Knowledge of students in the ultimate year of undergraduate pharmacy school about basic pediatric pharmacy

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ABSTRACT

Background Drug use in children is more challenging than in the adult population because of associated difference in drug handling.

Objectives This study assessed the level of knowledge and competency of pharmacy students in the ultimate year on basic pediatric pharmacy as well as the impact of an educational intervention.

Methods Baseline self-reported knowledge and competence of respondents on pediatric pharmacy was assessed with a questionnaire. An educational training was administered by a pharmacist who is a faculty member; thereafter knowledge and competence of the participants were re-assessed to determine the effect of the training.

Results All the respondents were familiar with "Pediatrics", 40 (65.6%) learnt the term before getting admitted to study pharmacy while 21 (34.4%) got to know it during the course of their study. Thirty-four (56%) respondents were affirmative in responding to whether they had taken courses in pediatric dosing. Only 7 (11.5%) had poor knowledge of pediatric pharmacy while 57 (93.4%) had poor competency in handling issues relating to drug dosing and administration. Fifty-four (88.5%) respondents opined to addition of more pediatric-based courses in their curriculum. The mean scores in three of ten knowledge questions and in 5 of 6 competency questions were significantly improved post-intervention with values ranging between $P < 0.001$ and $P = 0.047$.

Conclusion Pharmacy students in the ultimate year in a Nigerian university had appreciable basic knowledge in pediatric pharmacy but competency in handling dosing and drug administration issues in pediatric patients was poor. A training on basics of drug use in the pediatric population improved knowledge fairly and competency scores significantly.

Keywords: knowledge, pediatric, pharmacy, students

Connaissance de la pharmacie pédiatrique de base chez les étudiants en dernière année de licence de pharmacie

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RÉSUMÉ

Contexte : L'utilisation des médicaments chez les enfants est plus difficile que dans la population adulte en raison des différences associées à la manipulation des médicaments.

Objectifs : Cette étude a évalué le niveau de connaissance et de compétence des étudiants en pharmacie en dernière année sur la pharmacie pédiatrique de base ainsi que l'impact d'une intervention éducative.

Méthodes : Les connaissances et les compétences de base autodéclarées des répondants en pharmacie pédiatrique ont été évaluées à l'aide d'un questionnaire. Une formation pédagogique a été administrée par un pharmacien membre du corps professoral ; par la suite, les connaissances et les compétences des participants ont été réévaluées pour déterminer l'effet de la formation.

Résultats : Tous les répondants étaient familiers avec la "pédiatrie", 40 (65,6%) ont appris le terme avant d'être admis à l'étude de la pharmacie tandis que 21 (34,4%) l'ont appris au cours de leurs études. Trente-quatre (56 %) répondants ont répondu par l'affirmative à la question de savoir s'ils avaient suivi des cours sur le dosage en pédiatrie. Seulement 7 (11,5 %) avaient une faible connaissance de la pharmacie pédiatrique, tandis que 57 (93,4 %) avaient une faible compétence dans le traitement des questions liées au dosage et à l'administration des médicaments. Cinquante-quatre (88,5 %) répondants ont opté pour l'ajout de plus de cours axés sur la pédiatrie dans leur programme d'études. Les scores moyens dans trois des dix questions sur les connaissances et dans cinq des six questions sur les compétences se sont améliorés de manière significative après l'intervention, avec des valeurs comprises entre $P < 0,001$ et $P = 0,047$.

Conclusion : Les étudiants en dernière année de pharmacie dans une université nigériane avaient des connaissances de base appréciables en pharmacie pédiatrique mais la compétence dans la gestion des questions de dosage et d'administration des médicaments chez les patients pédiatriques était faible. Une formation sur les bases de l'utilisation des médicaments dans la population pédiatrique a amélioré de manière significative les scores de connaissances et de compétences.

Mots clés : Étudiants, Connaissances, Pédiatrie, Pharmacie

INTRODUCTION

Drug use in children is more challenging than the adult population because of associated difference in drug handling in this population. This is due largely to their developmental stage and also differs within different stages of childhood.[1] Although children experience different illnesses as in adults, drug use are mostly based on evidence from adult studies resulting in unlicensed drug use and medicines use off-label.[2] Consequently, in providing professional care to the pediatric patient, the pharmacist needs to be familiar with their peculiarities.

Persons between 0 and 14 years of age make up over 40% of the population in Nigeria with mortality rates in children under five years of age as high as 132 per 1000 live births.[3-4] This situation necessitates a high demand for pharmacists with adequate knowledge of drug use in pediatrics. Specialties in pediatric pharmacy in Nigeria are almost non-existent, pediatric pharmaceutical services are in most cases provided by pharmacists with basic pharmacy degree. In a country with such high mortality in children, the pharmacists' knowledge in pediatric pharmacy becomes imperative. While the advocacy for pediatric pharmacy and training programs are being considered, there is the need to strengthen the already existing basic pharmacy degree which in most cases are the Bachelor of Pharmacy (B.Pharm) degree and also the Doctor of Pharmacy (Pharm.D) now emerging in Nigerian universities. This is paramount because upon graduation, majority of these pharmacists find themselves either in the hospital or community practice settings providing care to majority of pediatric patients.

Pharmacists' interventions resulted in decrease in rate of medication errors in children,[5] therefore adequate preparation of the pharmacist during their academic training will enhance the ability of these professionals to improve on the health outcomes of the pediatric patients. Muzenburger and colleagues had reported on the ability of pharmacists to make recommendations in some topics related to pediatrics and the need of an additional training to improve proficiency in pediatric care.[6] Furthermore, Mukattash and colleagues had reported an alarming deficiency in pharmaceutical care knowledge among final year pharmacy students in Jordan.[7] It had been suggested previously, that encouraging research and training in pediatric clinical pharmacology and reviewing undergraduate and postgraduate training in clinical pharmacology will, among other factors, improve children's access to safe medicines in Nigeria.[6] The recent pharmacy graduate should be averse in basic knowledge in pediatric pharmacy such as drug dosing and administration and how to access drug information for pediatric patients, and thus not in a quandary when face to face with such situations. This Nigerian-based study assessed basic pediatric pharmacy knowledge and competency of pharmacy students in the ultimate year and determined the effect of a training.

METHODS

This cross-sectional and interventional study was done among students in the ultimate year of study in the Faculty of Pharmacy, Delta State University, Abraka, Nigeria. Only students who had completed all course work in their curriculum but yet to partake in clinical clerkship at the hospital made up the study population. Sixty-one students completed the study.

A questionnaire was used for the purpose of this study, content of the questionnaire was derived based on literature review[7-9] and consultation with an expert. The final questionnaire consisted of 25 items and was divided into four sections. Section (A) were the participants' socio-demographic data, Section (B) determined the background information on Pediatric pharmacy, Section (C) consisted of questions on knowledge of pediatric pharmacy, while Section (D) tested their competency. The questionnaire was reviewed by an expert in the field and unclear items were removed.

The study objectives and data collection procedure were introduced to the respondents all seated in a lecture hall. Socio-demographic information and baseline self-reported knowledge and competence on pediatric pharmacy was obtained on the first instance of the questionnaire administration. An educational intervention which was a training on basics of drug use in pediatrics was delivered by a pharmacist who is a member of the faculty after which the participants were allowed to ask questions for clarity. Questionnaires with the same items which were previously tested were administered to determine the effect of the training on students' knowledge and competence in pediatric pharmacy. The pre- intervention and post-intervention questionnaires were coded accordingly to ensure confidentiality and accurate matching.

Descriptive statistics such as mean and standard deviation were done for age while responses to knowledge and competency testing were presented as

percentages. Each correct response was scored 1 and an incorrect or uncertain response was scored 0. For items requiring two correct responses, incorrect responses were scored 0, while a correct response scored 1 and two correct responses were scored 2 marks for each question. Correct scores were reported as a percentage of total expected scores. Moreover, competency scores on drug dosing and administration were graded into poor and good respectively with correct scores of equal to or less than 2(50%) as poor and correct scores of 3 and greater as good. The differences in pre-intervention and post-intervention mean scores were tested using paired t-test. Mean differences at p-value <0.05 were statistically significant. The analysis was aided with the use of Statistical Package for Social Sciences SPSS version 23 (Armonk, NY)

Ethical approval for this study was obtained from the Ethics Committee, Central Hospital Warri,-Nigeria. The respondents gave their written informed consent and confidentiality was assured.

RESULTS

Response rate was 85.71% as 61 of 70 questionnaires were duly completed. Mean age of respondents was 23.6 years (SD=2.09), 39 (63.9%) were females and majority were single 58 (95.1). The totality (100%) of the respondents agreed they are familiar with "Pediatrics". Forty students (65.6%) learnt the term before commencement of their study of pharmacy while 21 (34.4%) got to know it during the course of their pharmacy study.

Thirty-four (56%) students were in the affirmative in response to whether or not they have had to take courses in pediatric dosing.

A total of 54 (88.5%) of respondents opined to the inclusion of more pediatric-based courses in the pharmacy curriculum.

Self-reported knowledge in pediatric pharmacy.

Ten items were employed to determine knowledge of pediatric pharmacy. Forty-three (71%) of the respondents knew children were not "little adults", while 57 (93.4%) knew children handle medicines differently from adults. Other responses are presented in Table 1.

Table 1. Responses on self-reported knowledge in pediatric pharmacy

Items on knowledge of pediatric pharmacy	RESPONSE		
	Yes (%)	No (%)	Not sure (%)
Children are "little adults"	13(21.3)	43(70.5)	5(8.2)
Children handle medicines differently from adults	57(93.4)	4(6.6)	0(0.0)
Young children and older ones respond to medicine the same way	4(6.6)	55(90.2)	2(3.3)
Range of illnesses in children are the same as in adults	6(9.8)	48(78.7)	7(11.5)
Oral absorption of penicillin is higher in children	15(24.6)	6(9.8)	40(65.6)
Medication errors in children have a higher potential to cause harm than in adults	48(78.7)	3(4.9)	10(16.4)
Do you know what unlicensed medications are?	40(65.6)	17(27.9)	4(6.6)
Do you know what off-label use of medicines is?	53(86.9)	6(9.8)	2(3.3)
Weight method is the most accurate method of dosage calculations in Pediatrics	53(86.9)	1(1.6)	7(11.5)
Percutaneous absorption is lower in infant than in adult	19(31.1)	8(13.1)	34(55.7)

Individual knowledge scores were further graded into poor, appreciable and excellent for correct scores of =4, 5-7 and =8 respectively. Seven (11.5%), 48 (78.7%) and 6 (9.8%) respondents had poor, appreciable and excellent knowledge scores respectively.

Competency testing.

Six items determined competency in basic pediatric pharmacy. Four were on drug dosing and administration in pediatrics, while two were on disease knowledge and drug information reference. Thirty-nine (63.9%) respondents were able to calculate dose from body weight, only 7 (11.5%) were able to instruct a caregiver on accurate dosage measurement, 29 (47.5%) were able to provide advice on the provision of oral syringe to ensure accurate measurement of dose in milliliters and 14 (23%) were able to advise on the extemporaneous administration of vitamin A from soft-gel capsule. Frequencies of responses are shown in Table 2.

Table 2. Responses on pediatric drug dosing and administration competency test

Competency Test	Correct frequency (%)	Incorrect frequency (%)
Efe, a three month old baby weighs 5.23kg. What dose of Acyclovir does he require if a 70kg adult takes a dose of 800mg?	39 (63.9)	22 (36.1)
An oral drug "Sarz" with a high therapeutic index is dosed 2mg/kg in children. How many milliliters will you instruct a care giver to administer to a 13.2 kg child if the suspension concentration is 15mg/ml?	7 (11.5)	54 (88.5)
A caregiver needs to administer a dose of 1.5ml amoxycillin/clavulanate to a child. The measuring cup is calibrated in 2.5ml and 5ml. How can you ensure the patient gets the right quantity of the drug?	29 (47.5)	32 (52.5)
How would you counsel a care giver to administer vitamin A to child of 1 year and 6 months, if the only available vitamin A in the pharmacy is the soft-gel capsule?	14 (23.0)	47 (77.0)

Also, two items determined their knowledge on common diseases of children in the tropics and drug references from which drug information can be obtained for pediatric patients. Respondents were required to mention two each of common diseases of children in the tropics and drug references from which information can be accessed for pediatric patients. A total of 84 (68.9%) common diseases mentioned were correct and only 32 (26.2%) drug references were correct.

A total of 57 (93.45) participants answered correctly two or less of the four questions on drug dosing and administration competency in children which represents a majority having poor scores. Only 4 (6.55%) participants answered correctly more than two questions and thus had good scores.

The effect of training on pediatric pharmacy and competency testing.

The difference in pre -intervention and post - intervention mean knowledge scores was determined with a paired sample t-test. There was significant difference in mean score of the items on "Children are little adults", "oral absorption is higher in children than in adults", "weight method is the most accurate method of dosage determination". Scores and p-values are shown in Table 4

Table 3. Impact of an educational intervention on knowledge of pediatric pharmacy

Items	Pre-Intervention Mean score(SD)	Post-intervention Mean score (SD)	P-value
Children are “little adults”	0.67(0.473)	0.80 (0.401)	0.045
Children handle medicine differently to adults	0.93(0.250)	0.89(0.321)	0.321
Young children and older ones respond to medicine the same way	0.93(0.30)	0.84 (0.373)	0.321
Range of illnesses in children are the same as in adults	0.79 (0.413)	0.70 (0.460)	0.301
Oral absorption of penicillin is higher in children	0.25 (0.434)	0.578 (0.740)	<0.001
Medication errors in children have a higher potential to cause harm than in adults	0.81 (0.393)	0.81(0.393)	1.000
Have you heard of unlicensed medications?	0.66 (0.497)	0.77 (0.424)	0.180
Have you heard of off-label use of medicines?	0.87 (0.340)	0.79 (0.413)	0.199
Weight method is the most accurate method of dosage calculations in Pediatrics	0.02 (0.128)	0.38 (0.489)	<0.001
Percutaneous absorption is lower in infant than in adult	0.02 (0.340)	0.25 (0.434)	0.076

SD Standard Deviation

All but one item on competency testing has significant difference in mean scores after the intervention was administered. These mean scores and their p values are shown in Table 4.

Table 4. Impact of an educational intervention competency on basic pediatric pharmacy

Items	Pre-intervention Mean score(SD)	Post intervention Mean score(SD)	Pvalue
Efe, a three month old baby weighs 5.23kg. What dose of Acyclovir does he require if a 70kg adult takes a dose of 800mg?	0.64 (0.484)	0.74 (0.444)	0.159
An oral drug "Sarz" with a high therapeutic index is dosed 2mg/kg in children. How many millilitres will you instruct a care giver to administer to a 13.2 kg child if the suspension concentrationis 15mg/ml?	0.11(0.321)	0.59 (0.496)	<0.001
A caregiver needs to administer a dose of 1.5ml amoxycillin/clavulanate to a child. The measuring cup is calibrated in 2.5ml and 5ml. How can you ensure the patient gets the right quantity of the drug?	0.48 (0.508	0.67 (0.473)	0.009
How would you counsel a care giver to administer vitamin A to child of 1 year and 6 months, if the only available vitamin A in the pharmacy is the soft-gel capsule?	0.23 (0.424)	0.51 (0.504)	<0.001
Mention two diseases common in pediatric patients in the tropics	1.377 (0.610)	1.557(0.592)	0.047
Mention two references from which drug information for pediatric patients can be obtained	0.525(0.744)	1.033(0.816)	<0.001

SD Standard Deviation

DISCUSSION

The pharmacist has a critical role in improving health outcomes, which is even more important in the pediatric population. Children in the developing countries are exposed to different range of disease conditions which impart negatively on their health care indices. Adequate preparation of the pharmacist in his training to handle basics of drug administration in pediatric patients will contribute positively to their healthcare. This study determined the knowledge of basic pediatric pharmacy use and competency of students in the ultimate year of undergraduate pharmacy study a Nigerian university.

All respondents had learnt the term pediatric pharmacy which means they were familiar with the term. This is somewhat different from the findings of a Jordanian study where 4.8% of such students were not aware of the term 'pediatrics'.[7] Nearly three quarter of the study population declined to the assertion that children were little adults. This knowledge is foundational in caring for this special age group because this informs judgment and decisions taken in their care. Although, the basis for much of medication used in children is extrapolated from adult studies, a whole lot of physiological and developmental differences exist between children and adults, and also

within different age ranges in the pediatric category.

Majority of the participants knew that children handle medicines differently from adults and that there is difference in response to drug use among a younger and older children but did not know for certainty that oral absorption of penicillin is higher in children than adults. About two-third of respondents had knowledge of unlicensed medicines while over half knew off-label use of medicines, this contrasts the findings in Jordan where more than half of the respondents were unfamiliar with unlicensed medicines and off-label use of medicines and other studies where healthcare professionals reported their non-familiarity with off-label use of medicines and unlicensed use.[7,10-11] Over three-quarter of the respondents were of the opinion that weight method was the most accurate method of dosage calculation while only one-third disaffirmed that percutaneous absorption is lower in infants than in adults. Although weight method of dosage calculation is the most commonly employed, the body surface area method remains the best as recommended by the British National Formulary and Martindale's Pharmacopeia[12-13] for dosage determination but this may likely be unknown to the respondents because the weight based method is commonly used in clinical practice in this part of the world. Three out of five respondents could accurately calculate a pediatric dose from a stated adult dose while only about one in ten could correctly instruct a caregiver on how to administer the right quantity of a liquid dosage form in milliliters to a patient considering the concentration of the drug and its therapeutic margin. This in fact is of utmost importance considering the fact that caregivers often misinterpret dosages of pediatric liquid medications.[14] Almost half of the respondents knew they should advise a caregiver to use an oral syringe to give the right quantity of a drug to ensure accurate dosing while only one-quarter of them could advise caregiver on administering soft-gel capsule of vitamin A to a very young child who could not swallow. In addition, overall score of the respondents on the knowledge of common pediatric diseases in the tropics was way above average while their scores for baseline knowledge of drug references which could be used to obtain information relevant to pediatric patients was poor. Educational intervention increased their knowledge on items involving "children are little adults", "Oral absorption of penicillin in children" is higher and "Weight method is the most accurate method of dose calculation" improved significantly. Also, determination of the right measureable volume of a liquid preparation with a high therapeutic index and method of administering soft-gel capsule to a young child of 18 months old were also significantly improved. Ability to mention common diseases in the tropics and the right drug reference for pediatrics were also significantly enhanced. This finding is not so different from the findings of Small et al, where competency and confidence scores were improved for pharmacists in pediatric emergencies after undergoing a training program.[15] Similarly, a significant improvement was observed in most self-reported comfort scores for pharmacists after participating in a self-study pediatric pharmacy training with optional live education sessions.[16]

This study was, however, not devoid of limitations. Students who participated in the study are yet to complete a clinical clerkship posting which is an experiential training required in the award of a Bachelor of Pharmacy degree. This posting may likely improve their exposure in pediatric pharmacy and ultimately their pediatric pharmacy knowledge and competency.

CONCLUSION

This study showed that students in ultimate year of the study of pharmacy in Delta State Nigeria had appreciable basic knowledge in pediatric pharmacy. However, competency in handling drug dosing and administration issues related to pediatric patients was poor. More inclusion of pediatric-related courses in the pharmacy curriculum was thought to be required. Whereas only some items on basic knowledge were improved by an educational intervention, competency scores improved significantly with values ranging between $P < 0.001$ and $P = 0.047$. This study should be replicated in other pharmacy schools and among practicing pharmacists in developing countries.

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References

1. Kearns GL, Abdel-Rahman SM, Alander SW, Blowey DL, Leeder JS, Kauffman RE. (2003). Developmental pharmacology--drug disposition, action, and therapy in infants and children. *New England Journal of Medicine* 349(12):1157-1167.
2. Hieschfeld S. Clinical Trials involving children: history, rationale, regulatory framework and technical considerations. In Yaffe SJ, Aranda JV, eds. Neonatal Pediatric Pharmacology : Therapeutic Principles in Practice, Lippincot, Williams and Wilkins, Philadephia, P,A, USA 2011
3. Report of Nigeria's National Population Commission on the 2006 Census (2007). *Population and Development Review* 33(1): 206-210. JSTOR www.jstor.org/stable/25434601. Accessed February 18,2021
4. National Population Commission (NPC) [Nigeria] and ICF.Nigeria Demographic andHealth Survey 2018, Abuja, Nigeria ,and Rockville, Maryland USA: NPC and ICF.2019.http://www.dhsprogram.com/pubs/pdf . Accessed February 20,2021
5. Naseralallah LM, Hussain TA, Jaam M, Pawluk SA (2020). Impact of pharmacist interventions on medication errors in hospitalized pediatric patients: a systematic review and meta-analysis. *International Journal of Clinical Pharmacy* 42:979-994.https://doi.org/10.1007//s11096-020-01034
6. Munzenberger PJ, Thomas RL, Edwin SB, Tutag-Lehr V (2011). Pharmacists' perceived knowledge and expertise in selected pediatrics topic. *Journal of Pediatric Pharmacolology and Theraputics* 2011;16:47-54
7. Mukattash TL, Jarab AS, Abu-Farha RK, Alefishat E , McElnay JC (2018). Pharmaceutical Care in Children: Self-reported knowledge ,attitude and competency of final-year pharmacy students in Jordan. *Sultan Qaboos University Medical Journal* 18(4): 468-475
8. Oshikoya KA, Senbanjo IO (2010). Providing safe medicines for children in Nigeria: The impediments and remedies. *Annals of African Medicine* 9:203-12
9. Scottish Neonatal and Paediatric Pharmacists Group(SNAPP)Introduction to Pediatric Pharmaceutical Care (Updated 2017). Available at : www.nppg.org.uk/paediatric-pharmaceutical-care-snapp Accessed November 2020
10. Stewart D, Rouf A, Snaith A, Elliot K, Helms PJ, McLay JS (2007). Attitudes and experiences of community pharmacists towards paediatric off-label prescribing: a prospective survey. *British Journal of Clinical Pharmacology* 64(1): 90-95.
11. Mukattash TL, Hawwa AF, Trew K, McElnay JC (2011). Healthcare professional experiences and attitudes on unlicensed/off-label paediatric prescribing and paediatric clinical trials. *European Journal of Clinical Pharmacololgy* 67(5):449-461. doi:10.1007/s00228-010-0978-z
12. Joint Formulary Committee (1995). British National Formulary 29th Edition. London: BMJ Group and Pharmaceutical Press.
13. Reynolds JEF, Parfitt K (1989). Martindale : The Extra Pharmacopoeia, 29th Edition. London: The Pharmaceutical Press.
14. Bailey SC, Pandit AU, Yin S, Federman A, Davis TC, Parker RM, Wolf MS (2009).Predictors of Misunderstanding Pediatric Liquid Medication Instructions. *Family Medicine* 41(10):715-21
15. Small L, Schuman A, Reiter RD (2008). Training program for pharmacists in pediatric emergencies. *American Journal of Health-System Pharmacy* 65:649-654
16. Riney EA, Crannage AJ , Hasan N , Murphy JA (2016). Impact of a training program on Pharmacists' Comfort with Pediatric Pharmacy Concepts and Basic Knowledge. *Hospital Pharmacy* 51(10):823-829