WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 4, 409-426. Research Article ISSN 2277– 7105

ASSESSMENT OF THE AWARENESS, KNOWLEDGE, ATTITUDE, AND PRACTICE OF SUDANESE COMMUNITY PHARMACISTS, IN KHARTOUM STATE, ABOUT DRUG INTERACTIONS.

Abduelrahman Salah Abduelrahman Tokka[1]* and Kamal-Addin Mohammad Ahmad Idris[2]

[1]*Central Laboratory, Ministry of Higher Education and Scientific Research, Khartoum, Sudan.

[2]Department of Pharmaceutics, Faculty of Pharmacy, University of Gezira, Wad Medani., Sudan.

Article Received on
16 Feb. 2017,

Revised on 07 March 2017,
Accepted on 27 March 2017

DOI: 10.20959/wjpr20174-8257

***Corresponding Author**
Dr. Abduelrahman Salah Abduelrahman Tokka
Central Laboratory, Ministry of Higher Education and Scientific Research, Khartoum, Sudan.

ABSTRACT

Background: Drug interactions, which are quite commonly encountered in medical prescriptions, may lead to serious health problems, though sometime might prove beneficial. Pharmacists in both private and public pharmacies are by profession in a unique position to acquire, utilize and use their competencies to detect and prevent drug interactions The **Objective**: To assess the overall general, awareness, knowledge, attitude and practice of Sudanese community pharmacists, about drug interactions. **Materials and Method**: A structured pre-piloted questionnaire composed of (45) questions, was handed over to (322) randomly selected community pharmacists in Khartoum state. Twenty-five (25) pairs of potential drug-drug, (nine pairs), drug-food (eight pairs) and drug-disease interactions (eight pairs), were included in the questionnaire. **Results**: The response rate was very high (99.4%). Respondent's median age (28 years), majorities (57.2%) were females, majority (75%) had an experience of less than 5 years and (58.8%) were from private sector settings. Respondent's averages of awareness, attitude and practice regarding drug interactions, correct knowledge of drug-drug, drug-food, drug-disease interactions and knowledge of modification targets were, (89.13%), (80%), (53.3%), (65.4%), (58.4%) and (53.62%), respectively. No significant correlations were found between, respondent's knowledge about drug-interactions and other different variables. Collaboration between doctors and pharmacists in this concern,

were poor. **Conclusion**: the study results showed respondents' high rates awareness, attitude and practice about drug interactions. However, knowledge about drug-drug interactions though fair, yet it was not up to researchers' expectations. Continuous on-job training and use of drug interactions booklets and detection softwares may help improve community pharmacists' knowledge.

KEYWORDS: Community pharmacists, knowledge, Drug-interactions, Sudanese.

1. INTRODUCTION

The topic of drug–drug interactions (DDIs) has received a great deal of recent attention from the regulatory, scientific and health care communities worldwide.[1] A large number of drugs are introduced every year and new interactions between medications are increasingly reported. Consequently, it is no longer practical for physicians and pharmacists to rely on memory alone to avoid potential drug interactions. The ability to identify potentially harmful drug-interactions is a critical facet of the pharmacist's job. Drug interactions have been associated with increased incidence of adverse events, hospitalizations and death.[2-5] The effect of the drug on a person may be different from that expected, due to drug-drug interaction (DDI) or due to food, beverages, and dietary supplements concomitantly taken with the drug (drug-nutrient/food interaction). Moreover, for a patient the drug may interact with the disease the person has (drug-disease interaction).[6]

Drug-drug interaction (DDI) may be defined as the pharmacological or clinical response to the administration of a drug combination that is different from that anticipated from the known effects of the two agents when given alone and that can result in reduced effectiveness or increased toxicity. DDI has three levels of severity: major, moderate and minor.[7] Drug interactions can alter the pharmacokinetics and/or pharmacodynamics of a drug. The pharmacodynamics interaction may be additive, synergistic, or antagonistic effects of a drug. Drug interactions (DIs) represent an important and widely under recognized source of medication errors.[8]

Drug–food interactions (DFIs) pose many challenges during drug treatment. This is because patients are used to a particular food over a long period, which may not be friendly with their disease condition or the drug they are taking. In addition, habitual foods of patients are not usually recorded in their hospital files and it is often difficult to predict which food a patient is likely to take next.[9] Although DFIs are less dangerous, it is often difficult to address and

at times, may lead to hospitalization. Underreporting of DFIs by patients is one of the major problems of DFIs.[10] Changes normally occur in the body in response to food intake such as gastric acid secretion, gastro-intestinal tract (GIT) motility and modification of transporter P-glycoprotein or chelation by food. DFIs may lead to synergistic, additive, or antagonistic drug effects.[11, 12] Ciprofloxacin, tetracycline, or sodium fluoride if taken with milk, the metals in the milk will form a complex with these drugs and impair their absorption. However, artemisinin classes of drugs are better absorbed when taken with milk and absorption of griseofulvin is enhanced by fats rich foods.[9, 10, 12] A previous study in Sudan concluded that the majority of community pharmacists surveyed demonstrated lack of knowledge about drug-nutrient interaction.[13] The absorption of some drugs (atenolol) may be enhanced by the concomitant presence of food in the stomach.

Drug–disease interactions (DDSIs) are situations whereby a new drug treatment elicits the preexisting medical condition. It also implies the ability of a newly prescribed drug to cause side- effects similar to one of the patient's disease condition.[14] In addition, the most frequent interactions among the prescriptions studied involved the treatment with non-steroidal anti-inflammatory drugs (NSAIDs) in hypertensive patients or patients with chronic heart failure and co-administration of ACE inhibitors and NSAIDs.[15]

Polypharmacy (PP) is often associated with treatment of chronic diseases (as in the elderly) providing indication for medical treatment with several drugs for each disease[16], also in acute cases where more than one drug are used for control of symptoms and polypharmacy is therefore frequently indicated. However, polypharmacy is associated with an increased risk of adverse drug reactions[17] that rises exponentially with the number of concomitant drugs used[18] and interactions may blur the intended effects of the drugs on the disease. Pharmacoepidemiologic studies, mostly carried out in Europe and the Americans, have found varying rates of potential DDIs, ranging from 5% to 80%.[15, 19, 20,21] Some drugs which are most potentially implicated in drug interactions (such as the NSAIDs, ACEIs, Aspirin, Metronidazole, Beta-blockers, Tetracycline, Ciprofloxacin, Rifampicin, The narrow therapeutic index medications (carbamazepine), the Macrolides antibiotics, Antacid combinations, etc.) are registered, marketed, and are quite frequently prescribed in developing countries, including Sudan.[22-24] Accordingly, in Sudan, same to other developing countries, irrational use of drugs and the incidence of drugs-interactions are expected and were reported to be relatively high.[25-28]

According to Mahmoud M. E. Mudawi et al., 2014,[29] physicians and community pharmacists are considered important health-care providers who can, are qualified and supposed to play a key role in working with their patients to reduce incidences of problematic drug-interactions.

However, because Sudanese doctors do not communicate sufficiently with patients, don't routinely ask patients about their medications' history, and counsel sufficiently counsel them to look for potential drug interactions,[25-30] those unsatisfied patients tend to visit more than one doctor, they, accordingly, become more prone to drug-interactions. With their detailed knowledge of medicines, pharmacists have the ability to relate unexpected symptoms experienced by patients to possible adverse effects of their drug therapy. The practice in clinical pharmacy also ensures that adverse drug reactions (ADRs) are minimized by avoiding drugs with potential side effects in susceptible patients. Thus, the pharmacist has a major role to play in relation to detection, prevention, and reporting of adverse drug reactions, in general.[31]

A study by Elkhawad et al, 2013,[32] about Sudanese pharmacist's awareness about drug-drug interactions concluded that: "the pharmacist's awareness about drug-drug interaction seems to be very poor". Moreover, the absence of a tailored, prescribed and mandated continuing pharmacy education for both undergraduates and graduated pharmacists is expected to negatively affect their level of medication knowledge and consequently the pharmaceutical care services delivered in community pharmacies. Accordingly, community pharmacists knowledge about drug interactions is expected be compromised and might not be up to the expected standards.

Based on all the above it was decided to conduct this study under the title and main objective of: The assessment of the awareness, knowledge, attitude and practice, of the Sudanese community pharmacists in Khartoum State, about drug interactions.

2. MATERIALS AND METHODS

2.1 Study design

The study was conducted as non-interventional, descriptive, cross sectional survey. Self-administered questionnaire was designed and used as the study tool. Verbal informed consent was taken from all potential respondent community pharmacists.

2.2 Sample size determination

According to the Directorate of Pharmacy, Ministry of Health, Khartoum state, Sudan, the total number of community pharmacies in Khartoum state was 1901. The distribution of pharmacies in the three cities of Khartoum state was 774 pharmacies in Khartoum city, 652 in Omdurman city and 475 pharmacies in Khartoum North city.

The sampling size was calculated based on 95% confidence level and 6% confidence interval and was accordingly decided to be (322). Two community pharmacists did not respond to the questionnaire and thus the total of respondents rested on (320). Using Disproportionate stratification, the sample size was decided for the three towns to be 150 (19.4%), 120 (18.4%) and 50 (10.5%) randomly selected community pharmacies from Khartoum, Omdurman and Khartoum North, respectively. The chief pharmacists within these community pharmacies were handed over the questionnaire's forms, face-to-face by the corresponding author of the study, made aware of the main objective of the study and requested to cooperate by filling the full questionnaire form and hand it back. They were also informed of their absolute freedom to cooperate or refrain and were also informed that their highly needed and appreciated participation, will considered a form of a free informed consent.

2.3 Survey questionnaire

The pre-piloted structured open to answer questionnaire which focused on potential respondents, was composed of forty five (45) questions, forty one (41) of them were closed questions and four (4) were multi-choice. A pilot study was conducted on ten (10) community pharmacists to check the questionnaire text readability, comprehension, questions design and length of the questionnaires. The piloted population was not included in the study population. The piloting helped in making minor changes in the text of the questionnaire.

The final form of the questionnaire is divided into three main sections:

1- The respondent's demographic characteristics section, which included age, gender, area of practice, years of experience as a qualified community pharmacist in practice, latest potential respondent's qualification certificate and place of undergraduate study.

2- Which is composed of (8) questions, elicited respondents' attitude and practice regarding drug interactions and their general awareness and knowledge.

3- Is meant to assess the respondent's knowledge about different selected drug interactions. Twenty-five (25) selected drug interactions pairs were used to investigate the potential respondents community pharmacist's knowledge about drug interactions (drug-drug, drug –

food and beverages and drug-disease interactions). They were selected, as they are the most common drug interactions mentioned in medical literature, including some that are special to Sudan.

2.4 Statistical analysis

The data were collected during the period of early June 2016 to October 2016 (four months), and analyzed using Statistical Package for Social Sciences (SPSS, version 20). The frequency distributions were obtained and the Chi-square test was used to find the association between the different qualitative variables. A significance level of $P \leq 0.05$ was set to detect any possible significant differences.

3. RESULTS

Results were expressed in frequencies and percentages. The response rate was (99.4%), where two potential participants were missing.

Table 1: Participant's demographic characteristics

Demographics	Frequency	Percentage
1-Gender		
Male	137	42.8%
Female	183	57.2%
Total	320	100%
2-Age		
21-25	132	41.25%
26-30	132	41.25%
>31	56	17.5%
Total	320	100%
3- Academic Qualifications		
B. Pharm	243	75.9%
M. Pharm	77	24.1%
4- Town of practice		
Khartoum	150	46.9%
Omdurman	120	37.5%
Khartoum North	50	15.6%
Total	320	100%
5- Years of practice		
1-5	240	75%
6-10	63	19.7%
> 11	17	5.3%
Total	320	100%
6-Area of practice		
Public	47	14.7%
Private	188	58.8%

Mixed	83	25.9%
Total	320	100%
7-Place of undergraduate study		
Sudan	292	91.2%
Abroad	28	8.8%
Total	320	100%

Table 2: Attitude and practice of participants regarding drug interactions.

Attitude and Practice		Frequency	Percentage
1- Was drug interactions part of your undergraduate course studies?	Yes	262	81.9%
	No	58	18.1%
	Total	320	100%
2- Have you ever come across cases of drug-interaction during your practice?	Yes	269	80.9%
	No	61	19.1%
	Total	320	100%
3-Before dispensing any drug, do you consider its potential interactions?	Yes	286	87.2%
	No	44	12.8%
	Total	320	100%
4-Do you usually ask your patient about the prescription, Over-The-Counter, drugs and food supplements, herbal medication he/she is using or intends to use.	Yes	251	75.6%
	No	79	24.4%
	Total	320	100%
5-Do you usually contact doctors when there is a drug-interaction in their prescriptions.	Yes	221	67%
	No	109	33%
	Total	320	100%

Table 3: Respondent's reaction and Medium of contact, and inter-professional collaboration with prescribers, when informed of clear drug interactions in their prescriptions.

Attitude and Practice		Frequency	Percentage
1-If yes, what is the way you usually use to contact doctors?	Telephone	93	29.1%
	Sending back the patient	68	21.3%
	Meeting him/her personally	38	11.9%
	Various facilities	22	10%
	Total	221	72.3%
2- Doctor's acceptance to opinion pharmacists when pointing to a drug-interaction in their prescriptions.	Agree	85	26.5%
	Disagree	53	16.6%
	Verify it first	101	31.6%
	Total	239	74.7%
3- Respondents' reaction, when the prescriber insists on dispense the prescription as it is, without any change, though it contains clear drug-interaction.	Dispense as it is	35	11%
	Alarm the patient and dispense as it is	91	28.4%
	Alarm the patient and refuse to dispense it	194	60.6%
	Total	320	100%

Table 4: Respondents' general awareness and knowledge about drug-interactions.

Awareness and knowledge of drug-interactions.		Frequency	Percentage
1-Do you know that some drug-interactions can be fatal?	Yes	291	90.9%
	No	29	9.1%
	Total	320	100%
2- Have you ever used a handbook or software program to check drug-interaction before dispensing?	Yes	233	72.8%
	No	87	27.2%
	Total	320	100%
3- Do you agree that, the drug-interaction must be given more time and attention during undergraduate pharmacy studies?	Yes	304	95%
	No	16	5%
	Total	320	100%
4- Is it important that doctors and pharmacists update their knowledge about drug-interactions?	Yes	313	97.8%
	No	7	2.2%
	Total	320	100%
*Respondent's average of awareness= 89.13%			

Table 5: Respondents' knowledge about the in-vivo different modification targets leading to drug- interaction (pharmacokinetics and pharmacodynamics).

Drug interaction can be due to alteration in the:	Absorption	184	57.5%
	Metabolism	199	62.5%
	Distribution	120	37.5%
	Excretion	130	40.6%
	Pharmacologic action	224	70%
	Total	897	100%
*Average of total respondent's knowledge of modification targets = 53.62%			

Table 6: Respondents' knowledge of drug-drug interactions

No.	Interaction	Correct Answer		Wrong Answer	
		Frequency	Percent	Frequency	Percent
Drug-drug interactions					
1	Ciprofloxacin with Ferrous fumarate	197	61.6%	123	38.4%
2	Mebendazole with Ciprofloxacin	144	45%	176	55%
3	Metronidazole with Paroxetine	134	41.9%	186	58.1%
4	Cephalexin with Metformin	159	49.7%	161	5.0.3%
5	Cyclosporine with Itraconazole	170	53.1%	150	46.9%
6	Paracetamol with Warfarin	178	55.6%	142	44.4%
7	Theophylline with Clarithromycin	151	47.2%	169	52.8%
8	Ibuprofen with Prednisolone	163	50.9%	157	49.1%
9	Cigarette smoking with Theophylline	240	75%	80	25%
Total		1536	53.3%	1344	46.7%
Drug-food interactions					
1	Warfarin with Green leafy vegetables	246	76.9%	74	23.1%
2	Ciprofloxacin with Dairy product	268	83.8%	52	16.2%
3	Griseofulvin with Low fat meals	172	53.8%	148	46.2%

4	Captopril (oral) with Food	156	48.8%	164	51. 2%
5	Amlodipine with Grape fruit juice	220	68.8%	100	31.2%
6	Tetracycline (oral) with Baobab fruit juice	154	48.1%	166	51.9%
7	Indomethacin on Empty stomach	221	69.1%	99	30.9%
8	Metronidazole with Alcoholic beverage	238	74.4%	82	25.6%
Total		1675	65.4%	885	34.6%
Drug-disease interactions					
1	Aspirin with Hemophilia.	272	85%	48	15%
2	Ibuprofen with History of peptic ulcer.	268	83.8%	52	16.2%
3	Hydrochlorothiazide with Gout.	199	62.2%	121	37.8%
4	Captopril with Congestive heart failure.	125	39.1%	195	60.9%
5	Non-selective B-blocker with Asthma.	262	81.9%	58	18.1%
6	Spironolactone with Congestive heart failure.	123	38.4%	197	61.6%
7	Imipramine with Benign prostatic hyperplasia	142	44.4%	178	55.6%
8	Nifedipine with congestive heart failure.	105	32.8%	215	67.2%
Total		1496	58.4%	1064	41.6%

Table 7: Respondents' demographic characteristics impact on respondent's knowledge of drug interactions.

Characteristic	Correct answer	Chi^2 value	P-value
Gender Male Female	 42.2% 57.8%	0.01	0.90
Age 21-25 26-30 > 31	 41.7% 41.2% 17.1%	0.021	0.99
Latest qualification Bachelor (B. Pharm) Master (M. Pharm)	 76% 24%	0.0003	0.98
Years of practice 1-5 6-10 11-15 >15	 74.7% 19.5% 3.7% 2.1%	0.07	0.99
Area of practice Public Private Mixed	 15.8% 57.6% 26.6%	0.121	0.94
Place of undergraduate study Sudan Abroad	 91.4% 8.6%	0.003	0.96
* Cross-tabulation revealed that there were no statistically significant differences between all these variables and pharmacist's knowledge regarding drug-interactions (P-value > 0.05).			

4. DISCUSSION

The total number of participants included in this study was (322) pharmacists. Because two of the potential respondents refused to participate in the study, the response rate was thus (99.4%). The mean age of participants was (28) years showing a relative young participant's population. Males were (42.8%), while females were (57.2%). According to The Federal Ministry of Health, 2014, females are a majority (55%) among the registered Sudanese pharmacists.[33] Majority of respondents (58.8%) were working in private sector. Most of them had earned a Bachelor degree (B.Pharm) in pharmacy as their latest professional degree. Regarding the area of practice, the majority (58.8%) of the studied pharmacists were from private sector pharmacy settings. The majority (91.2%) of respondents had their undergraduate studies in Sudan, Table 1. That is because the last three decades witnessed the establishment of more than fifteen (15) new pharmacy colleges in Sudan, compared to only three before the year 1989. This allowed more chances for pharmacy school admissions locally which are more convenient for both students and their families. Add to that, pharmacy studies abroad are costly.

Respondent's attitude and practice towards drug interactions were evaluated using seven questions. Results showed that around (80.9%) of the respondent had come across drug-interactions during their practice, which indicates the potential high incidence of drug interactions in the patient's prescriptions. A similar study conducted by Jamal et al., 2015,[34] reported that (67%) of their studied pharmacists had come across drug-drug interaction in their daily practice, (16%) of them pharmacists observed drug-food interaction and (5%) of them observed drug-lab interaction (in vitro). Eighty-seven percent (87.2%) of respondents, in this study, asserted that they usually consider the potential drug-interactions before dispensing the prescriptions. If that answer was correct, then they must have asked their patients about their medication history before dispensing. However, according to their own answer to the question: whether they routinely used to ask their patients about their medication history before dispensing (75.6%) of asserted that they sometimes do! This answer is inconsistent with their claimed consideration rate for drug-interactions before dispensing. It is almost very difficult, if not impossible, to guard against the potential drug-interactions without getting a detailed medication history (review) of the subject patients.[35] A Sudanese study conducted by Mahmoud M. E. Mudawi et al., 2014,[29] showed that their studied physician or pharmacists did not advise sixty-percent (60%) of patients about drug use and drug interactions.

Regarding the attitude of the respondent pharmacists toward collaboration with the prescribers when there is a drug-interaction in their prescription, about two-thirds (65.3%) of the respondents used to contact the prescribers, before dispensing the subject prescription, either by telephone or sending back the patients to the prescriber, for verification. Only (26.5%) of the respondents asserted that, the notified doctors usually agree with community pharmacists' opinion and decision, without reservations. This percentage is considered to be very poor. When the prescribing doctor does not agree with the opinion of the community pharmacists and insists that the prescription be dispensed, as it is, almost two thirds (60.6%) of the respondent pharmacists used to alarm the patient about the situation and refuse to dispense the prescription, altogether. The result of this study showed poor collaboration between prescribers and pharmacists in this regard, though a Sudanese study reported acceptable levels of inter-professional communication and collaboration between both parties.[36] Many authors pointed to and called for more collaboration between the different health care team members, specially the pharmacists and physicians, for the patient welfare.[37-38] Despite these rational calls for inter-professional collaboration, yet, the previous result informing of the respondents' refusal to fill the prescriptions, shows that they do not usually try hard to resolve their professional conflicts with the prescribing doctors, amicably. This result clearly points to a gap in the inter-professional communication and collaboration between Sudanese prescribers and the dispensing pharmacists, to the detriment of patient's health welfare. It is worth mentioning that, the results of two previous study by Awad et al, 2007;[39] showed that almost two-thirds (66.4%) of their respondent doctors asserted that they would agree with pharmacists decision and opinion in this regard. Almost same positive opinion of doctors about community pharmacists were reflected in a study by Mahmoud, et al, 2014.[36] It seems that things are deteriorating! Table 2 - 3.

Regarding inclusion of drug-interactions course in respondent's undergraduate curriculum, about eighty percent (80%) of respondents confirmed that though not in depth. That may indicate they have heard about drug interactions and its consequences, irrespective to their real and/or current practice. A very big majority of respondents (90.9%) were aware that some drug-interaction can be fatal. In addition, a study by Mudawi, et al; 2014,[29] for the evaluation of drug-interactions in renal failure centers, reported that detected major drug-interactions accounted for (5.6%), moderate accounted drug-interactions accounted for (61.6%) for and (28.8%) for minor drug-interactions. While the interaction of non-prescribed with prescribed drugs; accounted for about (0.8%) major, (11.2%) moderate and (2.4%)

minor. To be certain about drug –interactions, healthcare providers (HCPs) used handbooks to check for any possible drug-interactions, and/or use available software programs for same purpose. About (72.8%) of the respondents asserted that they routinely make use of such reliable helpers. Bearing in mind that the respondents had undergraduate courses in drug-interactions, this would enhance their abilities to easily and certainly detect any possible drug-interaction and accordingly they will mostly not miss them. Pharmacists can access the databases separately to help the prescriber, community health services and the public by providing information on drug–drug, drug - food, drugs –disease and interaction and drugs and test diagnostics interactions, side effects, the use of drugs in specific populations (e.g., elderly, pediatric, immunosuppressed),[40] Table, 4.

The respondent's knowledge about the in-vivo different modification targets for drug interaction (Pharmacokinetics and Pharmacodynamics), Table 5, showed relatively low respondents' correct answer rates (53.62%). The knowledge of community pharmacists about in vivo modification targets for drug interactions is extremely important as it helps predicting and consequently detecting and preventing any possible drug-interactions in the prescription.

In this study, Table 6, twenty-five drug interaction pairs, focusing on common drug interactions (drug-drug, drug-food and drug-disease interactions) mentioned in the medical literature including interactions some special to Sudan, were used to assess respondents' knowledge about drug-interactions. Results showed that he average for the correct answers about drug-drug interactions (25 pairs) was only (53.3%), which is considered by the researchers to be a poor result. The correct answers for the eight questions about drug-food interactions recorded an average of (65.4%), which was also less than expected, from medication specialist.

According to Seth and Vimlesh, 2009,[41] it is an important and a binding responsibility for pharmacists to provide information to patients about taking their medications in relation to food intake. The results of this study showed that the respondent's knowledge about interactions of drugs with traditional Sudanese juices was to some extent far under the expected. However, the same respondents answers for the potential interaction between the Tetracycline and Tabaldi fruit juice, "Adansonia digitata" which is known in Sudan as Tabaldi and which is known to contain high calcium and iron contents,[42-43] recorded very poor results (48.1%).

The poor results of the respondents regarding a famous local fruit nutritional contents, points to the importance of introducing food and nutrition education and training in the under graduate pharmacy schools curricula.[44] A study by Ali and Abdallah, 2014,[14] concluded that: "additional training and integration of knowledge and expertise about drug-nutrient interactions among healthcare professionals is essential to provide appropriate patient counseling and optimal therapeutic outcomes". These poor results are similar to those of other previous studies results where lack of knowledge about drug-food interactions among health care professionals was made evident.[10, 14, 45, 46]

As regards the use of ACE inhibitor (captopril) and the potassium-sparing diuretic spironolactone and that of calcium-channel blocker (nifedipine) with patients suffering from congestive heart failure (CHF), the total average responses were ranging between 39.1%, 32.8%, respectively. These results showed the very poor knowledge of community pharmacists toward drug-disease interactions, especially for heart diseases.

The correct answers for drug-disease interactions recorded an average of (58.4%), which was far less than the expected.

The total percentage of respondents' correct answers about all the twenty five (25) pairs of questions was only (59.03%), which could be considered an unsatisfactory level knowledge of drug-interactions. Even lower rates of community pharmacist's knowledge about drug interactions, than the results of our study, were reported in one study from Saudi Arabia.[47]

As shown in Table, 7, there is no significant difference in the correct responses between males and females respondents (P=0.90). However, we can notice that females were more accurate and this may be because of their higher representation in community pharmacies. With regard to respondents' different ages, insignificant difference in responses were showed (P=0.99), although the younger respondents (21-30 years) recorded higher correct answers than others. Regarding the respondent pharmacists' academic qualifications, astonishingly enough, the B.Pharm respondents recorded better correct answers than the M.Pharm respondents.

The results of study showed no significant association between respondents' knowledge of drug-interactions and their years of experience (P=0.99).

In contrast, the results of a study by Fakeye and Adisa; 2006,[48] reported that community pharmacists with less than ten years of in-job experience and practice possessed better knowledge than pharmacists with more than ten years of professional practice (P=0.05).

The study results showed that the respondent pharmacists working in the private sector showed a better knowledge of drug-interactions than those working in the public pharmacies. Differences were not significant (p= 0.94).

Most of surveyed respondents agreed that undergraduate and post graduate drug interactions teaching and training must be given more time and attention during. Respondent pharmacists also agreed that it is imperative that doctors and pharmacists continuously upgrade and update their knowledge about drug-interactions. Additionally, the lack of regulations in Sudan that oblige pharmacists to participate in Continuing Professional Development (CPD) programs limits the maintenance of professional competency. It is worth mentioning that, globally, there are limited studies concerning the awareness and knowledge of community pharmacists toward drug-interactions. The present study examined the association between dispenser's drug-interactions knowledge and their demographic characteristics and practice with regard to different respondents' academic qualifications. The results as per the above tables 1-7, clearly show that the respondents' knowledge about all forms of drug interactions were far lower than the researcher's expectations from medicine's specialists and professionals.

4. CONCLUSION

Although the pharmacists surveyed in this study demonstrated a lack of knowledge about drug- interactions, some exhibited a good knowledge. Inadequate knowledge of various forms of drug interactions may lead to inappropriate patient counseling and result in adverse medical consequences. Therefore, additional training and integration of knowledge and expertise about drug-interactions among community pharmacists is essential to provide appropriate patient counseling and optimal therapeutic outcomes. Further studies in this area, are recommended to document the extent and nature of gaps in knowledge, attitudes and practices of healthcare professionals and the best interventions to provide basic academic and continuing education about clinically significant drug‐ interactions and how to secure patient's safety. Proper and rational undergraduate training courses and integration of knowledge among healthcare professionals is beneficial to rationalize the use of drugs in

Sudan. It, as well, may raise the dispenser's awareness about the various problems and the associated patient's risks.

5. AKNOWLEDGMENTS

Authors would like to thank all the respondent community pharmacists for their cooperation.

6. CONFLICT OF INTEREST

Authors hereby declare that they have no conflict of interest, and no funding was received for this study from any part, which was fully funded by the two researchers only.

7. REFERENCES

1. Farkas D, Shader RI, von Moltke LL, Greenblatt DJ. Mechanisms and consequences of drug-drug interactions. In: Gad SC. Preclinical Development Handbook: ADME and Biopharmaceutical Properties. Philadelphia; John Wiley and Sons: 2008; 879-917.
2. Juurlink DN, Mamdani M, Kopp A, et al. Drug-drug interactions among elderly patients hospitalized for drug toxicity. JAMA, 2003; 289(13): 1652-8.
3. Knijff-Dutmer EA, Schut GA, van de Laar MA. Concomitant coumarin-NSAID therapy and risk for bleeding. Ann Pharmacother, 2003; 37(1): 12-6.
4. Shad MU, Marsh C, Preskorn SH. The economic consequences of a drug-drug interaction. J Clin Psychopharmacol, 2001; 21(1): 119-20.
5. Ray WA, Murray KT, Meredith S, et al. Oral erythromycin and the risk of sudden death from cardiac causes. N Engl J Med, 2004; 351(11): 1089-96.
6. Anne MH, Jennifer AP, Renee L, Heather McDonald, James DD, Mark C, Philip SW. Systematic Overview of Warfarin and its Drug and Food Interactions. Arch Intern Med, 2005; 1095-1106.
7. Edward AH. Handbook of drug interactions. 3rd ed., Hamilton press Inc. United states of America: 1976; 12.
8. Hansten PD. Appendix II: Important interactions and their mechanisms, In: Katzung BG. Basic and clinical Pharmacology. 9th ed., Boston; McGraw - Hill, 2004; 1110.
9. Bland SE. Drug-food interactions. J Pharm Soc Wisconsin, 1998; 14(Suppl 2): 28–35.
10. Benni JM, Jayanthi MK, Tubaki BR, Renuka M. Knowledge and awareness of food and drug interactions (FDI): a survey among health care professionals. Int J Pharmacol Clin Sci, 2012; 1(4): 97–105.
11. Bushra R, Aslam N, Khan AY. Food-drug interactions. Oman Med J, 2011; 26(2): 77–83.

12. Otles S, Senturk A. Food and drug interactions: a general review. Acta Sci Pol Technol Aliment, 2014; 13(1): 89–102.
13. Pugh MJV, Starner CI, Amuan ME, Berlowitz DR, Horton M, Marcum ZA, et al. Exposure to potentially harmful drug-disease interactions in older community-dwelling veterans based on the healthcare effectiveness data and information set quality measure: who is at risk? J Am Geriatr Soc, 2011; 59(9): 1673–8.
14. Ali A A A, Abdallah AA. Evaluation of attitudes of the community pharmacists toward warfarin interactions. Sudan Medical Monitor, 2014; 35-38.
15. Dubova SVD, Reyes-Morales H, Torres-Arreola LDP, Suárez-Ortega M. Potential drug-drug and drug-disease interactions in prescriptions for ambulatory patients over 50 years of age in family medicine clinics in Mexico city. BMC Health Serv Res, 2007; 7: 147.
16. Veehof L, Stewart RE, Haaijer- Ruskamp FM et al. The development of polypharmacy. Fam Pract, 2000; 17: 261-7.
17. Bjerrum L, Søgaard, Hallas J et al. Polypharmacy in general practice differences between practitioners. Br J Gen Pract, 1999; 49: 195-8.
18. Atkin AP, Veitch PC, Veitch EM et al. The epidemiology of serious adverse drug reactions among the elderly. Drugs Aging, 1999; 14: 141-52.
19. Gagne, J.J., Maio, V. and Rabinowitz, C. Prevalence and Predictors of Potential Drug-Drug Interactions in Regione Emilia-Romagna, Italy. Journal of Clin Pharm Therap, 2008; 33: 141-151.
20. Glintborg, B, Andersen S.E. and Dalhoff K. Drug-Drug Interactions among Recently Hospitalized Patients— Frequent but Mostly Clinically Insignificant. Europ J Clin. Pharm, 2005; 61: 675-681.
21. Vonbach, P., Dubied, A., Krähenbühl, S. and Beer, J.H. Prevalence of Drug-Drug Interactions at Hospital Entry and during Hospital Stay of Patients in Internal Medicine. Europ J Inter Med, 2008; 19: 413-420.
22. Cruciol- Souza J M, Thomson JC. Prevalence of potential drug-drug interactions and its associated factors in a Brazilian Teaching Hospital. J Pharm Pharmaceut Sci, 2006; 9(3): 427-433.
23. Ansari JA. Drug interactions and pharmacists. JYP, 2010; 2(3): 326-331.
24. Patel PS, Rana DA, Suthar JV, Malhorta SD, et al. A study of potential adverse drug-drug interactions among prescribed drugs in medicine outpatient department of a tertiary care teaching hospital. J Basic Cli Pharm, 2014; 5(2): 44-48.

25. Awad AI, Himad HA. Drug –use practices in teaching hospitals of Khartoum State, Sudan. Euro J Clin Pharmacol, 2006; 62: 1087-1093.
26. Ahmed AM, Awad AI. Drug use practices at pediatric hospital of Khartoum State, Sudan. Ann Pharmacother, 2010; 44(12): 1986-30.
27. Mahmoud RK, Kheder SI, Ali HM. Prescribing rationality in Khartoum state, Sudan: An update. Sudan Med Monit, 2014; 9(2): 61-65.
28. Ahmed FMO. Evaluation of prescribing pattern in pediatric outpatient at Albuluk pediatric hospital (Sudan). IJIPSR, 2015; 3(4): 244-252.
29. Mudawi MME, Babiker SK, Khalil EN, et al. Evaluation of drug interactions in renal failure centers. JPPDR, 2014; 4(1): 4-7.
30. Doume AEA, Hassan KY, Eltayeb BA, et al. Patients' complaints against their doctors at Sudanese Medical Council. SMJ, 2009; 45(2): 82-83.
31. Palanisamy S, Arul Kumaran KS, Rajasekaran A. A study on assessment, monitoring, documentation and reporting of adverse drug reactions at a multi-specialty tertiary care teaching hospital in South India. Int J Pharm Tech Res, 2009; 4: 1519-22.
32. Elkhawad A O, Abdel Magied A, Hieba M, Gaily A, Edress I, The awareness of Sudanese pharmacists about drug-drug interaction. "Ahfad Journal, 2013; 30(1): 47.
33. The Federal Ministry of Health, Federal General Directorate of Pharmacy; Annual pharmaceutical statistical report, 2014; 51.
34. Jamal et al. Pharmacist's interventions in reducing the incidences of drug related problems in any practice setting. ICPJ, January 2015; 4(2): 347-352.
35. FitzGerlad R J. Medication errors: the importance of an accurate drug history. BR J Clin Pharmacol, 2009; 67(6): 671-675.
36. Mahmoud AAE, Mohamed SSE, Ali AA. Doctors' perceptions on community pharmacists expanded roles in Sudan. WJPPs, 2014; 3(12): 335-349.
37. Lee VW, Fan CS, Li AW, Chan AC. Clinical impact of pharmacist-physician co-management in Hong Kong. J Clin Pharm Ther, 2009; 34(4): 407-14.
38. Snyder ME, Zillich AJ, Primack BA, et al. Exploring Successful community pharmacist-physician collaborative working relationship using mixed methods. Res Social Adm Pharm, 2010; 6: 307-323.
39. Awad A, Matowe L, Capps P. Medical doctor's perception and expectations of the role of hospital pharmacists in Sudan. Pharmacy World & Science 2007; 29(5): 557-564.
40. Ahmed IF, Mohamed I, Albert IW. Pharmacy practice in Indonesia: Pharmacy Practice in Developing Countries achievements and challenges. Elsevier: 2016; 53.

41. Seth SD, Vimlesh S. Textbook of pharmacology. 3rd ed., Elsevier, A division of Reed Elsevier India private limited. India. 2009; 1-54.
42. Hyacinthe T, Charles P, Adama K, Diarra C-S, et al. Variability of vitamins B1, B 2, and minerals contents in baobab (*Adansonia digitata*) leaves in east and west Africa. Food Sci Nutr, 2015; 391: 17-24. Doi:10.1002/fsn3.184.
43. Namratha V, Sahithi P. Baobab. A review about "The Tree of Life". IJAHST, 2015; 1(1): 20-26.
44. DiMaria- Ghalili R, Miratallo JM. Challenges and opportunities for nutrition education and training in the health care profession: intraprofessional and interprofessional call to action. Am J Clin Nutr, 2014; 99(5): 1184S-1193S.
45. Lasswell AB, Deforge BR, Sobal J, Muncie HL Jr, Michocki R. Family medicine residents' knowledge and attitudes about drug nutrient interactions. J Am Coll Nutr. 1995; 14: 137‑43.
46. Couris R.R, Tataronis G.R., Dallal G.E., Blumberg J.B., Dwyer J.T., Assessment of healthcare professionals' knowledge about warfarin-vitamin K drug-nutrient interactions. J. Am. Coll. Nutr., 2000; 19: 439-445.
47. Alhassan M. Community pharmacy practice in Saudi Arabia: An Overview. IJPHARM, 2009; 9(1).
48. Adisa and Fakeye. Assessment of the knowledge of community pharmacists regarding common phytopharmaceuticals sold in South Western Nigeria. Trop J Pharm Res, December 2006; 5(2): 619-625.