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Herbal supplements in Jordan: a cross-sectional survey of pharmacists' perspectives and knowledge

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ABSTRACT

Objectives Pharmacists are ideal partners for engaging with the needs and expectations of patients. They can play a vital role by providing information and supplying herbal medicines. In some community settings, pharmacists are also the main first point of care. This study explored Jordanian community pharmacists' perspectives and knowledge of herbal medicines available in pharmacies.

Design A cross-sectional study using an online survey was developed, and it was distributed via social media platforms. The one-way analysis of variance (ANOVA) test was used to compare the mean knowledge scores between different demographic groups. Multiple linear regression analysis was used to identify predictors of herbal medicines knowledge.

Setting Jordanian community pharmacies.

Participants 401 Jordanian community pharmacists.

Results Herbal supplements are sold in practically all pharmacies (98.5%). Slimming aids (14.7%), followed by sexual and sports enhancements (14%) and maintaining general health (12.1%) were most requested by Jordanian customers. While supplements for maintaining general health (12%), followed by slimming aids (11.4%) and skin conditions (9.3%) were most recommended by Jordanian pharmacists. 63.1% were not aware of potential herb–drug interactions, 95.6% did not receive complaints from customers about herbal medicines and 41.2% would not report adverse reactions to the national pharmacovigilance services. The mean knowledge score for knowledge of use, regulation, adverse reactions, and drug interactions was 3.7 (SD: 0.7), 3.5 (SD: 0.8), 3.6 (SD: 0.8), and 3.6 (SD: 0.8) (out of 5), respectively. ANOVA test showed that total pharmacists' knowledge scores significantly differed based on the length of time practising pharmacy ($p<0.05$).

Conclusion This study highlights some key concerns relating to recommendations, awareness and reporting of herbal medicines among Jordanian community pharmacists. Pharmacists need enhanced education to provide objective and evidence-based information on the benefits–risks of herbal medicines. Future studies need to be carried out to confirm whether our findings are transferable to other Middle Eastern countries.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study surveyed community pharmacists' perception, recommendation, and knowledge of the use and safety of herbal supplements. It presents the first study conducted in the Middle East assessing pharmacists' general awareness, experience with customers and views on reporting herbal supplements-related adverse reactions.
⇒ Community pharmacists are frontline healthcare professionals regularly asked to advise customers about herbal supplements.
⇒ Data collections are based on self-reporting from the pharmacist rather than direct observation. Being a self-reported questionnaire, response bias is likely.
⇒ Future qualitative studies seeking community pharmacists' perception and knowledge of herbal supplements may be needed to gauge concerns and complement our quantitative study results in the wider Middle East.

INTRODUCTION

Herbal products are used as supplements with preventive health benefits, as herbal medicines, in cosmetics and in a wide range of other products which are of medical-pharmaceutical relevance. Large sections of the population in low/middle-income countries still rely on traditional practitioners, medicinal plants and herbal medicines for their primary healthcare,[1 2] with the increasing importance of commercially available supplements and medical products. In the Middle East, diverse legislative approaches and classifications of herbal medicines were implemented in response to the public interest, market value and the potential safety issues of unregulated herbal supplements. In a global report by the WHO (2019), Jordan was reported as not currently having a national policy on the use of traditional medicine/complementary medicine (TM/CM); however, laws and regulations which had been established in 2001 were updated in 2016.[3] In addition, there are no independent national research institutes focusing on TM/CM or herbal medicines. The regulations of herbal medicines are partly the same as those for conventional pharmaceuticals. In Jordan, herbal medicines categorised as prescription medications

are sold in pharmacies (ie, with medical claims), which require a prescription, while herbal supplements sold in pharmacies and outlets as over-the-counter (OTC) products (ie, with claims on health benefits and nutrient content[4]) are dispensed by a pharmacist without needing a prescription.

In recent years, there has been an increased global interest in vitamins and herbal supplements. In 2017, their global market exceeded US$100 billion[5] and in 2021, the Europe market was worth US$19.96 billion and is estimated to reach US$26.71 billion by 2026.[6] However, this widespread use of herbal supplements might be associated with health risks related to medicinal plants' compositions, their inappropriate use/dosage or the quality of the products (eg, adulteration and contamination).[7–10] Moreover, due to the common use of these products in patients with comorbidities, interactions with prescription and OTC medications are possible, leading to a decrease in the effectiveness of pharmacological treatments or toxic manifestations.[11] The health consequences of these interactions were widely reported in both case reports and clinical studies.[12–20] Patients taking anticancer, cardiovascular and immunosuppressant medications were predominantly affected by these interactions.[21] With the lack of awareness in identifying and reporting these reactions among the public and healthcare professionals, this risk could be amplified. Among healthcare professionals, pharmacists are ideal partners for engaging with the needs and expectations of patients, and they could play a vital role by providing information and supplying herbal supplements.[10 22–32] In addition, healthcare professionals' perceptions and attitudes of these products may influence the patients' self-care decisions.

In Middle Eastern countries, such as Saudi Arabia, Jordan, Qatar and Kuwait, several studies reported relatively positive attitudes towards the role of community pharmacists. For example, in Jordan, most participants (62.7%) reported their willingness to seek pharmacists' advice when the condition was not so severe, requiring the visit of the physician.[33] In Saudi Arabia, 43% acknowledged the pharmacists' role in solving medication-related problems, 34% considered the pharmacist a healthcare provider, and 44.6% felt that the pharmacist is indispensable and an active part of the healthcare system.[34] In Qatar, most patients agreed that community pharmacists should provide them with the directions for use of the medication (93%) and advise them about the treatment of minor health conditions (79%).[35] In addition, treatment of minor health conditions, consultation on OTC medications and accuracy checking of prescription medications were among the expected duties of community pharmacists.[36]

While some publications have described the current pharmacy education in the Middle East,[37–39] no recent studies were identified on the education in pharmacognosy and phytochemistry in the pharmacy curriculum in the Middle East. However, in 2017, a study in Jordan reported that Jordanian universities have one or two pharmacognosy and phytochemistry courses in the clinical phytotherapy domain for the undergraduate BPharm and PharmD degree levels.[40] The PharmD degree level, which two public universities provide, also incorporates an additional course on the chemistry of medicinal plants with their approved therapeutic indications, dosage and precautions.[40]

With the increased use of herbal medicines in Jordan, primarily as self-medication for infertility, diabetes, dyslipidaemia and hypertension,[41–48] several significant adverse reactions and herb–drug interactions are poorly understood problems. This is exacerbated by a lack of understanding, reporting and awareness of these reactions among healthcare professionals, particularly pharmacists. To provide appropriate patient advice, the pharmacist must have good knowledge of herbal medicines, particularly those available in pharmacies.

Several studies conducted in the Middle East measure pharmacists' attitudes, knowledge and views of herbal medicines[49–51] or pharmacists' awareness of adverse reactions and herb–drug interactions of specific herbal supplements.[42 52–56] Another theme is the Jordanian pharmacists' and herbalists' opinions on education related to herbal medicines[40] and the prevalence of and awareness of the use of herbal medicines among pharmacy staff.[57] No studies focused on Jordanian pharmacists' perspective and knowledge of herbal medicines or on assessing the general awareness, experiences with customers and views on reporting of related adverse reactions. Therefore, this study aims to assess Jordanian pharmacists' knowledge of use, safety, awareness and willingness to report adverse reactions associated with herbal medicine use.

METHODS

Study design and population

Between May and July 2020, a cross-sectional online survey was conducted using social media platforms such as Facebook and Twitter, which were used to distribute the questionnaire link since social media are a valuable tool for conducting this type of data collection.[58] The study aims and objectives were clearly explained at the beginning of the survey. In addition, the participants were informed that participation in the study was completely voluntary. The study population included only pharmacists working at community pharmacies in Jordan.

Sample size calculation

Of the 24747 licensed pharmacists working in Jordan, 7525 are estimated to work in community pharmacies. The minimum recommended sample size for our survey study was calculated using the Raosoft sample size calculator ($n=Nx/(n-1)\ E2+x$), where n is the sample size required, N is the population size, x is the CI, which was considered to be 95%, and E is the margin of error, which is 5%.

The minimum recommended sample size was calculated to be 366. Therefore, in our study, the questionnaire link was kept open until 467 responses were collected to ensure that sufficient eligible participants would be included.

Patient and public involvement

The aim of this study was to explore Jordanian community pharmacists' perspectives and knowledge of herbal medicines available in pharmacies. The target population of this study was community pharmacists. At the design of the study, we decided that the input of pharmacists and their associations was the most important basis for developing the study. Although there was no direct involvement of patients or the public in the design, or conduct, or reporting, or dissemination plans of our study, the outcomes could potentially benefit the public by enhancing the safe and evidence-based use of herbal medicines. The results of this study will be freely available to participants via publication.

Development of survey questionnaire

The survey questionnaire was developed based on extensive literature review to gather pharmacists' views, knowledge, and practices in relation to the herbal medicines and supplements available in pharmacies[22–24 59 60] and from a previous survey study conducted in another Middle Eastern country.[61] The online questionnaire comprised five main sections with 19 questions covering the following components:

A. Participants' demographic data, such as age, gender, the university from where they graduated, qualifications, place of practice, length of time practising pharmacy, and degree or further training on herbal medicine.
B. Five questions covering uses, recommendations of herbal medicines and pharmacists' advice on these products. The response for this part was provided in the form of 'yes and no' for the advice question and in the form of a 7-point rank order: 1=most requested/recommended; 7=least requested/recommended for the use and recommendation questions.
C. Two questions designed to determine views and recommendations of herbal medicines in minor or long-term conditions. The response for this part was provided in the form of 'yes', 'no' and one answer option to select from (eg, herbal medicine, OTC medication, both or others).
D. Four questions, including self-assessed knowledge about uses, regulations, adverse reactions and drug interactions of herbal medicines. The response for this part of the questionnaire was provided in the form of a 5-point Likert scale that ranged from excellent to terrible, with the value of 1 assigned to the response 'terrible' and 5 to the response 'excellent'. Based on the use of Likert scale, the maximum obtainable self-assessed knowledge score for the four dimensions is 20.
E. Three questions based on pharmacists' practices towards experiences, awareness and reporting of adverse reactions relating to herbal medicines. The response for this part was provided in the form of 'yes' and 'no'.

The questionnaire took, on average, 10–15 min to complete. To minimise any misunderstanding between the terms of 'herbal medicine/supplements' and 'OTC' medication/drugs by the participants, the terms were clearly defined on the first page of the questionnaire. The questionnaires' content was reviewed, and it was piloted with five pharmacists who are native Arabic speakers and are practising pharmacy in the Middle East (eg, Jordan, Iraq, Kuwait, Lebanon and Saudi Arabia) and those whose first language is not English. This was explored to test the clarity and the logical flow of the questionnaire and since the questionnaire was not in Arabic, which is the first language in the country of research (ie, Jordan).

Statistical analysis

The SPSS software, V.26, was used to analyse the results. Descriptive statistics were used to describe demographic data, using percentages and frequencies to express categorical variables. Kolmogorov-Smirnov, Shapiro-Wilk tests and histogram were used to check the normality of the data, which showed that the data are normally distributed. Pharmacists' knowledge scores were interpreted as a continuous scale based on the scale midpoint (10 out 0f 20), where scores above the midpoint identified better knowledge about herbal medicines. The one-way analysis of variance (ANOVA) test was used to compare the mean knowledge scores between different demographic groups. Multiple linear regression analysis was used to identify predictors of herbal medicine knowledge.

RESULTS

Participants' characteristics

A total of 467 responses were obtained from distributing the survey link through social media. Of those, 58 were excluded as they did not meet one or more of the inclusion criteria (ie, Jordanian pharmacists currently practising pharmacy in other Middle Eastern countries). In addition, a further eight responses were also excluded as the participants only provided the demographic information and no data on the survey as such, leaving a total of 401 surveys for analysis. These 401 are practising community pharmacy in Jordan (for demographic details, see table 1).

The uses and advice on herbal supplements

Nearly all (98.5%) of the participants reported the availability of herbal supplements in their community pharmacies. Three hundred and eight (76.8%) of the participants reported that their customers ask for herbal supplements with those promoted were for weight loss (slimming aids) (14.7%), followed by supplements for sexual and sports enhancements (14%) and maintaining general health (12.1%) being customers' most commonly

Table 1 Characteristics of study participants (n=401)

Characteristics	Frequency (%)
Gender	
Male	223 (55.6)
Female	178 (44.4)
Age (years)	
21–30	258 (64.3)
31–40	94 (23.4)
41–50	38 (9.5)
51–60	11 (2.7)
Over 61	0
Qualifications (highest level)	
Bachelor's in pharmacy or diploma	379 (94.5)
Masters	18 (4.5)
PharmD	3 (0.7)
PhD qualifications	1 (0.2)
Institution/university they graduated from (n=380)	
Governmental universities	
University of Jordan	96 (24.3)
Jordan University of Science and Technology	20 (5.1)
The Hashemite University	5 (1.3)
Mutah University	4 (1.0)
Al-Balqa Applied University	3 (0.8)
Private universities	
Al-Isra University	112 (28.4)
Al-Zaytoonah University	46 (11.6)
University of Petra	23 (5.8)
Al-Ahliyya Aman University	22 (5.6)
Al-Zarqa Private University	12 (3.0)
Applied Science Private University	7 (1.8)
Middle East University	7 (1.8)
Philadelphia University in Jordan	5 (1.3)
Amman Training Centre	5 (1.3)
Jerash University	3 (0.8)
Others	9 (2.7)
Non-Jordanian universities (n=15)	
One University	9 (2.3)
Al-Khawarizmi University	2 (0.5)
Al-Quds University	2 (0.5)
Al-Karak University	2 (0.5)
Length of time practising pharmacy (years)	
1–10	351 (87.5)
11–20	36 (9.0)
21–30	12 (3.0)
Over 31	2 (0.5)
Degree/further training on herbal medicines	
Yes degree/further training	13 (3.2)
No degree/further training	388 (96.8)

requested supplements. Other categories were supplements promoted to treat chronic and acute health conditions, skin conditions, relieve stress and dissatisfaction with prescription medications and were the least ranked categories requested by Jordanian customers (n=298) (table 2).

Three hundred and nine (78.2%) of the participants said they would recommend herbal supplements to their customers (n=300) with supplements promoted for maintaining general health (12%), followed by slimming aids (for weight loss) (11.4%) and skin conditions (9.3%) being study participants' most commonly recommended. In addition, supplements for sexual and sports enhancements (9.1%) ranked fourth among the categories. Other categories were supplements promoted to treat chronic and acute health conditions, dissatisfaction with prescription medications and relief of stress and were ranked the least recommended categories by the participants (table 3). In general, there are some differences with respect to what is being sold versus what is being recommended by the participants. As for advice, 376 (96.9%) participants reported advising customers about the safety of herbal medicines (n=388).

Views and recommendations of herbal supplements

Half of the participants (50.4%; n=194) would recommend OTC medications for minor health conditions, while roughly one-third (35.1%; n=135) said they would recommend herbal medicines. A total of 14.3% (n=55) of the participants said their recommendation is based on the minor health condition and 0.3% for others (n=385).

When participants were asked about their recommendations to customers with long-term conditions, 83.6% (n=321) said they would not recommend the concomitant use of herbal medicines and prescription medications. In comparison, 16.4% (n=63) said they would recommend the concomitant use of herbal medicines and prescription medications (n=384).

Knowledge of herbal supplements

Among those who completed the knowledge of use of herbal medicines question (n=386), 63.2% reported 'good' knowledge, while for knowledge of regulation (n=385), 56.4% claimed to have 'good' knowledge on regulation. Furthermore, on knowledge of adverse reactions, 56.1% said they acquire 'good' knowledge, and for knowledge of herb–drug interactions (n=384), 56.8% said they have 'good' knowledge (table 4).

The mean knowledge score for the participants was 14.2 (SD: 2.8) out of 20 (which is equal to 71.0% out of the total score). The mean knowledge score for knowledge of use, knowledge of regulation, knowledge of adverse reactions, and knowledge of drug interactions was 3.7 (SD: 0.7), 3.5 (SD: 0.8), 3.6 (SD: 0.8), and 3.6 (SD: 0.8) (out of 5), respectively. ANOVA test showed that total pharmacists' knowledge scores significantly differed based on length of time practising pharmacy ($p<0.05$), indicating those with 11–20 years of experience had the highest

Table 2 Categories of herbal supplements as requested by the Jordanian customers (n=298)

	Most requested	2nd choice	3rd choice	4th choice	5th choice	6th choice	Least requested
Maintenance of general health	12.1%	20.8%	22.1%	19.8%	13.1%	6.7%	5.4%
Dissatisfaction with prescription medications	5.7%	11.4%	21.1%	21.8%	13.1%	13.8%	13.1%
For treatment of acute & chronic health conditions	5.4%	9.0%	18.1%	22.7%	10.0%	17.7%	17.1%
To relieve stress	6.7%	16.4%	17.1%	18.4%	15.7%	11.4%	14.4%
For weight loss	14.7%	17.7%	21.7%	18.7%	12.7%	5.7%	9.0%
For sexual & sports enhancement	14.0%	21.4%	21.7%	14.4%	14.7%	6.4%	7.4%
For skin conditions	5.4%	12.7%	19.1%	19.1%	15.4%	13.4%	15.1%

Measured on a 7-point rank order: 7=least requested; 1=most requested.

knowledge scores, followed by those with 21–30 years of experience, then those with 1–10 years of experience. Multiple linear regression analysis showed that having a PhD qualification is associated with a lower knowledge score (p<0.001) (table 5).

Awareness and reporting of adverse reactions related to herbal supplements

Out of all 385 participants who completed the question, 243 (63.1%) of participants were not aware of interactions between herbal medicines and prescription medications. In contrast, only 142 (36.9%) were aware of these possible interactions. Very few participants provided examples of herbs with the potential of drug interactions (n=4), such as St John's wort, Gingko biloba and warfarin with vitamin K supplements.

In addition, 386 (95.6%) of participants did not come across any adverse reactions, while 17 (4.4%) claimed to have encountered adverse reactions associated with herbal medicines (n=385). Limited examples were provided about adverse reactions encountered by the participants, such as hypoglycaemia, allergic reactions and fertility issues with herbal medicine (n=3).

When participants were asked about their view of reporting the adverse reactions of herbal medicines to the national pharmacovigilance services in the country (n=388), 228 participants (58.8%) would report adverse reactions from herbal medicines to the national pharmacovigilance services, while 160 (41.2%) would not consider reporting it.

DISCUSSIONS

The prevalence of herbal medicine use continues to grow globally, including in the Middle East[62–64] and specifically among the Jordanian population.[45 65] This, combined with the prevalence of chronic diseases,[66] the concomitant use of herbal medicines and prescription medications[67] and a lack of knowledge about herb–drug interactions among Jordanians, poses a poorly understood challenge to the healthcare professionals.[44]

Our study investigates customers' use and pharmacists' recommendation of herbal supplements, as well as pharmacists' knowledge, willingness to advise, awareness of safety and their views of reporting herbal-related adverse reactions in Jordan. It presents one of a few studies conducted in the Middle East assessing pharmacists' perspectives and knowledge of herbal medicines available in pharmacies.[42 49 50 52 53 55 56] This study reinforces that

Table 3 Categories of herbal supplements as recommended by the participants (n=300)

	Most recommended	2nd choice	3rd choice	4th choice	5th choice	6th choice	Least recommended
Maintenance of general health	12.0%	19.1%	19.7%	20.7%	16.4%	7.0%	5.0%
Dissatisfaction with prescription medications	5.0%	11.3%	18.0%	23.3%	14.7%	12.3%	15.3%
For treatment of acute & chronic health conditions	4.7%	10.7%	18.3%	17.3%	13.7%	16.7%	18.7%
To relieve stress	5.3%	17.3%	19.0%	21.3%	12.7%	10.3%	14.0%
For weight loss	11.4%	19.8%	19.5%	17.4%	12.8%	8.4%	10.7%
For sexual & sports enhancement	9.1%	17.8%	22.6%	17.2%	14.5%	8.1%	10.8%
For skin conditions	9.3%	10.0%	21.0%	20.0%	12.7%	12.0%	15.0%

Measured on a 7-point rank order: 7=least recommended; 1=most recommended.

Table 4 Participants' self-reported knowledge on use (n=386), regulations (n=385), adverse reactions (n=387) and drug interactions (n=384)

	Knowledge of the use of herbal medicines	Knowledge of regulation of herbal medicines	Knowledge of adverse reactions of herbal medicines	Knowledge of drug interaction of herbal medicines
Excellent	5.7%	5.2%	6.5%	6.5%
Good	63.2%	56.4%	56.1%	56.8%
Average	22.5%	25.2%	25.1%	24.5%
Poor	7.8%	11.9%	11.9%	11.7%
Terrible	0.8%	1.3%	0.5%	0.5%

Measured on a 5-point Likert scale: 5=excellent; 4=good; 3=average; 2=poor; 1=terrible.

pharmacists worldwide have frontline role in providing advice to customers about these products.[10 22–32]

Our study shows that herbal supplements are readily available in practically all pharmacies surveyed. This correlates with an increased demand from the public and pharmacists' recommendation to use supplements promoted for slimming and sexual and sports enhancements. The consumption of these supplements without medical advice or proper follow-up is a concern due to the nature of the therapeutic claims and lack of information provided with these products.[68] Moreover, the current regulatory framework may not ensure their quality and safety,[10 68 69] including a high risk of adulteration with undeclared synthetic substances, usually consisting of the addition of prescription or banned medications.[61 70–73] This clearly poses a health risk to the customers. In line with these findings, the use of a diverse range of slimming aids among Jordanians was reported,[74] with the majority reporting the use of these supplements in the 3 months prior to the survey.[74] According to Abdel-Qader *et al*,[65] Jordanians' use of herbal supplements is for chronic diseases and obesity, while sexual enhancers accounted for the lowest share.[65] In Jordan, limited pharmaceutical options for weight management exist (the sole registered pharmaceutical agent is orlistat). Treatment is quite expensive compared with individual income levels. Furthermore, orlistat has multiple side effects that restrict its usability among its users, including gastrointestinal upset and stomach and back pain. The proportion of people who use sexual enhancers is much higher than indicated, and thus research focusing on the use of sexual enhancers was suggested.[65]

Pharmacists' self-reported knowledge score on the herbal medicine uses, their regulations, potential adverse reactions and drug interactions of herbal medicines is 'good', with the total knowledge score being higher on

Table 5 Multiple linear regression analysis

	Unstandardised coefficients		Standardised coefficients			95.0% CI for B	
Model	B	SE	Beta	t	Sig.	Lower bound	Upper bound
(Constant)	14.629	3.796		3.854	0.000	7.164	22.093
Age							
31–40 years	0.536	0.344	0.083	1.558	0.120	−0.141	1.213
41–50 years	−0.435	0.570	−0.046	−0.763	0.446	−1.555	0.686
51–60 years	0.630	1.195	0.038	0.527	0.598	−1.719	2.979
Qualifications (highest level)							
Bachelor's in pharmacy or diploma	0.550	1.582	0.046	0.348	0.728	−2.561	3.661
Masters	0.674	1.705	0.051	0.395	0.693	−2.680	4.027
PhD qualifications	−14.148	3.080	−0.260	−4.593	**0.000*****	−20.205	−8.091
Length of time practising pharmacy (years)							
1–10	0.149	2.864	0.016	0.052	0.958	−5.483	5.781
11–20	−0.453	2.788	−0.028	−0.162	0.871	−5.934	5.029
21–30	−1.208	2.891	−0.145	−0.418	0.676	−6.893	4.476
Gender (female)	−0.468	0.277	−0.084	−1.689	0.092	−1.012	0.077
Degree/further training on herbal medicines (no)	0.329	1.123	0.015	0.293	0.770	−1.880	2.538

***P<0.001.

use than the one on their regulations, potential adverse reactions and herb–drug interactions. Similar findings were reported from studies conducted in Kuwait, Saudi Arabia, Palestine, Iraq, Lebanon and the United Arab Emirates,[15 24–27 30 31] which showed better knowledge of the herbal medicine uses among pharmacists,[49 50 53 55 56] in comparison with their knowledge of the potential adverse reactions and herb–drug interactions.[49 50 53 55 56] In addition, we found a significant inverse ($p<0.05$) correlation between self-reported 'total pharmacists' knowledge' and 'years of experience'. A possible explanation for this might be that newly graduated pharmacists had taken additional relevant courses about herbal medicines during their undergraduate studies. In support of this, two recent studies conducted in Jordan and Palestine exploring pharmacists' knowledge reported similar findings relating to knowledge scores and years of experience.[50 57] In contrast, other studies in the Middle East reported higher knowledge scores among those who received education/training/qualification on herbal medicines,[49 52] or pharmacists' knowledge was influenced by the place of work (ie, government or private sector),[56] which was not in our study. On the other hand, studies conducted in other parts of the world showed that the pharmacists' knowledge increased with an increase in years of experience.[22 75–77] Clearly, pharmacists gain more knowledge over time. Therefore, further research is needed to gain better understanding of whether this difference is influenced by differences in pharmacists' education and training across different geographical locations.

Pharmacists' knowledge, their experience of customer-reporting adverse reactions and their awareness of these reactions could play a vital role in identifying and reporting these reactions. More than half of the participants responding (n=243) were not aware of potential herb–drug interactions, and an even larger majority (n=386) did not receive complaints from the customers about herbal medicines. In contrast, more than a quarter of the Jordanian customers experienced unpleasant symptoms from herbal medicines, including constipation, diarrhoea, nausea/vomiting, palpitation, sweating, headache, fever and allergic reactions.[65] A possible reason for this variation in experience between Jordanian pharmacists and customers in our and other studies could be linked to these supplements being purchased from herbal shops and online rather than from pharmacies. Hence, the adverse reactions may have been reported back to the herbalists rather than to the pharmacists or not reported at all. In fact, herbal shops were cited by Abdel-Qader *et al*[65] as Jordanians' first choice to purchase herbal supplements, followed by pharmacies as their second choice.[65] Another explanation for this variation could be the pharmacists' lack of training relating to the knowledge of and awareness to identify adverse reactions.[31] Generally, findings across the literature investigating pharmacists' education related to herbal medicines were limited or non-existent, particularly in the Middle East. A previous Jordanian cross-sectional study found that none of the surveyed pharmacists received guidelines on dietary herbal supplements during their formal training before graduation.[78]

Participants' lack of awareness and experience with customers reporting complaints linked to herbal medicines were coupled with more than a quarter not willing to report the adverse reactions to the national pharmacovigilance centre. Adverse reactions from using herbal medicines could be anything from a minor adverse reaction caused by the medicinal plants' composition, such as heartburn caused by peppermint, to life-threatening reactions like cancer, hepatotoxicity or nephrotoxicity caused by *Aristolochia* spp.[79–82] In addition, the adverse reaction of herbal medicines could be caused in situations of low-quality herbal medicines or the misidentified, adulterated or contaminated herbs being used.[80 83–85] Based on the national pharmacovigilance database in Jordan, between 2010 and 2014, most medications implicated in adverse reactions were antineoplastics (37.6%), followed by immunomodulators (14.1%), antibiotics (10.3%) and analgesics (6.6%).[86] Although, in the past years, there has been a fourfold increase in adverse reactions reported, no reports were received for adverse reactions related to herbal medicines. This highlights some concerns related to the identification and recognition of these reactions leading to under-reporting of such reactions[87] by the public or pharmacists. Several barriers, such as lack of time, lack of knowledge about herbal medicines, the complexity of the reporting process and pharmacists' perception of their professional roles, could also be contributing to the issue of under-reporting.[88]

Our findings reinforce the importance of improving the public's and pharmacists' awareness and ability in recognising and reporting adverse reactions after consumption of herbal medicines. It also contributes to the important global debate on how to improve pharmacists' knowledge and awareness of the safety of herbal medicines available in pharmacies.[25–27 29 32 49 50 52–56 60] This, in turn, will impact the public's awareness and confidence and, thus in, safety associated with the use of such preparations.

There remain some important limitations. The survey link was completed online and circulated via social media. Snowballing cannot ascertain a representative distribution or completion of the survey. This might have affected the generalisability of our findings as we might have missed some of the targeted population. Although the formal pharmacy education in Jordan is in the English language, the survey questions were in English and not in the Arabic language, which might have affected the participants' understanding of the survey items. Also, data collection is based on self-reporting by the participants, therefore, response bias is likely. Furthermore, although the survey had a good response rate from those who completed bachelor's degree in pharmacy, there were very few responses from those who have PharmD or PhD qualifications. Therefore, our findings should be interpreted carefully.

Implications of findings to practice

The undergraduate pharmacy core curriculum in Jordan should be encouraged to include more formal academic training about the pharmacological and toxicological effects of herbal medicines, as well as on the detection, understanding and reporting of adverse reactions. Although participants generally reported a good self-perceived knowledge of herbal medicines, there is still a need to improve the breadth and scope of this education, particularly in areas of safety, awareness and reporting related to potential adverse reactions. Continuous professional development in these areas will also be warranted. This will help give pharmacists first-hand experience of what is expected in practice. In addition, it can provide Jordanian pharmacists with good knowledge about the uses and the safety of herbal medicines available in pharmacies. Hence, future pharmacists could provide more objective and evidence-based information on the risks and benefits of herbal medicines to customers. This improved knowledge will be important to enhance public safety.

In conclusion, the current study has revealed some specific problems relating to awareness, identification and reporting of potential adverse reactions related to herbal medicines among Jordanian pharmacists. In addition, the uses and recommendations of slimming aids and sexual and sports enhancement products are likely to be a customer health risk due to possible adulteration in these supplements. The limited research on awareness and reporting of potential adverse reactions of herbal medicines among pharmacists has wider implications on practice and customers' safety, particularly in the Middle East. In the pharmacy curriculum, the safety of herbal medicines should be covered more thoroughly and reinforced through continuous professional development. Hence, future pharmacists can provide evidence-based information and advise customers more effectively about the safe use of herbal supplements. Furthermore, raising awareness and educating the public about the risks and benefits of herbal supplements available on the market will also be warranted.

Contributors This study is a part of BJ's PhD dissertation (2021) at the UCL School of Pharmacy. BJ and MH developed the concept for this study and the main tool. JMP primarily supervised most of JB's PhD project and contributed to the method development and interpretation. AYN contributed to developing country-specific elements of the questionnaire, its dissemination in Jordan and statistical analysis. All authors contributed to the writing and approved the manuscript.

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