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Food Safety in Sub urban Market: Knowledge, Attitude and Practice of Hand Hygiene in Wadata Market, Makurdi, Benue State, Nigeria

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ABSTRACT

A large number of males and females are engaged in the provision of food in Wadata market. Hand hygiene is the cornerstone of infection prevention (IP). When optimally performed, hand hygiene reduces healthcare-associated infections (HAI), spread and antimicrobial resistance (AMR). Poor compliance with hand hygiene practices remains a challenge for IP practitioners all over the world. More than 250 food borne diseases are caused by bacteria or parasites. This study was conducted using a descriptive cross-sectional study of 138 respondents in Wadata market. Peer reviewed and pilot tested questionnaires were employed. The questionnaires were classified into four sections namely-socio - demographic characteristics, knowledge on hand hygiene, attitude towards food hygiene and hygiene practices. Data analysis was done using Epi info a software package for statistical analysis version 23. Majority (40.6%) of the respondents were between the ages of 21-30 years. There were more females (80.6%) food vendors than males. Over 65% of the respondents had education above secondary school; and most of them obtained information on hand hygiene from mass media. Over 62% could define hand hygiene correctly while more than 90% had positive attitude towards hand hygiene. The practice level of the respondents of hand hygiene (p<0.05). Overall knowledge of hand hygiene of the respondents was good and they had positive attitude towards hand hygiene to good practices of hand hygiene.

Keywords: Attitude, Knowledge, Market, Nigeria, Practice, Safety

INTRODUCTION

F had been considered as a measure of personal hygiene.¹ Hand hygiene is a general term that applies to hand washing, antiseptic hand wash, antiseptic hand rub or surgical hand antisepsis.² World Health Organisation (WHO) reported an overall estimate of about 1.4 million

patients in developed and developing countries affected anytime by health care associated infections resulting from poor hand hygiene.^{3,4} Hand hygiene is the cornerstone of infection prevention and control (IPC). When optimally performed, hand hygiene reduces healthcare-associated infections (HAI) and the spread and antimicrobial resistance (AMR).⁵ The World Health Organization (WHO) estimated that in developed



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countries up to 30% of the population suffer from food borne diseases each year, whereas in developing countries up to 2 million deaths are estimated per year.^{67,8} Accordingly, food handlers with poor personal hygiene and lack of awareness of important issues in preventing food borne diseases, working with food industry could be potential sources of infections of many intestinal helminthes of protozoa and enterogenic pathogens.^{9,10} Food vendors are significant part of food sources in both developed and developing countries including Nigeria¹¹. They contribute significantly towards ensuring food safety, especially during processing, storage, preparation or retailing of food, and its supply to consumers in times of need. Food borne diseases are on the increase throughout the world due to poor attention given to personal and food hygiene measures by both lawmakers and people in charge of food preparation, especially in developing countries like Nigeria¹. A study by the joint Food and Agricultural Organization (FAO) and the World Health Organization expert committee on food safety reported that illness due to contaminated food is perhaps the most widespread health problem in the world and a major cause of reduced economic productivity.²

In Nigeria several government agencies ranging from the local governments through states to the federal government establish several agencies for the regulation of food hygiene. The National Agency for Food and Drug Administration (NAFDAC) is responsible for the regulation of food standards in Nigeria including food hygiene.⁴ Food safety activities in Nigeria are highly uncoordinated. The local governments periodically send out inspectors to regulate hygiene activities among the food vendors similar to the state governments. They operate using different check lists and this is a source of confusion among the different regulatory agencies. Investigations of outbreaks of food borne diseases throughout the world showed that, in nearly all instances, they are caused by failure to observe satisfactory standards in preparation, processing, cooking, storing or retailing of food.^{1,5} This study examined the knowledge, attitude and practice of hand hygiene among food vendors operating in Wadata Market Makurdi, Benue State, Nigeria..

MATERIALS AND METHODS

Study Area

This study was conducted in Wadata area of Makurdi metropolis. Wadata constituted the largest slum in the city

and has a high population of mainly low class inhabitants. It has a population of 38,561 and with an average annual rainfall of 1,230 millimetres. This slum is located at the long coast line of River Benue towards the southern part. There is a constant inadequate water supply in the area due to poor service delivery by the state government, power failure and broken down pipes. The environment in this area is flirty because of poor refuse disposal and blocked drainages. The water table is high and there are numerous pools of stagnant water. The most common diseases that are prevalent in the area are cholera, dysentery, malaria, HIV and AIDS and motor cycle accidents popularly called 'going'. There were 1725 cases of cholera outbreaks between May 2014 and March 2015.^{3,11}

Study Design

A cross sectional descriptive study design was employed in this study.

Study Population

Makurdi metropolis has a total of five markets. Wadata market was selected by simple random sampling by balloting. The study population constituted all the food vendors operating at Wadata market. The market has an association of food vendors. They have registers where all the names of members are. The requirements for membership were medical certificate of fitness which must show results of chest x-ray, widal test, stool and urinalysis. They were also required to pay a registration fee of fifty five thousand naira only to the market authority. The total number of food vendors in the market was 310 and the industry is open to males and females. Registered members below eighteen years were excluded from the study.

Sample Size and Sampling Technique

 d^2

The sample size of this study was calculated using the formula = $\underline{z^2 pq}^{12,13}$

Where:

n=minimum sample size for a population, z=standard normal deviate corresponds to 1.96 at 95% confidence interval, p=prevalence obtained from previous study, which was 80.0% (diseases associated with poor sanitary condition in the world in 2015)16, p=80.0%=0.80, q=complementary probability, q= (1-P) =1-0.800=0.200, d=degree of accuracy and d=5% (0.05).

Therefore: $n = (1.92)^2 \times 0.800 \times 0.200$)
$(0.05)^2$	
$n = 3.842 \times 0.800 \times 0.200$	

0.0025

n=245.9, n=246.

Considering the fact the food vendors' population is less than 10,000 and attrition rate of 10%, the correction for infinite factor was made and minimum sample size was adjusted to 138.

Data collection

Data collection was made using an interviewer administered questionnaires. The information collected included sociodemographic characteristics, knowledge, attitude and practice of the respondents on food vendors hand hygiene. A pretesting of the questionnaire was carried on 14 (10% of the calculated minimum sample size) in Aliade market which .is thirty minutes drive from Makurdi. The studied was conducted between February and May 2019.

Data Management

Data collected were checked for completeness. All data generated were processed and analysed by EPI info version 23 an epidemiological software programme for testing proportions and calculations of means. Data were summarized and presented as frequency tables and charts. Chi-square(x2) test was used to test for statistical relationships between proper practices, attitude and knowledge of hand hygiene amongst food vendors in Wadata market.

Ethical Issues

Ethical approval for the study was obtained from the ethical committee of the Benue State University Teaching hospital Makurdi and a written approval was obtained from the management of Wadata Food Vendors Association. Informed verbal consent was obtained from each participant before the study was carried out.

RESULTS

Table 1 showed the socio-demographic characteristics of the respondents. Majority 56 (40.6%) of the respondents were between the ages 21-30, 41(29.7%) were between the ages 31-40 and less than one percent were between the ages 51-60 years. More than three-quarters of the respondents (80.6%)

were female food vendors. The study also revealed that majority of the respondents (65.6%) had secondary school education as the highest educational qualification while 23.9% had primary school education and only 8.9% had tertiary education. The rest (1.6%), had no formal education. Most of the respondents were traders (78.5%), farmers (1.7%) and civil servants (2.4%). The ethnic distribution of the respondents also showed that the major tribes were Tivs and Idomas.

Table 1: Socio-demographic characteristics of the respondents

Variable	Frequency	Percent	
Age groups of Respondents			
≥ 20	20	14.5	
21 - 30	56	40.6	
31 - 40	41	29.7	
41 - 50	19	13.8	
51 - 60	2	0.8	
Sex distribution of Respondents			
Male	23	16.7	
Female	115	83.3	
Highest level of education attained	I		
No formal education	3	2.2	
Primary school education	31	22.5	
Secondary educatio	91	65.9	
Tertiary education	13	9.4	
Occupation of Respondents			
Trading	115	83.3	
Farming	13	9.4	
Civil servant	4	2.9	
Student	3	2.2	
Housewife	3	2.2	
Tribe distribution of Respondents			
Tiv	82	59.4	
Idoma	26	18.8	
Igede	6	4.3	
Others	24	17.5	

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Fig 1 sources of information of the respondents.

Fig 1 showed that majority of the respondents 65.2% got the information on hand hygiene from mass media, 12.3% from health professionals, training (11.6%), friends (7.2%) and school (3.6%).

Table 2 showed the knowledge of respondents on hand hygiene. Majority of them (62.3%) defined hand hygiene correctly as washing of hands with the use of antiseptic and water, followed closely by 35.5% who opined that hand hygiene is "hand washing with water only" while (0.7%) said "cooking before washing of hands" was hand hygiene and 1.4% submitted that hand hygiene was "handling of food without washing of hands".

Almost half (46.4%) of the respondents defined improper hygiene to be "not washing of hands after the use of toilet", while 29.0% respondents opined that improper hand hygiene meant "keeping of long nails while handling food", 2.2% of the respondents opined that improper hand hygiene was "the use of hand ornaments while cooking", and 18.1% respondents submitted that improper hand hygiene meant "not washing of hands before cooking" and 4.3% respondents were of the opinion that improper hand hygiene was "serving food with open hand injuries". The results also showed that majority (76.8%) of the respondents had knowledge of diseases that may be associated with improper hand hygiene. Table 2: Knowledge on hand hygiene among the respondents

Variables	Frequency	Percent
Awareness of hand hygiene		
Yes	134	97.1
No	4	2.9
Hand hygiene is:		
Hand washing with water only	49	35.5
Washing hands with antiseptic and water	86	62.3
Coo king before washing hands	1	0.7
Handling of food without washing hands	2	1.4
What is improper hand hygiene?		
Keeping long nails while handling food	40	29.0
Not washing hands after use of toilet	64	46.4
Use of hand ornaments while cooking	3	2.2
Not washing of hands before cooking	25	18.1
Serving food with open hand wounds	6	4.3
Are you aware of diseases associated with		
poor hand hygiene		
Yes	106	76.8
No	32	23.2
List of diseases identified by respondents to		
be associated with poor hand hygiene		
Diarrhoea	41	29.7
Typhoid	26	18.8
Cholera	15	10.9
Dysentery	5	3.6
Fever	4	2.9
Food poisoning	2	1.4
Malaria	3	2.1
Vomiting	2	1.4
Stomach pain	1	0.7
Don't know	39	28.3
Respondents knowledge of methods of disease		
prevention while handling food		
W ashing hands before serving	31	22.5
Washing hands after defecation	84	
Regular trimming of nails	8	5.8
Avoid handling of food with open hand wounds	14	10.1
Proper hand washing after scratching of the body	1	0.7
Have you been trained on hand hyg?e		
Yes	25	18.1
No	113	81.960.9

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Table 3: Attitude of respondents towards hand hygiene

Variable	Frequency	Percent
Respondents belief on wearing		
protective covering while handling food		
Yes	119	86.2
No	19	13.8
Respondents belief on Washing hands		
before handling food		
Yes	3	97.8
N o	135	2.2
On whether persons with cuts in the		
hands should not handle food		
Yes	135	97.8
No	3	2.2
On washing of hands with soap and		
water		
after using the toilet		
Yes	134	97.1
No	4	2.9
On whether the towel used to clean food		
surfaces should be used to clean hands		
Yes	5	3.6
No	133	96.4
On whether food handlers should keep		
long nails		
Yes	136	98.6
No	2	1.4
On whether food handlers should wear		
hand ornaments		
Yes	129	93.5
No	9	6.5
On whether food handlers believe nose		
picking can transmit germs		
Yes	134	97.1
No	4	2.9

Table 3 showed that majority of the respondents119 (86.2%) believed wearing protective covering could reduce the risk of food contamination. Almost all (97.8%) respondents agreed that food vendors should wash their hands before handling food. Most of them (97.8%) also agreed that persons with cuts on the hand should not handle food. A vast majority of the respondents (97.1%) also agreed that food vendors should wash their hands after using the toilet. Most (96.4%) of them disagreed that the towel used to clean food surfaces should be used to clean hands. Almost all (98.6%) believed food handlers should keep long nails. Majority (93.5%) also believed food handlers should wear hand ornaments. Almost all (97.1%) believed nose picking could transmit germs.

Table 4: Practice of hand hygiene among Respondents

Variable	Frequency	Percent
On how often respondents cut their nails		
Always	52	37.7
Occasionally	86	62.3
Total	138	100
On how often respondents wash their		
hands with soap and water		
Always	79	57.2
Occasionally	58	42.0
Not at all	1	0.7
Total	138	100
On how often respondents use antiseptic		
hand wash		
Always	31	22.5
Occasionally	80	58.0
Not at all	27	19.6
Total	138	100
On how often respondents use tidy		
clothes for cleaning		
Always	85	61.6
Occasionally	50	36.2
Not at all	3	2.2
Total	138	100
On how often respondents take their		
bath		
Always	97	70.3
Occasionally	41	29.7
Total	138	100
On how often respondents take their		
bath		
Always	97	70.3
Occasionally	41	29.7
Total	138	100
On how many times respondents clean		
their working area per day		
Only once	11	8.0
Twice only	23	16.7
Once it is dirty	104	75.4
Total	138	100
On respondents that wash hands always		
before handling food		
Yes	135	97.8
No	3	2.2
Total	138	100
	_	
for washing hands	r	
Yes	6	4.3
No	132	95.7
Total	138	100

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Diarrhoea was the most identified disease (29.7%) associated with poor hand hygiene, typhoid (18.8%), cholera (10.9%), dysentery (3.6%) while malaria was (2.1%). Over 28% could not mention any disease associated with poor hand hygiene. Most (60.9%) of the respondents agreed that washing hands after defecation can prevent disease transmission, while 22.5% believed that washing hands before serving food is important for the prevention of food borne disease transmission and 10.1% believed people with open wounds on their hands should not handle food. The study also revealed that majority (81.9%) had no formal training on hand hygiene. Table 4 showed the practice of hand hygiene in Wadata market. In this study majority of the respondents (62.3%) cut their nails occasionally. Slightly over 57% of the respondents affirmed to washing their hands with soap and water always, while (42.0%) washed their hands occasionally, and (0.7%)did not wash their hand with soap and water at all. The study also revealed that more than half (58.0%) of the respondents occasionally used antiseptic hand wash and water, 22.5% used antiseptic hand wash always and 19.6% did not use at all. The study also showed that the respondents predominantly 85(61.6%) always used tidy clothes for cleaning, followed by 50(36.2%) who use tidy clothes occasionally for cleaning while 3 respondents (2.2%) did not use tidy clothes for cleaning at all. Regarding personal hygiene, most of the respondents (70.3%) took their bath always, whereas 29.7% took their bath occasionally. Concerning sanitary practices at the work place, 11 respondents (8.0%) cleaned their working area once only, 23 respondents (16.7%) cleaned their working area twice only and the vast majority (75.4%) cleaned their working area once it is dirty. Almost all (97.8%) the respondents washed their hands before handling food. However, majority (95.7%) of the respondents did not have a functional tap for hand washing hands.



Fig 2 Respondents knowledge score

Table 5: Cross Tabulation of Educational Status and Knowledge of hand hygiene among Respondents/practice of hand hygiene and knowledge of hand hygiene.

Variable	Chi square	Df	P value	Significance p < 0.05
Knowledge ∞ Education	8.633	1	0.001	Yes
Knowledge ∞ Practice	3.081	1	0.100	No

The relationship between educational status of the respondents and knowledge of hand hygiene was found to be statistically significant a p value 0.001. The relationship between knowledge and practice of hand hygiene was not statistically significant at a p value 0.100

DISCUSSION

This study assessed the knowledge, attitude and practice of hand hygiene among food vendors in Benue State Nigeria. Majority of the respondents were aged 21-30 years. This is similar to some studies from other parts of Nigeria.^{14,33} The greatest number of those in the food vending business in the country are young adults.9.14 There were more female food vendors than males. Food vending in most Nigerian small markets are on a small scale employing less than ten persons per stall. Females have comparative advantage over males in Nigeria's restaurant industry because of the culture of the people which believed that cooking is almost an exclusive area for females.¹⁴,¹⁵ This may be due to the fact that food vending is one of the few readily accessible avenues of employment open to women and it has low cost of entry and does not require high level of formal education.^{15,19} The near 10% of the respondents with tertiary education involved in food vending can be attributed to lack of job opportunities in most developing countries. High unemployment rate reduces discrimination in terms of jobs available for the various communities.¹⁶ Majority of the vendors are from the immediate environment the Tiv population. This is related to the fact that majority of the population of the people in the market are from the local area. People tend to patronize foods that are close to their cultural practices.^{15,17}

Overall the knowledge of the respondents in this study is good with regard to food hand hygiene. This compared favourably with other studies done in some zones in Nigeria.^{14,16} This findings contradicted studies done in East Africa and South East Asia were majority of the respondents had poor knowledge of food hygiene.^{8,17} Almost all the food vendors were aware of hand hygiene and more than half heard about it from mass media. The awareness of such important hygienic procedures by majority of the respondents in this study is very important in disease control in the food chain. It has been shown that food vendors with poor personal hygiene, their hands can serve as vehicles for disease transmission.^{14,18} This is particularly important in under-five children that are prone to diarrhoeal diseases. Studies have shown that diarrhoeal diseases are significantly reduced by proper hand washing.^{18, 19} Despite food handlers claiming that they wash their hands in the course of their duty staphylococci organisms have been isolated from their hands during epidemiological studies.⁷ The good knowledge score demonstrated in this study may be explained away by the high level of literacy exhibited by the respondents. Only slightly below 2% did not attend any level of education. It has been shown that education brings awareness in people and keeps them away from superstitious beliefs. Literacy level depends on education. Education promotes knowledge and understanding. Studies done in other countries showed that education had a positive correlation with knowledge.^{14,16}

In this study, over 90% of the respondents had positive attitude towards food hand hygiene. This is important in disease reduction and control strategy in any community. Attitude has both positive and negative relationship with knowledge and education. Some studies done showed that communities with higher level of education have better attitude towards disease control and reduction.¹⁹ The negative attitude shown by the respondents in respect of keeping long finger nails and wearing hand ornaments during food preparation is worrisome. These will introduce complications or failure in disease control amongst the food vendors. Transmissions of diseases through faeco- oral routes are greatly enhanced through keeping long finger nails and wearing of hand ornaments during preparation of foods.^{19,20} Food vending in Wadata market is dominated by females. Most women will do everything to look beautify all the time and that may be the reason for keeping these long finger nails and hand ornaments.^{19, 14, 21} It was however observed that despite good attitude of most food vendors towards hand hygiene, about 13.8% did not believe that wearing protective covering while handling food was important in preventing food contamination. There is therefore need for training for these respondents since only 18% had formal training in

proper hygiene in food vending. These compared favourably with some work done in Vietnam and India.^{19,22}

Practices are defined as ways in which people demonstrate their knowledge and attitude through their actions. The practice level of the respondents of hand hygiene in this study is poor (42.7%). This is far less than the practice levels obtained in some studies in Nigeria and Ghana.^{14,16} This is surprising because of the good knowledge and highly positive attitude shown in this work. The literacy level in this work is also high. Some studies have shown that high level of education and good knowledge promote good practices.¹² How ever few studies showed that 63% of food handlers with good knowledge in food safety did not demonstrate corresponding positive behaviour to food safety and hygiene practices. There is however significant association between practice and knowledge.^{1,23} It has been suggested that other factors such as employee motivation and continuous education and training on the job should be provided to inspire food-handlers, which will affect attitudes and subsequently food-safety practices.¹⁹ In this study, there is no significant association between practice and knowledge (p> 0.05). This contradicts some studies done in Vietnam, Ghana, and Nigeria and is surprising because of the high level of education among the respondents.^{14,16,19}

CONCLUSION

Food vendors' knowledge of hand hygiene was good despite low level of formal training. Their attitude was generally good. Despite good knowledge and good attitude towards hand hygiene, this did not necessarily translate to a good practice of hand hygiene. The significant relationship between education and knowledge should be exploited by the various governments to institute health education programmes that will increase the level of training amongst the respondents.

Recommendation

With rapidly increasing number of food vendors especially in urban areas due to enormous population increase, there is need for more attention in the hand and food hygiene. Governments should have in place coordinated, effective, integrated and preventive strategies that emphasize vendor registration, formal training on hand hygiene practices, initial medical and periodic medical certification as well as regular

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personal and environmental hygiene checks. Food vendors should be encouraged to put more effort in proper hand hygiene by frequent hand washing before handling food, use of hand washes and gloves and proper treatment of cuts on hands. Portable running water should be made available as hand hygiene is properly practiced if there is provision of adequate water supply. Also, health education on proper hand hygiene practices and dangers of improper hand hygiene should be on all media platforms (bill boards, newspapers, television, radio, and internet) in different languages for better understanding. Regular monitoring by appropriate agencies should be put in place by governments in conjunction with food vendor's union.

Conflict of Interest

None declared.

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Assessing the Clinical Utility of Haptoglobin to Creatinine Ratio as a Test for Detecting Nephropathy among Type 2 Diabetic Patients

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ABSTRACT

Diabetic nephropathy is the leading cause of diabetic complications and end stage renal disease worldwide, especially in Nigeria. This study assessed the clinical utility of urine Albumin to Creatinine ratio (UACR) and urine Haptoglobin to Creatinine ratio (UHCR) in detecting nephropathy among type 2 diabetic patients attending Aminu Kano Teaching Hospital. Eighty (80) type 2 diabetic patients attending Aminu Kano Teaching Hospital. Eighty (80) type 2 diabetic patients attending Aminu Kano Teaching Hospital were recruited for this study after excluding those with overt proteinuria. Blood sample was collected for quantitative determination of serum creatinine using Jaffe's method while the Urine sample was received for quantitative determination of urine albumin and urine haptoglobin levels. Linear regression model revealed a unit change in urine albumin to creatinine ratio (UACR) and urine haptoglobin to creatinine ratio (UHCR) with a significant reduction in estimated Glomerular Filtration Rate (eGFR) by 2.197ml/min and 27.969 ml/min respectively (p<0.05) when used while logistic regression model demonstrated that UHCR have 91.7% sensitivity, 95% specificity, 98% positive predictive value and 79% negative predictive compared to UACR with 83.3% sensitivity, 75% specificity, 91% positive predictive and 60% negative predictive. Based on these findings, UHCR is a good marker for detecting nephropathy in diabetic patients.

Keywords: Diabetic Nephropathy, Urine albumin, Urine Haptoglobin

INTRODUCTION

Sickle Diabetic nephropathy is a microvascular complication of diabetes mellitus and the leading cause of end stage renal disease worldwide.¹ It is a clinical syndrome characterized by persistent albuminuria, a relentless decline in glomerular filtration rate (GFR), raised arterial blood pressure and relative increased mortality from cardiovascular diseases.²

In Nigeria, prevalence rate of diabetes mellitus was

estimated to be 5.0%,³ with 3.0% prevalence in Northwest Nigeria and 5.5% prevalence in Southwest Nigeria.⁴Reports from seven tertiary hospitals in Nigeria show that 3.2% of diabetic complication accounts for diabetic nephropathy.⁵ Microalbuminura has been the hallmark diagnostic biomarker for early detection of diabetic nephropathy and assessing its associated condition.⁶ Microalbuminuria is defined as urinary albumin excretion between 30 and 300mg/24hrs or 20-200µg/min for timed urine collection.⁷Though, the

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appropriate sample for microalbumin estimation is 24 hours urine sample but due to the difficulties and errors that may occur during the collection, albumin/creatinine ratio (UACR) in early morning spot urine was adopted as a diagnostic alternative to correct for limitations.⁸However, studies have shown that urinary albumin to creatinine ratio is neither sensitive nor specific for early detection of diabetic nephropathy. ^{9,10}Studies have also shown that many patients who have microalbuminuria at one point in time might not have it when measured later and as such makes it a poor predictor of the development of macroalbuminuria.¹¹

Studies on diabetic induced transgenic mice also showed that haptoglobin is a major determinant of the development and progression of diabetic renal disease.¹² In a recent study, urinary haptoglobin was reported to predicts renal progression independent of albuminuria and also improve the predictive performance of albuminuria beyond traditional risk factors in Asians with type 2 diabetes mellitus.¹⁰ Haptoglobin is an alpha-2 sialo glycoprotein that is synthesized in the liver but other tissues including kidney have been shown to express it.¹³The early detection of diabetic nephropathy is of paramount importance to provide appropriate therapy that will prevent evolution to end stage renal disease most especially among low and middle income countries like Nigeria where facilities to cater for such patient may be prohibitive interms of availability and cost. In this regard, haptoglobin has recently been identified as a predictor of early renal injury before the manifestation of chronic kidney disease and end stage renal disease. Such a predictor, if available for early detection of renal injury may permits targeted treatment with more aggressive therapies at earlier stage that will prevent deterioration in kidney function. This study therefore aimed to assess the diagnostic utility of urinary haptoglobin/creatinine (UHCR) ratio for detecting diabetic nephropathy.

MATERIALS AND METHODS

This cross-sectional study was conducted between July 2018 to July 2019 among Type 2 diabetic patients attending Aminu Kano Teaching Hospital for follow up treatment. Kano State is located at 11°30'N 8°30'E in the Northern Nigeria. It was created on May 27, 1967 and bordered by Katsina State to the north-west, Jigawa State to the north-east, Bauchi State to the south-east and Kaduna State to the south-west. The capital of Kano State is Kano. It has a total Area of 20,131 Km² with an estimated population of 11, 058,300 and density of 470 /Km².

An estimated sample size of 80 was made based on the prevalence rate of diabetes in Nigeria using the formula proposed by Susan *et al.*, 2015.¹⁴ Recruitment was by systematic random sampling after obtaining an informed consent from the study subjects. Subjects presenting with the following conditions were excluded from the study: insulin therapy, pregnancy, cardiovascular disease, urinary tract infection, menstruation and cigarette smoking. A structured pretested questionnaire was used to obtain relevant disease and treatment history. Ethical approval was sought from the institutional research committee reference number N H R E C / 2 1 / 0 8 / 2 0 0 8 / A K T H / E C / 2 2 5 2 and AKTH/MAC/SUB/12A/P-3/VI/2352. Urine and Blood samples were collected from all recruited participants.

Statistical analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 16.0 Software. The measured values for urinary albumin, haptoglobin and creatinine concentrations were presented as mean \pm standard deviation. UACR and UHCR were calculated by dividing the urine albumin and urine haptoglobin values by the urinary creatinine values. Regression analysis was used to determine the clinical utility of UACR and UHCR for detecting DN. The measured percentage values for HbA1c were presented as mean \pm standard deviation. Relationship between HbA1c and UHCR were assessed using Spearman Correlation coefficient. Statistical significance was set at p<0.05.

Laboratory Methods

Urinalysis

Urinalysis was be carried out using urine reagent strip by Cortez Diagnostics, Inc.¹⁵

Glycated Haemoglobin

HbA1c was assayed using fluorescence immunoassay method by Finecaré^{TM 16}.

Haptoglobin

Haptoglobin was assayed using ELISA method by AssayMaxTMHuman Haptoglobin ELISA Kit.¹⁷

Microalbumin

Microalbumin was assayed using Immunoturbidimetric

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Characteristics

Urine Albumin

Haptoglobin

method by Microalbumin kit manufactured by Fortress Diagnostics Limited.¹⁸

Creatinine

Creatinine was estimated using modified Jaffe method.¹⁹

Estimated glomerular filtration rate (eGFR)

Kidney function was assessed by estimated glomerular filtration rate (eGFR) using Cockcroft and Gault formula.²⁰

Quality assurance

All analytical tests were done according to the standard operating procedures. It involved the use of inter and intra-run of control sera along with the samples. Pre-analytical, analytical and post analytical precautions were observed.

Table 1: Age, Sex and BMI of Study Subjects

Parameters		Number	Frequency (%)
Gender	Male	35	44
	Female 53.78 ± 9.5 years	45	56
Age (x±SD)	2		
BMI (x±SD) Duration of Diabetes(x±SD)	(Kg/m2) 27.3 ± 5.3 8.5 ± 4.8 years	Peak: 36 (4	45%) subjects 6-10 yr

Table 2: Glycaemic Control (Hba1c) of Study Participants

(x±SD 6.6±	2.0%		
		Number Frequency	(%)
	Good control (≤ 5.7)	31	39
	Borderline (5.7 - 6.4)	13	16
	Poor control (≥ 6.5)	36	45

Table 3: CKD Staging (NKF, 2002)

(x±SD eGFR:98.4±40.3ml/min/1.73m		
	Number	%
Stage 1 (≥90ml/min)	20	25
Stage 2 (60.0 - 89.9ml/min)	53	66
Stage 3 (30.0 - 59.9ml/min)	7	9

Table 4: Mean and Median of Bio-Chemical Characteristics

Characteristics	Mean±SD	Median(IQR)
Hap (ng/ml)	93.6±70.1	68.8(25.0-164.4)
UACR (mg/g)	78.3 ± 89.1	51.5(28.3-78.0)
UHCR (ng/g)	908.9±972.7	529.0(119.0-1414.0)

Table 6: Validity of UHCR for diabetic Nephropathy

Stage 1

5.3(4.5-6.0)

Diabetic Nephropathy Nephropathy based on eGFR Total F p-val				Odds	SEN	SPEC	CPPV	7
					%	%	%	%
	Yes n=60	No n=20	N=80					
UACR								
Yes	50(83.3)	5(25.0)	55(68.8)<0.001	1.6(1.3-1.9)	83.3	75	91	60
No	10(16.7)	15(75.0)	25(31.2)					
UHCR								
Yes	55(91.7)	1(5.0)	56(70.0) 0.089	7.8(3-19)	91.7	95	98	79
No	5(8.3)	19(95.0)	24(30.0)					

Table 5 Comparing Biochemical Characteristics According to CKD Stages

Stage 2

7.5(6.8-10.0)

21.3(11.3 - 25.0) 140.6(58.8-172.2) 193.8(187.5-197.5)

Stage 3

19.5(19.5-19.5)

Kruskal Walis p-value

60 934

61.023 0.001

0.001

DISCUSSION

The present study recruited a total of eighty (80) type 2 diabetic patients of which 43.8% (35) were males and the remaining 56.2% (45) were the female participants resulting in 1:1.2 male to female ratio. The higher number of female participants was in keeping with studies done on diabetic patients in the same center by Umar in 2016 as well as in Abakaliki.²¹

The mean age of the participant was 53.8 ± 9.5 years with the mean duration of the disease of 8.5 ± 4.8 years which is in concordance with the findings of Uloko *et al.*²² This finding is a suggests that middle age is the peak age incidence for diabetes in this environment. The mean body mass index of the study population was 27.3 ± 5.3 kg/m² comprising of 37.6% of both underweight and normal weight while the remaining 62.5% were overweight and obese patients.

HbA1cdetermination documented a mean value of $6.6 \pm 2.0\%$ with good glycaemic control recorded in 39% against 61.2% with poor glycaemic control. This connotes that the participants showed suboptimal glycaemic control which is in agreement with the study of Uloko *et al*,²² that most Nigerians diabetics have suboptimal glycemic control.

We observed a significant increase in the urine albumin, urine haptoglobin, glycated haemoglobin (P < 0.05) across the stages of chronic kidney disease in this studywhich agrees with a study that higher level of albuminuria, glycated haemoglobin and haptoglobinuria are recorded in patients that developed early renal function decline.⁹ Linear regression model was used to predict diabetic nephropathy using UACR and UHCR. The analysis showed that eGFR reduces by 2.197 ml/min in a unit change of UACR compared to 27.969 ml/min reduction in eGFR in a unit change of UHCR. This infers that UACR and UHCR predict nephropathy in type 2 diabetic patients

independently, though UHCR is found to have more predictive ability than UACR as equally reported in the previous studies in USA,⁹ and Asia.¹⁰We then evaluated the prediction accuracy of UHCR independent of UACR and this revealed that UHCR predictive ability significantly out performed UACR in the prediction of diabetic.

We further correlated HbA1C with UACR as well as UHCR and this study demonstrate a strong positive relationship exists with UHCR correlating having a stronger correlation coefficient (r=0.739) than UACR. This strong positive relationship was equally observed in a previous study among Asians,¹⁰ however is contrary to the study of Bhensdadia *et al.*⁹ 2013 that reported a weak positive relationship between UHCR and UACR.

Using logistic regression analysis, eGFR predicted 60 participants of the study population to have diabetic nephropathy. UACR predicted 83.3%(50) to have diabetic nephropathy with 83.3% sensitivity, 75%specificity, 91% positive predictive value and 60% negative predictive value while UHCR predicted 91.7%(55) to have diabetic nephropathy with 91.7% sensitivity, 95% specificity, 98%positive predictive power and 79% negative predictive power at p< 0.05 level of significance. UHCR significantly predicts diabetic nephropathy.

CONCLUSION

This study for the first time established that UHCR has better diagnostic utility than UACR exhibited a very good positive correlation with glycaemic control. Based on its high sensitivity and specificity we therefore recommend its use in screening for nephropathy in diabetic patients.

Further multicenter studies and longitudinal studies are also recommended.

Conflict of Interest

None declared.

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Comparison of Actual with Estimated Weight and Height in Children with Sickle Cell Anaemia in Lagos, Nigeria

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ABSTRACT

Sickle cell disorders are the most common genetic disorders worldwide as well as in Nigeria. The weight and height are the most used anthropometric measurements in paediatric practice for the calculation of many parameters. The objective is to determine the reliability of weight and height estimates among children with sickle cell anaemia compared with measured weight and height. A random sample of SCA children aged eight months to 12 years was studied. Height and weight were measured using standard methods, while BMI was estimated using kg/m2. These were compared with estimated weight, height and BMI. Five subjects were adjudged obese using estimated BMI: three of these five subjects were identified as obese using actual BMI. Regression analysis showed that there appears to be more positive linear relationship for weight and length/height among children aged 1– 6 years. The measured mean weight and BMI were significantly lower than the estimated mean values. The overall mean of estimated length/height did not differ significantly from overall mean of the actual length/height. In comparison with the actual BMI, the estimated BMI did not identify any of the subjects with either thinness or overweight while children with obesity were over-estimated. The formula methods of estimating weights and heights for the various ages in children with sickle cell anaemia are over-estimating their actual values; this is more obvious for weight.

Keywords: Measured, Estimated, Weight, Height, Body mass index

INTRODUCTION

Sickle cell anaemia is one of the commonest single gene disorders in man with variable distribution in different parts of the world and variable clinical manifestations.¹ In Nigeria, the prevalence of sickle cell trait is about 25% while the homozygous state is found in about 3% of the population². Africa has 70% of the world's annual figure of 300,000 affected new births.³ Nigeria has the highest burden worldwide.⁴ A recent WHO report estimated that approximately 20 per 1,000 births in Nigeria are affected by sickle cell anemia, giving a total of about 150,000 affected children born every year in Nigeria alone.⁵ The periodic measurement of height and weight are important parts of routine healthcare for all children, including those with sickle cell anaemia, and comparison of these measurements against reference standards or norms can serve as a screening tool for nutritional problems. Sickle cell anaemia commonly affects growth, leading to low mean weight, low mean height and decreased height velocity.⁶⁻¹⁰ However, there are difficulties in obtaining accurate measurements of height in children with sickle cell anaemia that have

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incapacitating conditions because the pain of vaso-occlusive crisis in patients with sickle cell disease is excruciating, and incapacitating to enable height measurement. Therefore under these difficult circumstances the weight and height have to be estimated. Children with sickle cell anaemia are vulnerable to growth deficits, of which stunting in height is one of those commonly described.⁶⁻¹⁰ The weight and height for age estimated using the universally accepted formulae uses a specific set of equations validated on the general population without sickle cell anaemia. Although the technique and these equations are widely used, to date no study has been published which established that it's equally useful among children with sickle cell anaemia.

This study was carried out to determine whether estimated weight and height among children with sickle cell anaemia agrees with measured weight and height. In addition we investigated whether Body Mass Index (BMI) calculated on the basis of estimated weight and height values agree with BMI values calculated on the basis of measured weight and height. It was a cross-sectional and descriptive study.

MATERIALSAND METHODS

The study subjects were children aged eight months to 12 years with sickle cell anaemia attending the sickle cell disease clinic of the Department of Paediatrics of Lagos State University Teaching Hospital, Ikeja, Lagos in South west Nigeria based on the clinic attendance records. The included children were in a steady state i.e. absence of any crisis in the preceding four weeks, no recent drop in the haemoglobin level and absence of any symptoms or sign attributable to an acute illness.11 They were also not taking medications known to affect growth e.g. steroids. All children, or parents when it concerned young children, gave informed consent for inclusion in the study.

Study subjects were recruited consecutively until the desired sample size was attained. This lasted three months. The study was performed according to the guidelines of the Medical Ethics Committee of the Lagos State University Teaching Hospital. The sample size was calculated with 90% power and 5% significance level (two-tailed) for prevalence of stunting of 25% reported by Henderson et al12 among children with sickle cell disease. In order to accommodate possible attrition or unforeseen errors in completing the study questionnaire, an additional 20% (14 subjects) of the calculated figure was recruited to bring the figure to 86, which

was approximated to 90 subjects.

Subjects' weights were measured barefooted and wearing light clothing. Weight measurements were taken on a Seca 761 series mechanical floor scale to the nearest 0.1Kg. Children two years of age and older had their heights measured using a stadiometer while the length of those below two years were measured using an infantometer. The various linear measurements were taken three times. Variation among measurements was not more than 0.3cm. The mean of these three measurements was recorded. For the purpose of quality assurance standardization of the instruments were done after every 10 measurements.

The weight and height for age were also estimated using the universally accepted formulae. The weight of the study subjects were estimated using the following formula¹³

For children aged less than one year: (n + 9)/2, where "n" is age in months.

For children aged 1 - 6 years: (2n + 8), where "n" is age in years

For children aged 7 - 12 years: (7n - 5)/2, where "n" is age in years

For the height estimate, the formula (6n + 77), where "n" is age in years, as recommended for children aged 2 - 12 years was applied. The estimated height for children aged one year was taken as 75cm.13 The body mass index was calculated using the formula Weight in kg/ Height in m2 (Kg/m2)14 Zscores were generated for actual BMI as well as the estimated BMI.

The data were entered into a standard computer system. The data was analysed using Statistical Package for Social Science (SPSS) version 19.0. Scatter diagram was plotted to determine the relationship between actual and estimated parameters. The mean, standard deviation and other parameters of statistical location were generated as necessary. Tests of statistical significance between means of actual and estimated parameters were by paired Student t-test. Level of significance was set at p < 0.05.

Operational definition

Actual weight – weight of patient measured with Seca by researcher

Actual height – height of patient measured with infantometer or stadiometer by researcher

Actual BMI – BMI of patient calculated on the basis of actual weight and height

Estimated weight - weight of patient estimated by

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researcher

Estimated height – height of patient estimated by researcher **Estimated BMI** – BMI of patient calculated on the basis of estimated weight and height

RESULTS

Characteristics of the study population

A total of 90 children who met the study criteria, were recruited over a study period of three months. The age and gender distribution of the study patients are given in Table I. Overall, the age of the subjects ranged from nine months to 12 years, with a mean of 67.73 (\pm 43.78) months. The modal age group was 1–6 years. The male to female ratio was 1:1.

Comparison of mean actual and estimated parameters of study subjects

This phase of analysis compared the measured parameters with the estimated parameters – Table II. The measured mean weight and BMI were significantly lower than the estimated mean of values. The overall mean of estimated length/height did not differ significantly from overall mean of the actual length/height. Further analysis of comparison between actual and estimated parameters shows that the least mean difference between estimated parameters and actual parameters was observed with length/height (0.6 ± 9.5 cm) and highest with weight (2.9 ± 5.0 Kg).

Scatter plot of actual and estimated parameters

The scatter diagrams showing the relationship between actual and estimated parameters are shown in figures 1, 2, and 3 for weight, length/height, and BMI respectively. The plots showed linear relationship between actual and estimated parameters. However, there appears to be more positive linear relationship for weight and length/height among children aged 1-6 years than those aged <one year and 7-12 years (fig 1 and 2).

Number of subjects in BMI groups: BMI based on actual weight and length/height vs. BMI based on estimates of those values

Z-scores were generated for both actual and estimated BMI derived by actual and estimated weigh and length/height. On the basis of the z scores, study subjects were then categorized into thin, overweight and obese. BMI Z-score cut-points of < -2.0, >+1.0, and >+2.0 are recommended to define thinness,

overweight and obese.15 Table III shows the prevalence of thinness, overweight and obesity using both the actual (observed) and the standardized BMI values. Table III shows that, altogether, one subjects were classified as thin on the basis of z scores of actual BMI, on the contrary none subject were identified as thin using z scores of estimated BMI. Two subjects were classified as overweight on the basis of z scores of actual BMI while none subject were identified as overweight using z scores of estimated BMI. Also, five subjects were adjudged obese using estimated BMI: three of these five subjects were identified as obese using actual BMI.

Table I – Demographic characteristics of study populations

Chara	cter	Number	Percentage (%)			
Gende	Gender					
	Male	45	50.0			
	Female	45	50.0			
	Total	90	100.0			
Age C	Age Group					
	<1 year	5	5.6			
	1 – 6 years	49	54.4			
	7 – 12 years	36	40.0			

Table II: Mean actual and estimated anthropometric measurements of study subjects

Anthropometric Measures						
-	Actual Mean (SD)	Estimate Mean (SD)	t- value	p- value		
Weight	17.9 (7.3)	20.8 (10.1)	0.885	0.029*		
Height	109.2 (23.8)	109.8 (23.6)	0.920	0.865		
BMI	14.7 (3.2)	15.9 (1.8)	0.118	0.002*		

 Table III: Comparison of BMI based on actual weight and length/height vs.

 BMI based on estimates of those values

	Thinness	Overweight	Obesity
Estimated BMI	0	0	5
Actual BMI	1	2	3

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Fig 1: scatter plot of actual weight and estimated weight



Fig 2: scatter plot of actual length/height and estimated length/height



Fig 3: scatter plot of actual BMI and estimated BMI

DISCUSSION

The measurement of weight, height/length, and body mass index is an invaluable tool in paediatric settings. They are measurement required for the evaluation of growth, calculation of nutritional indices, prediction and standardization of physiological variables such as lung volumes,¹⁶ glomerular filtration rate, metabolic rate, and for the tailoring of drug dosage in patients.¹⁷ In the emergency situations, fast and accurate methods of weight and height estimation are needed for immediate therapeutic interventions in order to save lives of children with sickle cell anaemia in crisis. Many estimation methods currently exist for general paediatric usage but most may not be relevant in children with sickle cell anaemia resulting in the fact that the formula estimation of weight or height may be overestimating the actual value in many of these children. Present study is the first attempt to determine whether estimated weight and height among children with sickle cell anaemia agrees with measured weight and height.

The present study shows that estimates of weight, height/length and BMI among children with sickle cell anaemia done using standard formula by healthcare workers were generally adequate, although overestimation of weight and height were as large as 2.9Kg and 0.6cm respectively. Length/height estimates were more accurate than weight estimates which was revealed by the relative closeness of the mean estimated height/length values to the mean measured height/length values. The over-estimation of weight and height using standard formula methods will result in significant over - dosing of some emergency drugs such as opoids for analgesia among children with sickle cell anaemia which will be more pronounced using estimated weight. The estimated mean weight value was significantly higher than the actual weight in the current study. This is most likely a consequence of effect of sickle cell anaemia on childhood growth. There was no consistent pattern observed between the estimated and actual weight. These observed differences may also be due to disparity in severity of illness among the study subjects which is incomparable. The reason why the estimated mean weight and not the mean height or both was significantly higher than the actual parameters was not apparent as both are linear growth parameters and which should be more affected by sickle cell disorder is difficult to predict.

In this present study the strongest positive correlations for

weight and length/height among children aged 1-6 years compared with aged below one year and 7 - 12 years. The findings are not surprising because both the weight and length/height variables are linear measurements which increase physiologically in the same direction with age. Considering the fact that under-nutrition is prevalent in Nigeria especially among under -five children^{18, 19} and sickle cell anaemia commonly affects linear growth,⁶⁻¹⁰ the formula over-estimating the weights and heights of the subjects was not an incidental findings. These formulae as applied in the current study were proposed many years ago. The growth pattern of children may have changed with poor nutrition as a result of worsening economic situation. Not surprisingly, we found a significantly higher estimated BMI compared with actual BMI. For the purpose of this study, actual BMI was calculated on the basis of actual height and weight, and estimated BMI was calculated on the basis of estimated height and weight values. With a higher estimated weight values than actual and comparable values for both actual and estimated values, if BMI is estimated in this case, estimation of BMI may lead to misleading results. In our study, patients with the lowest BMI were more likely to have an underestimated body weight, and patients with the highest BMI were more likely to have body weight overestimated.

In the current study the estimated BMI derived from estimated weight and height was observed not to identify the only one and two subjects with thinness and overweight respectively. On the contrary the estimated BMI were more likely to overestimate subjects with obesity. It is attractive to conclude that estimated BMI is not a good tool to identify nutritional abnormalities among children with sickle cell anaemia as they may fall into a wrong BMI category.

CONCLUSION

We conclude that estimation of length/height, weight, and BMI by healthcare workers is adequate in general. Height is generally better estimated than is weight. Overestimation of body fat content occurred particularly in the thinness and overweight subjects, whereas overestimation of body fat content occurred especially in subjects with a high BMI in obesity category. There is need for a multi-centre cohort study to test the various formulae in our children.

Limitation

The major limitation of the study is the small sample number

which provided too small of affected patients with growth deficit by sickle cell anaemia to make conclusive remarks. There is a need for collaborative, multicentre study involving larger pool of children with varying severity of sickle cell anaemia to confirm whether the standard equations are equally useful among children with sickle cell anaemia. The present study is to be considered as a first step in assessing the reliability of the standard formula among children with sickle cell anaemia.

Conflict of Interest

None declared.

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Glucose-6- Phosphate Dehydrogenase Activity in Newborn in Jos: A Necessary Evaluation for Icteric Neonates

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ABSTRACT

Red blood cell glucose-6-phosphate dehydrogenase (G6PD) is a key regulatory enzyme with the major role of meeting the cellular need for reductive biosynthesis and maintenance of redox status. G6PD deficiency is a common inherited enzyme defect associated with severe neonatal hyperbilirubinaemia that can result in permanent neurologic damage or death. This study was aimed at estimating the level of G6PD activity among icteric neonates to assess its usefulness in the evaluation of icteric neonates in Jos. One hundred and fifty icteric neonates (92 males and 58 females) whose parents consented were consecutively enrolled as they presented at the Special Care Baby Units (SCBU) of the Jos University Teaching Hospital (JUTH), Bingham University Teaching Hospital (BhUTH), and the Plateau State Specialist Hospital (PSSH), Jos. These subjects had their G6PD activity levels assayed using the Pointe Quantitative Diagnostic Kit (USA) while other relevant clinical information was obtained using a questionnaire. G6PD activity of the icteric neonates ranged between 0.54 and 24.18 IU/gHb with a mean of 8.02 ± 4.87 IU/gHb. Sixty-one (40.7 %), comprising 45 males and 16 female neonates were G6PD deficient with mean G6PD activity of 10.92 ± 4.24 IU/gHb. G6PD activity in icteric neonates in Jos varies widely with a relatively high proportion of these neonates being G6PD deficient. Determination of G6PD activity in icteric neonates should therefore form an important evaluation tool for identification and intervention in those with the deficiency.

Keywords: Evaluation, Glucose-6-phosphatedehydrogenase, Icteric, Neonates

INTRODUCTION

Glucose-6-phosphate dehydrogenase (G6PD) is a cytoplasmic enzyme distributed in all cells and catalyses glucose-6-phosphate oxidation to 6phosphogluconolactone, converting the co-enzyme nicotinamide adenine dinucleotide phosphate (NADP) to its reduced form (NADPH). NADPH is required for reduction of oxidized glutathione (GSSG) to its reduced form (GSH) by glutathione reductase which helps protect the red blood cells from oxidative stress and reactive oxygen species.¹ The red blood cell (RBC) is vulnerable to injury by exogenous and endogenous oxidants, G6PD enzyme deficiency or its impaired function, reduces the ability of the red blood cell to protect itself against oxidative injuries.¹ This results in haemolytic anaemia of varying severity as well as neonatal hyperbilirubinaemia a major cause of neonatal morbidity and mortality.^{1,2}

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Glucose-6-phosphate dehydrogenase deficiency, an inherited X-linked disorder is the most common of the red cell enzymes defect affecting about 400 million people globally with highest prevalence in the tropics, subtropics and in the Mediterranean countries. Migration has contributed to the worldwide distribution of G6PD deficiency with the prevalence varying among different ethnic groups.² In Nigeria, the prevalence of G6PD deficiency ranges from 4-26% with the male population and icteric neonates having a prevalence of 20-26% and 20.5-35.3% respectively.^{3, 4} It affects hemizygous males, homozygous females, about 10% of heterozygous females and those with Turner's syndrome The most significant manifestations of G6PD deficiency are drug-induced haemolysis, non-spherocytic haemolytic anaemia, favism, and neonatal hyperbilirubinaemia that is usually severe and prolonged with a tendency to developing brain damage, or death.⁵

Hyperbilirubinaemia in G6PD deficient neonates exposed to icterogenic agents occurs in association with many factors that include immaturity of their liver conjugating enzymes system, method of feeding, and neonatal sepsis.^{5,6}It is seldom associated with mortality when detected early however management of hyperbilirubinaemia remains a challenge for neonatal medicine in resource poor settings like ours.^{6,7}It is therefore necessary to assess the enzyme activity in the neonates so that those with the deficiency can be identified early and appropriate intervention instituted for better outcomes

MATERIALS AND METHODS

This cross-sectional study was carried out at the Special Care Baby Units of Jos University Teaching Hospital, Bingham University Teaching Hospital, and Plateau State Specialist Hospital, Jos between March 2013 and February 2014 following approval from the Human Research and Ethics Committees of these institutions. All Jaundiced neonates admitted into the SCBUs whose parents gave consent were enrolled excluding those with previous history of blood transfusion, cephalhaematomas, bleeding tendencies and asphyxia. Venous blood was taken into an EDTA and plain sample bottle for full blood count (FBC), G6PD enzyme assay, and bilirubin assay using standard laboratory procedures. G6PD enzyme assay was carried out using reagents and control samples manufactured by the Pointe Reagent Company (USA). Red blood cell G6PD enzyme activity < 6.0IU/gHb was considered deficient.

Statistical analysis

Data was analyzed using EPI-info Version 6 software. Mean, median, mode and standard deviation (SD) were used to describe continuous data. Students' t-test was used to assess the significance between means of two groups. Chi-square was used to compare categorical data. Results were presented in tables and chart. P value ≤ 0.05 was considered statistically significant

RESULTS

One hundred and fifty icteric neonates comprising 92 (61.3%) males and 58 (38.7%) females (M: F= 1.6:1) were studied. Their mean age at presentation was 3.28 ± 3.11 days. Majority, 133 (88.6%) were aged between 0 and 5 days at presentation. (Fig1).



Figure 1: Age and sex distribution of neonates presenting with jaundice in tertiary health facilities in Jos between March 2013 and February2014

Laboratory parameters of the neonates showed a mean and median haemoglobin concentration of 15.90 ± 2.23 g/dl and 15.69 g/dl respectively and a range of 11.33 to22.30 g/dl while the mean haematocrit was 0.47 ± 0.06 , median 0.45 and a range of 0.34-0.67. The mean serum bilirubin was $205.01 \pm 96.57 \mu$ mol/L with mode of 184.50μ mol/L and a range of 86.70 to 06.00μ mol/L.(Table 1)

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 Table 1- Relevant laboratory parameters of neonates presenting with jaundice in tertiary health facilities in Jos between March 2013 and February 2014 Parameters

 n; (150)

G6PD activity ranged from 0.54-24.18 IU/gHb with a mean activity of 8.02 \pm 4.87 IU/gHb and median of 7.19 IU/gHb. Sixty-one (40.7%) of them were G6PD deficient comprising 45 males and 16 females. Their mean G6PD activity was 3.53 ± 1.34 IU/gHb and 4.53 ± 1.18 IU/gHb respectively. There was a statistically significant difference between the mean G6PD activity of the male and female icteric neonates (t=2.64, P=0.01) (Table 2).

 Table 2- G6PD activity and Sex of neonates presenting with jaundice in tertiary health facilities in Jos between March 2013 and February 2014

Sex					
	Male	Female			
G6PD status	n (%) G6PD activity*	n (%) G6PD activity*	t P Total		
G6PD deficient	$45~(48.9)~~3.53\pm1.34$	16 (27.6) 4.53 ± 1.18	2.64 0.01 61		
G6PD normal	$47~(51.1)~10.86\pm4.60$	42 (72.4) 10.91 ± 3.86	0.14 0.89 89		
Total	92 (100)	58 (100)	150		
Parenthesis = Percentage total *(Mean ± SD) IU/gHb					

Twenty two (36.1%) of the G6PD deficient neonates and 40 (44.9%) of the G6PD normal neonates had mild hyperbilirubinaemia with a mean serum bilirubin of 132.3 \pm 24.6 μ mol/L and 135.8 \pm 28.9 μ mol/L respectively. Hyperbilirubinaemia in relation to G6PD status did not show any statistical significant difference, P>0.05. (Table 3)

Table 3- G6PD status and severity of hyper-bilirubinaemia of neonates presenting with jaundice in tertiary health facilities in Jos between March 2013 and February 2014

G6PD status								
		Deficie	ent		Nor	mal		
Hyper-bilirubinaemia	n	%	mean SB	n	%	mean SB	t	Р
Mild	22	36.1	132.3 ± 24.6	40	44.9	135.8 ± 28.9	0.70	0.49
Moderate	24	39.3	205.6 ± 26.6	36	40.4	203.7 ± 24.2	0.29	0.78
Severe	15	24.6	383.1 ± 110.1	13	14.6	338.9 ± 100.4	1.10	0.28
Total	61	100		89	100			

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DISCUSSION

The mean G6PD activity of the icteric neonates in this study was 8.02 ± 4.87 IU/gHb while that of deficient icteric neonates was 3.79 ± 1.37 IU/gHb. The proportion of neonates with G6PD deficiency was 40.7 %. Azma *et al* in Malaysia reported a mean G6PD activity of 12.43 ± 2.28 IU/gHb (Normal; 10.15-14.71 IU/gHb) in neonates while Reclos *et al* in Greece had an average G6PD activity level of 10.6 IU/gHb (Normal; ≥ 6.4 IU/gHb).⁷ ⁸ These estimations were carried out using different G6PD assay kits and in different geographical locations which could have contributed to the variance in mean G6PD activity observed in this study.

The mean G6PD level of the deficient neonates in this study was higher than the finding of 1.50 \pm 0.02 IU/gHb by Uko *et al* in Calabar.⁹ Similarly, Obasa *et al* in Ilorin while determining G6PD levels in babies delivered at University of Ilorin Teaching Hospital reported a normal value of 5.72 ± 2.45 IU/gHb in females and 4.99 ± 2.30 IU/gHb in males while babies with G6PD deficiency had comparable G6PD enzyme activities of 2.1 ± 0.66 and 2.05 ± 0.60 IU/gHb in males and females respectively.¹⁰ George *et al* in Port Harcourt, Nigeria, considered values below 40% of normal adult G6PD activity level (8.83 ± 1.59 IU/gHb) as deficient.¹¹

He reported a mean G6PD level for deficient Icteric newborns to be $17.3 \pm 10.9\%$ with a G6PD deficiency prevalence of 52.5%. In a study conducted in Brazil, G6PD activity < 2.0 IU/gHb was considered profound deficiency, 2.0-6.0 IU/gHb as partially deficient while activity of > 6.0 IU/gHb was termed normal. Prevalence of G6PD deficiency reported in the study in Brazil was 7.9%.¹² These findings are not surprising as it has been reported in Africa, South of the Sahara, that three different G6PD variants with polymorphic gene frequencies and activity exist.¹³ G6PD B is the commonest

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with normal enzyme activity followed by G6PD A⁺ with 98% activity without association with haemolysis.¹³ The third variant G6PD A⁻ with an activity of 20% is associated with haemolysis especially when the red cells are exposed to certain foods, chemicals or drugs.¹³ The difference in enzyme activity may be attributed to the G6PD enzyme variant amongst the ethnic population studied warranting variable reference ranges. This is corroborated by the report that in African populations, three different G6PD genotypes are recognised in males (GdA⁺, GdB and GdA⁻) whilst in females six genotypes are recognised (GdB/GdB, GdA⁺/GdB, $G d A^+/G d A^+$, $G d B/G d A^-$, $G d A^-/G d A^-$ and GdA⁺/GdA⁻).¹³Ademowo *et al* in a study in Nigeria, demonstrated that each of these genotypes expresses varying levels of enzyme activity ranging from 9.5 ± 3.7 IU/gHb in GdB in males to 1.7 ± 1.1 IU/gHb in GdA⁻/GdA⁻ genotype in females.¹³

The proportion of icteric neonates with G6PD deficiency in this study is similar to the finding in Zaria, North West and Ilorin, North Central Nigeria where Ahmed et al, and Amiwero et al reported a prevalence of 40 % and 43 % respectively.^{14,15} Prevalence of 47.7 % was found in Oshogbo, South Western Nigeria by Akanni et al and a comparable prevalence of 32% and 30.2% in Egypt and India respectively.¹⁶⁻¹⁸ These findings are however lower than the prevalence of 62% found in Ibadan, South West Nigeria as reported by Dawodu et al.¹⁹ These varying figures may be connected to the study population known to have different genetic composition and cultural practices.^{19, 20} This is supported by the prevalence rates of G6PD deficiency among the Jews with a rate of 30% to 60% and the Arab Muslims with rates of 1.8% to 8.5% though living together for centuries in the same environment, suffering the same epidemics of malaria stressors but different cultures and religion.²¹ Many geneticists believe that the varying prevalence of G6PD deficiency population is a reflection of adaptation to malarial environments but frequency of carrier individuals, race, cultures, consanguineous and inter-ethnic marriages may have altered this adaptive response to malaria resulting in this unexpected variation within the same environment or region.^{21, 22} A further study using a larger sample size will serve to confirm this finding. Methods of enzyme assay and sensitivity of these methods may have also significantly contributed to these variations.^{23, 24} There is

therefore the need to identify an acceptable, comparable, most sensitive and most specific assay method that will guarantee the authenticity of every report irrespective of where it is produced.

The sex distribution of G6PD deficient icteric neonates in this study showed a male proportion of 48.9 % while the females were 27.5% with an approximate male: female ratio (M: F) of 3:1 similar to a finding in Iraq and some other parts of the World. ^{25, 26} This thus reaffirmed the natural history of G6PD deficiency being an X-linked recessive disorder, affecting male hemizygotes and female homozygotes or hemizygotes due to Turners' syndrome and if the phenomenon of normal X-chromosome inactivation occurs. ²⁷A statistically significant difference between G6PD deficient males and females was observed in this study. The mean level of G6PD activity depicted a lower activity in the deficient males due to reduced enzyme activity in all the males' red blood cell population. This also supports the fact that in heterozygote G6PD deficient females, half of their red blood cell populations have normal enzyme activity with the other halfexpressing deficient enzyme activity.²⁸

In comparing the severity of hyperbilirubinaemia and G6PD levels, this study showed no statistically significant difference. This observation is comparable with that of Iolascum et al and Ainoon et al who stated that the level of enzyme activity in G6PD deficient erythrocytes does not bear a consistent relationship to degree of hyperbilirubinaemia.^{29,} ³⁰ It is however contrasting with a report from Iran where maximum total serum bilirubin levels were significantly higher among G6PD deficient icteric neonates when compared with G6PD normal icteric neonates.³¹ Contrary to the statistical conclusion on the relationship between hyperbilirubinaemia and G6PD status in this study, hyperbilirubinaemia of varying severity that requires urgent attention was demonstrated. Other factors may have influence the bilirubin levels in both groups and the fact still remains that attention must be given to any neonate with serum bilirubin levels of the magnitude demonstrated in this study irrespective of their G6PD status. The G6PD deficient icteric neonates in this study had normal haemoglobin concentration and haematocrit without changes suggestive of haemolysis. This therefore concurs with the view that the predominant factor in the pathogenesis of neonatal hyperbilirubinaemia associated with G6PD deficiency might

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be decreased bilirubin conjugation due to promoter polymorphism for the gene encoding the bilirubin conjugation enzyme resulting in decrease bilirubin elimination.^{32,33} This finding may also be related to the possible predominant G6PD variant in our environment which may not be the haemolysis causing variant.³⁴

CONCLUSION

The high proportion of icteric neonates with G6PD deficiency in this study calls for a policy on early screening of all neonates through assessing their G6PD activity irrespective of their icteric status. This will assist in early detection of neonates with this deficiency and those at risk of developing hyperbilirubinaemia with the aim of instituting interventional measures to prevent its complications. There is also a need to carry out a larger population studies at National level to assay the G6PD activity in all neonates, identify the different G6PD variants and determine the national prevalence in our population.

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Conflict of Interest

None declared.

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Toxicity Study of Potash Extract, "jar Kanwa": An Earthy Material Consumed for Remedy of various Ailments in Northern Nigeria

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ABSTRACT

Potash comprises potassium bearing minerals. These minerals are traditionally used for treatments of many ailments in Northern Nigeria with little knowledge of their safety profile. Acute toxicity (LD50) study of the potash extract was carried out on adults Wister rats. Based on the result of LD50; four groups of Wister rats; Group I, II, III and IV, each containing six males were formed. Group I was administered distilled water while group II was administered 20% (1,000 mg/kg) of the highest non-lethal dose. Group III and IV were administered 10% (500 mg/kg) and 5% (250 mg/kg) of the highest non-lethal dose respectively. These were done continuously for 28 days. Intakes of food and water were recorded daily while weights of animals were recorded weekly. There was no mortality at both phase 1& 2 of the LD50. Results of chronic toxicity revealed two mortalities recorded in group II. Acute toxicity studies of potash extract showed that it is generally safe but in sub-chronic toxicity study, the extract was lethal on the experimental animals at higher doses. Therefore, consumption of this earthy material on a long term basis should be discouraged due to its lethal effects on animal studies

Keywords: Consumption, Potash Extract, Safety Profile, Wister Rats

INTRODUCTION

Potash is a broad term that covers all the bases when looking at potassium-bearing minerals. These minerals are naturally found in large evaporate deposits from ancient lake and sea beds or in rock formations.¹ Literally potash means potassium compounds and potassium bearing materials. The word potash was derived in 1477 from the Middle Dutch word "potaschen" meaning pot ashes.² Several health benefits of potash have been unraveled. It has been used for the treatment of cough, tooth ache relief, fungicidal, abortifacient and as a preservative.³ It is widely consumed by Nigerians, particularly those in the Northern part of the country with the belief that it suppresses sexual desire and provides some contraceptive properties. Conversely, potash poses health hazards on human beings, especially when consumed in a large quantity. Recent reports based on expert opinions believed that consumption of potash suppresses steroidogenesis and the high sodium content could also cause pathological changes to the liver and kidneys.⁴ There are different types of potash namely; sylvite (KCl, called regular potash or Muriate of potash),

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polyhalite or potassium sulfate (K₂SO₄) /sulphate of potash, Carnallite (potassium magnesium chloride and water), Langbeinite (potassium magnesium) named sulfate of potash magnesia (SOPM), arcanite, arcanuni, salduplicatum, vitriolic tartar, Glaser's salt, Sal polychrestum Glaseri or potash of sulfur.^{1,3} Many types of mineral such as Polyhalite, Leonite, Kainite, Glaserite, Schönite, Langbeinite and potassium sulfate, can be separated from the potash.³

There is paucity of options and nomenclature of water soluble mineral salts especially by Hausas, of Northern Nigeria. Most evaporites including potash are called *kanwa in Hausa language*. The evaporites used in Northern Nigeria, locally called *farar kanwa, jar kanwa, ungurnu* are Tronas; Natron is classified as *dutse dan Libya* while *manda* is polyhalite.⁵

In Nigeria, *kanwa* deposits are commonly found in northern part of the country, particularly in Kano, Maiduguri areas extending to border countries like Niger and Chad.⁶ It has varieties of uses such as food supplement and as a medicine.⁶ Farmers also use it as salt lick for animals in Northern Nigeria.⁷ Potash is referred to as *kaun* in Yoruba language and is commonly known as *akanwu* in Igbo language.⁸ All the three major Nigerian tribes (Hausa, Igbo and Yoruba) use potash in soups, legumes and meat mainly to faster tenderize tough cuts of meat and legumes, to colloid oil and water and to increase viscosity in some types of soups.

Research on the health benefits of potash is limited in the literature. However, understanding of its use in the world major fertilizer production firms, and inhalation of its dust by workers led to the investigation of the relationship between atmospheric dust levels and workers' health. Findings in relation to its effect where unremarkable.⁹ In an attempt to investigate the effects of potash consumption on kidneys, a study was conducted in southern Nigeria on Wistar rats. Findings from the study showed that at varying concentration of potash, there were progressive tubular and vascular changes, cellular necrosis and glomerular degeneration and these imply that potash is cytotoxic to the kidney tissues of wistar rats. They concluded that excessive consumption of this earthy material may lead to its accumulation that could cause severe and irreparable damage to the kidneys and disrupt normal body functions.¹⁰ This research was aimed at determining the toxicity of potash extract among male wistar rats.

MATERIALS AND METHODS

This research was conducted in the Pharmacology laboratory of Bayero University Kano from 1st June, 2018 to 31st

October, 2018. A pure potash extract was collected from Haji Bukaran, an area of Nguru Local Government area of Yobe State. The collected pure sample of potash was grinded to a powdered state using pestle and mortar. Three kelograms of powdered potash was dissolved in 2 liters of distilled water. The solvent was filtered using No 1 Whatmann's filter paper, size 12.5 micron and allowed to dry in desiccators at 45°C. The process was repeated until adequate potash extract was obtained.

Adults Wistar rats were purchased from the Animal House of Ahmadu Bello University (ABU) Zaria with a weight of 110-130g each. The rats were kept at the animal house of Pharmacology department of Bayero University Kano (BUK) under normal laboratory conditions. They were allowed unrestricted access to standard feed (Vital feed growers) obtainable from Grand Cereals and Oil Mills Ltd, Bukuru, Jos, Nigeria and water ad libitum throughout the experimental period. They were handled in accordance with the guidelines for the care and use of laboratory animals. The animals were randomly selected and marked to allow individual identification and kept in their cages for five days prior to the experiment to allow for acclimatization to the laboratory conditions.

Acute toxicity (LD50) study of the potash was carried out using the method described by Lorke.¹¹

This method entertained two phases as follows:

Phase 1: This phase required nine Wistar rats which were divided into three groups of three animals each. Each group was administered different doses (10, 100 and 1000 mg/kg) of the potash solution. The rats were fasted for 18 hours prior to dosing. The potash solutions were administered to the rats once orally using 22-gauze oral feeding needle based on their weights. The Wistar rats were then placed under observation for 24 hours to monitor their behavior as well as if mortality would occur.

Phase 2: This phase involved the use of three wistar rats, which were distributed into three groups of one animal each. These wistar rats were administered higher doses (1600, 2900 and 5000 mg/kg) of potash extract solution and then observed for 24 hours for behavior as well as mortality.

Then the LD_{50} was calculated by the formula:

$$LD_{50} = \sqrt{(D_0 \times D_{100})}$$

 $D_0 =$ Highest dose that gave no mortality,

 D_{100} = Lowest dose that produced mortality.

Based on the result of LD50; four groups of wistar rats; Group I, II, III and IV, each containing six males were formed.

Group I were administered distilled water while group II were administered 20% of the highest non-lethal dose. Group III and IV were administered 10% and 5% of the highest non-lethal dose respectively. These were done continuously for 28 days. Intakes of food and water were recorded daily while weights of animals were recorded weekly. Approval for the study was obtained from the ethical committee of Bayero University Kano (BUK /CHS/ REC/ VI/ 56), after due consideration of animal health and the advancement of knowledge on humans or animals weighed against the potential impacts on the welfare of the animals. Following the approval, the researcher was under obligation to ensure that laboratory animals were treated according to high ethical and scientific standards.

Table 1: Acute Toxicity Study

RESULTS

Results of LD_{50} showed no mortality at both phase 1& 2. Table 1. Therefore, the maximum dose of 5,000 mg/kg was found to be non-lethal to the wistar rats. In the results of chronic toxicity, Group II, III and IV of the wistar rats were given 1,000 mg/kg, 500 mg/kg and 250 mg/kg of potash extract daily over a period of 28 days while group 1 (control) was on food and water only (Table 2) There were no significant changes in weight of the wistar rats, intake of food and water during the period of the study. There were two mortalities recorded in group II. Figure 1 and 2 depict the crude potash (*jar kanwa*) and the extract respectively.

Groups	Number of Wistar rats	Dose (mg/kg)	Period under observation (Hours)	Mortality/behavioral changes
Phase 1				
Group I	3	10	24	Nil
Group II	3	100	24	Nil
Group III	3	1,000	24	Nil
Total	9		•	
Phase 2				
Group I	1	1,600	24	Nil
Group II	1	2,900	24	Nil
Group III	1	5,000	24	Nil
Total	3	,		

Table 2: Chronic Toxicity Study

Groups	Number of Wistar rats	Dose (mg/kg)	Percentage of highest non- lethal dose (%)	Duration (days)	Mortality/ behavioral change
I (control)	6	0	0	28	nil
II	6	1,000	20	28	2 Mortalities
III	6	5000	10	28	nil
IV	6	250	5	28	nil

Note: Highest non lethal dose based on acute toxicity study was 5,000 mg/kg



Figure 1: Samples of Potash

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Figure 2: Extract of the Potash

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DISCUSSION

The result of lethal dose 50, the dose that kills 50% of test animals' population (wistar rats) when exposed to potash extract showed no mortality. This was similar to the findings of Imafidon and Omoregie¹² on toxicological and biochemical investigations in rats administered "*kaun*" (trona), a natural food additive used in Nigeria. Iweka and colleagues¹³ in South-Southern Nigeria in a study on the effect of potash on liver function of wistar rats also reported no mortality on acute toxicity study following potash treatment. This shows that the potash is safe when consumes on short term basis but on long term use, it is lethal for we recorded two mortalities in the 28 day period of exposure. Furthermore, the mortality was recorded in the 1,000 mg/kg group, i.e., the group with highest dose (20% of the non lethal dose).

A toxicological and biochemical investigations in rats administered trona, a naturally occurring inorganic substances (salts), used mainly as food additive showed that no demonstrable significant toxic effects. And its administration to rats up to 5000 mg/kg resulted in no mortality of the test rats after 24 hours. Hence the LD₅₀ of this potash extract was estimated to be greater than 5000 mg/kg as they also found in trona. $^{\rm 14}~$ The $\rm LD_{\rm 50}$ was not calculated in this study because there was no mortality at 5000 mg/kg dose level indicating that it is relatively safe under short term exposure. However, acute toxicity data are of limited clinical application since cumulative toxic effects especially at a dose of 1,000 mg/kg was found to be lethal due to the recording of two mortalities. Based on the findings of a study conducted on the effects of chronic exposure to lead, cadmium, and manganese mixtures on oxidative stress in rat liver and heart, it was concluded that exposure to these heavy metals could result in distribution and accumulation of these metals in the body and subsequent weakening of the immune system¹⁵ which could eventually lead to mortality as was noticed in this study.

CONCLUSION

Acute toxicity studies of potash extract showed that it is generally safe but in sub-chronic toxicity study, the extract was lethal on the experimental animals at higher doses. As part of our recommendation, we discourage consumption of these earthy materials on a long term basis due to its lethal effects on animal studies.

Limitation

We could not do pathological assessment of the wistar rats after chronic exposure of the potash extract.

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Conflict of Interest

None declared.

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Knowledge of Healthcare Workers on Immunization: New and Underutilized and Perception towards Future Vaccines

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ABSTRACT

Nigeria is making effort to address the child mortality burden by increasing vaccine coverage rates, yet the vaccine coverage falls short of 90% target. Scaling up of new and under-used vaccines to 90% coverage could save more than 600,000 Nigerian children. Healthcare givers knowledge of vaccine used for immunization is essential to increase the vaccine uptake rates. This study assesses the knowledge of routine, underutilized and future vaccines among health workers. A cross sectional descriptive study was done among health care workers at a tertiary health facility in Nigeria. Using a pre-tested semi structured interviewer administered questionnaire, 220 respondents were selected by cluster sampling technique. The health workers' knowledge of these vaccines was assessed using a scale developed for the study. Data collected were analyzed using SPSS version 22. The mean age of the respondents was 31.9 ± 5.7 years. Doctors and nurses formed more than half of the respondents, 51.8% (n=114). About three quarters of respondents 72.3% (n=159) had good knowledge of vaccines used in routine immunizations. Knowledge of under-utilized and future vaccine was low with less than a fifth 18.6% (n=41) and one tenth 9.1% (n=20) having good knowledge scores respectively. Similarly, poor perception scores of future vaccines were observed in 90.1% (n=218) of the respondents. Only marital status was associated with knowledge of underutilized vaccines (p<0.05) and no association was observed between other sociodemographic variables and knowledge of these vaccines (P>0.05). The awareness level of health care workers on routine immunization is high. Their knowledge and perception of under-utilized and future vaccines were however low. There is, therefore, need for more training and retraining of health care workers on the vaccines.

Keywords: Health worker, Knowledge, Under-utilized, Vaccines

INTRODUCTION

One of the most important ways to improve immunization services is to have parents and health care workers that work towards the benefits of immunization to the growing child. The purpose of the immunization program is to achieve high coverage among children so as to reduce morbidity and mortality that results from vaccine preventable diseases.¹ Although the benefit of preventing suffering and death from serious infectious diseases greatly outweighs the rare adverse effect following immunization,² disputes have arisen over the morality, ethics, cost, effectiveness and safety of vaccination.² Some vaccination critics say that vaccines are ineffective against disease, or that vaccines safety studies are inadequate.³ Some religious groups do not allow vaccination and some political groups oppose mandatory vaccination on the grounds of individual liberty.^{4,5} In the first decade of 21st century, religious and political leaders with some health care workers (HCW) in northern Nigeria, suspicious of western medicine advised their followers not to have their children vaccinated with oral polio vaccine (OPV). The immunization was suspended for several months. Subsequently, Nigeria reported over 200,000 measles, polio and other vaccine preventable disease (VPD) cases and about 600 deaths from measles in the first quarter of 2008.⁶

Studies have shown that parents and healthcare workers play an essential role in playing improving the number of children reached and ensuring they are fully covered with antigens appropriate for their age.^{7,8} Lack of adequate knowledge on immunization could be a major cause of decline of the vaccine coverage rate, thus training of providers has been found to improve immunization uptake elsewhere.8 In a review of evidence on how health care workers determine uptake of immunization it was found that suboptimal vaccination rates resulted from inadequate knowledge among healthcare providers of vaccination schedules, as well as the benefits and side effects.⁹ In some cases, healthcare providers were even found to have misleading beliefs about immunisation and sent unclear or untrue messages to parents.9 Nigeria has taken important steps in recent years to address the child mortality burden by increasing vaccine coverage yet, the vaccine coverage fall short of 90% target,¹⁰ Scaling up of new and under-used vaccines to 90% coverage could save more than 600,000 Nigerian children from VPD in the next ten years, and eventually add an economic value equivalent to \$17 billion to the nation's economy.^{11,12} The study was done at a tertiary health facility in Kano. The state has an estimated maternal mortality ratio of 1600 per 100,000 live births, an under-five mortality of 157 deaths per 1000 births in 2008. About 13% of deliveries in the state were attended to by a skilled birth attendant and only 11% of these deliveries take place in a health care facility. Furthermore, only 6% of the population receives required vaccination and more than half of the children have not received their immunization. We therefore, assessed the knowledge of routine and underutilized vaccine among HCW and their perception on future vaccines and how it relates to immunization services in the country.

MATERIALS AND METHODS

The study was a hospital based cross sectional descriptive study. Kano state has a total of 44 local government areas, and eight of them are metropolitan. The 2018 projected population of the state is 11,401,847 (based on the 2006 National Population Census), with an almost equal distribution of male (51%) and female (49%). The health system is organized at three levels namely: primary, secondary and tertiary levels. There are three tertiary health institutions sited in the metropolis; Murtala Mohammed Specialist Hospital, Mohammed Abdullahi Wase Specialist Hospital and Aminu Kano Teaching Hospital. There are an estimated 161 private health facilities distributed across the state. Aminu Kano Teaching Hospital (AKTH) was established on 24th of August 1988. The facility is located along Zaria road in Tarauni Local government area in Kano metropolis. It is a five hundred beds hospital that provides specialized services to patients from Kano and neighbouring states, as well as West Africa countries. The hospital has about 17 departments, 15 wards, laboratory complexes and specialty clinics. The hospital has a staff strength of 2,600 comprising of both administrative and clinical staff. Apart from medical services, the hospital also provides training for medical students, interns, resident doctors and mid-level healthcare workers.

Our study population were health care staff working at health facilities offering immunization in services. The Leslie Fishers formula was used to calculate the minimum size for this study. A total of 220 respondents were selected by cluster sampling technique after meeting up the inclusion criteria. A semi-structured interviewer administered questionnaire was developed and pre-tested for the study. The questionnaire captures information on the socio-demography of the respondents, knowledge of health care workers on routine immunization, new and under-utilized vaccines as well as the perception of the health workers toward future vaccine. The knowledge of routine, underutilized and future vaccine was assessed based on a scoring system developed for the study. Each positive response has one mark score and a zero score for a wrong response. The maximum score obtainable was 21 for assessment of knowledge of routine vaccines (score of 0-10 considered as poor knowledge, and scores of 11-21 was considered good knowledge). Similarly, the maximum score obtainable for assessment of knowledge of underutilized vaccines was 52-point scale (score of 0-26 graded as poor

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knowledge, and scores of 27-52 was considered good knowledge). Assessing the knowledge of future vaccines was a 7-point scale with scores of 0-3 considered as poor knowledge and scores of 4-7 good knowledge score. Perception towards future vaccine was analyzed using Likert's scale and also graded as good on a scale of 11-20 score and poor perception if it is between 0-10 score. The maximum score on the perception scale was 20 points. Data were entered manually into a spreadsheet on Microsoft excel and analyzed using SPSS Version 22. Quantitative data were summarized using mean, standard deviation, while Qualitative data were presented using frequency tables. Tests of associations between categorical data was performed, Chisquare test of association was used to test for statistically significant associations. A P-value of 0.05 or less was considered significant.

Ethical approval for this study was obtained from ethical committee of Aminu Kano Teaching Hospital and Kano State Hospital Management Board ethical committee. All respondents were made to sign consent before participating and assurances were given on confidentiality of data collected.

RESULTS

Of the 220 respondents that participated, 124(56.36%) were males, and 96(43.64%) were females. The mean age of the respondents was 31.9 with a standard deviation of 5.7 years. All the respondents were drawn from a tertiary health facility.

Table 1: Sociodemographic characteristics of the respondents

Socio demographic	Frequency	Percentage
features	N=220	8
Age groups (years)		
15-24	10	4.6
25-34	146	66.4
35-44	56	25.5
45-54	8	3.6
Sex		
Male	124	56.4
Female	96	43.6
Ethnic group		
Hausa	128	58.2
Igbo	32	14.6
Yoruba	29	13.3
others	31	14.1
Marital Status		
single	76	34.5
married	143	65.0
widowed	1	0.5
Professional Qualification		
Doctor	60	27.3
Nurse	54	24.5
CHEW	53	24.1
Lab Scientist	26	11.8
Technician	12	5.5
Others	15	6.8
Years of Service		
Less than 5	104	47.3
5-10	70	31.8
11-15	39	17.7
16-20	7	3.2

Table 2: Knowledge of routine immunization vaccines

Knowledge Assessed (n=220)	Correct knowledge	Incorrect knowledge
• · ·	F (%)	F (%)
Ever heard of routine Immunization vaccines	220 (100.0)	0 (0.0)
Facility offers vaccine for Immunization	220 (100.0)	0 (0.0)
Knows RI vaccine Schedule	173 (78.6)	47 (21.4)
Knows appropriate vaccine for age	175 (79.5)	45 (20.5)
Knows Vaccine preventable diseases	218 (99.1)	2 (0.9)
Knows when to start child Immunization	220 (100.0)	0 (0.0)
Knows Adverse events following Immunization	131 (59.5)	89 (40.5)
Knows Contraindications to Immunization	115 (52.3)	105 (47.7)

Table 3: Knowledge of Underutilized Vaccine among HCW

Knowladge Assessed (n=220)	Correct Knowledge	In Correct Knowledge
Kilowieuge Assesseu (II-220)	Ener (0/)	Error (9/)
	Freq (%)	Freq (%)
Aware of Underutilized vaccines	119 (54.1)	101(45.9)
Vaccines Identified as Under Utilized	(a) (a)	
Pneumococcal conjugate vaccine	62 (28.2)	158 (71.8)
Typhoid Vaccine	57 (25.9)	163 (74.1)
Influenza vaccine	48 (21.8)	172 (78.2)
Hepatitis A vaccine	42 (19.1)	178 (80.9)
Hepatitis B vaccine	77 (35.0)	143 (65.0)
Yellow fever vaccine	30 (13.6)	190 (86.4)
Rubella	23 (10.5)	197 (89.6)
Rotavirus vaccine	23 (10.5)	197 (89.6)
Cholera Vaccine	40 (18.1)	180 (81.8)
Meningococcal conjugate vaccine	69 (31.4)	151 (68.6)
Hemophilus Influenza type b vaccine	58 (26.4)	162 (73.6)
Human papilloma Virus Vaccine	75 (34.1)	145 (65.9)
Pneumococcal Vaccine		
Knows target population	75 (65.9)	145 (34.1)
Knows disease conditions it protects	59 (26.8)	161 (73.2)
Knows number of doses required for protection	2(0.9)	218 (99.1)
Knows availability	47 (21 4)	173 (78.6)
Typhoid Vaccine	., (21.1)	175 (7010)
Knows target nonulation	6 (27)	214 (97 3)
Knows disease conditions it protects	54(24.4)	166 (75.5)
Knows number of doses required for protection	3(14)	217 (98 6)
Knows multiplity	3(1.4) 28(127)	102(87.3)
	20 (12.7)	192 (87.5)
Innuenza vaccine	44 (20.0)	17((80.0)
Knows target population	44 (20.0)	170 (80.0)
Knows disease conditions it protects	50 (22.7)	1/0 (77.3)
Knows number of doses required for protection	5 (2.3)	215 (97.7)
Knows availability	45 (20.5)	175 (79.5)
Hepatitis A vaccine	00 (26 4)	140 (62 6)
Knows target population	80 (36.4)	140 (65.6)
Knows disease conditions it protects	/6 (34.5)	144 (65.5)
Knows number of doses required for protection	10 (4.5)	210 (95.5)
Knows availability	40 (18.2)	180 (81.8)
Hepatitis B Vaccine	110 (50 0)	110 (50.0)
Knows target population	110 (50.0)	110 (50.0)
Knows disease conditions it protects	105 (47.7)	115 (52.3)
Knows number of doses required for protection	60 (27.3)	160 (/2./)
Knows availability	95 (43.2)	125 (56.8)
Rota virus Vaccine		
Knows target population	26 (11.8)	194 (88.2)
Knows disease conditions it protects	39 (17.7)	181 (82.3)
Knows number of doses required for protection	7 (3.2)	213 (96.8)
Knows availability	7 (3.2)	173 (96.8)
Cholera Vaccine		
Knows target population	77 (35.0)	143 (65.1)
Knows disease conditions it protects	76 (34.5)	144 (65.5)
Knows number of doses required for protection	13 (5.9)	218 (94.1)
Knows availability	30 (13.6)	190 (86.4)
Meningococcal Vaccine		
Knows target population	32 (14.5)	188 (85.5)
Knows disease conditions it protects	84 (38.2)	136 (61.8)
Knows number of doses required for protection	7 (3.2)	203 (96.8)
Knows availability	63 (28.6)	157 (71.4)
Hib Vaccine		
Knows target population	67 (30.5)	153 (69.5)
Knows disease conditions it protects	56 (25.5)	164 (74.6)
Knows number of doses required for protection	13 (5.9)	207 (94.1)
Knows availability	43 (19.6)	177 (80.4)
HPV Vaccine		
Knows target population	76 (34.6)	144 (65.4)
Knows disease conditions it protects	85 (38.6)	135 (61.4)
Knows number of doses required for protection	11 (5.0)	209 (95.0)
Knows availability	43 (19.6)	177 (80.5)

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All the healthcare workers studied are aware of vaccines used in routine immunization and know when a child should start receiving vaccines. More than half of the respondents 131 (59.5) were able to mention at least three adverse events that could follow immunization in a child.

The respondents were assessed on underutilized vaccine. The responses are shown in table 2 above.

Table 4: Perception of Future Vaccines Amongst Health care workers

	Incorrect	Correct	Undecided
Perception	F (%)	F (%)	F (%)
When planning to introduce new vaccine we consider:			
Vaccine efficacy	220 (100.0)		
Vaccine effectiveness	218 (99.9)	0(0)	2 (0.1)
Severity of disease	209 (95.0)	7 (3.2)	4 (1.8)
Burden of disease	206 (93.6)	12 (5.5)	2 (0.9)
Risk to contacts	202 (91.8)	16 (6.8)	3 (1.4)
Public concerns	193 (87.7)	25 (11.4)	2 (0.1)
Coverage	211 (95.9)	6 (2.7)	3 (1.4)
When introducing a vaccine in to community consider:			
Supply issues	216 (98.2)	4 (1.8)	-
logistics associated with the new vaccine.	208 (94.6)	10 (4.5)	2 (0.9)
economic and financial issues	211 (95.9)	8 (3.6)	1 (0.4)
Introducing a new vaccine means you have to:			
Revise the practice guidelines	163 (74.1)	48 (21.8)	9 (4.1)
Revise of Road-to-Health charts	151 (68.6)	59 (26.8)	10 (4.6)
Training of health workers	169 (76.8)	51 (23.2)	
Cold chain Logistics and Manuals,	189 (85.9)	25 (11.4)	6 (2.7)
Information, Education and Communication for the public	207 (94.1)	12 (5.5)	1 (0.4)
Monitoring of Adverse Events	210 (95.5)	8 (3.6)	2 (0.9)
Surveillance of the disease in question.	204 (92.7)	12 (5.5)	4 (1.8)
You can monitor the success of a new vaccine by:			
Estimating the burden of the disease,	205 (93.2)	12 (5.5)	3 (1.4)
Determining the Effectiveness of the vaccine,	211 (95.9)	8 (3.6)	1 (0.4)
Determining the Coverage achieved	213 (96.8)	7 (3.2)	

Table 5: Knowledge and Perception of the respondent on Vaccines

Assessment	Freque	ncy Percentage
Knowledge of Routine Vaccine		
Good (score 11-21)	159	72.3
Poor (score 0-10)	61	27.7
Knowledge of Underutilized vaccin	ie	
Good (score 27-52)		
Poor (score 0-26)	41	18.6
	179	81.4
Knowledge of Future Vaccines		
Good (score 4-7)	20	9.1
Poor (score 0-3)	200	90.9
Perception of FutureVaccines		
Good Perception (score 11-20)	2	0.9
Poor Perception (score 0-10)	218	90.1

Fewer respondents have been observed to have good perception 0.9% (n=20), knowledge of future 9.1% (n=20) and underutilized vaccines 18.6% (n=41) from the study.

Table 6: Relationship between Sociodemographic features and Knowledge of Vaccines

Sociodemographic Characteristics Knowledge Assessment (n=220)

81	0					
	Good knowledge	Poor Knowledge	Test	P valua		
	F (%)	F (%)	Statistics	i faiut		
Sex						
Male	84 (39.5)	40 (18.2)	$x^2 = 2.91$	0.09**		
Female	75 (34.1)	21 (9.5)				
Marital status						
Single	50 (22.7)	26 (11.8)	$x^2 = 2.43$			
Married	109 (49.5)	39 (17.7)		0.12**		
Professional qualification						
Less than 10years	43 (19.5)	17 (7.7)				
More than 10 years	116 (52.7)	44 (20.0)	x ² =0.02	0.92**		
Voors of sorvico						
Less than 10years	123 (55.0)	51 (23.2)	$r^2 - 1.04$	0 31**		
More than 10 years	125 (55.9) 36 (16 A)	10(4.5)	* -1.04	0.51		
wore mail to years	50 (10.4)	10 (4.3)				
	Underutilized Vaccines					
	Good knowledge	Poor Knowledge				
	F (%)	F (%)				
Sex	~ /					
Male	25 (11.4)	99 (45.0)	$x^2 = 0.44$	0.51**		
Female	16 (7.3)	80 (36.4)				
Marital status						
Single	20 (9.0)	56 (25.5)	$x^2 = 4.51$	0.03*		
Married	21 (9.5)	123 (55.9)				
Professional qualification						
Less than 10years	15 (6.8)	45 (20.5)	$x^2 = 2.20$	0.14**		
More than 10 years	26 (11.8)	134 (60.9)				
Years of service						
Less than 10years	33 (15.0)	141 (64.1)	$x^2 = 0.05$	0.81**		
More than 10 years	8 (3.6)	38 (17.3)				
	Future vaccines					
	Good knowledge	Poor Knowledge				
	F (%)	F (%)				
Sex	11 (5 0)	112 (51.4)	~2 0.02	0.00**		
3 4 6 1 6			7			

	1 (70)	1 (70)		
Sex				
Male	11 (5.0)	113 (51.4)	$x^2 = 0.02$	0.89**
Female	9 (4.1)	87 (39.5)		
Marital status				
Single	13 (5.9)	63 (28.6)	$x^2 = 9.02$	0.003*
Married	7 (3.2)	137 (62.3)		
Professional qualification				
Less than 10years	7 (3.2)	53 (24.1)	$\chi^2 = 0.66$	
More than 10 years	13 (5.9)	147 (66.8)		0.42**
Years of service				
Less than 10years	19 (8.6)	145 (65.9)	$x^2 = 3.37$	0.07**
More than 10 years	1 (0.4)	45 (20.5)		

DISCUSSION

Good knowledge of vaccines used in routine immunizations was observed among the respondents, however knowledge of underutilized as well as future vaccine was poor. Awareness of routine immunization was high similar to what was

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reported by other studies,^{12,13} however differs from findings here because caregivers were used as study population in these studies. Inadequate parental knowledge and information and that of healthcare workers could grossly affect the uptake and utilization of childhood immunization as reported by many studies.^{14,15,} If the main problem among healthcare providers is lack of knowledge, in most cases, suboptimal vaccination rates result from this inadequate knowledge and will affect vaccination schedules and benefits.Vaccines against hepatitis B, Hemophilus influenza type b, yellow fever, rubella, typhoid and cholera have been widely available in industrialized countries for years, but are underutilized effectively in developing countries. New formulations or combination vaccines that decrease the number of injections, overcome vaccine wastage, and improve actual and perceived adverse event profile of the vaccines are available. Our study demonstrated poor knowledge of future and underutilized vaccines. Where the healthcare worker does not have adequate information on the vaccines used, it will undoubtedly affect uptake, coverage and utilization. Healthcare providers ranked first among most used and most trusted sources of information on vaccines as reported from studies in western Europe.¹⁷⁻¹⁹

Healthcare workers routinely provide information about recommended vaccinations to their patients and informed them about benefits and risks. When the healthcare providers sounded vague, some parents may interpret this as concern that the vaccine was unsafe.²⁰ Furthermore, if healthcare workers' knowledge was found to be inadequate, vaccination coverage in the general population may decrease. The same happens when healthcare workers were reported to have a relaxed attitude towards immunization, which is itself a consequence of lack of knowledge and may lead to more problems.⁹ We observed a very low perception to future vaccines. This differs to what was reported from Netherland,²¹ where 43% of the respondents were reported to have positive perception and attitudes towards all vaccinations including the new vaccines. Perhaps because the caregivers were used as the respondents in Netherland study. An extensive range of vaccines are in the development pipeline against many diseases of public health importance. Only marital status was found to be positively associated with Knowledge of vaccines(p<0.05). Contrary to what was reported by other studies where years of service and professional qualification plays a major role in the knowledge of health worker.

CONCLUSION

Healthcare workers were found to have a high knowledge of routine immunization vaccine but poor knowledge of future and underutilized vaccine. The perception of future vaccine was also observed to be low. The need to have training and more information on future and underutilized vaccine will go a long way in improving the utilization of some of these new and utilized vaccines in our community.

Recommendation

It is recommended from this study that healthcare workers that work in immunization units of our health facilities should have regular training and skills updates to enable them tackle the challenges of immunization in Nigeria. This will improve uptake, utilization and coverage of immunization services among the population.

Limitation

Our study has been limited by the fact that the health workers were drawn from the same facility but their selection followed a clearly laid down scientific procedure to eliminate any form of bias.

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Conflict of Interest

None declared.

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Case Report

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Invasive Sino-Orbital Aspergillosis in an Immunocompetent Patient

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ABSTRACT

Invasive aspergillosis that involves intra-orbital and intracranial extension occurs in immunodeficient and immunocompetent patients resulting in significant morbidity and mortality. We report the case of a 38year old farmer who had recurrent fronto-ethmoidal mucocoele and proptosis of the left eye. She presented with a history of hypertension and no other significant findings on examination. Computer tomography scan of the brain showed a left fronto-orbital uniform contrast-enhancing extra-axial lesion with thickened peripheral capsule and an associated left fronto-orbital skull defect. Cerebrospinal fluid analysis did not show any sign of infection. Intra-operative biopsy sample showed cheesy material which on culture grew Aspergillus species that was identified further using molecular methods. Antifungal agents were used to treat the patient. The present case strongly suggests that it is possible to control intracranial aspergillosis with a combination of surgery and antifungal chemotherapy.

Keywords: Invasive aspergillosis, Aspergillus, Immunocompetent, Fungal infection

INTRODUCTION

A spergillosis of the paranasal sinuses and orbit usually is self-limiting with a good prognosis. In contrast, invasive diseases may result in significant morbidity and mortality from intra-orbital and intracranial extension. Invasive disease occurs in debilitated patients with decreased immunity such as diabetes mellitus, Human Immunodeficiency Virus, cytotoxic drugs users, etc.¹²³ Intracranial extension often results in mortality despite therapy. Nonetheless, invasive sino-orbital aspergillosis may occur in immunocompetent patients resulting in significant morbidity and mortality. The standard treatment for invasive sino-orbital diseases has been radical surgical intervention, including orbital exenteration, sinus excision, and aggressive intracranial debridement. However more recently, poor prognosis have been reported with a combination of limited surgical debridement and anti-fungal therapy particularly in immunocompetent patients due to late presentation to health care facility. We present a case of invasive sinoorbital aspergillosis with extension into the dura complicated by cheesy collection in an immunocompetent patient. The patient was successfully managed with surgical debridement and anti-fungal chemotherapy.

Case report: history and examination

A 38 year old female who had gross total resection of

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fronto-orbital lesion, with intracranial extension for about 3 years prior to presentation. However, she started having serous discharge from the operation site about one year after the surgery with associated proptosis of the left eye. There was no discharge from the nose, ear or contralateral eye. Her medical history included only hypertension. The patient had marked proptosis, limitation of extra ocular motility, ptosis, and a large discharging (left) supra orbital sinus. The patient is immunocompetent as revealed by nonreactive retroviral screening test. The other findings from the physical examination were not significant. The patient was admitted and reviewed by both Neurosurgery and the Otorynolaryngology team, and a computer tomography scan of the brain was performed prior to surgery.

Hospital care

The imaging study of the patient's brain showed a left frontoorbital uniformly contrast-enhancing extra-axial lesion with thickened peripheral capsule. (fig1a,1b,1c) There was an associated left fronto-orbital skull defect and thickening of the left maxillary sinus mucosa and calcifications.

A thorough medical examination and review of patient, including Human Immunodeficiency Virus screening, did not reveal evidence of immunodeficiency disorder or systemic fungal infection. Given the immunocompetence of the patient, chronic nature of the disease, clinical and radiologic findings, a diagnosis of Recurrent fronto-ethmoidal mucocoele with fistula was made and the patient was prepared for external frontoethmoidectomy. Intraoperatively, a left fronto-cutaneous fistula was seen, cheesy material with frontal sinus with extension to the dura as well as reactive dura was observed. The cheesy material was evacuated and sent to the laboratory, irrigation was carried out and haemostasis secured with electrocautery. A frontonasal stent was placed for two weeks to allow for epithelization and enhanced drainage from the frontal sinus to the nasal cavity to allow for healing of the fronto-cutaneous fistula.

Microbiology and molecular examination

Cultures of the cheesy material sample obtained were consistent with *Aspergillus species* (figure 2). Internal transcribed spacer (ITS) region gene sequencing was performed to reliably identify the organism. The universal primers for fungi F(5'-TCCGTAGGTGAACCTGCGG-3') and R(5'-TCCTCCGCTTATTGATATGC-3') was used and

generating a sequence which on BLAST analysis matched Aspergillus aculeatus (GenBank accession number MN187974.1) was identified. Due to unavailability of antifungal drugs, patient was commenced empirically on intravenous fluconazole for two weeks and discharged home on oral voriconazole (300mg) twice daily. The patient is eight months post-surgery doing very great.



Fig 1a: Brain computer tomography scan showing lesion (arrow) in the fronto-nasal sinus.



Fig 1b: Computer tomography scan of the brain showing(arrow) a left fronto-orbital uniform contrast-enhancing extra-axial lesion.

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