible for entry in multiple linear regression, * significant at 0.05 significance level. BSc: Bachelor of Science

DISCUSSION

In recent years, financial hardships have emerged drastically leading to an increase in self-medication practices in addition to long waiting times at primary clinics, thus, increasing the possibility of medication errors besides DDIs. [16-18] Moreover, COVID-19 pandemic led to an increase in self-medication, especially, those deemed to boost immunity. [19, 20] A recent study from Jordan reported a percentage of 57.2 self-medication with antibiotics without a prescription and only 34.8% (n= 1928) received information from pharmacists about antibiotic use. [21] Consequently, this could potentially lead to antibiotic resistance development. Furthermore, the nascence of full electronic medical records for patients at community pharmacies and the paucity of full medication history would increase the risk of being a victim of DDI, even when using OTC products, this risk might be enhanced due to the lack of reliable drug information resources that could be used by pharmacists who are in direct contact with patients visiting the community pharmacies. [22, 23] Accordingly, this study aimed at assessing pharmacy students' knowledge and attitude of possible DDIs among commonly prescribed medications in Jordan and OTC products as classified by the Jordan FDA.

Most of Pharmacy colleges across Jordan offer obligatory OTC module in their curricula that would equip students with necessary skills to patient counselling as well as clinical reasoning when dispensing OTC products. [24] This module would also introduce different types of OTC medications and pharmaceutical preparations with recommended doses and relevant indications. Despite students informed that their undergraduate studies is the main source for their knowledge of common DDIs (n= 337, 86.6%), the results this study has reported in terms of students' knowledge of possible DDIs were not highly promising. The highest percentage received was only 53.5 for those who identified paracetamol interactions with ACEIs. This could be due to the fact that paracetamol being the most commonly dispensed OTC medication in Jordan so students might have read about its potential DDIs. [16] This small percentage could be justified by the fact that the OTC module at most Pharmacy colleges is only 2 credit hours delivered weekly for approximately 14 weeks and covering at best 10 different topics which is considered remarkably short to confer

all relevant DDIs. [24]

Majority of respondents believe that OTC products could cause DDI or drug-herb interactions (85.9%, n= 389) and should consult the healthcare provider in case of interactions possibility (84.3%, n= 389). These data suggests that pharmacy students are highly aware of OTC products as perpetrators to DDI. [25] On the other hand, 88.7% of students considers OTC products effective in improving the conditions they are dispensed for which is quite high percentage compared to a previous cross-sectional study conducted at Queens' University Belfast in which 68% (n= 153) of study participants reported their willingness to sell an OTC product despite lack of evidence on its effectiveness [26]. In contrast to the findings of *Bekele et. al*, 53% of our study participants thinks that OTC products are safe compared to 29.2% in previous studies.[17] This discordance could be due to the generalizability of the statement "OTC products are considered safe" while not indicating what OTC product is referred to in the previously mentioned statement.

Unsurprisingly, bridging students who had a prior pharmacy two-years diploma showed better knowledge of common DDIs compared to regular system students (P= 0.028). Factors contributing to their better score could be ascribed to the fact that these students have received pharmacy training as a prerequisite for pharmacy two-year diploma, which might have potentially given them the chance to be exposed to different cases at the pharmacy. Additionally, most of bridging students work as pharmacy assistants at different community pharmacies and hospitals while commencing their Bachelor degree in Pharmacy. Despite the short time available to deliver OTC module, students who studied OTC module by the time of filling out the questionnaire significantly showed better knowledge of possible DDI compared to other study participants (P= 0.002). This could be ascribed to the integrated teaching system as well as team-based learning being implemented to deliver OTC module at almost all Pharmacy colleges across Jordan in which students are requested to perform many assignments and home works relevant to OTC products.[24]

In agreement with *Gilligan et. al* findings about Pharmacy students' retention of DDIs following 1 year assessment, students' showed poor retention of DDIs knowledge (P= 0.04).[27] The humble knowledge of pharmacy students about OTC products common DDIs encourages the importance of not relying on memorizing these DDI while providing counselling services as well as introducing the need for telemedicine and free access to drug information resources at community pharmacies, especially in less privileged healthcare systems to support pharmacists in charge of patients counselling by minimizing the risk of DDIs and AEs development.[23]

In Jordan, there is no rigorous regulation to prohibit dispensing prescription medications without a prescription so far despite their presence. A study conducted by *Almaaytah* and colleagues demonstrated 74.3% (n= 202) antibiotic non-prescription dispensing pattern at community pharmacies in Jordan.[28] This led to an unjustified increase in dispensing medications such as antihypertensives (*e.g*. hydrochlorothiazide), anti-diabetic (*e.g*. metformin) and antibiotics (*e.g*. amoxicillin) without a prescription.[28] These practices might be the reason that students did not properly identified the above mention medications as non-OTC products. Continuing education to community pharmacists proved efficient in improving pharmaceutical services, especially, in the management of chronic illnesses.[29]

To the best of authors knowledge, this is the first comprehensive study to assess students' knowledge of DDIs in Jordan, in which its results highlights the need for both inclusion of an elective DDI course in addition to train students to use online DDI checking tools, especially, that previous studies confirmed improvement in DDIs knowledge following educational sessions.[30,31] Limitation to this study could be the long-time needed to fill out the questionnaire which made students' sometimes hesitant to take part in the study, in addition to the drop out being encountered (4.38%, n= 411). Future studies would take into account minimizing the number of questions by dividing it to more than one questionnaire. Furthermore, assessing students' knowledge, attitudes and practices before and after using DDI checking tools.

CONCLUSION

The purpose of the current study was to evaluate Pharmacy students' knowledge and perception of DDIs perpetrated by OTC products. This study has demonstrated for the first time that bridging students who were enrolled in a two-year diploma programme before pursuing BSc in Pharmacy have better knowledge of DDIs compared to ones on regular study program. However, the overall knowledge was unsatisfactory which highlights the need for a special course focusing on DDIs besides integrating online and/or mobile application to check for possible DDIs in order to improve Pharmacy services. Additionally, a special focus should be given to distinguish between medications dispensed with or without a prescriptions to avoid drug-related problems such as anti-microbial resistance.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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AUTHORS CONTRIBUTIONS

Rana Abutaima: Study design and development. conceptualization, literature review, data collection, results interpretations, final draft of the manuscript; Rana Abufarha: Statistical analyses; Samar Thiab: Validation, results interpretation and review of the manuscript; Hamza Alhamad: Validation, results interpretation and review of the manuscript; Fares Albahar: Validation, results interpretation and review of the manuscript.

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