



Knowledge of Herbal Medicines and Herb-drug Interaction Among Medical and Pharmacy Students of the University of Lagos, Nigeria

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article.

Abstract

Background: Concurrent use of herbal and orthodox medicines can result in herb-drug interaction, which could remain unidentified due to the limited knowledge of health care providers on herbal medicines effects and safety.

Objectives: This study aimed to assess the knowledge of medical and pharmacy students of the University of Lagos on herbal medicines and herb-drug interactions.

Method: The study was a cross-sectional survey of final year pharmacy and medical undergraduate students (422) of the University of Lagos. Data was collected using a validated, previously developed, and standardized self-administered questionnaire. Descriptive statistics was used to evaluate the students' demographics, knowledge of herbal medicines and herb-drug interactions, types and uses of herbal medicines, while inferential statistics was employed to assess the association between the students' demographics and their knowledge of herb-drug interactions. Statistical significance was set at $P < 0.05$.

Results: The response rate was 97%. The students (98.0%) knew that herbs can be used as medicines; common uses of herbal medicines reported by the students include malaria (11.4%), pain (24.6%), and fever (36.2%). There was no association between the students' demographics and their knowledge about herbal medicine. Age was significantly associated with knowledge of herb-drug interaction ($P < 0.05$). The students (96.8%) knew that herbs can interact with conventional drugs when administered concurrently. The sources of the students' knowledge about herbal medicine and herb-drug interaction include lectures (52.2%), literature (14%) and personal experience (13.9%).

Conclusion: The students had good knowledge of herbal medicines; however, the subject of herbal medicines and their effects should be given more attention in the medical and pharmacy program curriculum, in order to enhance the students' knowledge base of herbal medicines and interactions, and equip the future physicians and pharmacists adequately for better patient care.

Keywords: Herbal medicines, Herb-drug interaction, Pharmacy students, Medical students

INTRODUCTION

In the past few decades, there has been a progressively increasing use of herbal medicines globally, with developed nations increasingly embracing herbal medicines as a complement to their standard health care (Welz *et al.*, 2018). In developing nations like Africa and Asia, traditional medicine, which includes herbal medicine, is a part of their spiritual and cultural belief systems and eighty percent of these populations depend on traditional medicine for their primary health

care (WHO, 2008). In Nigeria, the use of herbal medicine is widespread in the general population (Oreagba *et al.*, 2011; Awodele *et al.*, 2014), pregnant women (Duru *et al.*, 2016) and various patient populations (Achigbu & Achigbu, 2009; Nwako *et al.*, 2009; Onyeka *et al.*, 2012; Amaeze *et al.*, 2018). Majority of herbal medicine use involves self-prescribing, and these herbal remedies are often consumed concurrently with prescribed medicines (Esimone, 2011; Ogunsola and Egbewale, 2018), which has raised serious safety concern especially

herb-drug interactions. Research has consistently shown that a huge proportion of patients do not disclose herbal medicine use to their physicians (Jou and Johnson, 2016; Ben-Arye *et al.*, 2017), usually because they believe that disclosure is unimportant. In addition, most physicians are not very knowledgeable about herbal medicines and are often not confident enough to discuss herbal medicines and their effects with patients (Ali and Mohamed, 2014, Marie *et al.*, 2018). The level of knowledge of health care providers on herbal medicines and herb-drug interactions relates to the overall quality of healthcare delivery, especially regarding possible adverse effects of herbal medicines (Clement *et al.*, 2005). Insufficient knowledge may result in herb-drug interactions being overlooked or missed due to poor communication between doctors and their patients about herbal drug use (Boparai *et al.*, 2017).

With the growing popularity and increasing use of herbal medicines by patients, the education and training of health care providers regarding herbal medicines and herb-drug interactions becomes very pertinent to enable them to provide optimal care and counselling to the increasing number of patients who use herbal remedies, most times concurrently with their prescribed medications. A number of researchers have assessed the knowledge, perception, beliefs and

METHODOLOGY

The study was a cross-sectional survey of final year medical and pharmacy undergraduate students of the University of Lagos. The sample size of 422 was the total population of these students comprising 278 and 144 medical and pharmacy students respectively. Data was collected using a structured questionnaire which was adapted from previous studies (Bah *et al.*, 2002; Boparai *et al.*, 2017). The questionnaire was piloted using twenty randomly selected 400 level pharmacy and medical undergraduate students to establish face validity, and the internal consistency of the test items was assessed using Cronbach's alpha, obtained as 0.747. The study instrument comprised three sections. The first section consisted of questions on the demographic characteristics of the students such as age and gender. The second section had questions which assessed the students' knowledge on types, formulations, uses, official documentation and regulation of herbal medicines. Nine of the questions were close-ended with a "yes" or "no" option while four questions were open-ended in which the students filled in their responses. The last section had eight open- and close-ended questions to assess the students' knowledge of herb-drug interactions. Knowledge of types, mechanisms, mediators of herb-drug interaction, as well as specific examples of herb-drug interactions was assessed here. This section also

attitudes of healthcare providers (Yeo *et al.*, 2005; Loh *et al.*, 2012; Alrashidi *et al.*, 2013), hospital pharmacists and physicians (Fakeye and Onyemadu, 2008) and community pharmacists (Adisa and Fakeye, 2006) on Complementary and alternative Medicine (CAM) and herbal medicine. Their reports revealed that physicians and pharmacists had poor knowledge of CAM and/ or herbal medicines. Similar studies of pharmacy and non-pharmacy students (Ashraf *et al.*, 2019), medical students in Nigeria (Agunu and Lawal, 2016), Pakistan (Majeed *et al.*, 2007), Ghana (Ameade *et al.*, 2015) and Turkey (Akan *et al.*, 2012; Guven *et al.*, 2019) also showed that medical students do not have adequate knowledge about herbal remedies.

Earlier studies in the United States (Suchard *et al.*, 2004; Kemper *et al.*, 2006), and recently in India (Boparai *et al.*, 2017) have attempted to investigate the knowledge of medical students and health professionals on herb-drug interactions. There is however, a dearth of information on the knowledge of Nigerian medical and pharmacy students on herb-drug interactions. The aim of this study was to assess the knowledge of final year medical and pharmacy students of the University of Lagos on herbal medicines and herb-drug interaction. Such studies have the potential to provide information which can be relevant for future curriculum review or development.

asked questions about what the students' think as regards their knowledge of herb-drug interaction and the need for more knowledge about herb-drug interactions. Each correct answer got a score of "1", while a wrong answer carried a score of "0". The maximum scores for knowledge of herbal medicine and herb-drug interaction were 22 and 5 respectively. Scores $\geq 50\%$ were categorized as good while scores $< 50\%$ were deemed poor (Ameade *et al.*, 2015).

The self-administered questionnaire was distributed to the students after explaining the study objectives and obtained a verbal informed consent from them. The respondents were allowed at least 20 min to complete the questionnaire, without the use of any resource or reference material.

Ethical approval for this study was obtained from the Health Research Ethics Committee (HREC) of the Lagos University Teaching Hospital (LUTH) Idi-araba Lagos, with approval number: ADM/DCST/HREC/APP/1663. The research did not pose any cost or risk to patients and the students' confidentiality was also maintained by not using their names and matriculation number on the data collection tool.

The collected data was checked for completeness and responses were coded and entered into Statistical Package for the Social Sciences (SPSS), version 24.0

(SPSS Inc, IBM, Chicago, IL, USA). Socio-demographic characteristics of the respondents, types and uses of herbal medicines cited by the students were evaluated using frequencies and percentages. Chi-square was used to assess the association between the students' demographics and knowledge of herbal medicines and herb-drug interaction. The mean of the

RESULTS

Socio-demographic characteristics of the respondents

A total of 410 students (33.4% - pharmacy, 66.6% - medical) completed the questionnaire giving a response rate of 97%. Of these, 232 (56.6%) were females, only 14 (3.4%) were married and 335 (81.7%) were Christians (Table 1).

Level of the respondents' knowledge of herbal medicine

The respondents (98%) knew that herbs can be used as medicines. Majority (93.7%) knew that herbal medicine preparations are available in various forms; however, only 59% could provide the different available forms of herbal medicines correctly. Eight forms of herbal medicine preparations were reported by the students: decoctions (17.1%), powdered herbs and capsules (13.2%), herbal tinctures (6.1%), herbal poultices (5.4%), herbal ointment (5.1%), fluid extract (2.7%), juices (2.2%) and essential oils (0.7%).

Majority of the respondents (97.3%) knew that herbal medicine is an integral part of traditional medicine, while 90.7% knew that herbal medicine is a type of Complementary and Alternative Medicine (CAM). Only 22.7% of the pharmacy students and 17.1% of the medical students knew of availability of an international and Nigerian herbal pharmacopeia. The students (66.3%) knew that herbal medicine was regulated in Nigeria and 52.9% of them submitted that NAFDAC was the regulatory authority

pharmacy and medical students' scores for knowledge of herbal medicine and herb-drug interactions was compared using the independent samples t-test. Statistical significance was set at $P < 0.05$. Spearman's rank for non-parametric correlation analysis was used to evaluate the relationship between the students' knowledge of herbal medicine.

responsible for the regulation of herbal medicines in Nigeria. The overall mean score for the students' knowledge of herbal medicine was 1.16 ± 1.64 and 1.36 ± 2.01 for the medical and pharmacy students respectively. The highest scores were obtained for the knowledge that herbs can be used as medicines, different forms of herbal preparations available and herbal medicine being an integral part of traditional medicine. The knowledge of the availability of herbal pharmacopoeias (international and Nigerian) had the lowest scores (Table 2). More than half of the students (67.6%) were able to give the common or botanical name of at least one medicinal herb, while 62.4% of them gave their uses. A total of twenty-six medicinal herbs was listed by the students; common uses reported by the students include fever (36.2%), pain (24.6%) and malaria (11.4%) (Table 3).

There was no association between the students' demographics and their knowledge about herbal medicine. However, age was significantly associated with the knowledge of herb-drug interaction for both the medical and pharmacy students at Chi Square = 15.143, p-value = 0.002 (Table 6). Also, there was no significant positive correlation between knowledge of herbal medicine and the knowledge of herb-drug interaction ($r = 0.070$, p-value = 0.078). The test for difference between the medical and pharmacy students on knowledge of herbal medicine showed a significant mean difference at $t = 3.553$, p-value = 0.000.

Table 1: Socio-demographics of the students

Characteristics	Medical students N (%), n= 273	Pharmacy students N (%), n=137	Total N (%)
Age (years)			
16 – 20	24 (8.8)	4 (2.9)	28 (6.8)
21 – 25	224 (82.1)	119 (86.9)	343 (83.7)
26 – 30	20 (7.3)	9 (6.6)	29 (7.1)
>30	5 (1.8)	5 (3.6)	10 (2.4)
Sex			
Male	131 (48)	47 (34.3)	178 (43.4)
Female	142 (52)	90 (65.7)	232 (56.6)
Marital status			
Single	262 (96)	130 (94.9)	392 (95.6)
Married	7 (2.6)	7 (5.1)	14 (3.4)
Others	4 (1.5)	0 (0.0)	4 (1.0)
Religion			
Christian	226 (82.8)	109 (79.6)	335 (81.7)
Muslim	42 (15.4)	28 (20.4)	70 (17.1)
Traditional	3 (1.1)	0 (0.0)	3 (0.7)
Others	2 (0.7)	0 (0.0)	2 (0.5)
Ethnicity			
Igbo	38 (13.9)	37 (27.0)	75 (18.3)
Yoruba	194 (71.1)	88 (84.2)	282 (68.8)
Hausa	3 (1.1)	1 (0.7)	4 (1.0)
Others	38 (13.9)	11 (8.0)	49 (12.0)

Table 2: Students’ mean scores for knowledge of herbal medicine

Statements/ Questions (response score)	Students Mean Response Score			
	Medical students [#] (N = 273)	% ^{\$}	Pharmacy students [#] (N = 137)	% ^{\$}
Herbs can be used as medicine (1)	0.98	7.03	0.98	6.02
Herbal preparations are available in different forms (1)	0.94	6.73	0.93	5.71
Listing at least two correct forms of herbal preparations (2)	1.09	7.81	1.36	8.35
List five Nigerian herbal medicines and their use (10)	6.30	45.13	7.66	47.06
More than 80% of people living in developing nations use herbal medicine for their treatment of their ailments (1)	0.70	5.01	0.76	4.67
Herbal medicine is an integral part of traditional medicine (1)	0.98	7.03	0.96	5.90
Herbal medicine is a type of CAM (1)	0.88	6.30	0.96	5.90
Are you aware of any international herbal Pharmacopoeia? (1)	0.15	1.07	0.39	2.40
Are you aware of a Nigerian Pharmacopoeia? (1)	0.19	1.36	0.13	0.80
Is herbal medicine regulated? (1)	0.62	4.44	0.75	4.63
Name of the regulatory authority for herbal medicine in Nigeria (1)	0.62	4.44	0.75	4.63
Are you aware of clinical trials on efficacy and safety of herbal medicines (1)	0.51	3.65	0.64	3.93
Sum of mean scores (22)	13.96	100.00	16.28	100.00
Percentage of sum of mean scores ^a	46.16		53.84	
Overall mean score ^b	1.16		1.36	

CAM = Complementary and Alternative Medicine

[#]The values represent the mean of the response score of each item.

^{\$}The values were obtained as mean response score (MRS) relative to sum of mean scores (SMS) multiplied by 100. That is (MRS/SMS)*100.

^aObtained for each group as SMS/(13.96 + 16.28)*100.

^bThe mean of the mean response scores for each group

Table 3: Medicinal plants and their uses reported by the students

Medicinal plants		Uses	No. (%) of students who cited it	
Common name	Botanical name		Medical students n=273	Pharmacy students n=137
Bitter leaf	<i>Vernonia amygdalina</i> *	Malaria	13 (7.6)	4 (3.8)
Agbo-iba	A poly-herbal* formulation	Fever	46 (26.7)	10 (9.5)
Yoyo bitters	A poly-herbal formulation [#]	Pile (hemorrhoids)	10 (5.8)	12 (11.4)
Moringa	<i>Moringa oleifera</i>	Flushing	5 (2.9)	2 (1.9)
Lemon grass	<i>Cymbopogon citratus</i>	Typhoid	2 (1.2)	5 (4.8)
Oroki	A poly-herbal formulation [§]	Purgative/ laxative	8 (4.7)	7 (6.7)
Aloe vera	<i>Aloe vera</i>	Dysentery	5 (2.9)	-
Garlic	<i>Allium sativum</i>	Bodyaches	5 (2.9)	1 (1.0)
Dongonyaro	<i>Azadirachta indica</i>	Antioxidant	21 (12.2)	12 (11.5)
Scent leaf	<i>Ocimum gratissimum</i>	Hypertension	4 (2.3)	3 (2.9)
Ginkgo	<i>Ginkgo biloba</i>	Iron supplement	6 (3.5)	-
Agbo-jedi	A poly-herbal formulation	Stomach pain/Waist pain	26 (15.1)	10 (9.5)
Pawpaw	<i>Carica papaya</i>	Weight loss	5 (2.9)	3 (2.9)
Green tea	<i>Camilla sinensis</i>	Cough	1 (0.6)	-
Digitalis	<i>Digitalis purpurea</i>	Haematinics	4 (2.3)	1 (1.0)
Bitter cola	<i>Garcinia cola</i>	Skin infection	3 (1.7)	2 (1.9)
Ugu leaf	<i>Telferia occidentalis</i>	Insomnia	2 (1.2)	-
Black soap	-----	Bipolar disorder	1 (0.6)	3 (2.9)
St. John's wort	<i>Hypericum perforatum</i>	Diabetes	1 (0.6)	-
Rauwolfia	<i>Rauwolfia vomitoria</i>	Sickle cell anaemia	3 (1.7)	4 (3.8)
Mango	<i>Magnifera indica</i>	Carminative	1 (0.6)	5 (4.8)
Senna	<i>Cassia senna</i>	Laxative/Constipation/ Weight loss	-	15 (14.3)
	<i>Cajanus cajan</i>	Food/Nutritional Supplement	-	4 (3.8)
Cinchona	Cinchona	Pain/ ulcers	-	1 (1.0)
Ginger	<i>Zingiber officinale</i>	Antibiotics	-	1 (1.0)

#Poly-herbal formulation containing *Acinos arvensis*, *Citrus aurantifloia*, *Aloe vera*, *Cinamum aromaticum*, and *Chenopodium murale*.

§Poly-herbal formulation containing *Sorghum bicolor* stem, *Khaya grandifoliola* bark, *Cassia sieberiana* root, *Staudtia stipitata* root, *Alstonia congensis* bark, *Ocimum basilicum* leaves, *Mangifera indica* leaves, *Cyathula prostrata* leaves, *Securidaca longepedunculata* root, and *Saccharum officinarum* stem.

Knowledge of herb-drug interaction

The students (96.8%) had the knowledge that herbs can interact with conventional drugs when administered concurrently, however, only 21.5% could provide specific examples of such interactions. A total of eleven examples of herb-drug interactions were given by the students. Lectures (52.2%) were the most common source of information for students regarding herbal medicines, followed by literatures (14.1%), personal experience (13.9%) and other sources (12.2%). A large number of the students (98.2%) knew that herb-drug interaction is mediated by pharmacokinetic and pharmacodynamic mechanisms and that drug metabolizing enzymes and transporters play significant roles in herb-drug

interactions. The overall mean score for knowledge of herb-drug interaction was 0.80 ± 0.29 and 0.81 ± 0.19 for the medical and pharmacy students respectively. The knowledge of the possibility of an interaction between herbs and orthodox medicines, and the mechanisms of herb-drug interaction had the highest scores. The lowest score was recorded for correctly providing examples of specific herb-drug interactions. Majority of the students (93.9%) submitted that they need more knowledge about herb-drug interactions (Table 4). The specific herb-drug interactions as reported by the students is shown in Table 5. The test for difference between the medical and pharmacy students' knowledge of herb-drug interaction showed no significant mean difference.

Table 4: Students’ mean scores for knowledge of herb-drug interaction

Statements (response score)	Students mean response score			
	Medical students [#]	% ^{\$}	Pharmacy students [#]	% ^{\$}
An herb can interact with a conventional drug when they are taken together (1)	0.97	22.61	0.96	22.12
List two correct specific herb-drug interactions (2)	0.37	8.62	0.54	12.44
Herb-drug interaction is mediated by pharmacokinetic and pharmacodynamics mechanisms (1)	0.94	21.91	0.89	20.51
Drug metabolizing enzymes and transporters play significant roles in herb-drug interactions (1)	0.95	22.14	0.86	19.82
Sum of mean scores (7)	3.23	100.00	3.25	100.00
Percentage of sum of mean scores ^a	49.85		50.15	
Overall mean score ^b	0.80 (0.29)		0.81 (0.19)	

[#]The values represent the mean of the response score of each item.

^{\$}The values were obtained as mean response score (MRS) relative to sum of mean scores (SMS) multiplied by 100. That is (MRS/SMS)*100.

^aObtained for each group as SMS/(3.23 + 3.25)*100.

^bThe mean of the mean response scores for each group

Table 5: Examples of herb-drug interactions as mentioned by the students

Examples of herb-drug interactions	Medical students	Pharmacy students	Total (N=410)
	Freq. (%)	Freq. (%)	Freq. (%)
<i>Ginkgo biloba</i> and antidiabetics	4 (1.5)	1 (0.7)	5 (1.2)
St John’s wort and many drugs (antidepressants)	13 (4.8)	4 (2.9)	17 (4.1)
Green vegetable and warfarin	13 (4.8)	10 (7.3)	23 (5.6)
Alcohol based herbs and tramadol	7 (2.6)	1 (0.7)	8 (2.0)
Garlic & aspirin	4 (1.5)	0 (0.0)	4 (1.0)
Ginseng and tetracycline	5 (1.8)	1 (0.7)	6 (1.5)
<i>Ginkgo biloba</i> and diazepam	3 (1.1)	1 (0.7)	4 (1.0)
Metronidazole and alcohol-based concoctions	2 (0.7)	10 (7.3)	12 (2.9)
Glibenclamide and <i>O. gratissimum</i>	0 (0.0)	4 (2.9)	4 (1.0)
Insulin and moringa	0 (0.0)	3 (2.2)	3 (0.7)
Lemon fruit and arthemeter/lumefantrine	0 (0.0)	2 (1.5)	2 (0.5)
Nonresponse	222 (81.3)	100 (73.0)	322 (78.5)

Table 6: The association between the students’ demographics and knowledge of herbal medicines and herb-drug interaction

Socio-demographic factors	Knowledge of herbal medicine			Knowledge of herb-drug interaction		
	Chi-square	Df	p-value	Chi-square	Df	p-value
Sex	1.880	1	0.170	1.911	1	0.167
Age	3.336	3	0.343	15.153	3	0.002
Marital status	1.718	2	0.424	3.921	2	0.141
Religion	2.976	3	0.395	1.994	3	0.574
Tribe	3.428	3	0.330	0.645	3	0.886

DISCUSSION

Herb-drug interaction results from the concurrent use of herbal and conventional medicines. These adverse events which could be harmful often go unnoticed in patients due to the varied reasons including deficient knowledge of health care practitioners on herbal medicines and herb-drug interactions (Boparai *et al.*, 2017).

In this study, almost all the students (98%) were aware that herbs can be used as medicines, similar to a previous report on dental students (Sekhri *et al.*, 2013) and medical undergraduates (Boparai *et al.*, 2017). The students showed good knowledge of the different forms of herbal preparations, and herbal medicine being an integral part of traditional medicine and a facet of Complementary and Alternative Medicine. Pharmacy students however, had better level of knowledge of herbal medicines relative to the medical students. This finding agrees with a previous report, in which pharmacy students demonstrated better knowledge of herbal medicines than their non-pharmacy counterparts (Ashraf *et al.*, 2019). This could be due to their exposure to topics on medicinal plants in Pharmacognosy and other related areas which are all embedded in the Pharmacy curriculum. More than half of the students were aware that herbal medicines are regulated in Nigeria by the National Agency for Food and Drug Administration and Control (NAFDAC). In a similar study of medical undergraduates in India (Boparai *et al.*, 2017), majority of the students did not know of the regulation of herbal medicines by the regulatory authorities in the country. Likewise, medical students in Turkey (18 - 21% of the study population) considered legal regulations of herbal medicines unnecessary. Regulation of herbal medicines is critical for ensuring safety, efficacy and quality of herbal medicinal products (WHO, 2005). Traditional medicine policy and regulation represents an integral part of the WHO proposed critical determinants of herbal medicine safety (Awodele *et al.*, 2014a), and many WHO member states have established laws and regulations regarding herbal medicines. It is thus important for health care providers in training, particularly medical doctors and pharmacists to have good knowledge about the regulation of herbal medicines.

Importantly also, only a small percentage of the students were aware of a herbal pharmacopoeia, which is a documentation of plant monographs including their physical, chemical, botanical, ethnomedical, quality control, pharmacological, toxicological, therapeutic and other regulatory standards (Elujoba, 2012). This finding mirrors that of a previous study (Ameade *et al.*, 2015), which showed that medical undergraduate students in Ghana had very poor knowledge of herbal Pharmacopoeias. A herbal

Pharmacopoeia should be a vital and indispensable source of information on herbal medicine and readily available for students' use. Currently, few herbal pharmacopoeias are available and efforts are being intensified towards producing more. The first edition of the Nigeria herbal Pharmacopoeia which contains forty two (42) commonly used medicinal plants in Nigeria was published in 2008 and is currently being reviewed to make it more inclusive and valuable (The review of Nigeria herbal pharmacopoeia, 2018).

The students had a good knowledge of the names of some Nigerian herbal medicines. The herbal medicines and products which were most reported by the students include "Agbo-iba", "Agbo-jedi", Dongoyaro (*Azadirachta indica*), Yoyo bitters[®], Bitter leaf (*Vernonia amygdalina*), Senna (*Cassia senna*), Pawpaw (*Carica papaya*), Moringa (*Moringa oleifera*) and *Aloe vera*. These are popular herbal medicines in Nigeria, especially the South-West where this study was carried out. "Agbo-iba", "Agbo-jedi" and Yoyo bitters[®] are indigenous poly-herbal formulations comprising several medicinal plants. In a similar study (Sekhri *et al.*, 2013), the students were familiar with turmeric, neem, *Aloe vera*, garlic and clove. In yet another study, students knew more about neem, pawpaw, moringa, and mango mainly for their use in the treatment of malaria (Ameade *et al.*, 2015). These differences can be explained by the differences in geographical location and the predominant herbal medicines in the different locations. Treatment of malaria was the most popular use of herbal medicine reported by the students, similar to a previous report in Ghana (Ameade *et al.*, 2015). This is not surprising, considering the high prevalence and endemicity of malaria in Nigeria. Interestingly, the source of information on herbal medicine most mentioned by the students was lectures, which shows that the programs' curriculum have some herbal medicine content. In other studies, family members and the media were the main sources of information about herbal medicines. Such information may not have a scientific basis as it is generally based on local beliefs and personal experience (Perkin *et al.*, 2002; Sekhri *et al.*, 2013; Boparai *et al.*, 2017).

Almost all the students demonstrated knowledge that herb-drug interactions result from a combination of herbs and conventional medicines, similar to the report of Sekhri *et al.* (2013). However, only about a fifth of the students could correctly provide examples of specific herb-drug interactions, highlighting their deficient knowledge on the topic. Other studies which support this observation have been reported on medical students from Canada (Xu *et al.*, 2008), Ireland (Loh *et al.*, 2012) and India (Sekhri *et al.*, 2013, Boparai *et al.*, 2017). In these studies, medical

residents and students submitted that their formal education had very little content of topics on herbal medicines. This could be a possible reason for the students' poor knowledge of specific herb-drug interactions. Age was significantly associated with the students' knowledge of herb-drug interaction (p-value = 0.002). The older students had more knowledge than the younger ones on herb-drug interaction. This could mean that they have more exposure to herbs and their effects compared to the younger students.

The use of herbal medicines is increasing worldwide; the incidence of herb-drug interactions is also on the rise. Future physicians and pharmacists should be provided with more exposure on herbal medicines,

their uses, effect, safety and drug interactions in order to equip them adequately to deal with questions of herbal medicines from patients, and to prevent dangers associated with herb-drug interactions. This study is limited by the fact that it was conducted in only one medical school and Faculty of pharmacy, and so may not be generalized to the entire medical and pharmacy undergraduates in Nigeria. A survey of pharmacy and medical students in other Nigerian universities would be beneficial to further understand the subject matter. Other limitations include the small sample size used and the cross-sectional study design. These limitations however, do not alter our findings in anyway.

CONCLUSION

The students had good knowledge of herbal medicines, though the pharmacy students seemed more knowledgeable as regards herb-drug interactions. With the increasing trend of concurrent use of herbal and orthodox medicines, there is need to further incorporate and expand the course contents on herbal medicines, particularly their uses, effects and drug interactions in the pharmacy and medical

students' curriculum. This would invariably enhance the students' knowledge and get them better prepared for effective patient care in practice. Continuing professional education for doctors and pharmacists should also provide more training and support on herbal medicines safety and drug interactions, so that these health care practitioners can communicate with patients effectively on herbal medicines, and provide optimal services and care to patients.

DECLARATIONS

Ethical approval

Ethical approval for this study was obtained from the Health Research Ethics Committee (HREC) of the

Lagos University Teaching Hospital (LUTH) Idi-araba Lagos, with approval number: ADM/DCST/HREC/APP/1663.

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