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**EFFECTS OF ETHANOLIC EXTRACT OF *Nauclea Latifolia* STEM BARK ON LIPID PROFILE, LIVER AND KIDNEY FUNCTION IN SWISS ALBINO MICE AFTER EXPOSURE TO CRUDE OIL**  
*Ijomah, O.O.<sup>1</sup> Obijadi, C.C.<sup>1</sup> Oweh, O.T.<sup>2</sup> Avidime, O.M.<sup>3\*</sup> and Nurudeen, O.Q.<sup>4</sup>*

**ABSTRACT**

The study was carried out to investigate the effects of the administration of ethanol extract of *Nauclea latifolia* stem on lipid profile, liver, and kidney parameters of mice fed with crude oil contaminated diets (CCD). Twenty-four rats were grouped into six groups. Each group consists of four rats. Group A served as the negative control and was fed with CCD and left untreated while Group B was administered with 0.1ml of vitamin C. Groups C, D and E were administered 500, 2000 and 5000 mg/kg of ethanol extract of *Nauclea latifolia* stem, respectively while group F was administered 2 mL distilled water and fed with normal diet. Administration lasted for twenty-eight days, after which the mice were sacrificed twenty-four hours after administration on the twenty-eight day. Blood samples were collected by ocular puncture, and alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, urea, creatinine, as well as lipid profile evaluated. The results showed a significant ( $p < 0.05$ ) concentration-dependent decrease in total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG). Administration of 2000 mg/kg of the extracts significantly reduced serum urea, while the extracts had no significant effect on serum creatinine. There was a significant reduction ( $p < 0.05$ ) in liver aspartate aminotransferase and alkaline phosphatase activities. However, the extract administration resulted in a significant increase in liver alanine aminotransferase. This revealed the lipid profile and renal function-protecting effect of the extracts. However, the ethanolic extracts at the doses administered might pose some toxicity to the liver.

**Keywords:** Contaminated Crude Diet, Lipid Profile, Liver, *Nauclea latifolia*, Renal Function

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## INTRODUCTION

Crude oil, which is chiefly composed of hydrocarbons, some trace metals, and heavy metals (Goldstein *et al.*, 2011), has been reported to be toxic primarily due to its heavy metal content. These heavy metals, such as arsenic, mercury, cadmium, and lead, are of concern to public health because of their ability to cause major organ failure even at low exposure (Nyeche *et al.*, 2015). The exposure to some of these harmful constituents (heavy metals) of crude oil alters the normal body metabolic processes with some adverse effects on major organs and systems such as pulmonary, dermatologic, and hepatorenal systems (Ita *et al.*, 2015).

The liver and kidneys are vital in the body's metabolic processes. The liver, for instance, executes numerous functions such as metabolism, digestion, carbohydrate storage, and detoxification (Mancuso *et al.*, 2018). On the other hand, the kidneys sustain the volume of blood (homeostasis), control the level of minerals within the blood, and remove waste products of body metabolism (Reche *et al.*, 2012). It is therefore imperative to note that the major function of both the liver and the kidneys is the elimination of harmful substances. Hence, the continuous exposure to crude oil constituents could be associated with increased risk of liver and kidney dysfunction (Alqurashy *et al.*, 2023).

*Nauclea latifolia* (family Rubiaceae) has numerous names in Nigeria; it is called African peach in English, Ubulu inu in Igbo, tuwon biri in Hausa, and Egbesi in Yoruba (Arise *et al.*, 2012). Traditionally, different parts of the plant are used in treatment for pain, dental caries, diabetes, and diarrhoea in Africa (Gidado *et al.*, 2005). Furthermore, the plant is used as a treatment therapy for hypertension, gastrointestinal disorders, extended menstrual flow, and sleeping sickness (Elujoba, 1995).

Previous reports showed that phenolic-rich extracts of *N. latifolia* fruit improve lung tissues and haematology toxicity induced by lead acetate poisoning in Wistar rats (Busari *et al.*, 2021). Furthermore, *N. latifolia* fruit was reported to reverse lead acetate-induced liver and kidney damages and, at a higher dosage, reduce hepatic and renal injuries in Wistar rats (Busari *et al.*, 2021). The reports of Arise *et al.* (2012) revealed hepatotoxic and nephrotoxic tendencies of the aqueous extract of *Nauclea latifolia* stem. However, there is a paucity of literature on the restorative effects of the ethanolic extract of *N. latifolia* stem bark (ENLSB) on the kidney and liver function, and the lipid profile of Swiss Albino mice exposed to crude oil.

## MATERIALS AND METHODS

**Experimental Animals:** Twenty-four mice weighing between 21g-35g were obtained from the Animal House, Nigeria Institute of Medical Research

(NIMR), Lagos State, Nigeria. The mice were fed with grower's marsh feed (a product of Top-Feeds) and water given ad libitum. Animals were housed in cages constructed of stainless steel and plastic under controlled conditions of a 12 h: 12 h light: dark cycle. The animals used in this study were maintained according to the guidelines as stated in the Guide for the Care and Use of Laboratory Animals.

**Kits, chemicals, and reagents:** The biochemical kits used were obtained from AGAPE Laboratories, Hombrechtikon, Switzerland. The chemicals and reagents used were obtained from Sigma-Aldrich Chemical Company, St. Louis, USA.

**Plant collection:** Fresh fruit and stem of *N. latifolia* were collected from the Ota area in Ado Odo, Ota local government, Ogun state, Nigeria. The plant was identified at the herbarium of the Department of Botany, University of Lagos, Nigeria by Dr. Rodoza George, and a specimen was deposited at the herbarium of the University.

**Preparation of stem extracts:** *Nauclea latifolia* plants were dried at room temperature for 7 days. A sample of the stem of *Nauclea latifolia* was dried and then pounded in a mortar; it was then further ground into powder and stored in an air-tight container until required.

The grounded stem bark sample (100g) was soaked in 1L of 80% ethanol and distilled water for three days. Ethanol extraction of the crushed *Nauclea latifolia* stem was performed using a Soxhlet apparatus with an electro-thermal heating mantle. The extract was dried in an oven at 55°C to remove all ethanol and then stored in the refrigerator until needed. The ethanol extract was re-extracted with cold water for use in this experiment. Residues were removed through filtration with Whatman No. 1 filter paper. The concentration of the extract was determined gravimetrically by drying a known volume and weighing the resulting residue. Throughout the experiment, the extract was kept refrigerated to maintain its stability.

**Animal grouping:** The Wistar albino mice were divided into six groups of four mice each and fed different concentrations of crude oil-contaminated diet (CCD), except for group 1, as shown below.

**Group A:** Negative Control CCD+ Distilled water

**Group B:** CCD+ 0.1ml/kg body weight of Vit C

**Group C:** Low dose of CCD + 500 mg/kg body weight of ENLSB

**Group D:** Medium dose of CCD + 2000 mg/kg body weight of ENLSB

**Group E:** High dose of CCD + 5000 mg/kg body weight of ENLSB

**Group F:** Positive control (0.5 ml/ Kg bw. 0.9% saline solution)

The crude oil was mixed with the diet of the mice at varying concentrations and was given to all groups except group F for twenty-eight days. The different doses of the extracts were administered to the mice in groups C, D and E daily for twenty-eight days. Similarly, vitamin C was also administered to the mice in group C daily for twenty-eight days, while the mice in group B had no treatment. The animals were weighed, euthanized by cardiac puncture on the 28<sup>th</sup> day after an overnight fast. Thereafter, blood samples were collected, liver and kidneys were also collected for further analysis.

**Serum, liver, and kidney preparations:** Serum was prepared by using the procedure described by Yakubu *et al* (2009). Briefly, the rats were euthanized by cervical dislocation at day 28, and the blood samples were collected by cardiac puncture from the inferior vena cava of the heart into serum sample bottles. The blood samples were allowed to clot at room temperature, and serum was obtained by centrifuging at 3000 rpm for 10 min. The liver and kidneys were collected, washed, blotted, and weighed as described by Busari *et al.* (2015).

Biochemical assays Marker enzymes and metabolites of liver and kidney damage All enzymes and metabolites of liver and kidney damage were determined by using appropriate biochemical kits (Randox and Agape commercial kits) according to the methods: sodium (Yakubu *et al.*, 2003), Potassium (Tietz *et al.*, 1994) and Chloride (Schoenfeld & Lewellan, 1964), alkaline phosphatase (Rec, 1972), alanine amino transferase and aspartate amino (Reitman & Frankel, 1957), total protein (Mu & Plummer, 2001), albumin (Doumas *et al.*, 1971), urea (Kaplan *et al.*, 1965), creatinine (Tietz *et al.*, 1994), Histology of the liver and kidney was performed using methods described by Busari *et al.* (2021).

**Data analysis:** The data were represented as Mean,  $\pm$ Standard error of mean of four replicates, which were analyzed using analysis of variance (ANOVA) and a Post hoc Duncan multiple comparisons test on SPSS version 22. p-value < 0.05 was considered significant.

## RESULTS

The results obtained are presented in tables. Table 1 shows the result of the acute oral toxicity study ( $LD_{50}$ ) of the stem extract of *N. latifolia* in albino mice. The mice had no behavioral changes, and no death was recorded in all treated groups (from group 1- group 3) after 48 hours of administration.

**Table 1: Acute toxicity of ethanolic stem extract of *Nauclea latifolia* in albino mice**

Groups	Dosage(mg/kg Body weight)	Survival ratio
1	500	0/4
2	2000	0/4
3	5000	0/4

Table 2 shows the effect of the various doses of the ethanolic extract of *N. latifolia* stem bark on the weight of mice fed with a crude oil-contaminated diet. The mice in the positive control group had the highest percentage weight gain (28 %) after the period of the experiment, while the negative control mice had the highest percentage weight loss (-15.84 %) after the experiment. The group administered with 5000 mg/kg of the extract had the highest percentage weight gain (14.5 %) amongst the treatment group, which compared favorably with the group treated with the standard drug (12.38 %). The group with the lowest dosage of the extract, 200 mg/kg, showed a percentage weight loss of (-7.99 %) while the group administered with 2000 mg/kg of the extract had a minimal percentage weight gain of 2.34%.

The lipid profile markers of the animals in the various groups were presented in Table 3. The administration of the extracts resulted in a significant decrease ( $P < .05$ ) in serum cholesterol and LDL when compared with the negative control group and the group treated with the reference drug. However, serum VLDL showed no significant difference ( $P > .05$ ) amongst all groups. The administration of 2000 and 5000 mg/kg of the extract significantly ( $P < .05$ ) altered serum triglyceride when compared with the negative control and the group treated with the reference drug, and compared favorably with the positive control group. However, the administration of 500 mg/kg of the extract significantly ( $P < .05$ ) alters serum triglyceride when compared to the negative and positive groups and compared favorably with the group administered the reference drug.

**Table 2: Effect of ethanolic extract of *N. latifolia* stem bark on the weight of mice fed with crude oil contaminated diet**

Groups	Weight before treatment	Weight at sacrifice	Weight difference	% Weight gain/loss
A	28.35 ± 1.70	23.86 ± 1.62	-4.49 ± -0.08	-15.84
B	20.20 ± 1.33	22.70 ± 1.77	2.5 ± 0.44	12.38
C	25.53 ± 1.95	23.49 ± 0.35	-2.04 ± -1.8	-7.99
D	25.63 ± 0.82	26.23 ± 1.06	0.60 ± 0.24	2.34
E	27.09 ± 1.49	31.02 ± 2.20	3.93 ± 0.71	14.5
F	25.00 ± 1.78	32.00 ± 2.50	7.00 ± 0.72	28

Values represent the Mean ± SD; Weight in (g)

**Table 3: Effect of ethanolic extract of *N. latifolia* stem bark on lipid profile of mice fed with crude oil contaminated diet**

Groups	HDL	Trig	Chol	LDL	VLDL
A	0.15 ± 0.03 <sup>b</sup>	1.07 ± 0.13 <sup>bc</sup>	4.88 ± 0.86 <sup>c</sup>	4.24 ± 0.83 <sup>c</sup>	0.20 ± 0.00 <sup>a</sup>
B	0.20 ± 0.01 <sup>b</sup>	1.69 ± 0.14 <sup>d</sup>	4.59 ± 0.49 <sup>c</sup>	3.64 ± 0.38 <sup>c</sup>	0.19 ± 0.06 <sup>a</sup>
C	0.18 ± 0.01 <sup>bc</sup>	1.40 ± 0.05 <sup>cd</sup>	2.40 ± 3.15 <sup>b</sup>	1.58 ± 3.12 <sup>b</sup>	0.31 ± 0.05 <sup>a</sup>
D	0.06 ± 0.01 <sup>a</sup>	0.68 ± 0.13 <sup>a</sup>	0.71 ± 0.06 <sup>a</sup>	0.34 ± 0.02 <sup>a</sup>	0.18 ± 0.10 <sup>a</sup>
E	0.49 ± 0.02 <sup>d</sup>	0.77 ± 0.12 <sup>ab</sup>	2.45 ± 1.50 <sup>b</sup>	1.61 ± 1.46 <sup>b</sup>	0.15 ± 0.02 <sup>a</sup>
F	0.50 ± 0.02 <sup>d</sup>	0.80 ± 0.15 <sup>ab</sup>	2.50 ± 1.55 <sup>b</sup>	1.65 ± 1.50 <sup>b</sup>	0.18 ± 0.04 <sup>a</sup>

Values represent the Mean ± SD. Values with the same alphabet in each column are not statistically significantly different ( $P > .05$ ) from control for each of the parameters in the table. Whereas values with the different alphabet are statistically significantly different ( $P < .05$ ) from the control group in each column for each parameter.

Serum HDL was significantly reduced ( $P < .05$ ) upon the administration of 2000 mg/kg of the extract compared to the negative, positive groups, and the groups treated with the reference drug. However, the administration of 5000 mg/kg of the extract significantly increased ( $P < .05$ ) serum HDL when compared to the negative control group and the reference drug, but compared favorably with the positive control group. The administration of 500 mg/kg of the extract significantly ( $P < 0.05$ ) altered serum HDL compared to the positive control group.

**Table 4: Effect of ethanolic extract of *N. latifolia* stem bark on selected liver enzymes of mice fed with crude oil contaminated diet**

Groups	ALT (U/L)	AST (U/L)	ALP (U/L)
A	82.47 (± 13.15 <sup>a</sup> )	126.77 (± 4.68 <sup>d</sup> )	14.14 (± 1.95 <sup>b</sup> )
B	95.57 (± 1.40 <sup>b</sup> )	117.87 (± 9.40 <sup>c</sup> )	10.46 (± 0.83 <sup>a</sup> )
C	92.37 (± 2.19 <sup>b</sup> )	105.95 (± 2.65 <sup>b</sup> )	9.20 (± 1.59 <sup>a</sup> )
D	92.45 (± 3.67 <sup>b</sup> )	120.30 (± 4.62 <sup>c</sup> )	11.96 (± 4.22 <sup>a</sup> )
E	99.15 (± 1.15 <sup>c</sup> )	122.27 (± 10.20 <sup>c</sup> )	14.72 (± 3.19 <sup>b</sup> )
F	81.3 (± 5.15 <sup>a</sup> )	60.27 (± 1.33 <sup>a</sup> )	10.72 (± 3.19 <sup>a</sup> )

Values represent the Mean ± SD. Values with the same alphabet in each column are not statistically significantly different ( $P > .05$ ) from control for each of the parameters in the table. Whereas values with the different alphabet are statistically significantly different ( $P < .05$ ) from the control group in each column for each parameter.

Table 4 revealed the impact of the extracts on serum ALT, AST, and ALP. Administration of 500, 2000, and 5000 mg/kg of the extract did not significantly alter serum ALT compared to the positive control and reference drug. However, the three doses significantly increased serum ALT compared to the negative control group. Furthermore, the administration of both 2000 and 5000 mg/kg of the extract did not significantly alter serum AST compared to the negative, positive controls, and the reference drug, while the administration of 500 mg/kg of the extract significantly reduced serum AST activities. 5000 mg/kg of the extracts significantly increased serum ALP compared to the positive control and reference drug while administration of 500 and 2000 mg/kg of the extract did not significantly alter serum ALP when compared to the positive control and reference drug. The administration of the extract did not significantly alter serum creatinine level. However, the administration of 2000 mg/kg significantly reduced serum urea level compared to the negative control group Table 5.

## DISCUSSION

Toxicity of chemicals and medicinal plants are frequently studied with animal models because of their usefulness in early identification of undesirable effect (Nurul et al., 2018). It is also well established that mortality is used to determine the acute toxicity of plants extracts and other chemicals. In addition to mortality, behavioural changes, changes in organs and

**Table 5: Effect of ethanolic extract of *N. latifolia* stem bark on selected renal markers of mice fed with crude oil contaminated diet**

Group	Creatinine (mmol/L)	Urea (mmol/L)
A	1.95 ± 0.00 <sup>a</sup>	9.48 ± 1.34 <sup>b</sup>
B	1.96 ± 0.03 <sup>a</sup>	8.04 ± 0.18 <sup>a</sup>
C	2.37 ± 0.29 <sup>a</sup>	8.70 ± 0.68 <sup>b</sup>
D	2.41 ± 0.25 <sup>a</sup>	6.68 ± 0.49 <sup>a</sup>
E	2.16 ± 0.19 <sup>a</sup>	8.71 ± 0.37 <sup>b</sup>
F	4.00 ± 4.50 <sup>b</sup>	10.30 ± 0.41 <sup>c</sup>

Values represent the Mean ± SD. Values with the same alphabet in each column are not statistically significantly different ( $P > .05$ ) from control for each of the parameters in the table. Whereas values with the different alphabet are statistically significantly different ( $P < .05$ ) from the control group in each column for each parameter.

body weight are also essential when investigating toxicity using animal models. At the acute toxicity phase, the results revealed no behavioral changes, and no death recorded in all treated group (from group 1 – group 3) after 48 hours of administration with ethanol extract of *Nauclea latifolia*. This, therefore, indicates that the ethanol stem extract of *Nauclea latifolia* may not be toxic at doses not greater than 5000mg/kg (Asare et al., 2012).

Low density lipoprotein cholesterol is often designated as “bad” cholesterol since high levels of it in the plasma are linked with increased deposition of cholesterol in the arterial walls while HDL serve as acceptors of cholesterol from various tissues. They promote the removal of cholesterol from cells and its secretion into the bile by the liver (Trajkovska & Topuzovska, 2017). The best single indicator of the likelihood of developing atherosclerotic heart disease is not total plasma cholesterol but rather the ratio of plasma LDL cholesterol to plasma HDL cholesterol. The reduction in serum total cholesterol and LDL concentration following the repeated and prolonged administration of the extract agrees with the report of Aprioku and Obianime (2009). This will normally suggest a beneficial effect in pathological conditions. The observe decreased in triglyceride following administration of the extract could be due to increase in lipolysis caused by the extract. A decrease in triglyceride that is accompanied by a decrease in LDL is associated with a decreased risk in cardiovascular events. Low density lipoprotein transport cholesterol from its site of synthesis in the liver to the various to the various tissues and body cells where it is separated and used by the cells. HDLs on the other hand, transport excess or unused cholesterol from the tissues back to the liver, where it is broken down to bile acids and then excreted.

This makes HDL beneficial to health. The significant reduction in HDL concentration, therefore, may negatively impact the function of the liver.

Liver function parameters used to detect the presence of liver disease or potential harm to the liver include the serum levels of the enzymes AST, ALT, and Alanine phosphatase. Usually, any kind of liver injury can cause a rise in ALT (Shivary et al., 2009) and the release of ALT and AST from the cytosol occurs when there is injury to hepatocytes, especially in membrane damage (Chikwendu et al., 2015). The significant decrease in liver alkaline phosphatase activity of the groups treated with 500 and 2000 mg/kg of the extract is suggestive of possible damage to the tissue cell plasma membrane. This may imply loss of the enzyme to extracellular fluids or the inactivation of the enzyme *in situ* by the components of the extract and their metabolites.

Alanine aminotransferase (ALT) activities in the blood are increased in conditions in which cells are damaged or dead. Elevation of alanine aminotransferase and aspartate aminotransferase (ALT and AST) activities in the liver homogenate following twenty-eight days of administration may indicate derangement of hepatic cytosolic content and interference with kidney amino acid metabolism. The elevation in AST and ALT in liver tissues or liver homogenate at the high doses of 2000 and 5000 mg/kg of the extract could imply some forms of inflammation of liver. Possibly, the doses of the extracts administered or the duration of administration are toxic to hepatic cells. Our findings corresponded with the reports of Ogenyi et al. (2015), who reported the increase in serum AST and ALT of rabbits exposed to ethanolic extracts of *N. latifolia*. However, our findings negate the report of Arise et al. (2012), who reported a decrease in serum AST and ALT of rats after the administration of aqueous extract of *N. latifolia* stem. Therefore, the ethanolic extracts of *N. latifolia* stem may not be beneficial in protecting the liver from crude oil contamination-induced liver anomaly.

The kidney plays a very important role in the removal of metabolic wastes from the bloodstream. Its functionality, therefore, can be assessed among many others by determining the serum concentration of excretory constituents (Spencer et al., 2011). The extracts at the doses administered showed a slight increase in the creatinine level measured, although not significant. The increased levels of blood urea in the crude oil contaminated diet group imply the inability of the kidneys to excrete this by-product, leading to their elevated levels in the blood and decreased excretion in urine (Akinrinde et al., 2020). The decrease in the urea concentration after the administration of 2000 mg/kg

of the extract resonates with the report of Busari et al. (2021), who revealed the decrease in serum urea by *N. latifolia* extracts after lead acetate-induced increase. This could be indicative of a protective effect on some kidney functions.

## CONCLUSION

In conclusion, this study indicates that the ethanol stem extract of *Nauclea latifolia* may be useful in ameliorating crude oil contamination-induced lipid profile anomaly and renal function. However, the extracts showed some toxicity to the liver, which could be due to the high dosages or the length of administration.

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## PREVALENCE AND DETERMINANTS OF DEPRESSION AMONG NIGERIAN FOREIGN TRANSFER MEDICAL STUDENTS IN BAYERO UNIVERSITY KANO.

*Fatima Zahrau Abdulrahman<sup>1</sup> and Hadiza Musa Abdullahi<sup>1\*</sup>*

### **ABSTRACT**

*Background: Depression is a significant mental health concern among medical students, particularly those affected by displacement due to conflict. This study assesses the prevalence and determinants of depression among Nigerian foreign transfer medical students repatriated from Sudan to Bayero University Kano (BUK).*

*Methods: A cross-sectional study was conducted among 146 foreign transfer medical students at BUK. Data were collected using a structured questionnaire incorporating the Patient Health Questionnaire-9 (PHQ-9) for depression screening. Descriptive and inferential statistical analyses were conducted using SPSS version 22.0.*

*Results: The prevalence of depression among respondents was 40.4% (mild), 26.0% (moderate), and 4.1% (moderately severe). Academic stress (45.2%), uncertainty about future career/education (33.6%), and social isolation (50.7%) were major determinants. Female students exhibited higher depression rates than males. Despite high knowledge levels about depression, limited mental health support, and financial stress worsened symptoms.*

*Conclusion: There is a high prevalence of depression among repatriated medical students, driven by academic stress, financial constraints, and displacement trauma. Targeted mental health interventions, counselling services, and financial support are crucial to improving their well-being.*

**Keywords:** *Depression, Medical Students, Foreign Transfer, Sudan, Conflict, Mental Health.*

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## INTRODUCTION

Conflicts and civil wars all over the world have disrupted human lives and have led to the deaths of millions of people. According to a study released in June, 2023, by the Institute for Economics and Peace, almost a quarter of a million people died in conflicts around the world in 2022 (Global Citizen, 2022). The UN refugee agency stated that more than 114 million people worldwide have been forced to flee their homes by the end of September 2023, due to conflict, persecution, and human rights violations (United Nations, 2023). As well as displacing people by the millions. Conflicts disrupt access to basic services like food and water, and force people into extreme poverty, with profound and enduring consequences that reverse progress towards achieving the UN Global Goals (Global Citizen, 2022).

The outbreak of conflicts and political instability in Sudan disrupted the educational pursuits of Nigerian students studying in the country. Students faced heightened security risks, logistical challenges, and uncertainties about their future. As a result, many Nigerian medical students who were studying in Sudan found themselves compelled to return to their home country, hoping to continue their education in Nigerian universities. Nigerians in Diaspora Commission said the total number of evacuated Nigerians from Sudan was 2,246 (The Cable, 2023).

Bayero University Kano (BUK) absorbed some of these repatriated Nigerian medical students seeking to resume their academic endeavours in a familiar environment. However, the transition from studying in Sudan to re-joining the academic community at BUK presents its own set of challenges, including academic readjustment, social integration, and psychological adaptation. Globally, mental health among undergraduate students represents an important public health entity. University students face considerable demands in school and family, resulting in significant psychological stress that may lead to serious disorders and mental health issues such as depression and anxiety (Mirza *et al.*, 2021).

Depression is a common mental disorder characterized by a sad mood, reduction in energy levels and activity (anergia), loss of interest in pleasurable activities (anhedonia), sleep disturbances, and pessimism, amongst others. Approximately 280 million people in the world have depression (Mirza *et al.*, 2021; WHO, 2024; Chikezie & Okoro, 2021).

Many factors are associated with depression worldwide, including stress. Stress contributes to a higher prevalence of depression among medical students than in the general population. Other factors demonstrated to be associated with depression include the presence of chronic medical conditions, alcohol

consumption, level of study, and smoking (Onyemaechi, 2024). The impact of armed conflicts on mental health is of significant global concern. These issues are particularly relevant in the context of the ongoing armed conflict in Sudan, where both direct and indirect effects of conflict can have severe and long-lasting impacts on mental health and sexual violence (Ngasa *et al.*, 2020). The direct impacts of armed conflict on mental health are extensive and can include post-traumatic stress disorder (PTSD), depression, and anxiety (Aderinto & Olatunji, 2023).

The estimated frequency of depression or its manifestations in medical students around the world was 27.2%, according to a recent systematic review and meta-analysis. In medical students, previous systematic reviews have shown that the prevalence of depression ranged between 6-66.5% in North America, while a more global systematic review and meta-analysis study reported a prevalence of 27.2% (Mirza *et al.*, 2021). In Africa, there is still a paucity of data on depression among medical students, and worse, no systematic reviews have been done to collate evidence from different studies done in Africa (United Nations, 2023). A study among medical students in South Africa showed that nearly one in four students reported depression/anxiety diagnoses and were on psychotropic medication, significantly more than age-based expectations (Suraj *et al.*, 2021). Among medical students in Cameroon, a study showed that about one out of every three medical students is depressed, with a considerable number being moderately to severely depressed (Van der *et al.*, 2020). In a study conducted among medical students in Bayero University Kano, the prevalence of depression among the participants was found to be 15.1%, with females more likely to be depressed than males (Mirza *et al.*, 2021). After the transfer of these students to Bayero University, there had been no mental status evaluation, psychotherapy, or counseling sessions for them. Therefore, this study aimed to address the significant gap in the literature concerning the mental health of Nigerian foreign transfer medical students from regions affected by the Sudan Civil War. By investigating the prevalence and determinants of depression and anxiety within this population, this study aimed to generate evidence that can inform targeted interventions and support services aimed at promoting mental well-being and academic success among the foreign transfer medical students.

## MATERIALS AND METHODS

**Study Design and Sampling:** A cross-sectional descriptive study was conducted at Bayero University Kano, Nigeria, among foreign transfer medical students. The university admitted 200 students

repatriated from Sudan due to the civil war. The sample size was estimated using Fisher's formula (Ngasa *et al.*, 2017), the prevalence of depression from a previous study (33.7%) (Lwanga & Lemeshow, 1991), a 95% confidence level, and a 5% error margin. The calculated minimum sample size, 132, was increased by 10% to address non-response and rounded up to 146. A stratified random sampling method was used. Participants included foreign transfer medical students who consented to participate. Exclusion criteria included students unwilling to participate and those with severe illnesses.

**Data Collection:** Data was collected using an interviewer-administered semi-structured questionnaire. This questionnaire was designed based on the Patient Health Questionnaire-9 (PHQ-9), a widely validated tool for assessing depression. This was modified to suit the objectives of the current study. It incorporated Socio-demographics, the PHQ-9 scale for depression assessment, and Factors influencing depression (academic stress, financial status, social support).

The PHQ-9 is a validated tool for screening, diagnosing, monitoring, and measuring the severity of depression. It consists of 9 items, each corresponding to one of the DSM-IV criteria for major depressive disorder. Respondents are asked to rate the frequency of each symptom over the past two weeks on a scale from 0 (not at all) to 3 (nearly every day). The total score ranges from 0 to 27, with higher scores indicating greater severity of depression: 0-4: Minimal or none, 5-9 Mild, 10-14 Moderate, 15-19: Moderately severe, 20-27: Severe.

**Data Analysis:** Data were analysed using SPSS version 22.0. Descriptive statistics summarized categorical variables, while Chi-square and logistic regression identified associations between depression and independent variables. A p-value <0.05 was considered statistically significant.

**Ethical Considerations:** The Bayero University Kano Research Ethics Committee gave ethical approval. All participants gave informed consent.

## RESULTS

**Socio-Demographic Characteristics of Respondents:** The mean age of respondents was  $22.90 \pm 2.37$  years. Most were female (81.5%), Hausa (68.5%), and all were Muslim. Additionally, 94.5% were single, and 44.5% lived on campus, while 39.7% stayed with parents or relatives.

**Table 1: Sociodemographic characteristics of respondents**

Variable	f(n=146)	%
<b>Age Groups</b>		
16-20	18	12.4%
21-24	93	64.1%
25-30	31	21.4%
>30	3	2.1%
<b>Sex</b>		
Male	27	18.5%
Female	119	81.5%
<b>Tribe</b>		
Hausa	100	68.5%
Fulani	46	31.5%
<b>Religion</b>		
Islam	146	100.0%
<b>Marital Status</b>		
Married	8	5.5%
Single	138	94.5%
<b>Place of Residence</b>		
On Campus	65	44.5%
Off-Campus	23	15.8%
With Parents/ Relatives	58	39.7%

**Table 2: Prevalence of depression among respondents**

Depression Severity	PHQ-9 Score Range	f (n=146)	%
Minimal Depression	0-4	43	29.5%
Mild Depression	5-9	59	40.4%
Moderate Depression	10-14	38	26.0%
Moderately Severe Depression	15-19	6	4.1%
Severe Depression	20-27	0	0.0%

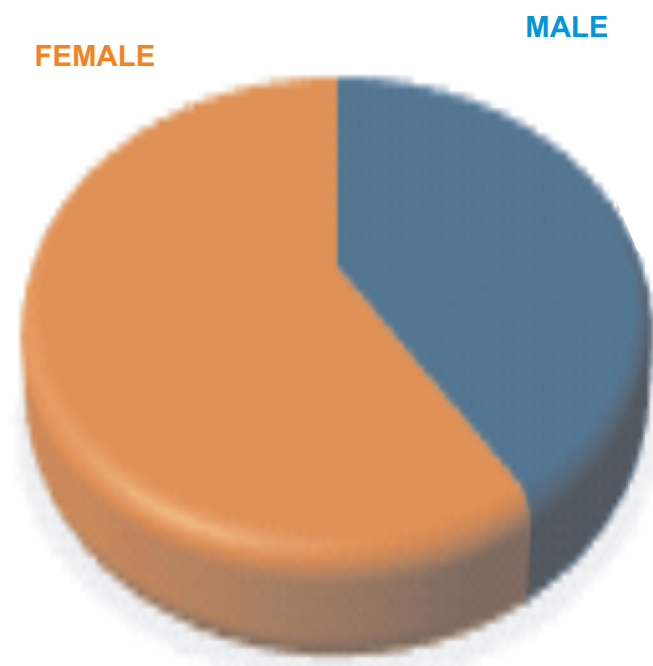
Tables 3a and 3b show that nearly half of the respondents (40.4%) experienced mild depression, followed by minimal depression (29.5%) and moderate depression (26.0%). Only 4.1% had moderately severe depression, and no respondents were classified as having severe depression.

**Table 3a: Determinants of Depression**

Factor Type	Factor	Yes (%)	No (%)
<b>Academic Factors</b>	Disruption in studies increased academic stress	80 (55)	66 (45)
	Adjustment to the new academic environment has been stressful	90 (61.6)	56 (38.4)
	Limited academic support in Nigeria has affected studies	70 (48)	76 (52)
<b>Social and Cultural Factors</b>	Separation from friends/support networks affected emotional well-being	85 (58.2)	61 (41.8)
	Cultural differences have made emotional adjustment difficult	75 (51.4)	71 (48.6)
	Support from local students/faculty has helped with adaptation	60 (41.1)	86 (58.9)

**Table 3b: Determinants of Depression**

Factor Type	Factor	Yes (%)	No (%)
<b>Economic Factors</b>	Financial difficulties since the transfer have increased stress	95 (65)	51 (35)
	Increased living expenses have impacted daily life and stress levels	80 (55)	66 (45)
	Lack of financial support/scholarships has impacted studies and stress levels	70 (48)	76 (52)
<b>Psychological Factors</b>	Uncertainty about future career and education caused anxiety/depression	85 (58.2)	61 (41.8)
	Conflict in Sudan reduced concentration and focus on studies	75 (51.4)	71 (48.6)
	Trauma from Sudan negatively impacted emotional resilience and coping	65 (44.5)	81 (55.5)
	Limited mental health support in Nigeria worsens stress/emotional challenges	78 (53.4)	68 (46.6)



**Figure 1: Prevalence of Mild Depression by gender**

Over half of respondents (55%) experienced increased academic stress, and two-thirds (61.6%) struggled with adjusting to a new environment. Emotional distress from separation (58.2%), cultural differences (51.4%), financial difficulties (65%), anxiety about their future (58.2%), and limited mental health support (53.4%) were also found to be very common among them.

**DISCUSSION**

The study revealed a high prevalence of depression among Nigerian foreign transfer medical students, with 70.5% exhibiting some level of depressive symptoms. This aligns with findings from similar populations in conflict-affected regions, where forced displacement and academic pressure contribute to poor mental

health (Abdulhamid *et al.*, 2024; Mohammed *et al.*, 2018). Depression prevalence in this study (40.4% mild, 26.0% moderate) is consistent with studies in Kano (Suraj *et al.*, 2021), Afghanistan (39.2%) (Mohammed *et al.*, 2018), and Sudan (33.7%) (Abdulhamid *et al.*, 2024). The prevalence of depression observed in this study aligns with research conducted in Afghanistan and Sudan, where displaced students were found to experience higher levels of mental health challenges due to the compounded stress of academic disruptions and personal trauma (Mohammed *et al.*, 2018; Murthy and Lakshminarayana, 2006). Medical students, particularly those displaced by conflict, are at a higher risk of mental health disorders, as the uncertainty of their academic and personal future, coupled with the trauma of displacement, often leads to psychological distress. In this study, the high levels of depression highlight the urgent need for targeted mental health interventions aimed at displaced medical students.

The study identified several key factors contributing to the high levels of depression observed among respondents, including academic stress, financial difficulties, and social isolation. Academic stress was also a significant determinant, similar to findings among South African and Nigerian medical students. Additionally, 33.6% of respondents cited uncertainty about their future careers and education as a significant source of anxiety and depression. This finding mirrors results from studies conducted among displaced students in conflict-affected regions, where the disruption of academic and career plans due to conflict exacerbates mental health challenges (Lim *et al.*, 2022). Social isolation was also a major factor, with more than half of the respondents (50.7%) reporting feelings of sadness due to separation from their support networks. This is in line with studies conducted in Nigeria and South Africa, where students who lack strong social support systems are more vulnerable to mental health issues (Van der *et al.*, 2020; Ngasa *et al.*, 2017). For displaced students, the loss of these support networks due to forced relocation further compounds the emotional strain, leading to increased levels of depression.

However, 24.7% of respondents reported that their experiences in Sudan had strengthened their coping mechanisms, highlighting the duality of trauma and resilience. While some individuals develop greater emotional resilience in response to adversity, others experience prolonged psychological distress. This dual response to trauma has been well-documented in psychological studies, where resilience is seen as a dynamic process influenced by individual, social, and environmental factors (Mohammed *et al.*, 2018). This study also underscored the importance of mental health support systems in addressing depression among

displaced medical students. While 37.0% of respondents felt supported by local students and faculty, 14.4% reported increased stress due to a lack of sufficient support. This finding is consistent with studies conducted in Germany and the United States, where the availability of mental health services has been shown to significantly mitigate the effects of depression among medical students (Voltmer *et al.*, 2012). In the context of displaced students, who may face unique challenges such as trauma from conflict and disrupted academic careers, access to mental health services is crucial for their well-being.

This descriptive study is among the first to assess the prevalence and determinants of depression among foreign transferred medical students in Northern Nigeria. It highlights the significant burden of depression among repatriated Nigerian foreign transferred medical students, primarily due to academic stress, financial difficulties, and social isolation. Improving availability and access to mental health support remains the key to combating these findings.

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**PREVALENCE AND PATTERN OF NECK PAIN AMONG UNIVERSITY STUDENTS MOBILE PHONE USERS IN MAIDUGURI, NORTH-EASTERN NIGERIA**  
*Salamatu Umar Aliyu\*<sup>1</sup>, Abdullahi Musa<sup>1</sup>, Ahmad Muhammad Yazo<sup>1</sup>, Umar Abba Tar<sup>1</sup>*

**ABSTRACT**

Neck pain is a common musculoskeletal disorder that affects a significant portion of the population, and it has been suggested that mobile phone use may be a contributing factor. In Nigeria, even though university students use mobile phones more frequently, little is known about the association between this population's use of mobile phones neck pain. This study aimed to determine the prevalence and pattern of neck pain and its associations among university students and mobile phone users of the Faculty of Allied Health Sciences, University of Maiduguri, Borno State, Nigeria.

It is a cross-sectional study, conducted using a multistage sampling technique to select a total of 266 male and female clinical students. The Nordic questionnaire was used to determine the prevalence and pattern of neck pain. Descriptive statistics of frequency and percentages were used to summarize the Sociodemographic characteristics, prevalence, and pattern of neck pain among university student mobile users. Inferential chi-square statistics were used to determine the significant association between the prevalence of neck pain and Sociodemographic characteristics of the participants. Chi-square was used to determine the statistically significant association between neck pain and the pattern of mobile phone use.

Results: High neck pain prevalence (69.2%) was found among the university student mobile phone users. There was a significant association between neck pain and study departments ( $p < 0.05$ ). No significant association was found between the prevalence of neck pain and age, gender, and academic level ( $p > 0.05$ ), respectively. The majority of the students, 112(60.9%), use their phone for 5-10 hours daily, and sitting position, 90(48.9%), was the most adopted posture when using the phone. The majority used their phone for studying, 124(67.4%), and only 21(11.4%) used

their phones for gaming. A higher number, 119(64.7%), uses both hands while using their phones. There was a significant association ( $p < 0.05$ ) between neck pain and patterns of mobile phone usage.

Conclusion: The study showed a high prevalence of neck pain among clinical student mobile phone users. It is recommended that healthy mobile phone usage practices, such as taking regular breaks and using a mobile phone holder or stand to reduce neck flexion angle, should be encouraged.

**Keywords:** Mobile Users, Neck pain, Prevalence, Pattern, Students, University

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## INTRODUCTION

Neck pain is the second most prevalent musculoskeletal condition, after low back pain (Storheim & Zwart, 2014). Despite being little understood, it has a major impact on physical functioning, work productivity, and health-care expenses (Son *et al.*, 2013). Neck pain is a pain with or without referral in the upper limb or limbs that lasts for at least one day (Wu *et al.*, 2024). Neck pain is a complex condition, which means that various factors contribute to its onset and persistence. These include physical, psychosocial, and individual-related factors (Guzman *et al.*, 2009).

Neck pain can be classified as acute, sub-acute, and chronic Neck pain. Treatment protocols for acute and sub-acute neck pain are standard and widely agreed upon (Ishaq *et al.*, 2023). However, conventional treatments for chronic neck pain remain debatable and include interventions such as the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and narcotics for pain management, manual therapy, strengthening exercises, education, dry needling, or laser therapy (De Oliveira-Souza *et al.*, 2025). Furthermore, the literature on long-term treatment outcomes has been inconclusive at best. Although symptoms of neck pain resolve in the acute phase, most cases do not resolve (Hush *et al.*, 2011; Carroll *et al.*, 2008). Also, more than one-third of patients with neck pain will develop long-lasting symptoms within 6 months (Ogwumike *et al.*, 2015). Exacerbations, as well as a high incidence of recurrence and persistence, are characteristics of neck pain (Ogwumike *et al.*, 2015).

Globally, the overall prevalence of neck pain in the general population ranges between 0.4% and 86.8%, while point prevalence ranges between 0.4% to 41.5%, and 12-month prevalence ranges from 4.8% to 79.5% (Hoy *et al.*, 2010). In 2021, the global age-standardized rates for incidence and YLDs of neck pain per 100,000 populations were 519 (95% uncertainty interval, 408-633) and 242 (163-343) per 100,000 populations, respectively (Wu *et al.*, 2025). Females also had a higher age-standardised prevalence rate (2890 [2330–3620] per 100000) than males (2000 [1600–2480] per 100000). It has been projected that by 2050, the prevalence of neck pain is expected to rise, with a larger effect expected in low-income and middle-income countries, and a rapidly ageing global population. Neck pain continues to pose a challenge in terms of disability burden worldwide. Differences in study population and genetic dispositions of participants accounted for these wide ranges in neck pain prevalence.

Studies in Northern Nigeria on the prevalence of neck pain are generally limited. In a study by Ogwumike *et al.* (2015), North-West Nigeria reported the lifetime

prevalence, 12-month, and point prevalence of neck pain among rural community dwellers as 67.9%, 65.9%, and 17.0%, respectively. Additionally, a high 12-month and point prevalence among truck drivers with neck pain in Maiduguri, North-Eastern Nigeria, were reported as 67.3% and 42% respectively in a study by Shittu *et al.* (2022).

Despite the high global and local prevalence of neck pain, its causes, associated risk factors have not been properly identified among the populace. Causes are largely multifactorial, resulting from sleep disorders, repetitive movements, lack of exercise, inflammatory and degenerative changes of the spinal discs, joints, ligaments, and nerves, sport-related events, work-related events, and poor posture (Wu *et al.*, 2024) while performing daily living activities. Daily life activities, such as prolonged use, can cause postural issues, leading to common neck pain. Long-term static positions, such as working on digital platforms and mobile phones in daily lives for extended periods, may cause neck muscle overload (Elvan *et al.*, 2024).

Mobile phones are the most popular portable electronic device nowadays, with recent estimates showing that at least 77% of the world's population has their mobile phone (Schabrun *et al.*, 2014). The main reason mobile phone use is emerging and becoming increasingly popular worldwide is that it is a reliable device for communication and entertainment (Kim, 2015). Mobile phones are also used as an adjunct to teaching and learning activities in academic institutions, and the use and development of mobile applications are rising (Kalra & Singh, 2017). According to Borelo *et al.* (2011), texting, emailing, scheduling appointments, and browsing the internet on smartphones consume approximately three and a half hours of university students' time per day. As a result of the increased usage of their mobile phones, for more than three hours per day university students commonly report pain in the neck, shoulders and at the base of the thumb, which can be attributed to the postures assumed by the students during mobile phone usage i.e. biomechanical factors (Cheung *et al.*, 2021; Gao *et al.*, 2023). Long-term usage of mobile phones can lead to the development of fixed head and neck positions, placing increased pressure on the neck muscles and spine (Elvan *et al.*, 2024).

Consequently, mobile phone addiction and usage are linked to musculoskeletal disorders, particularly in the neck and upper limbs. Heavy mobile phone use might produce considerable stress on the cervical spine, thus changing the cervical curve (Park *et al.* 2015). It increases pressure on the discs and ligaments between the cervical vertebrae, causing a forward head position that causes a flexion posture in

the cervical and thoracic regions, leading to muscle imbalance, which develops neck pain over time (Elvan *et al.*, 2024).

The user extends the neck to gaze down at the smartphone screen, leading to excessive lordosis in the lower cervical area and compensatory kyphosis in the upper thoracic region. This faulty posture is known as the "forward head", "turtle neck", or "text neck" posture, and it can cause inefficiency and fatigue by abnormally loading the articular structures of the cervical spine and neck extensor muscles due to excessive gravitational moment (Derakhshanrad *et al.*, 2021 and Damasceno *et al.*, 2018). These Static activities of neck flexion posture, which is the most common posture mobile phone users adopt when looking at their mobile phone visual display terminals for extended periods, potentially provide risk for neck pain (Zirek *et al.*, 2020).

Mobile phone users commonly maintain head flexion of 33°-45° from vertical when using a mobile phone (Lee *et al.*, 2015). A study by Ning *et al.* (2015) among university students also demonstrated that mobile phone users maintained significantly more neck flexion when operating a smartphone (44.7°). The weight on the spine dramatically increases when flexing the head forward at varying degrees; an adult head weighs 10 to 12 pounds in the neutral position. As the head tilts forward, the forces on the neck surge to 27 pounds at 15°, 40 pounds at 30°, 49 pounds at 45°, and 60 pounds at 60° (Hansraj, 2014). The visual display terminal, which has a small screen, requires users to bend their necks more, thereby also increasing the activity of the shoulder muscles (Straker *et al.*, 2008).

Even though the use of electronic device is on the rise and is associated with neck pain symptoms, studies reported that there is limited evidence regarding electronic device use, and various aspects of its use (i.e. amount of usage, features, tasks, and positions), and associated neck pain symptoms and exposures (Toh *et al.*, 2017). Moreover, our extensive search showed that there are scarce published regional reports about the prevalence of neck pain associated with neck pain in the sub-Saharan region, with limited or scarce primary data in Nigeria particularly, on the prevalence of neck pain among university students and mobile phone users.

In Nigeria, little is known about university students' usage of mobile phones and neck pain. Additionally, no study has been conducted on the prevalence and pattern of neck pain and its association with mobile phone use among university students in Maiduguri, Nigeria. Based on these gaps, we decided to assess the prevalence and pattern of neck pain and mobile phone use among university students in Maiduguri. Therefore, this study aims to investigate the prevalence and pattern of neck pain among university

students mobile phone users, Maiduguri, Nigeria.

## MATERIALS AND METHODS

**Study population:** The population of the study comprised clinical students (400 and 500 level) in the Faculty of Allied Health Sciences, University of Maiduguri.

**Inclusion Criteria:** Regular 400 and 500 level students of the Faculty of Allied Health Sciences, University of Maiduguri, who are using mobile phones for one year or above, were included in this study.

**Exclusion Criteria:** Students with a previous history of neck disease, Previous neck surgeries, Previous diagnosis of cervical disc problems, and those with a recent history of neck trauma were excluded from the study. First, second, and third-year students were also excluded from the study.

**Study Design and Sampling Technique:** The study was a cross-sectional survey, and a multi-stage sampling technique was used to recruit the participants for the study.

**Research Instrument: Standardized Nordic Questionnaire:** A modified Standardized Nordic Questionnaire (Kuorinka *et al.*, 1987) was used to determine the presence of neck pain among students in the past 12 months and seven days. The questionnaire contains a diagram that shows the approximate position of the body part referred to as neck.

This questionnaire contains four parts: Part I of the questionnaire elicited sociodemographic information of gender, age, academic level, and study department. Part II: Elicited information on characteristics related to mobile phone usage, which contains ten questions. Part III: Elicited information on postural pattern (characteristics) (Sitting, standing, lying on chest) while using a mobile phone, and it contains three questions. Part IV: Elicited information on characteristics related to pain, which consists of one question and a diagram of the body part referred to as neck). The questionnaire asked participants to indicate if they have experienced neck pain during the past 12 months. If they answer "yes" they were given a score of 1. If they answer "no", they were given a score of 0.

**Reliability and validity of the questionnaire:** The reliability of the Nordic Musculoskeletal Questionnaire, using test-retest methodology, found that the number of different answers ranged from 0 to 23%. Validity tested against clinical history and the Nordic Musculoskeletal Questionnaire found a range of 0 to 20% disagreement (Kuorinka *et al.*, 1987). Comparing pain in the last 7 days and clinical examination found sensitivity ranged between 71% and 88%.

**Study procedure:** An ethical approval for the study was sought and obtained from the Research and Ethics Committee of the College of Medical Sciences, University of Maiduguri. Informed consent was obtained from all participants who met the inclusion criteria. The content of the questionnaire and the procedure of the study were explained to the participants. Then, the questionnaires were distributed by the researcher to the respondents and were completed and returned. The study was carried out between the period of January 2024 to July 2024.

#### Data Analysis

1. Descriptive statistics of frequency and percentages were used to:

- Summarized the socio-demographic characteristics of the participants (gender, Age, study department, and academic level)
- Summarized the prevalence of neck pain
- Summarized the pattern (characteristics) related to mobile phone usage (Reading, Texting, social media, Watching movies) with neck pain.
- Summarized the characteristics related to posture while mobile phone.

2. The chi-square test was used to test the association between socio-demographic characteristics of the participants and neck pain (gender, age, study department, and academic level). The statistical package for social sciences SPSS version 20 was used to analyse the data. The level of significance was set at  $p < 0.05$ .

## RESULTS

### Sociodemographic characteristics of the participants

A total of two hundred and sixty-six (266) healthy students of the Faculty of Allied Health Sciences, University of Maiduguri, participated in this study. Overall, 161(60.5%) of the participants were male while 105 (39.5%) were female. Most of the participants 143 (53.8%) were within the 23 to 27-year age group. Most of the participants 72 (27.1%) were from department of medical laboratory science and a very large proportions, 187 (70.3%), were from the 500 level. The details on information on the Sociodemographic characteristics of the participants are shown in (Table 1.)

### Association between Sociodemographic characteristic of the participants and neck pain among students' mobile phone users

Based on the neck pain among students' mobile phone users. Majority of the students 184 (69.2%) reported that they experienced neck pain in the last 12 months; see Table 3. A statistically significant association was observed among the participants' departments and

**Table 2: Prevalence of neck pain among different Sociodemographic characteristics of the participants**

Variables	Yes n(%)	No n(%)
<b>Neck pain prevalence</b>	184(69.2)	82(30.8)
<b>Gender</b>		
Male	106(39.8)	55(20.7)
Female	78(29.3)	27(10.2)
<b>Age group</b>		
18-22 years	18(6.8)	10(3.8)
23-27 years	100(37.6)	43(16.2)
28-32 years	53(19.9)	25(9.4)
33-37 years	12(4.5)	3(1.1)
37 and above years	1(0.4)	1(0.4)
<b>Departments</b>		
Physiotherapy	47(17.7)	23(8.6)
Radiography	40(15.0)	28(10.55)
Medical Lab. Science	59(22.2)	13(4.8)
Nursing Science	38(14.3)	18(6.8)
<b>Academic level</b>		
400 level	59(22.2)	20(7.5)
500 level	125(46.9)	62(23.3)

*n*= population, %= percentage

neck pain in the last 12 months ( $\chi^2 = 9.104$ ,  $P < 0.028$ ).

However, there was no significant association observed between neck pain in the last 12 months and gender ( $\chi^2 = 2.127$ ,  $P > 0.05$ ), age group ( $\chi^2 = 1.576$ ,  $P > 0.05$ ) and academic level of the students ( $\chi^2 = 1.600$ ,  $P > 0.05$ ). See the details of association in table 3.

### Association of patterns of mobile phone use and postural characteristics among students with neck pain

The result found that a large proportion of students with neck pain used their mobile phone daily for reading (67.4%) and this was statistically significantly associated with neck pain ( $\chi^2 = 22.261$ ;  $p < 0.000$ ), while only 21(11.4%) students used their mobile phone for games daily. There was a statistically significant association between neck pain and using a mobile phone daily for social media ( $\chi^2 = 157.065$ ;  $p < 0.000$ ). Majority of student mobile phone users 112(60.9%) have typical usage time of 5-10 hours per day and it was significantly associated with neck pain among the students ( $\chi^2 = 80.033$ ;  $p < 0.000$ ). The result found the most common posture during use of the mobile phone to be significantly associated ( $\chi^2 = 109.869$ ;  $p < 0.000$ ) with neck pain. The result shows the proportion in sitting as 90(48.9%) followed by lying on back 71(38.6%), lying on chest 19(10.3%), and standing

**Table 3: Association between Sociodemographic characteristics of the participants and neck pain among students' mobile phone users**

Variables	Yes	No	$\chi^2$	P
<b>Gender</b>				
Male	106	55	2.127	0.145
Female	78	27		
<b>Age group</b>				
18-22	18	10	1.576	0.813
23-27	100	43		
28-32	53	25		
33-37	12	3		
37 and above	1	1		
<b>Department</b>				
Physiotherapy	47	23		
Radiography	40	28		
Med. Lab. Sc.	59	13	9.104	0.028*
Nursing Sc.	38	18		
Academic level				
400 level	59	20	1.600	0.206
500 level	125	62		

**Key: n= population, %= percentage,  $\chi^2$ =chisquare value, \*= Significant association**

4(2.2%). The result also found a significant association between neck pain and position when using mobile phone with 161(87.5%) of the students holding their phone below eye level by adopting position of neck flexion. The result significantly shows a higher proportion 119(64.7%) of the students using both hands to manipulate their phones were associated with neck pain ( $p < 0.000$ ). Significant association between neck pain and the number of social media used daily was reported ( $\chi^2 = 67.967$ ;  $p < 0.000$ ). Majority of mobile phone users 93(50.5%) used 2-3 different type of social media daily whereas 23(28.0%) of them used four or more types of social media daily. Details of the patterns of mobile phone and adopted postures are shown in table 4.

#### **Prevalence of neck pain with different Sociodemographic characteristics of the participants**

The result showed that there was a high 184(69.2%) prevalence of neck pain among clinical students who participated in this study. It was shown that 106(39.8%) of the participants within the male responded to having neck pain and 55(20.7%) responded to not having neck pain. While the female participants responded to having neck pain 78(29.3%) and 27(10.2%) of them responded to having no neck

**Table 4a: Association of Pattern of Mobile Phone Use and Postural Characteristics among Students with Neck Pain**

Variables	Neck Pain n (%)	$\chi^2$ Value	p
<b>Use for reading</b>			
Yes	124(67.4)		
No	60(32.6)	22.26	0.00
<b>Use for watching a video.</b>			
Yes	51(27.7)		
No	133(72.3)	36.54	0.00
<b>Use for gaming</b>			
Yes	21(11.4)		
No	163(88.6)	109.59	0.00
<b>Use for social media.</b>			
Yes	177(96.2)		
No	7(3.8)	157.067	0.00
<b>Total usage per day</b>			
1-5 hours	59(32.1)		
5-10 hours	112(60.9)		
>10 hours	13(7.1)	80.03	0.00

**Key: n= population, %= percentage,  $\chi^2$ =chi-square value, \*= Significant association**

**Table 1: Sociodemographic characteristics of the participants**

Variables	f	%
<b>Gender</b>		
Male	161	60.5
Female	105	39.5
<b>Age group</b>		
18-22	28	10.5
23-27	143	53.8
28-32	78	29.3
33-37	15	5.6
37 and above	2	0.8
<b>Department</b>		
Physiotherapy	70	26.3
Radiography	68	25.6
Med.. Lab. Sc.	72	27.1
Nursing Science	56	21.1
<b>Academic level</b>		
400 level	79	29.7
500 level	187	70.3

pain. The age group of 18-22 years 18(6.8%), 23-27 years 100(37.6%), 28-32 years 53(19.9%), 33-37 years 12(4.5%), and 37 and above years 1(0.38%) responded to having neck pain. While age group of 18-22 years 10(3.8%), 23-27 years 43(16.2%), 28-32 years 25(9.4%),

33-37 years 3(1.1%), and 37 and above years 1(0.38%) responded to having no neck pain. Students in the department of physiotherapy 47(17.7%), radiography 40(15.0%), medical lab. Science 59(22.2%) and the nursing science 38(14.3%) responded to having neck pain. Also, students from the department of physiotherapy 23(8.6%), radiography 28(10.5%), medical lab. Science 13(4.8%) and the nursing science 18(6.8%) responded to having no neck pain. The results found students in the 4<sup>th</sup> year of study 59(22.2%) and those in their 5<sup>th</sup> year 125(46.9%) responded to having neck pain. Likewise, students in 4<sup>th</sup> year 20(7.5%) and 5<sup>th</sup> year 62(23.3) responded to having no neck pain. Details of the prevalence of neck pain are shown in table 2.

## DISCUSSION

The study aimed to determine the prevalence and pattern of neck pain in the past 12 months among clinical students, mobile phone users of the Faculty of Allied Health Science, University of Maiduguri, Borno state, Nigeria. The results indicate that neck pain is common among them.

This study found a high prevalence, 184 (69.2%) among clinical students' mobile phone users, which is slightly higher than a similar study conducted in Ethiopia by (Ayhuallem *et al.*, 2021), who reported a moderate prevalence (47.4%) of neck pain among smart phone users in the university of Gondar, Ethiopia. It is slightly higher when compared with other studies in Taiwan (52%) (Yang *et al.*, 2017), India (46.9%) (Ahmed *et al.*, 2019), and Brazil (66.7%) (De Vitta *et al.*, 2020).

The prevalence of neck pain in this study was slightly lower than some of the similar studies carried out in other countries like China (78.9%) (Woo *et al.*, 2016), Singapore (74%) (Toh *et al.*, 2020), Saudi Arabia (72.6%) (Maayah *et al.*, 2023), and Pakistan (95.5%) (Iqbal *et al.*, 2024).

The differences in the prevalence of neck pain could stem from variations in the study participants, study areas, sample sizes, sampling techniques, inclusion criteria, and data collection methods. The disparity observed may also result from factors such as facilities available to students at their institution, exposure to electronic devices, patterns of use, daily usage hours, and other environmental factors between clinical students at the Allied Health Sciences University of Maiduguri, Nigeria, and those in the previously mentioned study areas. The rising prevalence of neck pain among mobile phone users appears to be increasing, likely linked to the shift from analogue devices to more advanced digital devices in all areas of life.

The prevalence of neck pain in this study was not statistically linked to any sociodemographic factors

**Table 4b: Association of Pattern of Mobile Phone Use and Postural Characteristics among Students with Neck Pain**

Variables	Neck Pain n (%)	$\chi^2$ - Value	<i>p</i>
<b>The frequent posture adopted during use</b>			
Sitting	90(48.9)		
Standing	4(2.2)		
Lying on back	71(38.6)		
Lying on chest	19(10.3)	109.87	0.00
<b>Position of phone</b>			
At eye level	16(8.7)		
Above eye level	7(3.8)		
Below eye level	161(87.5)	243.60	0.00
<b>Style of holding the phone</b>			
Left	15(8.2)		
Right	50(27.2)		
Both	119(64.7)	91.32	0.00
<b>Use other device</b>			
Yes	54(29.3)		
No	130(70.7)	31.39	0.00
<b>Type of device use</b>			
<b>Laptop/tablet</b>			
Yes	58(31.5)		
No	126(68.5)	25.13	0.00
<b>Desktop</b>			
Yes	7(3.8)		
No	177(96.2)	157.07	0.00
<b>Number of social media</b>			
1	9(4.9)		
2-3	93(50.5)	67.97	0.00
>4	23(28.0)		

Key: n= population, %= percentage,  $\chi^2$ =chi-square value, \*= Significant association

except for the students' academic department. The findings showed that students from the medical laboratory science department were significantly more likely to experience neck pain. This could be due to the posture they adopt during bench work, such as forward neck flexion while reviewing microscopes, in addition to their use of mobile phones.

Most of the student participants use their mobile phones for 5-10 hours daily, and this was significantly associated with the development of neck pain than other hours. This is in contrast with the study by Elvan *et al.* (2024) that reported mobile usage time of slightly more than 4 hours daily. This indicates that the present study population might have developed

unhealthy habits/behaviours of mobile phone use, and it shows that probably the usage may extend even during their academic or clinical hours, which might affect their concentration, thus their academic performance, apart from the resulting musculoskeletal effects. This effect was reported by Iqbal et al. (2024) in their study, where 38.8% agreed and 18.4% strongly agreed to having difficulty concentrating in class or during assignments during mobile phone use. The study by Elvan et al. (2024) reported a strong relationship between daily phone usage and neck pain. This finding is not surprising when compared with the high prevalence of neck pain reported in the current study, as it could be due to increased muscle, ligament, and tendons strain and stress due to the continuous prolonged abnormal posture, which is significantly associated with the neck pain observed among this subgroup of the population. Furthermore, a study by Cheung et al. (2021), shows that a merger phone usage of 10 minutes may contribute to the development of neck-related discomfort and pain, that believed to cause the changes in the biomechanical alignment of the neck and other factors. Additionally, over 6 hours per day of studying on a mobile phone is the most common factor associated with neck pain (Maayah et al., 2023).

A higher number of students (50.5%) use two to three types of social media per day in this study. This is consistent with the studies of Al-Dubai et al. (2013) and Toh et al. (2020). The similarity in results might be associated with increased hours of using different social media platforms adopted by students in recent times.

The study revealed that the majority of students use their mobile phones for reading and are more likely to develop neck pain than their counterparts. This finding is similar to a study conducted in Jeddah, Saudi Arabia, by Maayah et al. (2023), who reported that those who spent more time studying on smart devices were more likely to have a longer neck pain duration. Al-Hadidi et al. (2019), documented that engaging in active tasks with a mobile phone, such as playing games and reading, can lead to an increase in head and neck flexion angle and an increase in muscle activities in the upper trapezius, deltoid, and cervical extensor muscles.

The study also revealed sitting to be the most frequent posture adopted by the students while using their phones. This finding is consistent with the study by Iqbal et al. (2024) that reported sitting position is associated with more neck pain among their participants. This was also consistent with the study finding of Maayah et al. (2023), who reported sitting as the most common position when using a cell phone among their participants.

The study revealed majority of the students positioned their mobile phones below eye level

compared to the other levels. Though our study did not measure the angles of phone usage among the students, it was able to assess three different positions of holding mobile phones, namely holding at eye level (12%), above eye level (3.8%), and below eye level (84.2%), respectively. Namwongsa et al. (2019) reported that the higher the neck flexion angle position the higher the muscle activity. Muscle activity (cervical erector spinae) was significantly different between neck flexion at 0° to 15°, 30°, and 45° angles, respectively. Therefore, the lowest muscle activity was 0° neck flexion angle, whereas the highest muscle activity was at 45° neck flexion angle. Therefore, viewing their mobile phones below eye level might place high demand on the neck structures, which will, in turn, predispose them to muscle fatigue and imbalance.

The study revealed that students mainly use both hands while using their phones rather than using either the right or left hand. It also revealed use of both hands is significantly associated with neck pain than using either the left or right hand. This finding was not consistent with the study of Maayah et al. (2023), who reported that single-hand use was higher than using both hands among their participants. The literature documented higher levels of muscle activity in cervical erector spinae and upper trapezius while performing smartphone bilateral texting, smartphone unilateral texting, and computer typing tasks among young people with neck-shoulder pain when compared with healthy subjects (Xie et al., 2017).

These study findings have clinical implications in that they reveal factors such as demographics and patterns of mobile phone usage associated with neck pain among university students. The findings suggest that students use mobile phones for such long durations, adopting various neck flexion positions, which in turn can bring about neck disorders. The study recommends awareness lectures/seminars to promote healthy mobile phone usage practices, such as taking regular breaks and using mobile holders or stands to reduce neck flexion angle among students. The study also recommends awareness of the importance of posture and ergonomics, especially when using a mobile phone for an extended period. It also recommended the implementation of institutional policies that will limit the use of mobile phones in academic settings, such as during lecture or examination periods. It also recommends the use of billboards around institutional campuses to inform and remind students of the effects of prolonged mobile phone usage on their overall health and its preventive strategies.

Though the current study investigated thoroughly the prevalence and patterns of mobile use

among clinical university students, the study is not without limitations. First, the study only draws its sample population from clinical students. The cross-sectional study design could not make it possible to draw a causal effect, and convenient sampling was used to recruit participants; therefore, caution generalising findings to other populations. Another limitation is the use of self-reported measures to assess the presence of neck pain in the past 12 months, and patterns of mobile phone use can lead to the risk of recall and response biases.

The strength of the study is that it will provide reference data on the prevalence and pattern of students' mobile phone use for future investigations, considering the scarcity of research data among this population, especially in Nigeria. It also provided information on the association of neck pain with demographic and patterns of mobile use among clinical university students.

## CONCLUSIONS

In conclusion, this study found high neck pain prevalence (69.2%) among the students' mobile users. It found a statistically significant association between neck pain and study departments ( $p < 0.05$ ). No statistically significant association was found between the prevalence of neck pain with age, gender, and academic level ( $p > 0.05$ ), respectively. The majority of the students use their phones for 5-10 hours daily, and the sitting position was the most adopted posture used during phone usage. The majority used their phone for studying and only use their phone for gaming. A higher number use both hands while using their phones. A significant association between neck pain and the various patterns of mobile use was observed.

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## A COMPARISON OF MEAL FREQUENCY AND 24-HOUR DIETARY RECALL AMONG BENEFICIARY AND NON-BENEFICIARY PUPILS IN THE SCHOOL FEEDING PROGRAM AT PUBLIC PRIMARY SCHOOLS IN NORTH-WESTERN NIGERIA.

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### ABSTRACT

**Introduction:** Childhood and adolescence are vital periods for promoting healthy eating habits, as non-communicable diseases (NCDs) increasingly threaten young people's rights to health, nutrition, education, and play. Addressing NCDs is essential for achieving Universal Health Coverage (UHC). Undernutrition in childhood contributes to high mortality rates in developing countries and is linked to slower cognitive development and health issues in later life. Assessing dietary intake in children is crucial not only for preventing obesity but also for understanding nutritional status and adherence to dietary guidelines.

**Methods:** A cross-sectional comparative study design was employed to compare beneficiaries and non-beneficiaries of the school feeding program in public primary schools. The study included a sample of 150 pupils for each group: those participating in the program (the study group) and those not participating (the control group). A multi-stage sampling technique was utilized for both groups. Data was collected using a semi-structured, interviewer-administered questionnaire, which captured information on the following: socio-demographic characteristics, frequency of meals provided by the school feeding program and at home, and a 24-hour dietary recall of the pupils.

**Results:** The mean ages for the study and control groups were  $12.11 \pm 1.789$  years and  $11.33 \pm 1.334$  years, respectively. The study group received an average of  $1.03 \pm 0.199$  meals per day at school, while at home, they had  $3.06 \pm 0.371$  meals. In total, the average number of meals consumed per day, both at home and in school, was  $3.65 \pm 0.868$  for the study group. For the control group, the average number of meals received at home was  $3.05 \pm 0.292$ . In both groups, the majority of pupils primarily consumed carbohydrates for breakfast, lunch, and dinner, while animal protein was the least consumed food item.

**Conclusion:** The findings indicate a similar pattern of food consumption in both the study and control groups.

**Recommendations:** The Federal, State, and Local Governments should enhance their commitments to agriculture and promote agricultural diversification to improve the population's dietary intake.

**Keywords:** School feeding program, communicable diseases, Universal health coverage, pupil

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## INTRODUCTION

Childhood and adolescence are critical stages offering a window of opportunity for interventions to inculcate healthy eating habits (Ochola and Masibo, 2014). There has been a rise in non-communicable diseases such as cardiovascular diseases, different types of cancers, and type 2 diabetes worldwide. (Vik et al., 2019). Diet is one of the key factors explaining this trend. Each year, about 1 million people under the age of 20 die from treatable NCDs, accounting for over 15.85 % of deaths in the age group. Non-communicable diseases (NCDs) are a growing threat to children and adolescents. NCDs undermine children's and adolescents' right to health, nutrition, education, and play. Universal Health Coverage (UHC) cannot be achieved without addressing NCDs in children. NCDs make up 70% of deaths globally, and 86% of premature NCD mortality occurs in low- and middle-income countries. Over 2.1 billion children and adolescents less than 20 years of age are affected by NCDs. Undernutrition in childhood was and is one of the reasons behind the high child mortality rates observed in developing countries. Chronic under-nutrition in childhood is linked to slower cognitive development and serious health impairments later in life that reduce the quality of life of individuals. An estimated 26 percent of the world's children are stunted (Grebmer et al., 2014). Consequently, estimates of the prevalence of malnutrition among school-aged children suggest that the effects of malnutrition do not improve much with age (Frye, 2013). Great attention has been given to children's eating behaviour, as dietary habits acquired in childhood tend to persist into later ages. This will help mitigate diet-related chronic diseases in later life associated with poor eating habits in earlier life. Also, adequate dietary intake has a positive effect on the cognitive function and school performance of schoolchildren (Ochola and Masibo, 2014). Considering the relationship between dietary intake and health, the usefulness of dietary intake assessments in children goes far beyond their potential in preventing obesity. It can serve as an instrument for obtaining relevant information regarding nutritional status and level of adherence to dietary guidelines. In addition, nutritional data that have been obtained can be utilized to create appropriate interventions such as nutritional education addressing needs, deficits, and over-consumption. In general, a regular meal frequency is important for health.

**General Aim:** To compare the meal frequency and 24-hour dietary recall among pupils in public primary schools in North-Western Nigeria.

**Specific objectives:** 1. To obtain the meal frequency among pupils in public primary schools in North-Western Nigeria. 2. To obtain a 24-hour dietary

recall among pupils in public primary schools in North-Western Nigeria. 3. To compare the meal frequency among pupils in public primary schools in North-Western Nigeria. 4. To compare the 24-hour dietary recall among pupils in public primary schools in North-Western Nigeria.

## MATERIALS AND METHODS

A cross-sectional comparative study design compared beneficiaries and non-beneficiaries of the school feeding program in public primary schools.

**Study Population:** The pupils in the public primary schools where the school feeding program was implemented in Kano State (study group). The pupils in public primary schools without the school feeding program in Kaduna State (control group).

**Inclusion Criteria:** All pupils above six years of age in public primary schools in Kano state, where the school feeding program was practiced. All pupils above six years in the public primary schools in Kaduna state, where the school feeding program was not being practiced.

**Exclusion Criteria:** Pupils who had spent one year or less in the public primary schools of study in Kano and Kaduna states. Pupils who were sick and those absent from school at the time of the study.

**Sample Size Determination:** The number of pupils in the public primary schools to be recruited for the study was determined using the formula for comparative study below.

$$N = D [(Z\alpha + Z\beta)^2 \times (p_1(1-p_1) + p_2(1-p_2))] \div (p_1 - p_2)$$

Where N = required minimum sample size per survey round or comparison group. D = design effect (assumed to be the default value of 2).

$Z\alpha$  = The Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size ( $P_2 - P_1$ ) would not have occurred by chance ( $\alpha$  - the level of statistical significance).  $Z\beta$  = the z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size ( $P_2 - P_1$ ) if one occurred ( $\beta$  - statistical power).  $P_1$  (The estimated level of the indicator (meal frequency) measured as a proportion at the time of the first survey or for the control area taken as 79% (Proportion of children who eat 3-4 meals per day in both control and intervention groups at baseline) (Vik et al., 2019).  $P_2$  The expected level of the indicator (proportion of children with increased meal frequency) after an intervention (school feeding) has been done for the study areas. (Such that the quantity ( $P_2 - P_1$ ) is the size of the magnitude of change it is desired to be able to detect.

$P_2 - P_1$  The size of the magnitude of change is desired to be able to detect in this case, 13.0%  
 $D=2, Z\alpha= 1.645$ (at 90% confidence interval),  $Z\beta=0.840$ (at power of 80%),  $p_1= 79.0\%$ .  
 $P_2 =91\%$  (=> the desired magnitude of change from  $p_1$  is 12.0%, i.e., we want to increase the proportion of the children with meal frequency up to 3 to increase from 79% to 91%.

$$n = \frac{2[(1.645+0.840)^2 * (0.79(1-0.79) + 0.91(1-0.91))}{(0.91-0.79)^2}$$

$$= 2.048 + (0.0819) \div 0.0144$$

$$n = 2.1299 \div 0.0144; n = 147.9, n = 148$$

Approximately 150

Thus minimum sample size = 150

**Sampling Technique:** A multi-stage sampling technique was used for both study and control groups.

**First Stage:** Selection of LGAs: Using a simple random sampling technique by balloting one local government area (LGA) was selected from each senatorial district; Kano metropolitan area (Kura LGA), northern Kano state (Tofa LGA), and southern Kano state (Wudil LGA), respectively, for Kano state. In Kaduna state, Zaria, Kaduna South, and Kachia LGAs were selected from each of the three senatorial districts in the state. There were three local government areas for each state: the study and control groups.

**Second stage:** Wards were selected from each local government that had been selected.

**Third stage:** Schools were selected from each of the selected wards by simple random sampling, balloting.

**Fourth stage:** Involved the selection of the units of enquiry: At the school level, pupils from primary four and five were selected using stratified sampling. However, proportionate allocation was used to determine the number of pupils per class who were administered the questionnaire; these pupils were selected through simple random sampling. The sampling technique and selection of wards and schools are shown in Table 1.

**Study Instruments:** A semi-structured, interviewer-administered questionnaire was used to capture information on socio-demographic characteristics, the frequency of meals provided by the SFP and at home, and a 24-hour dietary recall of the pupils. The 24-Hour multiphase recall (24-h MPR) requires a respondent to recall dietary intake consumed in the 24 hours prior to the interview.

**Table 1: Sampling technique for the beneficiary and non-beneficiary pupils of the school feeding program in Kano and Kaduna states, Nigeria.**

State	Senatorial district	Local government area	School
Kano	Kano Metropolitan area	Kura	LGEA Primary School Karfi
	Kano north	Tofa	Model primary school Tofa
	Kano South	Wudil	LGEA Primary School Wudil
Kaduna	Central Kaduna	Kaduna south	Abubakar Mahmud Gumi LGEA primary school
	Northern Kaduna	Zaria	Dutsen Abba LGEA Primary School
	Southern Kaduna	Kachia	Army children's school, Kachia

RESULTS

**Table 2: Baseline socio-demographic profile of the beneficiary and non-beneficiary pupils of the school feeding program in Kano and Kaduna states, Nigeria.**

Variables	f %		Test	
	Study group n=150	Control group n=150	X	p
<b>Age group</b>			12.60	0.002
<b>Years</b>				
5-9	6 (4)	6 (4)		
10-14	125 (83.3)	141 (94)		
15-19	19 (12.7)	3 (2)		
Mean	12.11 ±1.79	11.33 ±1.33	4.28	0.001
<b>Sex</b>			0.86	0.417
Male	86 (57.3)	78 (52)		
Female	64 (42.7)	72 (48)		
<b>Class</b>			1.34	0.298
Pry 4	74 (49.3)	84 (56)		
Pry 5	76 (50.7)	66 (44)		
<b>Religion</b>			32.10	0.001
Islam	150 (100)	121 (80.7)		
Christianity	0	29 (19.3)		

Mean difference = 0.058, 95% CI= -0.167 - 0.060

The mean ages for the study and control groups were 12.11 ± 1.789 and 11.33 ± 1.334 Years, respectively. (Table 2)

**Table 3: Frequency of meals received by beneficiary pupils of the school feeding program in Kano State, Nigeria (in school and at home).**

Variable	Mean ± SD Study group (n = 150)
Mean number of meals per day in school	1.03 ± 0.199
Mean number of meals per week in school	3.97 ± 1.114
Mean number of meals per day at home	3.06 ± 0.371
Mean number of meals per day at home and in school	3.65 ± 0.868

The mean number of meals received by the study group per day in school was 1.03 ± 0.199, while at home it was 3.06 ± 0.371, and the mean number of meals received per day at home and in school was 3.65 ± 0.868 (Table 3).

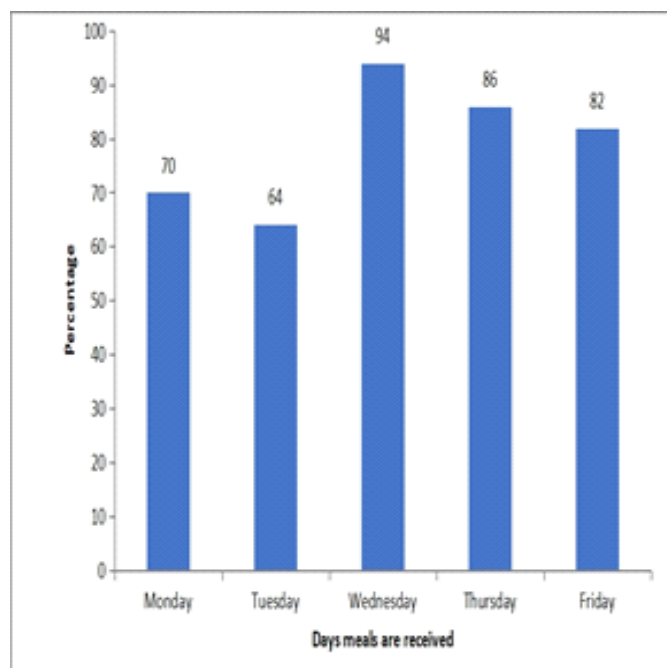
**Table 4: Frequency of meals received by non-beneficiary pupils of the school feeding program in Kaduna State (Control), Nigeria, (in school and at home).**

Variable	Mean ± SD Control group (n = 150)
Mean number of meals per day at home	3.05±0.292
Maximum number of meals at home per day	5
Minimum number of meals at home per day	2

The mean number of meals received by the control group per day at home was 3.05 ± 0.292 (Table 4).

The majority (94%) of the pupils received food from the school feeding program on Wednesdays, as shown in Figure 1, while the day with the least number of pupils receiving food from the program was Tuesdays (64%).

The majority of the pupils in the study group had carbohydrates as the main part of the meal for breakfast, lunch, and dinner, while the least consumed food item was animal protein (as seen in Table 4). The same pattern of food consumption was observed in the control group.



**Figure 1: Days meals were received in school from the school feeding program among the beneficiary pupils of the school feeding program in Kano state**

The majority of the pupils in the study group had carbohydrates as the main part of the meal for breakfast, lunch, and dinner, while the least consumed food item was animal protein (as seen in Table 6). The same pattern of food consumption was observed in the control group.

## DISCUSSION

The mean number of meals received by the study group per day in school was  $1.03 \pm 0.20$ . This is similar to the frequency in a study carried out in Mali, where food provision consisted of a school lunch meal served at noon (Masset & Gelli, 2013). Also, in another study in Malawi, a similar frequency was found; here, children attending the Malawian school feeding program were served one meal per day in school (Nkhoma *et al.*, 2013). This is also similar to another study in Gujarat, India, where a school meal consisting of a mid-day meal or school lunch was served (Gopaldas, 2005). However, this is different from a study in Kenya where the SFP provides one meal which is a lunch-time meal to children in the primary grades. In addition, in some early childhood development schools pre-primary aged children received a micronutrient-fortified blend in the form of porridge as a mid-morning snack, then lunch at noon (Finan *et al.*, 2010). These differences could be because there is no 'one-size-fits-all' home-grown school feeding (HGSF) model. Every country that implements or is looking to implement HGSF programs

**Table 5: Count of food items consumed in 24-hour dietary recall by the beneficiaries (Study) and non-beneficiary (control) pupils of the school feeding program in Kano and Kaduna States (Multiple response questions)**

Food item	Frequency (%)	
	Study group (n=150)	Control group (n=150)
<b>Carbohydrate</b>		
Pap/kunu	74(51.1)	46(40.0)
Tea	54(37.2)	27(18.8)
Bread	44(30.3)	34 (23.6)
Tuwo	141(97.3)	159(110.4)
Rice	135(93.2)	105(72.9)
Spaghetti	46(31.7)	35(24.3)
Macaroni	49(2.8)	10(6.0)
Yam	6(4.2)	18(12.5)
Sweet potatoes	2(1.4)	4(2.8)
Irish potatoes	4(2.8)	1(0.7)
<b>Plant protein</b>		
Bean cake/Kosai	39(26.9)	18(12.5)
Beans	90(62.1)	37(25.7)
Moi -moi	1(0.7)	8(5.6)
Soyabean cake	15(10.3)	0
<b>Animal Protein</b>		
Meat	23(15.8)	17(11.8)
Fish	34(23.5)	22(15.3)
Chicken	1(0.7)	0
Milk	13(9.0)	5(3.5)
Egg	8(5.5)	3(2.1)
<b>Vegetable</b>		
Dry okro soup	20(13.8)	13(9.1)
Fresh okro soup	59(40.7)	49(34.0)
Vegetable soup	25(17.2)	20(13.9)
Egusi soup	3(2.1)	5(3.5)
Tomato stew	63(43.4)	44()
Baoba leaves soup/Miyankuka	42(29.0)	69(48)
<b>Others</b>		
	162(112)	65(45.1)

\*Others: Bean dumplings (Danwake), Garri, Rice cake (Waina), pepper and oil, local bread (Gurasa), Cocoyam, Porridge

**Table 6: Count of food items consumed in 24-hour dietary recall disaggregated by meal time (breakfast, lunch, and dinner) by the beneficiaries (study) and non-beneficiary (control) pupils of the school feeding program in Kano and Kaduna states.**

Food item	Frequency (%)			Frequency (%)		
	Study group (beneficiaries of school feeding) (n =150)			Control group (Non beneficiaries of school feeding) (n = 150)		
	Breakfast	Lunch	Dinner	Breakfast	Lunch	Dinner
<b>Carbohydrate</b>						
Pap/kunu	69 (47.6)	2 (1.4)	3 (2.1)	43 (29.9)	3 (2.1)	-
Tea	44 (30.3)	1 (0.7)	9 (6.2)	23 (16.0)	-	4 (2.8)
Bread	36 (24.8)	-	8 (5.5)	30 (20.8)	-	4 (2.8)
Tuwo	48 (33.1)	12 (8.3)	81 (55.9)	54 (37.5)	22 (15.3)	83 (57.6)
Rice	14 (9.7)	89 (61.4)	32 (22.1)	17 (11.8)	60 (41.7)	28 (19.4)
Spaghetti	7 (4.8)	25 (17.2)	14 (9.7)	3 (2.1)	21 (14.6)	11 (7.6)
Macaroni	1 (0.7)	2 (1.4)	1 (0.7)	3 (2.1)	5 (3.5)	2 (1.4)
Yam	-	3 (2.1)	3 (2.1)	3 (2.1)	10 (6.9)	5 (3.5)
Sweet potatoes	1 (0.7)	-	1 (0.7)	1 (0.7)	2 (1.4)	1 (0.7)
Irish potatoes	3 (2.1)	1 (0.7)	-	-	-	1 (0.7)
<b>Plant Protein</b>						
Bean cake/Kosai	39 (26.9)	-	-	18 (12.5)	-	-
Beans	13 (9.0)	47 (32.4)	30 (20.7)	8 (5.6)	18 (12.5)	11 (7.6)
Moi -moi	1 (0.7)	-	-	-	7 (4.9)	1 (0.7)
Soyabean cake	7 (4.8)	2 (1.4)	6 (4.1)	-	-	-
<b>Animal Protein</b>						
Meat	5 (3.4)	8 (5.5)	10 (6.9)	-	10 (6.9)	7 (4.9)
Fish	4 (2.8)	16 (11.0)	14 (9.7)	6 (4.2)	6 (4.2)	10 (6.9)
Chicken	-	1 (0.7)	-	-	-	-
Milk	10 (6.9)	-	3 (2.1)	5 (3.5)	-	=
Egg	5 (3.4)	-	3 (2.1)	-	-	3 (2.1)
<b>Vegetable</b>						
Dry okro soup	8 (5.5)	-	12 (8.3)	6 (4.2)	2 (1.4)	5 (3.5)
Fresh okro soup	22 (15.2)	6 (4.1)	31 (21.4)	14 (9.7)	10 (6.9)	25 (17.4)
Vegetable soup	5 (3.4)	7 (4.8)	13 (9.0)	6 (4.2)	2 (1.4)	12 (8.3)
Egusi soup	1 (0.7)	1 (0.7)	1 (0.7)	1 (0.7)	1 (0.7)	3 (2.1)
Tomato stew	7 (4.8)	38 (26.2)	18 (12.4)	5 (3.5)	24 (16.7)	15 (10.4)
<b>Baoba leaves</b>						
soup/Miyankuka	14 (9.7)	2 (1.4)	26 (17.9)	26 (18.1)	8 (5.6)	35 (24.3)
<b>Others</b>						
	34 (23.4)	80 (55.2)	51 (35.2)	18 (12.5)	32 (22.2)	15 (10.4)

\*Others: Beans dumplings (Danwake), Garri, Rice cake (Waina), pepper and oil, local bread (Gurasa), Cocoyam, Porridge

requires different approaches suitable to its specific context (Grebmer *et al.*, 2014).

For the beneficiaries of the school feeding program (study group), the food frequency at home was  $3.06 \pm 0.371$ , and the mean number of meals received per day at home and in school was  $3.65 \pm 0.86$ . The majority, (94.0%) of the pupils received food from the school feeding program on Wednesdays, the day the least number of pupils received food from the program was on Tuesday, which was (64%). However, pupils received food from the SFP every day, though the proportions vary. This finding is similar to those in a study conducted in Limpopo, South Africa, where pupils received food at their respective schools daily. However, in the Limpopo report, unlike this study, up to 90% of the pupils received food every school day (Monday to Friday) from the school nutrition program. This could be explained by the fact that the Limpopo school nutrition program has an adherence to the guidelines of their national school nutrition program, which stipulates that learners should have food at school every school day of the week from Monday to Friday (NSNP, 2008).

The count of food items consumed in a 24-hour dietary recall by beneficiaries of SFP (study) and non-beneficiary pupils (control groups) showed majority of the pupils in the study group had carbohydrates as the main part of their meals for the day, either breakfast, lunch, or dinner. Most of the pupils (93.2%) had rice, Tuwo was consumed by 97.3% of the pupils, and Pap/Kunu by 51.1%. This is similar to the control group, where Rice, Tuwo, and Pap were consumed by 72.9%, 110.4%, and 40.0%, respectively. The least food items consumed were animal protein, where the study group had Chicken consumption by 0.7%, egg consumption by 5.5% (Table 5). This is similar to the control group, where the percentages were: chicken, 0%, and egg, 2.1%. This shows that carbohydrates formed the major source of their diet, like most households in Nigeria. This is similar to the study in central northern Nigeria, where carbohydrates in the form of root and tuber crops (86%) constituted the food group consumed by most households, and some tribes also reported the use of cereals in up to 78.6% of the households. Similarly, eggs, milk, meat, fruits, and vegetables were the least consumed in the north central study, too, which gives a picture of low dietary variety in the diet consumed (Baxter *et al.*, 1999). The findings are also similar to another study in Nnsuka, South East Niger where a high proportion of the children had taken rice for breakfast, lunch, and dinner; (39%), (22.8%), and (26%) respectively. However, due to the ultimate reliance of dietary recalls on memory, which is subject to a variety

of errors (Dwyer and Krall, 1987) the salience of the food items in the diet could be emphasized such that common foods or main course items are more easily recalled than less common foods (Baxter *et al.*, 1999).

## CONCLUSION

The mean number of meals received by the beneficiaries of SFP (study group) at home was  $3.06 \pm 0.371$ , while the mean number of meals received by the non-beneficiaries of SFP (control group) per day at home was  $3.05 \pm 0.292$ . However, the mean number of meals received per day at home in school by the study group was  $3.65 \pm 0.868$ . The same pattern of food consumption was observed in both the beneficiaries and non-beneficiaries of the SFP.

**Limitations:** The 24-hour dietary recall tool depends on the memory of the pupils for the recall. This recall depends on the interviewer's ability to probe appropriately while conducting an interview and the respondent's ability to recall intake from the preceding 24 hours. Thus, there is a potential for erroneous data from inaccurate recall, resulting in over- or underreporting of intake.

**Recommendations:** The federal, state, and Local governments should improve commitments towards agriculture and encourage agricultural diversification in order to improve the dietary consumption of the populace.

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