

African Journal of Health and Medical Sciences

Volume 10, Number 1, 2025

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RESEARCH ARTICLE



Comparative Assessment of Serum Zinc and Iron Deficiency in Cuban Women of Reproductive Age

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Abstract:

Background: Iron (Fe) deficiency anemia is the primary nutritional deficiency in Cuba, with limited documentation on serum zinc (Zn) and copper (Cu) deficiencies. This study aimed to compare the magnitude of Fe, serum Zn and Cu deficiency and its relationship with anemia and inflammation in women of reproductive age from different provinces in Cuba.

Materials and Methods: A cross-sectional study conducted between 2016-2018 included a non-probabilistic sample of 654 apparently healthy women aged 18 to 40 years from Havana, the eastern region (Santiago de Cuba and Holguin), and the central region (Sancti Spiritus and Cienfuegos), who were mothers of young children. Hemoglobin, ferritin, serum Zn and Cu, high-sensitivity C-reactive protein (CRP-hs), alpha-1 glycoprotein (AGP), and ceruloplasmin (Cp) were measured. Data were analyzed to estimate quartiles, frequencies, and associations among variables, with ferritin adjusted for inflammation using SPSS 20.0 statistical package.

Results: Anemia was identified in 18.1% of participants, Fe storage deficiency was 7.5% (unadjusted for inflammation) and 10.0% (adjusted); serum Zn deficiency in 36%, and serum Cu deficiency in 14.3%. Low Cp levels were found in 13.3%, and inflammation was present in 43%. Anemia showed a positive association with Fe storage deficits (OR=3.90;95%CI: 2.23-6.71) and serum Zn deficiency (OR=1.94;95%CI: 1.30-2.91), and a negative association with serum Cu deficiency (OR=0.53;95%CI: 0.30-1.10). Inflammation modified the relationship between anemia and Fe storage and serum Cu deficiencies but not the relationship with serum Zn.

Conclusion: Findings reveal high rates of anemia and micronutrient deficiencies, particularly Zn, in Cuban women. These results underscore the need for interventions to improve nutritional health and address potential risks related to anemia and inflammation.

Received: November 11, 2024

Accepted: December 31, 2024

Published: January 15, 2025

Keywords: Serum zinc, copper, inflammation, ceruloplasmin, anemia, cuba.

1. INTRODUCTION

Anemia is a global health problem commonly caused by nutrition deficiencies, in particular iron deficiency anemia [1,2,3,4,5,6,7]. Iron (Fe) and zinc (Zn) are among the micronutrients with the highest

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prevalence of deficit worldwide [7,8,9,10,11,12]. An association between Zn deficiency and Fe deficiency anemia has been identified in women of reproductive age (15-49 years) [3], particularly in low- and middle-income countries [1,8,9]. Various mechanisms have been proposed to explain the link between Zn and Hb metabolism, but to date there, there is insufficient data to demonstrate the role of Zn in the etiology of anemia [9]. Copper (Cu) deficiency also causes anemia, although the extent of Cu deficit is not well established [13-15].

All three micronutrients have structural roles in proteins, participate in redox reactions, and regulate metabolic processes [1,9,13,14,16,17,18]. The main biomarkers for assessing the nutritional status of Fe, Zn, and Cu are serum ferritin, serum Zn, serum Cu and ceruloplasmin (Cp) enzyme (EC 1.16.3.1) [7]. The concentrations of these biomarkers can vary during inflammation; therefore, it is recommended to measure them alongside inflammatory biomarkers such as the highly sensitive C-reactive protein (CRP-hs) and alpha-1 acid glycoprotein (AGP) [7,11,12,14,15,19,20].

Fe deficiency anemia is considered to be the main nutritional deficiency problem in Cuba [21]. However, there is limited information on the prevalence of Zn and Cu deficiencies and their association with anemia in Cuban women of reproductive age. Cu are essential for immune function, growth, and reproduction [13,14]. Women of reproductive age are particularly vulnerable due to their increased nutritional demands, making targeted interventions essential to break cycles of poor health and malnutrition. Thus, the objective of the study is to compare the magnitude of Fe, serum Zn and Cu deficiency and its relationship with anemia and inflammation in women of reproductive age from different provinces in Cuba.

2. METHODS

2.1. Study Design

We conducted a an analytic, cross-sectional study with a clinical and community-based approach from 2016 to 2018. The study population was comprised of mothers of children aged 6 to 59 months of age, who were included in the National Survey of Anemia and Iron Deficiency of Cuban preschool children, directed by the National Institute of Hygiene, Epidemiology and Microbiology (INHEM in Spanish) of the Ministry of Health.

2.2. Participants

The study included healthy-appearing women of reproductive age (18-40 years old) who were mothers of children from the eastern region (Santiago de Cuba and Holguin), the Central Region (Sancti Spiritus and Cienfuegos), and Havana. Pregnant and lactating women, women in the postpartum period (up to 6 months), women with sickle cell disease, or those attending medical consultation for hematological disorders were excluded. Women with conditions typically associated with an inflammatory response, such as cancer, diabetes mellitus, high blood pressure, severe asthma, chronic obstructive pulmonary disease, kidney failure, Cu metabolism disorders, physical deformities, and clinical conditions linked to Zn deficiency, such as hypothyroidism, were excluded from the study. Additionally, participants consuming mineral supplements and/or medications that interfere with the metabolism of Zn or Cu were also excluded. These conditions were identified either through self-reporting by the participants during the initial screening process or by physicians at the primary health care level. Additionally, non-fasting women were excluded. We excluded 23 hemolyzed sera and 3 with Zn values above 160.9 $\mu\text{g/dL}$, a limit considered indicative of probable contamination [22].

2.3. Procedures

2.3.1. Biochemical Measurements

Blood samples were collected after an overnight fast via antecubital vein puncture, following area disinfection. A total of 6 ml of blood was collected, with 1 ml used for hemoglobin measurement and 5 ml for serum analysis. The extraction was performed by authorized and trained personnel, adhering to recommendations for processing minerals in biological materials to avoid contamination. Hemoglobin (Hb), ferritin, serum Zn, serum Cu, Cp, CRP-hs and AGP were measured after an overnight fasting [11]. For Hb

measurement, 1 ml of blood was taken and added in a tube with 10% EDTA anticoagulant. The remaining 5 ml was used to obtain serum by centrifugation at 14,000 rpm for 5 minutes, which was then stored at -40°C for further analysis.

Hb was measured using an ABX Micros 60 hematological analyzer (Horiba, France). Ferritin, CRP-hs, AGP, and Cp were measured using the INLAB 240 using immunoturbidimetric method (CPM Scientifica Tecnologie Biomediche, Italy). These determinations were performed by trained personnel at the INHEM Nutritional Anemia Laboratory in Havana, Cuba, using reference materials for quality control. The equipment was calibrated and certified.

Zn and Cu were measured in the INHEM Environmental Pollutant Laboratory using a Shimadzu AA-6800 atomic absorption spectrophotometer (Japan). The method followed Smith et al. [23]. Standard working solutions for calibration (0.05, 0.1, 0.2, 0.4, 0.8 µg/mL for Zn, and 0.05, 0.1, 0.2, 0.4, 0.8, 1.6 µg/mL for Cu) were prepared from appropriate dilutions of primary standard solutions of Zn and Cu (Merck, Germany) dissolved in 0.5mol/L nitric acid at a concentration of 1 mg/mL. For dilution of the standard working solutions and blank solution we used 5% distilled glycerin (99.5%) from a commercially available product (Titolchimica, Italy), and deionized water.

Before measuring Zn and Cu, a serum pool was prepared from blood samples of eligible women. The standard addition method was used for the serum pool, and recovery study showed average recovery percentages of 95.66% and 94.63% for Zn and Cu, respectively. Serum samples were diluted to 1:6 with deionized water (500 µl serum/2 mL water). For each series of determinations, curves were prepared with standard working solutions, serum pool, and fresh blank solutions. Instrumental parameters were adjusted for the determination of both Zn and Cu.

Instrumental parameters for Zn and Cu determination included hollow cathode lamps with wavelengths of 213.9 nm and 324.8 nm, acetylene air flow 2.0 L/min and 1.8 L/min, band width 0.5 nm for both minerals, lamp currents of 8 mA and 6 mA, and background correction with a deuterium lamp. All materials used in minerals analysis were treated to prevent contamination. The cut-off points used to assess serum Zn and Cu deficiencies, as well as ferritin levels, were based on expert recommendations and are appropriately referenced in Table 1.

2.3.2. Statistical Analysis

Data analysis was performed using SPSS 20.0 statistical package. Continuous variables were described by median and interquartile range due to positive skewness. Ferritin values were adjusted for inflammation using correction factors from Thurnham et al. [24]. The kappa concordance index was used to evaluate the degree of agreement between adjusted and unadjusted serum ferritin values for inflammation. Categorical variables were summarized using absolute numbers and percentages. The relationship between anemia and ferritin, serum Zn, serum Cu, Cp, and inflammation was assessed by calculating the Odds ratio (OR) and 95% confidence interval (95% CI). Serum Zn and Cu intercorrelation was evaluated using the Pearson correlation coefficient (r). The diagnostic capability of Cp as an inflammatory biomarker was assessed using a ROC curve.

2.3.3. Ethical Considerations

The study adhered to the principles of the Declaration of Helsinki [25] and was approved by the INHEM Scientific Council's Guide to Procedures for Human Research on March 21, 2014. All participants signed the informed consent form and data on participants diagnosed with anemia were reported for treatment to the primary health care level corresponding to their place of residence.

Table 1 presents the study variables and their cut-off points.

3. RESULTS

A total of 654 women were evaluated. The median age of women was 28 years with a minimum age of 18 and a maximum age of 40. Table 2 presents descriptive statistics of the biochemical variables of wom-

en. Missing data in some variables was due to blood clotting or insufficient amount of serum and therefore did not represent a risk of bias for the calculation of descriptive statistics or association measures.

Table 1. Cut-off points for normality in variables used for the evaluation of women of reproductive age. Cuba, 2016-2018

Variable	Indicator	Cut-off points
Zinc	Serum Zn concentration ($\mu\text{g/dL}$)	< 70 [11]
Copper	Serum Cu concentration ($\mu\text{g/dL}$)	< 80 [26]
Ceruloplasmin (Cp)	Ceruloplasmin concentration (g/L)	0.22-0.61 [26]
Anemia	Hemoglobin (g/L)	< 120 [6]
Severity of anemia [6]	Hemoglobin (g/L)	Severe: <80
		Moderate: 80–109
		Mild: 110-119
Iron deposit deficit	Serum ferritin ($\mu\text{g/L}$)	< 15 [27]
Inflammation	C-reactive protein-hs (mg/L)	> 5 [27]
	Alpha-1 glycoprotein (g/L)	> 1 [27]

Abbreviations: Zn: zinc, Cu: copper, Hb: hemoglobin, Cp: ceruloplasmin, CRP-hs: High sensitivity C-reactive protein, AGP: alpha-1 glycoprotein acid, $\mu\text{g/dL}$: micrograms/deciliters, g/L: grams/liters, mg/L: milligrams/liters.

Table 2. Descriptive statistics as quartiles of biochemical variables in women of reproductive age.

Variable	p25	p50	p75
Hb g/L (n=639)	123.0	130.0	136.0
Serum Ferritin no adjusted ($\mu\text{g/L}$) (n=641)	29.6	54.2	84.7
Serum Ferritin adjusted ($\mu\text{g/L}$) (n=641)	26.2	44.4	70.4
Serum Zn ($\mu\text{g/dL}$) (n=654)	10.0 (65.3)	11.5 (75.1)	13.3(87.1)
Serum Cu ($\mu\text{g/dL}$) (n=645)	14.1 (89.4)	16.7 (106.0)	20.0(125.9)
Cp (g/L) (n=639)	0.27	0.34	0.42
CRP-hs (mg/L) (n=641)	1.1	2.3	6.4
AGP (g/L) (n=641)	0.6	0.8	1.0

Abbreviations: P25: 25th percentile, p50: 50th percentile, p75: 75th percentile, Hb: hemoglobin, Serum ferritin adjusted: serum ferritin adjusted for inflammation, Serum Ferritin no adjusted: serum ferritin not adjusted for inflammation, Serum zinc, Serum copper, Cp: ceruloplasmin, CRP-hs: high sensitivity C-reactive protein, AGP: alpha-1 acid glycoprotein.

Absolute and relative frequencies were as follows:

Anemia: 18.1% (116/639)

Deficit in Fe deposits: 7.5% (48/641) measured by serum ferritin not adjusted by inflammation, and 10% (63/641), serum ferritin adjusted by inflammation.

Zn deficit: 36% (233/654)

Cu deficit: 14.3% (92/645)

Decreased Cp: 13.3% (85/639)

As for biomarkers of inflammation, increased CRP-hs was detected in 31.7% (203/641) and increased AGP, in 25.1% (161/641).

In women with anemia, the deficit was mild in 81.9% (95/116), moderate in 17.2% (20/116), and severe in 0.9% of the cases (1/116). Anemia with deficit in Fe deposits was present in 18.2% (21/115) of women. After adjusting serum ferritin by inflammation, the proportion of anemic women with Fe deficiency increased to 21.7% (25/115). High concordance (kappa = 0.85) was found between deficit in Fe deposits with serum ferritin adjusted and unadjusted for inflammation. In women with anemia serum Zn deficit was present in 49.1% (57/116) and serum Cu deficit in 8.8% (10/114) of the cases.

Table 3 shows the proportion of women without deficit, or with deficiency of one or more of the three micronutrients evaluated. Multiple micronutrient deficiencies were observed in women with and without anemia, although this condition was more frequent in the anemic group. Anemia was associated with deficiency in Fe deposits (OR=3.90;95%CI: 2.23-6.71), serum Zn deficiency (OR=1.94;95%CI: 1.30-2.91) and serum Cu deficiency (OR=0.53;95%CI: 0.30-1.10).

Table 3. Proportion of women with one, two or more deficiencies in Fe, Zn and Cu, Cuba

NUM. of micronutrients in deficit	% Women with anemia (n=113)	% Women without anemia (n=507)
No micronutrient deficiency	41.2	54.2
One micronutrient deficient	42.5	36.1
Two micronutrients deficient	13.3	9.5
Three micronutrients deficient	3.0	0.2

Note: Data presented as percentage.

Of the total number of women, 43.0% (273/641) had inflammation when considering both biomarkers CRP-hs and AGP. After stratifying the sample by inflammation, a positive association was found between anemia and Fe deposits deficiency, OR=4.37 (95% CI: 2.30-8.01) and serum Zn deficiency, OR=1.90 (95% CI: 1.30-2.91). The association was negative between anemia and serum Cu deficiency OR=0.59 (95%CI: 0.30-1.10). Inflammation modifies the influence of Fe deficiency on anemia: deficiency occurs with 24.1% of anemia when there is inflammation, but with 56.2% when there is none (Table 4).

Table 4. Anemia and deficits iron deposits, serum zinc and copper by presence or absence of inflammation, Cuba.

		Inflammation			Non-inflammation		
		Anemia	No Anemia	Total (n)	Anemia	No Anemia	Total (n)
Fe	Deficit	7 (24.1)	22 (75.9)	29	18 (56.2)	14 (43.8)	32
	No deficit	40 (16.5)	203 (83.5)	243	50 (15.4)	275 (84.6)	325
Cu	Deficit	1 (5.3)	18 (94.7)	19	9 (13.0)	60 (87.0)	69
	No deficit	45 (18.4)	200 (81.6)	245	58 (20.2)	229 (79.8)	287
Zn	Deficit	25 (25.3)	74 (74.7)	99	32 (24.8)	97 (75.2)	129
	No deficit	22 (12.7)	151 (87.3)	173	36 (15.8)	192 (84.2)	228

Note: Data presented as n (%). Fe: iron, Cu: copper, Zn: zinc.

Figure 1 depicts the proportions of women with deficits in serum Zn and Cu and in Fe deposits in the presence and absence of inflammation. The results suggest that inflammation modified the association be-

tween anemia and deficits in serum Cu and Fe deposits, but not the association between anemia and serum Zn deficits.

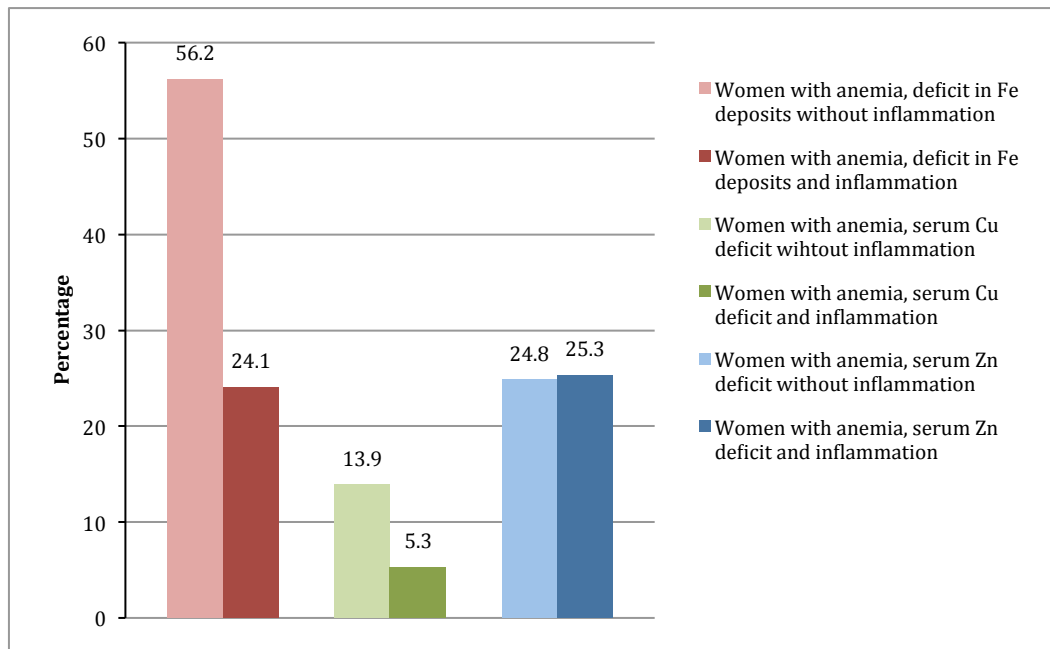


Figure 1. Effect of inflammation on Fe deposits, serum Zn and Cu deficits in anemic women.

Figure 2 illustrates the ROC curve for CP, CRP and AGP, with inflammation as the state or dependent variable. The biomarker with the highest explanatory power, as indicated by the AUC was CRP-hs, followed by AGP and Cp, with AUC and 95% CI values of 0.92 (0.90-0.94), 0.87 (0.84-0.90) and 0.72 (0.68-0.76), respectively.

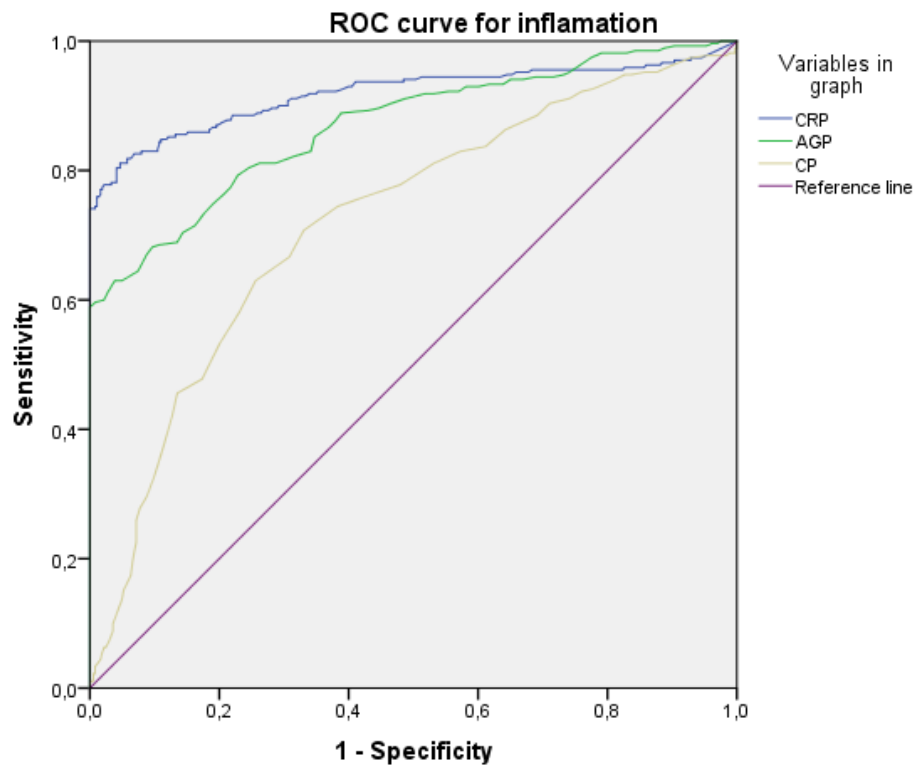


Figure 2. ROC curve analysis for Cp as a biomarker of inflammation showed an AUC of 0.72 as compared to CRP and AGP, with AUC's of 0.92 and 0.87, respectively.

The Cp cut-off suggested by some to diagnose inflammation is close to 0.5 g/L [28,29]. However, this value showed low sensitivity (17.4%) and high specificity (93%) in the sample studied. Cut-off values in the range of 0.34 to 0.35 g/L increase sensitivity while maintaining specificity above 65%. A value of 0.35 g/L was chosen as a useful cut-off point, with a sensitivity of 71% and specificity of 67%. This cut-off value differs by 0.26 units from the upper limit of the reference range of the method used to determine Cp in the present study (Table 1).

4. DISCUSSION

The study findings corroborated initial assumptions that more than one mineral deficiency is associated with anemia. Analysis of studies conducted from 2003 to 2019 in different countries and regions confirmed the high prevalence of Fe and Zn deficiency [8,9,10,12].

According to Stevens et al. [10], 20% or more of the women in the samples evaluated in 13 of 15 countries had serum Zn deficiency, reaching proportions higher than 50% in Cambodia, Malawi, Cameroon and Vietnam. The Fe deficit was 20% or greater in samples from 10 countries, including the United States and the United Kingdom, and reached figures greater than 40% in Azerbaijan, Mexico and Pakistan. Simultaneous deficiencies of Fe and Zn among other micronutrients were reported in Guatemala, Ecuador, United Kingdom, Vietnam, Ethiopia, Malawi, Cameroon, India, Bangladesh and Pakistan [10].

Few studies have included the evaluation of serum Cu. In a sample of Chilean women, only 2.3% had a mineral deficiency [30], while in a sample of Ghanaian women this figure was 12% [31]. In Cuba, there are few reports of evaluation of serum Zn and Cu in women of reproductive age. Taboada et al. [32] reported in 2019, in apparently healthy women, 79.4 ± 7.1 µg/dL of serum Zn and 106.8 ± 30.6 µg/dL of serum Cu, which were within the normal reference range [13,16].

The proportion of women with anemia in the present study was similar to the prevalence previously reported by Pita-Rodríguez et al. in a sample from the City of Havana (24.6%). However, the proportion of women with anemia associated with Fe deficiency in our study was markedly lower than that reported by Pita-Rodríguez et al. (82.3%). This difference could be attributed to the higher frequency of inflammation in the current study, in contrast to the results of Pita-Rodríguez et al., who reported a prevalence of 8.4% of acute inflammation and 19.9% of chronic inflammation [21]. The method of adjusting serum ferritin for inflammation used in this study may still be underestimating the Fe deficiency in our sample. Other authors have used different methodologies to perform this adjustment in women of reproductive age.

The BRINDA project used a decile linear regression model to adjust serum ferritin concentration by CRP and AGP concentrations for biomarkers reflecting inflammation and nutritional determinants of anemia [33], while Rodríguez et al. employed a quantile regression model [34]. The proportions of women with serum Zn deficiency (36.2%) and with serum Cu deficiency (19.1%) were similar and lower, respectively than those previously reported in women from Havana [21]. Cuba developed a National Plan for the prevention and control of anemia, focusing on two main strategies: Fe supplementation and food fortification [36]. However, no documentation was found regarding a similar intervention for Zn.

Implementing interventions to improve Zn nutritional status in vulnerable Cuban groups would require demonstrating that its deficiency constitutes a public health problem, defined as 20% or more of the population having serum Zn values below 70 µg/dL [11]. Meats are common food sources rich in Fe, Zn and Cu. [13,16,17]. According to Jiménez et al., the Cuban diet primarily consist of rice, beans, vegetables (mainly potatoes, sweet potatoes, cassava, malanga, banana and pumpkin), eggs, and to a lesser extent, meat products. A study of children aged 6 to 23 months in Havana reported deficient Zn consumption [37]. However, data on Zn intake adequacy in women of reproductive age was not available.

The findings of this research, in which Cu deficiency is the least prevalent among the three micronutrients considered in women with anemia, both in the presence or absence of inflammation, is in line with the fact that though it is widely recognized that Cu deficiency may cause anemia, it is not mentioned among its main nutritional causes [13].

The mechanisms that regulate Cu metabolism are not fully understood, although it is known that the decrease in Cu alters Fe metabolism and erythropoiesis leading to anemia [14, 38]. However, in the curly-hair Menkes syndrome, which includes alteration of Cu metabolism and intracellular utilization, children do not have anemia [13].

Dugger et al. [38], contends that Cu deficiency anemia is almost indistinguishable from Fe deficiency anemia, but unlike the latter, it is very rare [13,38]. McArdle [13] argues that neither serum Cu nor Cp are good biomarkers to evaluate Cu nutritional status. One reason supporting this observation is that Cp, being an acute phase protein, increases during inflammation, and is the main protein that transports Cu in blood [13, 38]. However, serum Cu and Cp remain the most frequently used biomarkers to evaluate Cu nutritional status [39, 40]. Cp transports approximately 90% to 95% of blood Cu. Some causes of decrease circulating Cp include Wilson's disease, Menkes' disease, aceruloplasminemia and Cu deficiency due to nutritional causes or conditions linked to low protein intake [41]. When ruling out these diseases due to study exclusion criteria, some nutritional factors could influence the results of serum Cu deficiency.

Intestinal absorption of Fe, Zn and Cu is inhibited by phytates, and other chemical compounds present in foods such as cereals, which are consumed more rates in low- and middle-income countries [1, 16, 17, 18, 39, 42]. Inflammation is a factor that could bias the measurement of Fe, Zn and Cu. Although Cuba is considered a country with a low burden of infections [43], current results point to the presence of acute and chronic inflammation. The BRINDA study demonstrated the usefulness of controlling for inflammation when evaluating Fe nutritional status, as even in countries with low inflammation prevalence, micronutrient status biomarkers were affected [44].

Hepcidins a hormone secreted by the liver which stimulates intestinal cells and the macrophage system, with two respective effects, reduction in Fe absorption and sequestration of circulating Fe. During the inflammatory process, interleukins stimulate the secretion of hepcidin by the liver [7].

According to Raiten et al [7], during inflammation, serum Zn enters the liver, and its blood concentration tends to decrease [7]. However, this was not demonstrated for women of reproductive age in the BRINDA project study [22]. The present study's findings are similar to those reported by BRINDA, although it remains unclear how inflammation modifies Zn metabolism in women of reproductive age, who may be influenced by hormonal factors.

Cp is one of the last proteins to rise after the inflammatory stimulus, reaching its maximum concentration within 2 to 5 days [7]. During inflammation, serum Cu leaves the liver bound to Cp, and its concentration tends to increase [30], potentially explaining the lower proportion of women with serum Cu deficiency in the group with inflammation.

The ROC curve is commonly used to estimate the diagnostic capacity of variables related to specific events [45]. The $AUC > 0.7$ [45,46,47], associated with the Cp ROC curve suggests that it could be used to identify individuals with inflammation. Other authors have used Cp as an inflammation biomarker in nutritional evaluation studies [29, 30]. Like AGP, Cp only increases 30 to 60% above its basal value in response to inflammation, with its maximum response occurring between the 4th and 5th day after the inflammatory stimulus. However, AGP 2 to 5 times its basal value during inflammation. CRP value in the presence of inflammation tends to be 20 to 1000 times higher than its baseline value in the first 24 to 48 h of the inflammatory stimulus [7].

Although CRP and AGP are the two most recommended frequently used biomarkers in clinical and population studies, they are not always available, especially in low-resource countries. Therefore, it is desirable to use other biomarkers, even those with lower explanatory power, such as Cp and CRP, which increase at different times after the inflammatory stimulus. The subjective choice of 0.35 g/L as the cut-off point in the present study was based on a reasonable balance between sensitivity and specificity.

The findings of this study serve as a potential alert for Cuban public health, particularly given the current context. The prevalence of low serum Zn levels exceeds 20%, the threshold established by experts to identify populations at risk of this micronutrient deficiency. These results highlight the critical importance of incorporating the assessment of inflammation into clinical protocols for investigating anemia of proba-

ble nutritional origin. Further research is strongly recommended to deepen the understanding of the relationship between anemia, serum Zn and Cu deficiencies, and the impact of inflammation, as well as to identify the underlying factors contributing to micronutrient deficiencies in women of reproductive age.

Among the limitations of this study is the lack of measurement of food intake. The absence of information on dietary intake data limits the possibility to fully interpret the relationship between micronutrient deficiencies and anemia, as well as to identify potential dietary contributors to these deficiencies. The age range used may also be considered a limitation, as women of reproductive age include adolescents from 15 years old to adults over 40 years old. The decision to focus on women aged 18 to 40 was based on the low parity of Cuban women after 40 years and the need to optimize the limited resources available. Despite these limitations, the strengths of the study include the sample size, the biochemical analyses conducted, and the robust statistical analysis employed. Another strength is that this study presents findings using the first micronutrient data from Cuban women.

CONCLUSIONS

In conclusion, the present study highlights the urgent need to address malnutrition problems, particularly micronutrient deficiencies such as Zn and Fe, and their association with anemia. These deficiencies, exacerbated by anemia and inflammation, pose a critical public health concern in Cuba and other developing countries. It also underscores the importance of considering the effect of inflammation on nutritional anemias in clinical practice. Some recommendations include the implementation of targeted interventions such as dietary diversification, nutritional education, and fortification programs, complementing existing strategies for anemia prevention. Further research is essential to explore the interplay between inflammation and micronutrient metabolism, as well as the effectiveness of tailored public policies in reducing these deficiencies. Strengthening surveillance systems to monitor nutritional biomarkers is crucial to inform and evaluate public health initiatives.

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

LIST OF ABBREVIATIONS

INHEM	= National Institute of Hygiene, Epidemiology, and Microbiology
FAO	= Food and Agricultural Organization
CRP-hs	= High Sensitivity C Reactive Protein
AGP	= Alpha-1 Glycoprotein
Cp	= Ceruloplasmin
Fe	= Iron
Zn	= Zinc
Cu	= Copper
BRINDA	= Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia
OR	= Odds Ratio
AUC	= Area Under the Curve

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

This study was conducted with the technical and financial resources of the National Institute of Hygiene, Epidemiology, and Microbiology (INHEM) of the Ministry of Health of Cuba.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to the content of this study.

ACKNOWLEDGEMENTS

Thanks to INHEM Cuba, its technicians and professionals, the working groups from the Hygiene, Epidemiology, and Microbiology Centers in the provinces where the study was conducted, as well as to FAO Cuba and Mesoamerica for their support in reviewing and assisting with the manuscript preparation. The authors wish to express their sincere gratitude to Cathleen Juan, Alex Brito, and Armando Aban for their invaluable contributions in reviewing and providing grammatical corrections to this manuscript.

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RESEARCH ARTICLE



Assessing the Prevalence of Workplace Violence against Nurses Working in Public Health Facilities in Anambra State

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Abstract:

Background of the Study: Workplace violence among healthcare workers in public health facilities including nurses is one of the major issues in health systems today hampering the wellbeing and social improvement of the society. This study assessed the prevalence of workplace violence against nurses working at public health facilities in Anambra state.

Methods: A cross-sectional descriptive design was employed in carrying out the study among nurses working at public secondary and tertiary levels of care facilities in Anambra state. Multi-staged sampling technique was used to select sample 5 facilities and sample size of two hundred and ninety-two nurses. WHO standardized questionnaire on workplace violence was adapted for data collections which were analysed with Statistical Software Package version 16.0.

Results: The results revealed that 75% of the nurses have experienced workplace violence related to their work with verbal violence (60.3%) as the most experience and sexual violence (2.8%) was least experienced with visitors / patient's relatives as the most common perpetrators of workplace violence against nurses.

Conclusion: There is high prevalence of workplace violence among nurses working at the public health facilities in Anambra state. It is imperative for strategic policies by the national and subnational government to address this menace.

Received: August 27, 2024
Accepted: November 22, 2024
Published: January 15, 2025

Keywords: Prevalence, Workplace, Violence, Nurses, Perpetrators.

1. INTRODUCTION

All over the world, health workers are exposed to untold violent experiences more than any other working group. World Health Organization report (WHO) shows that between 8% to 38% of health workers suffer physical violence at some point in their careers and a greater number are exposed to verbal aggression [5]. National Institute for Occupational Safety and Health statistics revealed that 13.2 and 38.8 per 100 nurses per year suffer physical assaults and non-physical assaults respectively [6]. In 2018, Bureau of labour statistics in United States also showed that 73% of workplace injuries and illnesses due to violence were observed among health care workers including nurses [7] It is more worrisome that workplace violence has not only a negative impact on the psychological and physical well-being of health-care staff, but also affects their job motivation and compromises the quality of care and puts health-care provision at risk [5].

Violence could be defined as “incidents where employees are abused, threatened, assaulted or subjected to other offensive behaviour in circumstances related to their work” [8]. This description observed that workplace violence has to do with obnoxious behaviours to which a person is subjugated in circumstances

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related to their work. Workplace Violence as experienced by nurses can be defined “as any act or threat of verbal or physical violence, harassment, intimidation, or other threatening disruptive behaviour that occurs at the worksite with the intention of abusing or injuring the target.” [9]. Literature abound on the negative effect of nurses’ workplace violence on nurses’ health, job satisfaction and quality of care provided to patients [1,2,3]. The matter of violence at the workplace has become a growing transnational challenge which not only hampers the wellbeing of individuals but also hinders societal improvement [4].

Nurses offer quality healthcare services relatively more directly to patients which exposes them more to workplace violence but are not offered adequate security from workplace violence in hospitals and health systems at large despite their pivotal role in the healthcare system hence the rising incidence of workplace violence against nurses [10]. Nurses’ exposures to violence at the workplace are frequent and in several forms such as threats, verbal abuse, intimidation and physical violence [11]. Workplace violence can have grave impacts on the nurse both physically causing mild or serious body injuries. It can affect the victims emotionally leading to low morale for work, poor performance at work and can even lead to death. It also affects service delivery and even the facility as a whole [6].

Previous studies show that Nigeria is not exceptional in the issue of Workplace violence. In Oyo, a south western state in Nigeria, high prevalence of workplace violence was observed as the authors found that almost 60% of nurses experienced workplace violence within one year preceding the study [12]. In a more recent study on Workplace violence among nurses in general hospitals conducted in Osun state, South Western Nigeria, the authors reported that 66% of the nurses had encountered violence at duty [13]. This shows an increase in the prevalence of workplace violence in Nigeria. A study by Olabisi and his colleagues also found that the prevalence of physical, verbal and sexual violence among nurses were 53%, 85% and 25% respectively [14]. Another study in Nigeria found that 72.5% of the health workers have been victims of workplace violence [15]. In southeast Nigeria, a study in Abia state revealed that the prevalence of workplace violence in a tertiary health institution was approximately 88% although the study covered all health workers in the health facility [16]. A more recent study in Enugu state on psychological violence alone found that 50% of nurses experienced psychological violence [17].

However, the researcher discovered that there is an increased prevalence of workplace violence against nurses globally but there is paucity of literature on prevalence of workplace violence among nurses in Public Health facility in Southeast Nigeria particularly Anambra state that will be used to inform policies for effective health administration especially nursing management. This study provides the prevalence of workplace violence among nurses in public health facilities in Anambra state. The information will be important for Health policy makers for policy reviews that will ensure safe working environment for nurses to offer pertinent services to their clients.

2. METHODS

This is part of a cross-sectional descriptive study on work-place violence among nurses working at public health facilities in Anambra state partly published in another journal [18]. Purposive and Random sampling techniques were employed to select two tertiary health facility and three secondary health facilities respectively for the study. The sample size was calculated using the Cochran formula for cross-sectional studies and was 283. Proportionate to size sampling was used to select the respondents from all the selected facilities. A WHO standardized questionnaire on workplace violence was adapted for the study. The questionnaire was self-administered and the data were analyzed using Statistical Package for Social Science (SPSS) software version 16.0 (Stata Corp LLC, California, U.S.A, 2019).

3. ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval protocols were observed and ethical approval was secured from the medical research ethical committee of Nnamdi Azikiwe University Teaching Hospital Nnewi (NAUTH) with reference number NAUTH/C5/66/Vol.16/VER.3/260/2022/148 and data collection approval was secured from Chukwue-meka Odmegwu Ojukwu Univeristy Teaching Hospital (COOUTH) Amaku, Awka with reference number COOUTH/CMAC/Rec.L/Vol.1/FN/04/0093 and state ministry of health, Anambra state with reference

number MH/AWK/M/321/413. The respondents voluntarily participated in the study and anonymity of their identity was maintained.

Table 1. Respondent Characteristics.

Variable	Frequency (n=283)	Percentage (%)
Age in years: <30	37	13.07
31-40	125	44.17
41-50	89	31.45
51-60	32	11.31
Gender: Female	268	94.70
Male	15	5.30
Marital status: Divorced	1	0.35
Married	244	86.22
Separated	1	0.35
Single	37	13.07
Level of education: Diploma	86	30.39
Graduate	154	54.42
Post Graduate	43	15.19
Years of experience: 1-5	56	19.79
6-10	117	41.34
11-15	41	14.49
16-20	34	12.01
>20	35	12.37
Rank:		
Assistant Chief Nursing Officer	16	5.65
Assistant Director of Nursing services	7	2.47
Chief Nursing Officer	32	11.31
Deputy Director of Nursing Services	9	3.18
Principal Nursing Officer	54	19.08
Senior Nursing Officer	82	28.97
Nursing Officer I	43	15.19
Nursing Officer II	40	14.13

The results on the table above portrayed that the modal age of the respondents that participated in the study was 31-40 years which constituted 44.17 percent of the respondents whereas the respondents between 51-60 years (11.31 percent) were the least.

The results also showed that most of the respondents were of female gender 94.70 percent (268) and 5.30 percent (15) were males. This clearly showed that there were more female nurses than male nurses that participated in the study.

The marital status of the respondents was also shown in the results. The results portrayed that 86.22 percent (244) of the respondents were married, 13.07 percent (37) were single, then 0.35 percent (1) each were separated and divorced respectively.

Educational level of the respondents clearly showed that most of the respondents were graduates 54.42 percent (154) followed by diploma holders 30.39 percent (86) and lastly postgraduates 15.19 percent (43).

The results on the table also showed the years of experience of the respondents. The results showed that the majority of the respondents had a working experience between 6-10 years 41.34 percent (117), followed

by 1-5 years 19.79 percent (56) and those with working experience between 16-20 years (12.1 percent, 34) were the least.

The results also portrayed the different ranks or position of the respondents at the time of data collection. Most of the respondents were senior nursing officer 82 (28.97 percent) followed by Principal nursing officer 54 (19.08 percent) and Assistant director of nursing services 7 (2.47 percent) were the least of the respondents.

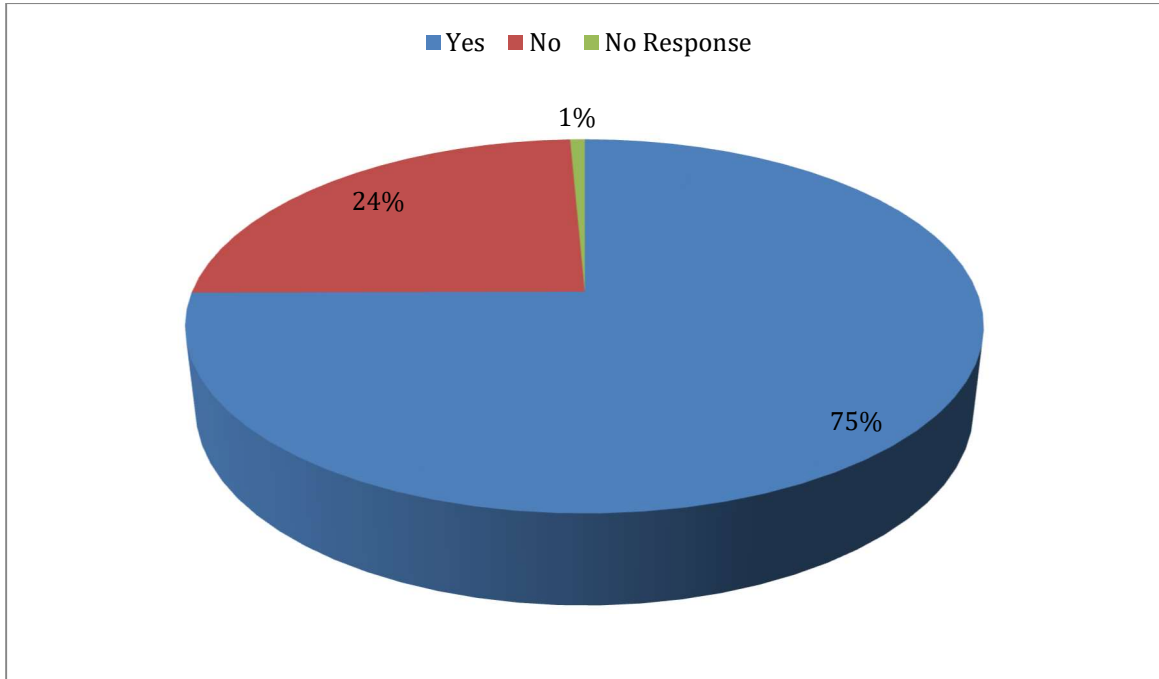


Figure 1. Prevalence of workplace violence among the study participants.

Figure 1 shows that out of the 283 respondents, 75 percent have experienced workplace violence related to their work whereas only 24 percent have not.

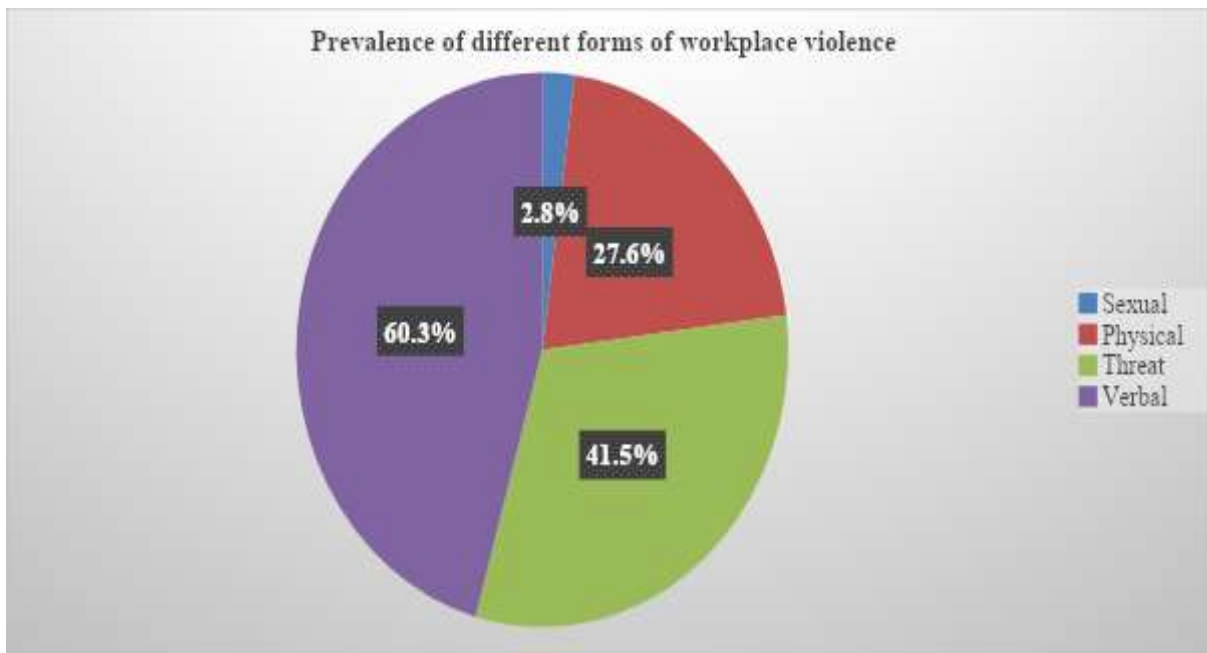


Figure 2. Prevalence of different forms of workplace violence among the study participants.

From the chart above, the majority of the respondents experienced the verbal form of violence (60.3 percent), followed by threats (41.5 percent) and sexual (2.8 percent) was least experienced.

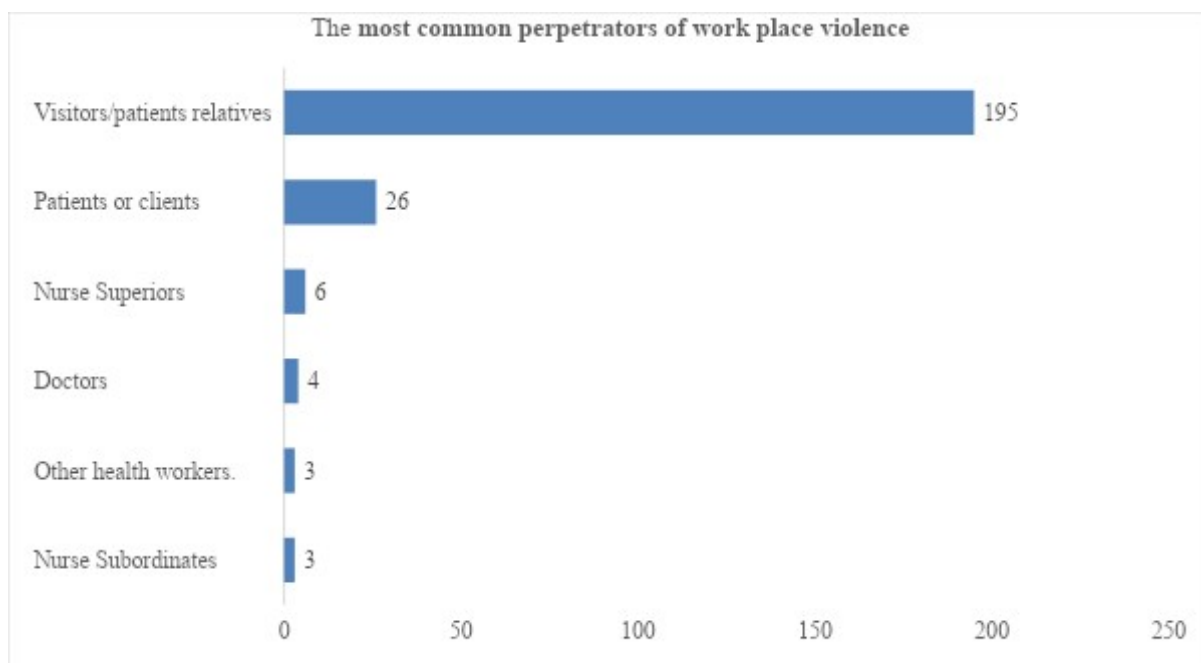


Figure 3. The most common perpetrators of workplace violence.

From the above chart, the most common perpetrators of workplace violence are visitors/patient relatives, followed by patients/clients, nurse superiors whereas doctors, other health workers and nurse subordinates are at the same level.

Table 3. Characteristics of perpetrators.

Variable	Frequency (n=283)	Percentage %
Female	54	19.10
Male	180	63.60
Unknown	49	17.30
Total	283	100
Age group of the perpetrators		
21- 35 years	119	42.05
Above 35 years.	116	40.99
Less than 20 years	1	0.35
No Response	47	16.61
If the perpetrators are under the influence of anything?		
Yes	57	20.14
No	178	62.90
No Response	48	16.96
Total	283	100

The results revealed that the majority of the perpetrators were males (63.60%). The results showed that most perpetrators were between 21-35 years (42.05 percent), followed by those above 35 (40.99 percent) and least of the perpetrators were less than 20 years (0.35 percent). The results on the table also showed that

20.14 percent (57) of the respondents were under an influence whereas 62.90 percent (178) were not under any influence.

4. DISCUSSIONS

We discovered that nurses in Anambra state's public health facilities had a significant rate of workplace violence. 75% of the participants in our study reported having encountered workplace violence. Our results closely align with those of a cross-sectional study conducted in Australia, which reported that 79.3 percent of nurses experienced workplace violence [19]. The results are similarly consistent with a research conducted in Istanbul, which reported that 64.1% of nurses had experienced workplace violence [4]. Additionally, according to an Iranian survey, 69% of nurses have dealt with some sort of workplace violence in the previous year [10]. Nonetheless, a previous Nigerian study discovered a lower rate of workplace violence among Oshogbo nurses was roughly 54%. This is worrisome because it is an indicator that there is little or no improvement in nursing management in Nigeria as the finding is almost a decade ago [12]. This variation may be due to staff shortages as the nurses were usually two on duty most of the time attending to many patients as there is usually a heavy influx of patients in public hospitals.

According to our research, 60.3% of the nurses had been the victims of verbal abuse. This demonstrated that the majority of respondents had encountered verbal abuse. This might be because women made up the majority of the responders. This result agrees with Günaydın and Kutlu's [4] findings. In their investigation of the prevalence of workplace violence among Turkish nurses in Istanbul, the researchers discovered that while nurses were exposed to a variety of violent acts, verbal abuse accounted for the majority of incidents (94.2 percent). This result is consistent with that of a Nigerian study conducted by Abodurin and colleagues [12], which found that verbal abuse accounted for 64.6% of all forms of violence reported by nurses. Verbal abuse (61.0%) was also shown to be connected with workplace violence among nurses employed in public hospitals in Eastern Ethiopia, according to another study conducted in Ethiopia. The results of this investigation are similarly consistent with a Chinese study that found that verbal abuse accounted for 80% of all violent incidents [20]. There is a discrepancy between these results and those of Gad [21], who noted that verbal aggression was experienced by just 27.3% of the respondents. Variations in the research setting may be the cause of this discrepancy.

We also found a prevalence of 41.5 percent of threats in our study. This finding is consistent with that of Banda and associates, where they found threatening behaviours (73%) as one of the common forms of violence experienced by nurses in the workplace [22]. A study in China (17.4%) of Health workers experienced threats in the past year [23]. High prevalence of threat is worrisome because studies have shown that threat alone could lead to fear of service provision in urgent and severe cases in the health facilities. It can also lead to resignation from duty [23]. A recent Nigeria study also revealed high retention risk among health workers including nurses in Nigeria [24].

In this study 27.6 percent experienced physical form of violence which is one of the most common forms of violence experienced by nurses. This finding is consistent with that of Kwok who discovered that physical violence (18%) was one of forms of workplace violence experienced by nurses [20]. Also Shi and colleagues found that 11.8% of the nurses experienced physical violence [25] as well as Zainal who also realised from their study that 11.0% of the nurses suffered physical violence [26]. All these studies agree with the fact that physical violence is one of the common forms of violence experienced by nurses in the workplace, however the varying rates may be due to differences in research context and also shows that more efforts are needed to curb violence among nurses.

Our finding showed that 2.8 percent experienced the sexual form of violence. This study revealed sexual violence as the least form of violence experienced by nurses. This finding is congruent with that of Günaydın and Kutlu, Abodurin, Largesse and Zhang [4,12,27,3] where they discovered from their study that sexual violence was the least experienced form of workplace violence. This could be to the fact that sexual violence is sensitive and cannot be performed in the open unlike other forms of violence.

The study revealed that the commonest perpetrators of workplace violence is patient relatives (63.25 percent). Other perpetrators identified in this study were patients (13.78 percent), colleagues (4.24 percent)

and other hospital staff (1.77 percent). This is not surprising because a study found that family members of a sick person have three primary emotions including sadness, anger, and fear [28]. These emotions can lead to violence and destructive behaviours. This finding is close to that of Günaydın and Kutlu in their study to ascertain the experience of workplace violence among nurses in Istanbul, Turkey. They realised that the most common perpetrators of workplace violence were visitors/patient relatives (56.7 percent) and patients (37.4 percent) [4]. The findings also agree with that of Stanley and Nwosu, in a study to assess workplace violence among primary healthcare workers in Enugu metropolis, wherein they found the main perpetrators of workplace violence to be patient relatives [29]. The finding is also in consonance with a Chinese study which revealed patient relatives (83.1 percent) as the main perpetrators of workplace violence [25]. However, the findings are in contrast with that of Banda and friends, who found patients (71 percent) to be the major perpetrators of workplace violence in their study on violence against nurses in the southern region of Malawi [22]. The disparity could be due to the nature of the patients as per their disease condition because a critical patient may not have the strength to be violent hence their relatives.

We also found that most of the perpetrators were males (63.60 percent) with their major age being between 21 and 35 years, followed by those above 35 years. The major gender that perpetrates violence among nurses found in our study is similar to the finding by Günaydın and Kutlu in Istanbul [4]. This could be the case because women make up the majority of nurses, and in the context of the study, women are still subjected to discriminatory laws, cultural and religious norms, gender stereotypes, low levels of education, and the disproportionate impact of poverty on women. This is despite the fact that non-discrimination and gender equality are guaranteed by the Nigerian Constitution. [30] More still, most of the perpetrators were perceived not to be under the influence of drug or alcohol (62.90 percent) pointing to the fact that most of the perpetrators deliberately inflicted violence on the nurses.

CONCLUSION

The prevalence of workplace violence against nurses in public health facilities in Anambra state is unacceptably high and there are indicators that gender inequality is a factor although the study design being cross-sectional did not allow the establishment of causal relationships. There is a need for strategic policies by health care facility managers to control workplace violence among nurses for improved productivity and job satisfaction.

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

RECOMMENDATIONS

Formal guidelines for reporting and managing Workplace Violence in Health facilities are urgently needed.

Massive awareness campaigns including media campaigns across health facilities in Anambra state involving nurses, patients and other health care staff towards the dangers associated with workplace violence and its prevention workplace violence.

Policy makers should enact apt policies against workplace violence and disseminate it to the public to be informed about the consequences of indulging in workplace violence and be deterred from it.

LIMITATIONS OF THE STUDY

The methodology used in this study limits the establishment of causal relationships.

The study was prone to recall bias as the respondents were required to answer questions like “when did you last experience workplace violence” and that may have affected the study outcome.

The poor attitude of nurses towards research and answering questionnaires. The researcher had to be patient to get the required number of the respondents from each of the facilities

COMPETING INTERESTS

There is no form of conflict of interest among the authors in regard to this study.

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

No funding was received for this study, the study was funded with personal funds.

ACKNOWLEDGEMENTS

Declared none.

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RESEARCH ARTICLE



Factors Associated with Malaria in Regions Implementing Case Based Surveillance in Mainland Tanzania, August 2021 to May 2022

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Abstract:

Introduction: A malaria case-based surveillance system (mCBS) was established in Kilimanjaro, Arusha, and Manyara regions in Tanzania following reports of very low parasite prevalence. The system aims to eliminate malaria by 2030, but had not been analyzed since its start. Our study used data from August 2021 to May 2022 to identify factors associated with malaria among contacts of local cases

Methods: This was a cross-sectional study that analyzed mCBS data collected between August 2021 and May 2022. The dataset included index cases and contacts information obtained through proactive and reactive case detection methods (pro-ACD and re-ACD respectively). Multivariate logistic regression was used to identify factors associated with malaria among contact cases. Statistical significance was tested at a 95% confidence interval and p-value ≤ 0.05

Results: From August 2021 to May 2022, 949 malaria cases were reported, with 63.8% being over 16 years old, median age 20 years. Most cases were local-introduced (96.5%), males accounting for 54.8%. Arusha region reported most cases (53%). Among 642 tested contacts, 51% were female, and only 3.7% tested positive. Factors associated with lower malaria positivity included, household size \geq six members (aOR = 0.11, 95% CI = 0.02 – 0.62), being afebrile past three days (aOR = 0.03, 95% CI = 0.01 – 0.14), having no history of contact with individuals on malaria treatment within past 28 days (aOR = 0.01, 95% CI = 0.004 – 0.04), as well as having no history of travel to malaria-endemic areas within past 28 days (aOR = 0.24, 95% CI = 0.06 – 0.92)

Conclusion: A history of contact with a household member treated for malaria or had travelled to an endemic area in past 28 days as well as a family size with fewer than three members are risk factors for malaria in regions implementing case-based surveillance in Tanzania

Received: August 10, 2024
Accepted: November 15, 2024
Published: January 15, 2025

Keywords: Malaria, Case based surveillance, Reactive case detection, Proactive case detection, Tanzania.

1. BACKGROUND

Malaria remains to be a global disease of public health concern. In 2021, nearly 247 million malaria cases were reported worldwide, of which 95% of them (234 cases) were in Africa. Malaria-related deaths have reduced from 897,000 deaths in 2000 to 619,000 deaths in 2021 (1).

In Mainland Tanzania, the disease prevalence has declined from 18.1% in 2008 to 7.5% in 2017 (2), with the target of eliminating the disease by the year 2030 (3). However, there have been reports of uneven disease distribution among regions such that some regions, such as Kilimanjaro, Arusha,

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and Manyara, have been reporting a very low malaria prevalence of up to <1% (4, 5). These regions were categorised as regions under malaria elimination in Tanzania, and a malaria case-based surveillance (mCBS) system was therefore introduced in these regions as an interventional strategy to ensure that local malaria cases are eliminated.

The mCBS system determines whether an infection was acquired locally, the likely location of the infection, and whether Indigenous transmission leads to onward transmission. Through passive case detection (pro-ACD), local index malaria cases are identified. A reactive case detection (re-ACD) is then conducted in households of identified index cases, where every contact member is tested for malaria using a malaria rapid diagnostic test. Those found positive are treated and classified as either local Indigenous or locally introduced cases (6).

Nations such as China achieved zero Indigenous malaria cases, proving the effectiveness of a case-based surveillance system in contributing to the country's efforts to malaria elimination (7). In the context of Tanzania, since the implementation of mCBS in the year 2020, system data has never been analyzed for decision-making. We used the mCBS dataset collected from August 2021 to June 2022 to determine factors associated with malaria among household members of the identified index cases. The results of this analysis will help the National Malaria Control Program (NMCP) set up interventional priorities to attain disease elimination in the region by 2030.

2. METHODS

This was a cross-sectional study that used secondary data collected from the Malaria case-based surveillance (mCBS) system from August 2021 to May 2022. The dataset included both local malaria cases detected after passive case detection (pro-ACD), and contact cases recorded after reactive case detection (re-ACD) from health facilities in regions implementing case-based surveillance. The data were cleaned and analyzed using Stata (version 15). Bivariate and multivariate logistic regression was used to determine factors associated with malaria among household members of the identified index cases. Statistical significance was tested at 95% CI and p-value ≤ 0.05 .

2.1. Ethical Considerations

The Muhimbili University of Health and Allied Sciences granted permission to conduct the study. Approval to use the data was granted by the National Malaria Control Program (NMCP) in Dodoma, Tanzania. The data were kept confidential and never shared with any third party. Names and addresses of individuals in the dataset were not recorded during data collection.

3. RESULTS

3.1. Demographic Characteristics of Participants

A total of 2667 malaria cases were reported in the system from August 2021 to May 2022. Of these, 949 cases (35.5%) were reported as Local (index) cases. The majority of the index cases were over 16 years old, 63.8% (605/949). Males accounted for most of the index cases by 54.8% (520/949), and the median age of these cases was 20 years (IQR) = 10 - 31). Most of the index cases were classified as local-introduced cases 96.5% (916/949).

On the other hand, of 949 index cases, 642 household/contact members were tested for malaria during re-ACD. The majority of the contacts, 57.6% (370/642), were over 16 years old. Females were most of the reported contacts by 51% (327/642) and had a median age of 20 years old (IQR 95 = 7- 34). Of the 642 contacts, only 24 cases (3.7%) had a positive malaria rapid test. Most of the malaria-positive contacts were classified as local – indigenous 58.3% (14/24). Arusha region had the most index cases, 53% (504/949), and contact members, and 73% (472/642) (Table 1).

Table 1. Characteristics of index and contact cases reported from regions implementing mCBS from August 2021 to May 2022.

Characteristic	Index cases		Contact members	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Age (years)				
≤5	167	17.6	115	17.9
6 – 15	177	18.7	157	24.5
≥16	605	63.8	370	57.6
Region				
Kilimanjaro	153	16.1	31	4.8
Arusha	504	53.1	472	73.5
Manyara	292	31.8	139	21.7
Sex				
Male	520	54.8	315	49.1
Female	429	45.2	327	50.9
Malaria Rapid Test Results				
Positive	949	100	24	3.7
Negative	0	0	618	96.3
Local Case Category				
Indigenous	33	3.5	14	58.3
Introduced	916	96.5	10	41.7

3.2. Risk Factors Associated with Malaria Infection among Family Members Identified through Reactive Case Detection

Factors such as age, sex, family size, history of fever in the past three days before re-ACD, history of contact with a person treated for malaria in the same household in the past 28 days, as well as the history of travel to a malaria endemic area in the past 28 days, were analyzed to assess their association with testing positive for malaria among contact cases

Multivariate analysis showed that the odds of a positive malaria rapid test decreased with an increase in family size such that households whose family size was over members had 81% lower odds of having a positive malaria rapid test compared to households with a family size of less than three members (aOR = 0.19, 95% CI = 0.05 – 0.72). Similarly, household members who had a history of contact with a household member who had been treated for malaria in the past 28 days had 2.6 times the odds of having a positive malaria rapid test compared to those who had not contacted household members known to have been on malaria treatment (aOR = 2.60, 95% CI 113 = 1.11 – 6.06). On the other hand, household members who had a history of travel to malaria- endemic areas in the past 28 days had about four times the odds of testing positive for malaria compared to those who hadn't travelled (aOR = 3.67, 95% CI = 1.47 – 9.20) (Table 2).

4. DISCUSSION

Tanzania is among malaria endemic countries in the world with malaria prevalence varying within and among its regions. The burden of malaria varies from as low as <1% in the highlands to as high as 24% along the Lake and Western zones of the country. As an interventional strategy toward disease elimination in the country by the year 2030, malaria case-based surveillance was introduced in regions that consistently reported a disease prevalence of <1%.

Table 2. Bivariate and Multivariate Logistic regression analysis of factors associated with malaria infection identified through reactive case detection

Characteristics	Malaria rapid test results		Bivariate analysis	Multivariable analysis		
	Positive N (%)	Negative N (%)	cOR*(95% CI)	p-value	aOR*(95% CI)	p-value
Age (Years)						
≤ 5	6 (5.2)	109 (94.8)	1.6 (0.60 – 4.48)	0.33		
6 – 15	6 (3.8)	151 (96.2)	1.2 (0.44 – 3.22)	0.74		
≥16	12 (3.2)	358 (96.8)	1			
Sex						
Male	8 (2.5)	307 (97.5)	0.51 (0.21 – 1.20)	0.12	0.46 (0.19 – 1.12)	0.09
Female	16 (4.9)	311 (95.1)	1			
Family Size						
≤ 3	9 (7.1)	117 (92.9)	1			
4 - 5	12 (4.1)	280 (95.9)	0.56 (0.23 – 1.36)	0.20	0.66(0.27 – 1.66)	0.38
≥6	3 (1.3)	221 (98.7)	0.18 (0.05 – 0.66)	0.01	0.19(0.05 – 0.72)	0.02
History of Fever Three Days Prior re-ACD						
Yes	11 (4.1)	257 (95.9)	1.19 (0.52 - 2.70)	0.68		
No	13 (3.5)	361 (96.5)	1			
Contact with a Family Member Treated for Malaria Last 28 Days						
Yes	14 (5.9)	224 (94.1)	2.46(1.08 -5.63)	0.03	2.60 (1.11 - 6.06)	0.03
No	10 (2.5)	394 (97.5)	1			
History of Travel to a Malaria-Endemic Area Past 28 Days						
Yes	8 (9.2)	79 (90.8)	3.41 (1.41 – 8.23)	<0.01	3.67 (1.47– 9.20)	<0.01
No	16 (2.9)	539 (97.1)	1			

Note: *cOR = Crude Odds Ratio, aOR = Adjusted Odds Ratio

Our study investigated factors associated with malaria infection in regions implementing Case Based Surveillance in Tanzania from August 2021 to May 2022. The findings suggest that having a history of contact with a household member who had been on malaria treatment in the past 28 days as well as having a history of travel in a malaria endemic area within the past 28 days, are significantly associated with increased odds of malaria positivity, whereas having a family size of more than 6 members is significantly associated with reduced odds of malaria positivity.

We observed significantly higher odds of having a positive malaria test in individuals with a history of contact with a person previously treated for malaria in the past 28 days. Similar findings have been reported by previous literature (8–11). This concern may have been contributed by either delay in obtaining a malaria treatment or non-adherence to antimalarial drugs, which may have all contributed to increased risk of disease transmission from index cases to contacts. Increased malaria infectivity has been reported by individuals who had delayed or had not adhered to malaria treatment (12). These factors may have made these individuals act as reservoirs for the ongoing transmission of malaria parasites from one individual to another in the household. The lack of index case data on drug adherence and schedules from this dataset provides a setback to making comparisons with other studies.

Furthermore, our analysis showed that a history of travel to the malaria-endemic area in the past 28 days before re-ACD was significantly associated with an increased risk of having a positive malaria test. These

results are congruent with the findings reported from a meta-analysis study that reported travel as a key risk factor for malaria transmission in pre-elimination settings (13). Similarly, our results are also similar to previous literature (14–16). Being regions of potential tourism interest, Kilimanjaro, Arusha, and Manyara regions are likely to be visited by different individuals across the world who might be potential sources of the infection. However, the use of ultra-sensitive diagnostic tests such as loop-mediated isothermal amplification polymerase chain reaction has been suggested as an alternative approach to early detection of travel-associated malaria at key border entry points (17).

Surprisingly, our analysis has revealed that the higher the family size of more than 6 members, the lower the risk of malaria infection. This finding is contrary to what has been reported by other literature on an increased risk of malaria infection with increasing family size (18–20). Other studies have found no significant association between family size and risk of malaria transmission (21, 22). However, households with larger family sizes have been associated with having good knowledge and positive attitudes about malaria (23). Therefore, households with large family sizes, are more likely to use their good knowledge engaging in malaria prevention practices enough to cover a large area of house surroundings during cleaning.

CONCLUSION

Having a history of contact with a family member treated for malaria or had traveled to a malaria-endemic area in the last 28 days, as well as having a family size of fewer than three members, were risk factors for positive malaria rapid tests among contacts of index cases in the Kilimanjaro, Arusha, and Manyara regions under malaria surveillance. Enhancing community engagement in malaria elimination programs could accelerate progress in these regions.

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The author confirms that this article's content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

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RESEARCH ARTICLE



Assessment of Breakfast Consumption Habits and Nutritional Status of Adolescents in Selected Secondary Schools in Abeokuta, Ogun State, Nigeria

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Abstract:

Background and Objectives: Learning healthy eating habits in adolescence is an investment in one's current and long-term well-being. This study evaluated the breakfast eating patterns and nutritional condition of adolescents attending secondary schools in Abeokuta, Ogun state.

Materials and Methods: The study's design was cross-sectional and descriptive; 200 adolescent boys and girls were chosen using a multi-stage sample technique. Standard Procedures were used to take anthropometric measurements and a breakfast consumption habit questionnaire was used to gather information about breakfast consumption habits.

Results: The BMI-for-age was computed using WHO Anthro software. 96.5 percent of students eat breakfast, 89.5% report feeling better after eating breakfast in class, and 79% believe breakfast is the most important meal of the day. Of the evaluated pupils, 2% were obese, 5% were overweight, and 27.5% were underweight.

Conclusion: These results point to the necessity of education and awareness campaigns highlighting the benefits of eating breakfast every day.

Received: October 31, 2024
Accepted: December 28, 2024
Published: January 15, 2025

Keywords: Food Habits, Anthropometric, Adolescents, First meal.

1. INTRODUCTION

One of a person's quickest growing stages in life is adolescence. At this point, growth calls for a lot of energy, much of which can only be obtained from eating healthful meals [1]. The adolescent's lifestyle and eating habits as an adult will be influenced by the food habits they develop throughout this period [2]. Breakfast is the most important meal of the day and should consist of whole grains, fruits, vegetables, and dairy products as well as other dietary categories and calcium sources. Breakfast has been identified as a critical meal linked to increased blood glucose levels, high protein, vitamin, and mineral intake, and more [3]. Breakfast is different from the other meals we eat in that it is consumed after the longest postprandial fast—in this case, an overnight fast—from a physiological perspective. It replenishes the glucose reserves to boost vitality and attentiveness. Children's cognitive performance may be enhanced by regular breakfast consumption and higher-quality breakfast foods [4]. The breakfast also supplies other vital nutrients needed for optimal health.

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A comprehensive and balanced diet must be consumed in order to preserve health in the best possible way and avoid health risks over one's entire life. But because diet affects brain maturation and future health markers, it becomes crucial during the developmental stage and especially during early adolescence [5]. Adolescent eating habits are therefore crucial to their general well-being, conduct, and cognitive function—all of which are significant outcomes at the age of the scholar [6]. According to the World Health Organization (WHO), having a healthy breakfast is critical for providing energy and vital nutrients for the best possible physical and cognitive performance [7].

Nonetheless, not enough research has been done to explicitly look at the breakfast habits and nutritional status of Abeokuta secondary school pupils. This study was motivated by the fact that most earlier studies [8,9] focused on breakfast eating patterns and nutritional status in primary school students, ignoring the unique demands and difficulties experienced by secondary school students.

2. MATERIALS AND METHODS

A descriptive cross-sectional study was carried out to evaluate the breakfast consumption patterns and nutritional health of 200 adolescents enrolled in particular secondary schools in Abeokuta, Ogun State. This study's participants were adolescents between the ages of 10 and 19 who attended a recognized secondary school. Students who did not provide permission or whose ages do not fall between 10 and 19 were not allowed to participate. The process of collecting data involved the use of a multi-stage sampling technique. Out of the 21 wards in Ogun State's Abeokuta South and Abeokuta North Local Government Areas, 4 wards were chosen using a simple random selection technique. Using a random sampling technique, four (4) secondary schools were chosen from the designated wards. From the chosen schools, 200 pupils in total were chosen at random to be assessed.

2.1. Data Collection

A structured questionnaire was employed to collect data from the participants. There were four sections to it. The first section gathered information on the respondents' sociodemographic and socioeconomic traits. The second section gathered information on the respondents' breakfast consumption patterns. Data on the respondents' food consumption habits were gathered in Section three. A customized food frequency survey was employed. Data on the respondents' anthropometric traits were gathered in Section four. The respondents' weights and heights were recorded, and this information was used to determine their Body Mass Index (BMI). The weight/height² formula was used to calculate the respondents' body mass index, which was then compared to BMI-for-age look-up tables for children and adolescents aged 5 to 18.

2.2. Statistical Analysis

Using statistical package software for analysis (SPSS version 25.0) and the mean, median, and mode as well as frequencies and percentiles, the collected data was subjected to descriptive statistics analysis. The anthropometric information of the adolescents was examined using WHO Anthro software.

2.3. Ethical Consideration

Ethical approval was obtained from the Ogun State Hospital, Ijaye Abeokuta, Reference Number: SHA/RES/VOL.23/055. The Ogun State school board, the relevant school administrators, and the respondents provided written, informed consent for the study to be conducted. At the beginning of the study, the respondents provided their informed consent; they were free to withdraw from the study at any moment if it did not feel right for them.

3. RESULTS

The demographic and characteristic details of the surveyed respondents, including age, gender, class, religion, parents' educational attainment, and family size (Table 1). The section titled "Breakfast Consumption Habits of the Respondents" offers insights into the respondents' beliefs and habits related to breakfast consumption. In terms of breakfast consumption, the majority of respondents (96.5%) reported eating breakfast, while a small percentage (3.5%) indicated they did not. Regarding how often they ate

breakfast, about half of the respondents said they did so every day, followed by 24.5% who said they did so 1-3 times per week and the same amount who said they did so 4-6 times per week.

Table 1. Demographic and Socio-Economic Status of the Respondents.

Variable	Frequency (n=200)	Percent
Gender		
Male	83	41.5
Female	117	58.5
Religion		
Christianity	162	81
Islam	37	18.5
Others	1	0.5
Ethnic group		
Yoruba	170	85
Igbo	19	9.5
Hausa	2	1
Others	9	4.5
Class		
JSS1- JSS3	74	37
SSS1- SS3	126	63
Father's occupation		
Civil servant	98	49
Trader	22	11
Teacher	15	7.5
Farmer	4	2
Others	61	30.5
Mother's occupation		
Civil servant	66	33
Trader	40	20
Teacher	42	21
Farmer	5	2.5
Others	47	23.5
Father's level of education		
Primary school	5	2.5
Secondary school	12	6
Post-secondary school	183	91.5
Mother's level of education		
No formal education	3	1.5
Primary school	4	2
Secondary school	20	10
Post-secondary school	173	86.5

Variable	Frequency (n=200)	Percent
Number of children in the family		
1-3	129	64.5
4-6	68	34
7 and above	3	1.5

Concerning where they got their breakfast, 77.5% of respondents reported it was something they made at home, while only 3% reported they got it somewhere else. Furthermore, 17% of respondents reported they got their breakfast from a combination of buying and preparing it at home. On the timing of breakfast consumption, 45% of participants said they ate it between 6:00 and 7:30 am, followed by 22.5% between 7:31 and 8:30 am, and 30% between 8:31 and 9:30 am. When asked where they ate breakfast, 83% of respondents revealed they did so at home. Only 5% and 10% of respondents, respectively, reported they ate breakfast at school or on the way to school.

Of the respondents, 82.5% reported they had eaten breakfast during the previous 24 hours, and 17.5% reported they had not. 89.5% of those who ate breakfast reported feeling more alert and focused in class on those days as opposed to those when they skipped it. 88.5% of students who were asked how they felt in class said that they paid attention and focused, 6% said they were fatigued, 2.5% said they had trouble focusing, and 3% stated they frequently fell asleep.

When asked if they always felt more focused and energized after eating breakfast, 61.5% responded that they did, 20.5% that they did most of the time, 11.5% that they did occasionally, and 6.5% that they did not really. When asked if their academic performance differed on day they skipped breakfast vs days they had it, 50.5% said they performed better on the days they skipped breakfast, 35.5% said they saw no difference, and 14% said they did not skip breakfast, and therefore couldn't compare.

Very high (42.5%), high (48.5%), average (8.5%), and low (0.5%) were the responses given by respondents regarding their level of concentration in morning classes. A sizable portion of the respondents (70.5%) reported skipping meals; 26% skipped breakfast, 48% skipped lunch, and 7.5% skipped dinner. The reasons given for skipping breakfast included not having enough time in the morning (35.5%), not feeling hungry (18.5%), not liking breakfast foods (4%), wanting to sleep longer (2.5%), and not having access to breakfast items (1%).

When it comes to attitudes on breakfast and health, the majority—79%—strongly agreed that having a sufficient and nourishing breakfast is crucial for general health and wellbeing, with only 17.5% disagreeing. Just 0.5% of respondents strongly disagreed, and 3% disagreed. The information gathered on the respondents' food consumption patterns is displayed in Tables 2-4. The results show how frequently different food groups—from drinks to staple foods—are consumed.

Information on the respondents is provided via their anthropometric characteristics, which include their height, weight, and body mass index (BMI). The weight ranged from 26 kilograms at the lowest to 87 kilograms at the most. The heights varied from 1.28 meters at the lowest to 1.84 meters at the highest.

Table 2. Food Consumption Pattern of the Respondents.

Food Groups	Never	1-3 days	4-6 days	Everyday	More than once per day
Drinks/Beverages					
Energy Drinks	18%	22%	20%	20%	21%
Carbonated Drinks	18%	20%	18%	25%	20%
Malt Drinks	20%	25%	23%	23%	10%
Zobo	19%	22%	20%	22%	18%
Kunu	25%	25%	18%	18%	15%

Food Groups	Never	1-3 days	4-6 days	Everyday	More than once per day
Cocoa Drinks	26%	24%	16%	17%	18%
Herbal Drinks	23%	25%	23%	15%	15%
Yam					
Boiled Yam	14%	33%	22%	21%	12%
Roasted Yam	17%	21%	22%	22%	19%
Fried Yam	15%	23%	25%	21%	17%
Amala Dudu	13%	20%	22%	26%	20%
Yam Pottage	11%	28%	22%	20%	20%
Pounded Yam	16%	28%	22%	21%	14%
Ikokore	16%	28%	22%	21%	14%
Boiled Water Yam	14%	21%	24%	19%	23%
Fried Water Yam	15%	21%	33%	19%	14%
Ojojo	15%	24%	24%	24%	14%
Potatoes					
Boiled Sweet Potatoes	19%	25%	24%	19%	14%

Table 3. Food Consumption Pattern of the Respondents (contd.)

Food Groups	Never	1-3 days	4-6 days	Everyday	More than once per day
Potatoes					
Fried Sweet Potatoes	14%	21%	21%	23%	21%
Sweet Potato Pottage	21%	23%	19%	18%	20%
Boiled Irish Potatoes	15%	20%	20%	23%	23%
Fried Irish Potatoes	21%	23%	22%	17%	19%
Irish Potato Chips	13%	18%	29%	21%	19%
Mashed Irish Potatoes	20%	24%	19%	18%	20%
Poundo Potato	16%	24%	22%	17%	22%
Plantain					
Boiled Plantain	11%	24%	30%	19%	18%
Roasted Plantain	14%	27%	25%	18%	18%
Fried Plantain	16%	24%	22%	18%	21%
Plantain Chips	15%	26%	19%	21%	21%
Plantain Flour Meal	20%	23%	21%	20%	17%
Rice					
White Rice (Boiled)	22%	21%	23%	17%	19%
Jollof Rice	21%	24%	19%	18%	18%
Fried Rice	20%	27%	19%	17%	19%
Ofada Rice	15%	23%	33%	20%	10%
Coconut Rice	21%	38%	12%	20%	11%
Tuwo Shinkafa	33%	20%	20%	15%	13%

Food Groups	Never	1-3 days	4-6 days	Everyday	More than once per day
Maize					
Eko/Agidi	12%	17%	28%	26%	17%

Table 4. Food Consumption Pattern of the Respondents (contd.)

Food Groups	Never	1-3 days	4-6 days	Everyday	More than once per day
Maize					
Popcorn	11%	33%	22%	15%	20%
Maize Pap	14%	22%	24%	30%	10%
Tuwo Masara	18%	20%	30%	20%	13%
Egbo	20%	19%	16%	18%	28%
Corn Flakes	15%	17%	19%	31%	19%
Golden Morn	19%	22%	32%	18%	10%
Wheat					
Macaroni	20%	25%	15%	23%	18%
Whole Wheat Bread	18%	24%	16%	22%	21%
White Bread	20%	23%	28%	15%	16%
Semolina	20%	20%	23%	20%	18%
Spaghetti	2%	3%	2%	3%	2%
Noodles	22%	32%	15%	18%	15%
Wheat Flour Meal	18%	22%	21%	22%	19%
Beans					
Beans Pottage	20%	25%	20%	13%	23%
Bean Cake	21%	18%	26%	16%	19%
Moi-Moi	21%	19%	21%	24%	17%
Gbegiri	9%	17%	31%	12%	32%
Ekuru	10%	33%	26%	18%	14%
Akara Chips	14%	16%	34%	19%	17%

Table 5 provides information on the respondents' Body Mass Index (BMI) categories. Approximately 27.5% of the 200 responders who underwent assessment fell into the underweight category, with a BMI-for-age. A smaller portion of the respondents, 5%, were classed as overweight with a BMI that was appropriate for their age, while the majority, 65.5%, fell within the normal range. Finally, 2% of the participants met the criteria for obesity, based on a BMI range.

4. DISCUSSION

This study was designed to evaluate adolescents' breakfast habits and nutritional status in a subset of Abeokuta's secondary schools. In this study, there are more female participants than male participants lateef *et al.* [10], Medin *et al.* [11], and numerous more researchers have revealed similar findings. It was usual for the parents of the respondents to have completed postsecondary education. This can indicate increased purchasing power and a higher standard of living. It might also have an impact on parents' level of knowledge and the dietary care they provide for their children. According to the study, the majority of respondents had breakfast at home, and 20% had breakfast at school. These findings are consistent with re-

search from a few developed nations that have studied the issue of schoolchildren not eating breakfast at school [12]. It is impossible to overstate the influence that parents have in forming their children's breakfast-eating habits. In addition to allowing parents to closely monitor their children's breakfast consumption, parents should prepare wholesome food for their children to eat before they go for school [13].

Table 5. BMI Category of the Respondents.

BMI-for-age Category	Frequency (n=200)	Percent
Underweight (-3 SD < Z < -2 SD)	55	27.5
Normal (-2 SD < Z < 1 SD)	131	65.5
Overweight (1 SD < Z < 2 SD)	10	5
Obese (> 2 SD)	4	2

The majority of the respondents' eating habits also reveal that they ate less vegetables and eggs and more items from the groupings of cereals, roots and tubers, fruits, meats, oils, and fats. This could have an impact on the respondents' access to the nutrients (such as proteins and minerals) included in these dietary groups. The cause of this, nevertheless, might be attributed to fast food being a part of modern living, which makes it one of the least consumed or badly prepared meals. The overwhelming majority of study participants indicated that they eat breakfast, which is consistent with research by Adonu *et al.* [14] and Guiné, *et al.* [15] in which the author found that 78.4% of participants consistently eat breakfast. The fact that the data collection period coincided with school exams may have contributed to the high percentage of respondents who reported eating breakfast the day before. The majority of students often ate breakfast to avoid feeling peckish while taking the test. Another study conducted among teenagers according to similar findings published by Foluke *et al.* [16], most participants had breakfast the day prior to the data collection. Just a small minority of participants in this survey had breakfast at school; the majority of respondents had breakfast at home. The practice of eating breakfast at home is beneficial since, in comparison to home-cooked meals, meals consumed outside the home typically have smaller amounts, a higher calorie content, and are generally unhealthy dietary selections [17].

The study participants engaged in breakfast intake on an almost regular basis, with nearly all of them acknowledging to have had breakfast. This encouraging result might be the result of the respondents living with their parents, guardians, or other caregivers, who take on the responsibility of deciding what to eat and when. The discovery that over 75% of the participants ate breakfast consisting of homemade items lends support to this conclusion. Since more than three-quarters of the respondents have breakfast at home, this is useful as it may encourage healthy eating habits among adolescents and give parents and guardians the chance to keep an eye on the first meal their wards are ingesting. The majority of study participants acknowledged that eating breakfast improves their ability to concentrate in early lectures. This is to be expected, as breakfast breaks the overnight fast, as the name implies. It supplies additional vital nutrients needed for optimal health while also replenishing the body's glycogen reserves, which increase energy and alertness. For general health and wellness, most study participants agreed—and agreed strongly—that eating a sufficient and nourishing breakfast is essential. This may also serve as a catalyst for their optimistic outlook on eating breakfast.

This study's findings are consistent with those of several previous studies since most of the adolescents were within the normal range for BMI [11, 18].

CONCLUSION

This study provided valuable insights into the physical health, breakfast habits, nutritional status, and daily dietary practices of the respondents. The bulk of responders were placed into the normal BMI range, according to an analysis of BMI categories. It is noteworthy, therefore, that while a lesser percentage was classed as overweight and obese, a large fraction was classified as underweight. When data on breakfast consumption patterns are taken into account, it becomes clear that the majority of respondents reported eating breakfast on a regular basis, indicating the meal's significance in their daily routines. Additionally, the respondents reported feeling more at ease and focused in class on the days when they had breakfast, suggesting that eating breakfast may have a good effect on their general wellbeing. A small percentage of respondents gave the following excuses for skipping breakfast: not feeling hungry, lack of time in the morning, and dislike of breakfast foods. These results point to the necessity of education and awareness campaigns that highlight the benefits of eating breakfast every day and offer solutions for typical obstacles.

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

There are no funding sources

CONFLICT OF INTEREST

The author confirms that this article's content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

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RESEARCH ARTICLE



Investigation of Moral Distress in the Emergency Department Nurses: A Cross-sectional Study from Northwest of Iran

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Abstract:

Background and Objectives: Nurses working in the emergency department increasingly face moral distress due to the nature of their profession, negatively affecting their love and compassion toward the patient. Therefore, this study sought to investigate of moral distress in the nurses of the emergency departments of the hospitals in Ardabil.

Methods: The current cross-sectional (descriptive correlational) study was conducted using consensus sampling. The study population comprised all nurses working in the emergency departments of hospitals in Ardabil in 2022(N=283; 21 people did not meet the inclusion criteria and were excluded from the study, leading to a sample size of 262). Data were gathered using standard questionnaire moral distress by Hamric *et al.* (2012). The data were analyzed using SPSS - 20 software and descriptive s (mean, standard deviation and frequency) and inferential statistics, including independent T-test and one-way ANOVA.

Results: Moral distress was higher than average in governmental hospitals (2.12±0.58) and below average in private and social security hospitals (1.72±0.68). In addition, there was a significant correlation between gender (p=0.001) and income (p=0.003) and MD. According to the results, the mean of MD was higher in male than female nurses. In addition, the results showed that the higher the income, the lower the MD (the significance level of the test error for the confidence level was 0.95).

Conclusion: The level of moral distress reflects the impact of conditions causing moral distress on the quality of care and the necessity to prevent such conditions by providing appropriate solutions. Informing nurses about moral distress and its consequences and providing periodic counseling can contribute to its identification and control.

Received: October 09, 2024
Accepted: November 25, 2024
Published: January 15, 2025

Keywords: Moral Distress, Nurses, Emergency Department.

1. INTRODUCTION

Providing high-quality healthcare services and increasing customer satisfaction with healthcare are among the main goals of healthcare and the most significant responsibilities of healthcare managers (1). Nurses are actively involved day and night in providing clinical care to clients (2) and are legally and ethically responsible for quality care (3). Therefore, they should be able to manage ethical challenges and problems effectively (4).

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Moral distress (MD) is one of the most critical moral issues and problems among nurses (5-7). MD was proposed for the first time by Jumpton (1984), who described it as a psychological imbalance caused by ethical decisions that do not lead to ethical performance due to organizational limitations (8, 9).

Previous studies have reported different levels of MD among nurses (10). For example, one study showed that 23.1%, 45.1%, and 31.8% of nurses had low, moderate, and severe MD, respectively. (11) Another study reported low levels of MD among nurses (12).

MD may be associated with different problems for nurses, such as burnout, low job satisfaction, poor quality of care, intention to leave the profession, and compassion fatigue (13–17). Nurses respond to the existing conditions in different ways, including opposition, failure to adapt to the existing conditions, expressing dissatisfaction, and leaving their profession (18). Meanwhile, some nurses, forced to endure the existing conditions contrary to their desire, gradually refuse to be at the bedside of patients and provide care to them, experiencing frustration and fatigue in providing patients with the required care (18,19).

On the one hand, moral distress is a critical issue in the nursing profession, and on the other hand, nurses face special working conditions in our society from various cultural and organizational aspects, which can lead to specific moral problems and adverse consequences on the quality of care and professional conditions of nurses. Therefore, the study aimed to provide a clear picture of the moral distress in nurses working in the emergency departments of Ardabil hospitals and develop educational interventions to improve the current situation.

2. MATERIALS & METHODS

2.1. Study Design and Setting

The current cross-sectional (descriptive correlational) study aimed to investigation of moral distress in the nurses of the emergency departments of the hospitals in Ardabil Province, Iran.

2.2. Study Participants and Sampling

The statistical population included all nurses working in emergency departments in Ardabil city (N=283; 21 people did not meet the inclusion criteria and were excluded from the study, leading to a sample size of 262). The research setting was all emergency departments of hospitals in Ardabil, including the public hospitals of Imam Khomeini (n=117), Dr. Fatemi (n=46), Alavi (n=17), Bu Ali (n=25), and Imam Reza (AS) (n=17), private hospitals (Arta and Qaem) (n=8), and social security hospital (Sablan) (n=32). The research was conducted from April to September 2022.

Having at least a bachelor's degree in nursing, at least one year of work experience in the emergency department, and involvement in direct patient care in the emergency department were the inclusion criteria. Also, lack of consent to participate in the study, lack of cooperation to continue the project, and incomplete completion of the questionnaires were the exclusion criteria.

The sampling method was consensual, conducted by distributing 283 questionnaires among nurses in the research environment. Totally, 262 respondents answered the questionnaires (8 people were excluded due to lack of cooperation and 13 because of less than one year of experience).

2.3. Data Collection Tool and Technique

Data were gathered using a questionnaire. The first part of the questionnaire was about demographic information (age, sex, work experience, marriage, etc.), and the second part of the questionnaire was about moral distress (19).

The 21-item Hamric *et al.*'s standard moral distress questionnaire (2012) was designed for nurses. The scoring method of this questionnaire is based on a 5-point Likert scale from zero (none) to four (very high). In their study, Corley *et al.* divided the score of frequency and severity obtained from the whole scale into three categories: low (0-2), average (2.01-4), and high (4.01-6) (20). The content validity of this questionnaire was assessed and confirmed by experts (CVI=89%), and Cronbach's alpha was used to obtain its reliability, which was 0.87 for the whole questionnaire.

Questionnaires were distributed among the nurses working in the emergency departments of Ardabil hospitals in different shifts and filled by them.

2.4. Data Analysis

The data were analyzed using SPSS-20 software and descriptive and inferential statistics. Frequency distribution tables, mean, and standard deviation were used for descriptive statistics. Independent t, and one-way ANOVA were used to analyze the correlation between variables at a significance level of 0.05 ($P < 0.05$). Also, the Kolmogorov-Smirnov test was used to determine the normality of the study variables (Table 1).

Table 1. The Kolmogorov-Smirnov test results to determine the normality of research variables.

Statistics	Moral distress
Kolmogorov-Smirnov z value	1.18
significance level	0.12

Based on the results of Table 1 and considering that the significance level of the test error is > 0.05 for the confidence level of 0.95, the distribution of the research variables is normal, and parametric tests can be used to analyze the hypotheses.

2.5. Ethical Considerations

Ethical considerations of the study included obtaining permission to start work and the code of ethics from the research vice-chancellor of Ardabil University of Medical Sciences, introducing the researcher and explaining research objectives to the subjects, and taking into account their willingness to participate in the research and ensuring the anonymity of the participants (consent to complete the questionnaire). It should be mentioned that the consent to complete the questionnaire was mentioned in a completely clear and expressive manner in the first part of the research questionnaire. This article is a part of the emergency nursing master's thesis under the code of ethics IR.ARUMS.REC.1401.064, conducted at Ardabil University of Medical Sciences without financial support.

3. RESULTS

According to the descriptive results, 67.9% of nurses were married, and 32.1% were single. Also, 43.9% of nurses were < 30 years old, 43.9% were 30 to 40 years old, and 12.2% were > 40 years old. Of the practitioners, 93.1% had a bachelor's degree, and 6.9% had a master's degree. It was also shown that 24.4% of nurses had > 10 years, and 42% had < 5 years of service experience. Finally, 4.2% of nurses stated their income as high, and 59.9% stated their income as average (Table 2).

Table 2. Frequency of personal characteristics of participating nurses.

Demographic characteristics	Frequency	Percent
Sex Male	95	36.3
Female	167	63.7
Marital status Married	178	67.9
Single	84	32.1
Age < 30 years	115	43.9
30 to 40 years	115	43.9
> 40 years	32	12.2
Education Bachelor's degree	244	93.1
Master's degree	18	6.9

Demographic characteristics	Frequency	Percent
Work experience <5 years	110	43
5 to 10 years	88	32.6
>10 years	64	24.4
Employment type Official	142	54.1
Contractual	42	16
Temporary-to permanent	19	7.3
Corporate	13	5
Service commitment	46	17.6
Income Low	94	35.9
Average	157	59.9
High	11	4.2
Shift Fixed	40	15.3
Rotating shift	222	84.7

The results showed higher-than-average levels of moral distress in governmental hospitals (2.12 ± 0.58). The highest amount of MD belonged to Alavi hospital nurses (2.34 ± 0.55), followed by Bu Ali (2.29 ± 0.45) and Imam Reza (2.26 ± 0.52) hospital nurses. Meanwhile, the lowest amount of MD belonged to social security hospital nurses (1.69 ± 0.60).

Therefore, according to the results of the study, MD was higher than average in Fatemi, Bu Ali, Imam Reza, and Alavi hospitals and Imam Khomeini Corona emergency department and below average and low in Imam Khomeini emergency department, private hospitals, and social security hospital (Table 3).

Table 3. Mean and standard deviation of nurses' moral distress in the emergency department of different hospitals.

Hospital	Mean	SD
Dr. Fatemi Educational and Treatment Hospital (Governmental)	2.22	0.62
Bu Ali Educational and Treatment Hospital (Governmental)	2.29	0.45
Imam Reza Educational and Treatment Hospital (Governmental)	2.26	0.52
Alavi Educational and Treatment Hospital (Governmental)	2.34	0.55
Corona emergency of Imam Khomeini Educational and Treatment (Governmental)	2.04	0.62
Internal emergency of Imam Khomeini Educational and Treatment (Governmental)	1.99	0.61
emergency hospitalization of Imam Khomeini Educational and Treatment (Governmental)	1.76	0.73
Private Hospitals (Arta and Qaem)	1.76	0.76
Sablan Social Security Hospital	1.69	0.60
Total	2.04	0.63

In addition, there was a significant correlation between gender ($p=0.001$) and income ($p=0.003$) and MD. According to the results, the mean of MD was higher in male than female nurses. In addition, the results showed that the higher the income, the lower the MD (the significance level of the test error for the confidence level was 0.95).

4. DISCUSSION

According to the results of the study, the average moral distress in the emergency department of Ardabil hospitals was 2.04. Also, the highest mean of MD was related to the emergency nurses of Alavi hospital (2.34), followed by the emergency nurses of Bu Ali (2.29) and Imam Reza (2.26) hospitals. Meanwhile, the lowest average of MD was related to the social security hospital's emergency nurses (1.69). Besides, MD

was higher than average in Dr. Fatemi, Bu Ali, Imam Reza, and Alavi hospitals and Imam Khomeini Corona emergency departments, and lower than average in the Imam Khomeini emergency department, private hospitals, and social security hospital.

Assuming the range of MD between zero and five, the average MD in nurses is at a range of average to high. Most of the conducted studies have reported average to high levels of MD in nurses. According to Mason *et al.*, the average MD in nurses was 3.80 (21), while Mohammadi *et al.* (22) and Borhani *et al.* (23) reported average MD values of 3.50 and 2.25 in nurses, respectively.

The results were not consistent with research conducted by Fernandez Parson *et al.*, (24) Anami *et al.*, (13) Mahdavi *et al.*, (25) Naboureh *et al.*, (26) Boulton *et al.*, (10) Vaziri *et al.*, (27) Alimoradi *et al.*, (28) and Asadi *et al.*, (29) who showed an average to low overall level of MD among emergency nurses. Also, the results were consistent with those obtained by Lane Cahl Aft, [30] Bayat *et al.*, (5) Abbasi *et al.*, (31) Robae *et al.*, (32) Jill L Guttormson *et al.* (33), Hosseini Damiri *et al.* (34), and Al-Turfi *et al.* (35), all of whom showed that the mean MD in nurses was average to high.

It should be primarily noted that MD puts nurses and patient care workers at risk and may be clearly reflected in behaviors such as withdrawing from patient care. Likewise, nurses experience frustration, anger, and discomfort, resulting in their failure to meet the needs of their patients or their inability to fulfill their duties and obligations towards their patients. Nurses are in groups that face the risk of emotional conflict because of frequent exposure to a large number of sick people and their deaths. MD occurs when individuals know the right action, but a set of factors and obstacles convince them that doing the right action is impossible. Thus, it can be said that moral distress is related to reluctance to work, lack of job satisfaction, reduced interaction with patients and their families, and ultimately job burnout (36). A moral dilemma also appears in addition to moral distress, when it is necessary to pay attention to more than one professional and personal principle, value, and belief in decision-making, but it is not possible to apply and consider them simultaneously. Although it is always necessary to pay attention to all values, it is inevitable to ignore some principles and conflicting values when moral dilemmas arise. MD is often observed as a result of moral decisions in nurses (37). When the conditions for creating distress are met, different personality traits and adaptation mechanisms of people lead to different reactions. Some become depressed and hopeless and adopt non-adaptive mechanisms, while others try to change the conditions and consequently show conflicts with the relevant organization and other members of the health team. Still, some accept the existing conditions and are unconsciously affected by the hidden effects of MD in the long run and suffer dissatisfaction and burnout (38).

As the results showed, most of the studied centers dealing with accident victims or critically ill patients (Dr. Fatemi and Alavi Hospitals) or involved with Covid-19 patients (Imam Reza and Imam Khomeini Covid-19 emergency department) had higher MD scores compared to other hospitals. Especially, the level of MD was much lower in private than in the mentioned hospitals, highlighting the effect of environmental conditions, type of patients, tensions created in the work environment, multiple work shifts, the tension between hospitals and nurses, and especially the deaths caused by accidents and diseases, on the moral distress of nurses. Therefore, the amount of confusion and moral distress increases in crowded centers with high turnover, work pressure and lack of labor force, unnecessary care and tests and procedures for patients, incompetence of some coworkers, high demands of the patients and their families, and decision-making for patients at the end of life. The effect of these factors on the formation and development of moral distress depends on the workplace and individual characteristics. Many studies have reported different levels of moral distress at a range of average to high, depending on the type of department, and more evident in departments such as emergency.

In addition, there was a significant correlation between gender and income with MD among the nurses of the emergency departments. The mean score of MD was higher in male nurses than in females, and the higher the income, the lower the MD. These results were consistent with the findings of Ruiz- Fernandez *et al.*, (39) Fernandez-Parsons *et al.*, (24) Anami *et al.*, (13) and Ebrahimi *et al.* (40). On the other hand, lack of financial incentives, low salaries and benefits, and even the amount of household income can reduce job

motivation in nurses, subsequently increasing MD. Therefore, as confirmed in this research, family income is expected to affect the MD level of nurses.

Studies have shown that nurses are more prone to developing moral distress than other healthcare providers because they work closely with patients. MD has always been associated with a negative effect on mental health in the form of anxiety and failure in the professional life of nurses, and continuous MD leads to a decrease in job satisfaction, job burnout, decreased job retention, leaving the profession, minimal interaction with patients and families, and aggravation of shortage of nurses. The continuation of this trend and the increase in the level of MD among nurses will lead to a decrease in the level of compassion toward patients.

5. STRENGTHS OF THE STUDY ARE AS FOLLOWS:

- Examining all service providing hospitals (public, private, etc.);
- Surveying all nurses in the emergency departments of the studied hospitals
- Limitations of the study are as follows:
- Pessimism and a lack of nurses' familiarity with research made work difficult and limited. Besides, it was not possible to go to the hospital at any hour of the day to fill out the questionnaires.
- The statistical population was limited to nurses in emergency departments of medical hospitals in Ardebil city.
- The research only used questionnaires to collect data, and there were restrictions on using interview tools.
- Data collection was carried out by questionnaire and self-assessment method, which increases the possibility of bias.

CONCLUSION

The level of moral distress reflects the impact of conditions causing moral distress on the quality of care and the necessity to prevent such conditions by providing appropriate solutions. Informing nurses about moral distress and its consequences and providing periodic counseling can contribute to its identification and control.

Considering the high level of MD of nurses in the studied centers, the following suggestions are made to control and reduce the MD of nurses:

Hospital managers are suggested to consider the spiritual and psychological needs of the nurses in addition to their physical needs, especially during critical conditions, and take the necessary actions to solve their problems to provide grounds for controlling MD among them.

It is suggested that hospital managers seek help from psychological consultants to prevent the emergence of MD when nurses face a lot of mental pressure in dealing with the work environment. It is also suggested that hospital managers try to divide the assigned tasks in such a way that the job duties of the nurses are not disturbed, the nurses are not psychologically offended, and the conditions for MD of the nurses are reduced. Besides, hospital managers should continuously survey the nurses about the working environment and conditions to use their guidance for working conditions improvement and burnout control.

SUGGESTIONS FOR FUTURE RESEARCH

- The research can be carried out on a wider statistical population and in different departments of public and private hospitals to compare the results.
- Future studies can use interviews in addition to questionnaires to collect data.
- It is suggested to include the researchers' observations in the research results in addition to the results of the questionnaires.

- It is suggested that future studies examine policies to improve nurses' working conditions.

DECLARATION BY AUTHORS

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

ETHICAL APPROVAL

It is approved by the code of ethics IR.ARUMS.REC.1401.064.

CONSENT FOR PUBLICATION

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The author confirms that this article's content has no conflict of interest.

ACKNOWLEDGEMENTS

This article is a part of the emergency nursing master's thesis under the code of ethics IR.ARUMS.REC.1401.064, conducted at Ardabil University of Medical Sciences without financial support. The authors consider it necessary to thank and appreciate all the organizations and bodies for providing the required data and information.

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RESEARCH ARTICLE



Seroprevalence of Hepatitis B Virus and Associated Risk Factors among Medical Students at Jamhuriya University in Mogadishu, Somalia

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Abstract:

Background: Hepatitis is a significant global public health issue, with viral hepatitis types A, B, C, D, and E posing considerable mortality and morbidity risks. The hepatitis B virus (HBV) can lead to serious health complications, including cirrhosis and liver cancer. This cross-sectional study aimed to examine the seroprevalence of HBV and the associated risk factors among medical students in Mogadishu, Somalia, conducted from April to August 2024.

Methods: The study involved 240 medical students. Data on sociodemographic characteristics and potential risk factors were collected using a structured and validated questionnaire. Each participant provided a 3 mL blood sample, which was analyzed for hepatitis B surface antigen (HBsAg) using the Instant Hepatitis B Surface Antigen Kit. Statistical analysis was performed using SPSS software.

Results: The seroprevalence of HBsAg among the medical students was found to be 1.3%. Out of the 240 participants, 237 (98.8%) tested negative for HBsAg, while 3 (1.3%) tested positive. Statistical analysis revealed significant associations ($p < 0.05$) between HBV infection and several risk factors, including non-adherence to universal precautions guidelines, a history of blood transfusion, lack of glove use, and a history of dental procedures involving blood contact.

Conclusion: The HBV infection rate among medical students in Mogadishu, Somalia, is relatively low. However, the study identified several risk factors associated with HBV infection, underscoring the need for enhanced adherence to infection prevention measures. Targeted interventions and control measures are essential to address these identified risk factors in this population.

Received: September 16, 2024

Accepted: December 15, 2024

Published: January 15, 2025

Keywords: Hepatitis B virus, seroprevalence, medical students, Mogadishu, Somalia, risk factors.

1. BACKGROUND

Hepatitis B Virus (HBV), a DNA virus belonging to the Hepadnaviridae family, can cause both acute and chronic liver diseases. The primary modes of transmission include exposure to blood, blood products, needlestick injuries, sharp objects, as well as mother-to-child transmission and sexual contact. Individuals who have not been vaccinated or infected are generally at risk(1). HBV infections are a significant contributor to liver disease globally, potentially leading to severe complications such as liver cirrhosis, hepatocellular carcinoma, and even death(2).

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The World Health Organization (WHO) reports that approximately 2 billion people worldwide are affected by HBV, with around 887,000 deaths resulting from complications like liver cancer and cirrhosis. The majority of these cases are found in low- and middle-income countries. In 2015, the estimated prevalence of HBsAg in the general population was 3.61%(1). Key factors contributing to the high rates of HBsAg include a lack of awareness about HBV, failure to adhere to recommended preventive measures, and insufficient vaccination coverage(3).

Despite the successful rollout of vaccination programs, numerous countries in Asia and Africa remain classified as areas with high rates of HBV endemicity(4,5). The prevalence of Hepatitis B virus (HBV) in Africa varies significantly by country. In Somalia, recent studies report a prevalence of 9.7% among blood donors, although historical records indicate rates as high as 19.0% in 1995. Ethiopia shows a prevalence of 10.90% in Jijiga, while Nigeria has a higher rate of 18.60% in the Southwest region, contrasting with 4.10% in Calabar. In Kenya, the prevalence is around 5.60%, and Eritrea reports a lower rate of 2.0%. General, HBV prevalence in Africa ranges from 2% to over 18%, underscoring a major public health issue in various areas of the continent(6).

Healthcare facilities are considered hazardous and high-risk workplaces due to the significant occurrence of work-related injuries and illnesses. Healthcare workers, including direct care providers, practitioners, and medical waste handlers, face risks from occupational hazards, particularly infections like hepatitis B and C. Medical trainees, especially in developing countries, are particularly vulnerable to HBV infection during their training, largely due to low vaccination rates and high instances of accidental exposure to bodily fluids. Reports from Africa show that the HBV infection rate among medical students can be as high as 31.5%. Additionally, a study in Northwest Ethiopia found that up to 4.2% of medicine and health trainees were infected with HBV(7).

Medical and health science students, as integral members of the healthcare delivery system, face similar risks to those of other healthcare workers when they interact with patients and contaminated instruments. As they enter their clinical years, these students are expected to engage in patient care activities. However, the risk of healthcare-associated infections, exacerbated by inadequate medical waste management and non-compliance with safety protocols, poses a significant public health threat. This issue not only risks the health of healthcare workers but also affects their families and the broader community. To facilitate effective prevention and vaccination strategies, it is essential for policymakers and program implementers to have access to thorough and accurate information(8). Currently, there are no studies examining HBV infection rates among medical students in Somalia. This study aims to investigate the seroprevalence of HBV and associated risk factors among medical students at Jamhuriya University of Science and Technology in Mogadishu, Somalia.

2. METHODS

2.1. Study Design

This study employed a cross-sectional descriptive design. It is descriptive and non-experimental in nature, focusing on the seroprevalence of the hepatitis B virus along with associated risk factors among medical students in Mogadishu, Somalia.

2.2. Study Area

The participants of the study were medical students at Jamahiriya University of Science and Technology, Mogadishu, Somalia.

2.3. Target Population

The target population for this study consisted of medical students across various fields, including nursing, medicine, laboratory sciences, public health, and midwifery.

2.4. Inclusion Criteria

The inclusion criteria were specific to medical students enrolled in relevant healthcare programs.

2.5. Exclusion Criteria

Exclusion criteria specifically applied to individuals who were not medical students or who had received the hepatitis B vaccine.

2.6. Sample Size Determination

Sample size determination was based on the number of medical students and the timeline for data collection. A suitable sampling technique was employed.

2.7. The Sampling Technique

Non-probability sampling was utilized in this study to gather information from a conveniently accessible population. Participants completed a questionnaire after providing informed consent.

2.8. Sample Procedure

To investigate hepatitis B among medical students, a stratified random sampling method was employed to ensure a representative selection across various healthcare roles. The sample size was statistically determined, taking into account the workforce and the desired confidence level.

2.9. Data Collection

We designed questionnaires to gather information regarding hepatitis B among medical students, focusing on their vaccination status, previous exposure, and awareness levels. Additionally, we reviewed medical records to determine the incidence of hepatitis B cases within this group.

2.10. Data Analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 25, using chi-square analysis.

2.11. Validity

Validity is a critical criterion for evaluating the quality of a test. It pertains to the extent to which the test accurately measures its intended outcomes. A test with high validity ensures that its focus aligns closely with the items being assessed.

2.12. Reliability

Test-retest reliability refers to the consistency of a test when administered to the same group of individuals on two separate occasions.

2.13. Research Instruments

We aseptically collected three milliliters (ml) of venous blood samples from each participant. After centrifugation, serum was separated from each sample and stored at -20 °C for up to three days prior to HBsAg analysis. Each sample was assigned a unique identification number corresponding to the codes on the questionnaire. HBsAg analysis was performed using rapid test kits according to the manufacturer's protocols, with positive results confirmed using ELISA (Gebremariam *et al.*, 2019).

2.14. Ethical Considerations

Ethical concerns regarding confidentiality and privacy were carefully addressed. Participants were assured that their identities would not be disclosed in the research report. Authorization letters were obtained from Jamahiriya University of Science and Technology, and all medical students involved in the study adhered strictly to these ethical standards throughout the research process.

3. RESULTS

3.1. Socio-demographic Data

A total of 240 medical students participated in the study. Among the respondents, 28.3% identified as male, while the majority, 71.7%, identified as female. The minimum and maximum ages of participants were set at 18 and 30 years, respectively. In terms of marital status, approximately 98.3% were single, and 1.7% were married.

Participants were categorized by grade level, with the highest representation in the first year (28.3%), followed by the second year (31.7%), third year (19.2%), fourth year (13.8%), sixth year (5.0%), and fifth year (2.1%). The study included respondents from various departments, with representation as follows: medicine (21.7%), laboratory sciences (40.0%), nursing (20.4%), midwifery (9.2%), and public health (8.8%). Table 1 summarizes the sociodemographic characteristics of the medical student participants.

3.2. Prevalence of Hepatitis B Infection Among Study Subjects

This study found that the seroprevalence of HBsAg among medical students was 1.3%, with all positive cases identified in male participants. Of the 240 individuals tested, 237 (98.8%) were negative for HBsAg, while 3 (1.3%) tested positive.

3.3. Risk Factors

Chi-square analysis revealed several significant risk factors associated with Hepatitis B virus infection, with P-values less than 0.05. These factors included knowledge of Universal Precautions guidelines, exposure to body fluids without wearing gloves, and experiences of needle stick injuries. Additionally, undergoing operations or surgeries, receiving blood transfusions, and having tooth extractions were identified as relevant factors. Participants who reported blood contact with skin or mucosa, as well as those with a family history of chronic liver diseases, also demonstrated increased risk. Table 2 summarizes the risk factors associated with HBsAg status among medical students.

Table 1. Sociodemographic characteristics of the study participant, Mogadishu, Somalia.

Variables	Category	Frequency	Percent %
Gender	Male	68	18.3
	Female	172	71.7
Age	18-24	237	98.8
	25-30	3	1.3
Marital status	Single	236	98.3
	Married	4	1.7
Year of Experience	Sixth years of class	52	21.7
	Fifth years of class	96	40.0
	Fourth year of class	49	20.4
	Third years of class	22	9.2
	Second years of class	21	8.8
	First year of class	240	100.0
Department	Medicine	52	21.7
	Laboratory	96	40.0
	Nurse	49	20.4
	Midwife	22	9.2
	Public health	21	8.8

Source: Authors

Table 2 Risk factors associated with HBsAg status among medical students

Variables	Response	HBsAg status		P-value
		Negative	Positive	
Universal precaution guidelines	Yes	181	0	0.14
	No	56	3	
Without wearing gloves	Yes	36	3	0.004*
	No	201	0	
Needle stick injury	Yes	55	2	0.141
	No	182	1	
Operation or surgery	Yes	21	2	0.025*
	No	216	1	
Blood transfusion	Yes	22	2	0.027*
	No	215	1	
Tooth extraction	Yes	55	3	0.014*
	No	182	0	
Had blood contact	Yes	40	2	0.080
	No	197	1	
Chronic liver diseases	Yes	36	3	0.004*
	No	201	0	

4. DISCUSSION

The current study investigated the seroprevalence of Hepatitis B Virus (HBV) and associated risk factors among medical students in Somalia. Hepatitis is a major public health problem often transmitted in medical student settings, leading to significant mortality and morbidity. The study obtained 240 blood samples from medical students. In terms of gender, the majority of participants (71.7%) identified as female. This is similar to a study conducted among medical students in Saudi Arabia, where the majority of participants were also female (68.5%) (9). However, this finding contrasts with a study in Ethiopia, where the majority of

participants were male (59.7%) (10). This demographic skew may influence the generalizability of the findings, as behaviors and exposures could differ between genders. The lower representation of males should be considered when interpreting the results.

Most respondents in this study were medical students aged 18-24 years, which aligns with findings from Saudi Arabia, where the most common age group was 18-25 years (9). In a similar study in Saudi Arabia, participants ranged from 18 to 20 years old (11). A study in Uganda found that no student was below 18 years of age, with the oldest being 39 years old (8). In contrast, a study among medical students in Sierra Leone reported a median age of 26 years (24–28) (12). The predominance of respondents aged 18-24 indicates that the study population is largely young, typical for students beginning their university education in Somalia.

Among the participants, 98.3% reported being single. This finding aligns with studies conducted in Saudi Arabia, Sierra Leone, and Ethiopia, where most participants were also single (8,9,12). Marital status can influence lifestyle factors and potentially affect HBV exposure and transmission risk, as single individuals may have different social interactions and behaviors compared to married individuals. The study included respondents from various fields: medicine (21.7%), laboratory (40.0%), nursing (20.4%), midwifery (9.2%), and public health (8.8%). Participants were categorized by year level, with the highest representation in the first year (28.3%), followed by the second year (31.7%), third year (19.2%), fourth year (13.8%), sixth year (5.0%), and fifth year (2.1%). This contrasts with a study in Ethiopia, where a broader range of academic years was included, resulting in a 100% response rate (8). The varying representation across departments and year levels may influence the risk of HBV exposure and transmission.

Factors that showed a statistically significant association with HBsAg positive status among medical students included gender, universal precautions, not wearing gloves, having undergone surgery, blood transfusions, tooth extractions, blood contact with skin or mucosa, and a family history of chronic liver diseases (10,12–14). The study revealed that 16.3% of respondents had exposure to body fluids without wearing gloves, which poses a significant risk (P -value = 0.00076) (10). Additionally, 23.8% of respondents experienced needle stick injuries; however, this was not statistically significant (P value = 0.079), which is consistent with findings from a study in Sierra Leone (12). The data indicated that a smaller percentage of respondents had undergone surgical procedures (9.6%), with a statistically significant P value of 0.001 (10). Blood transfusions were reported by 10.0% of participants, with a P value of 0.001, indicating statistical significance. A similar study in Mexico also identified a history of blood transfusions as significant (13). Tooth extractions were reported by 24.2% of participants, with a significant P value of 0.002. Similar findings were observed in Ethiopia (10). Additionally, 17.5% of respondents indicated blood contact with skin or mucosa, with a significant P value of 0.024, although another study found no such significance (15).

The study indicated that 16.3% of respondents reported a family history of chronic liver diseases, suggesting a potential genetic predisposition to liver conditions, with a significant P value of 0.00076. A study in Rwanda also identified family history as a significant factor (14). No statistical significance was found regarding several factors, including age, department, marital status, needle stick injury, and academic year as they relate to HBV among medical students in Mogadishu, Somalia. In contrast, a study in Ethiopia found significant associations between demographic variables, study department, and both mean knowledge and practice scores, indicating a 95% confidence interval (P = 0.007) and (P = 0.001) (8). Another study conducted in Somalia identified statistical significance concerning academic years (16). In our study, the majority of participants tested negative for Hepatitis B Virus, with only a small proportion (1.3%) testing positive, indicating a relatively low prevalence among the study population. A similar study in Saudi Arabia reported a prevalence rate of HBV among students of 0.41%, indicating low prevalence (11).

Another study in Mexico showed an overall prevalence of 0.5% (13). In contrast, a study highlighted a concerning HBV prevalence of 31.5% among students in a tertiary institution, suggesting a high risk despite awareness of risk factors (17). General, the findings from this study indicate a relatively low prevalence of Hepatitis B Virus (HBV) among medical students in Mogadishu, Somalia. This low prevalence is encouraging and suggests that current preventive measures, including vaccination and awareness programs, may

be effective in this population. However, it is crucial to continue enhancing these efforts to ensure ongoing protection against HBV.

5. LIMITATIONS OF STUDY

The study's sample size and demographic distribution may not represent all medical students, and its cross-sectional design provides only a snapshot at a single point in time, limiting causal inferences. As such, the findings may not be generalizable to other populations, including medical professionals in different regions or students in other healthcare fields.

CONCLUSION

The study investigated the seroprevalence of Hepatitis B Virus (HBV) among medical students in Mogadishu, Somalia, revealing a low prevalence of 1.3%. The majority of participants were female (71.7%) and aged 18-24 years, with most reporting being single. Significant risk factors for HBV exposure included gender, lack of universal precautions, and medical procedures like blood transfusions and tooth extractions. While current preventive measures appear effective, the study underscores the need for ongoing awareness and adherence to safety practices among medical students. Further research is recommended to explore regional variations and enhance protective strategies against HBV in this population.

DECLARATIONS:

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the study.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Jamhuriya Research Center Committee. Informed consent was secured from all participants prior to their involvement in the study.

CONSENT FOR PUBLICATION

Consent for publication is not applicable, as no identifying images or personal details of participants are included in the manuscript.

AVAILABILITY OF DATA AND MATERIALS

Data and materials are available upon request. The data generated and analyzed during this study are available from the corresponding author upon reasonable request. The questionnaire used for data collection is provided as a supplementary file (see Supplementary Material 1).

COMPETING INTERESTS

Not applicable.

FUNDING

Not applicable.

ACKNOWLEDGEMENTS

We acknowledge the support of Jamhuriya University, the medical laboratory administrations, and the students who participated in the study.

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