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Ebola: The Bundibugyo virus is back

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FRONT COVER IMAGE: Health workers using personal protective equipment (PPE) at a training during the Ebola outbreak in Guinea, 2014 (CDC/Lindsey Horton - Public Health Image Library ID #18706)

Ebola: The Bundibugyo virus is back

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On 17 May 2026, the World Health Organization (WHO) declared the new outbreak of Ebola Virus Disease (EVD) in the Democratic Republic of the Congo (DRC), a public health emergency of international concern.[1] As of 22 May 2026, there were 750 suspected cases, and 177 deaths had been reported in the DRC; two cases (with one death) had been reported in Kampala, Uganda. New cases and deaths are expected to rise as the virus spreads. This is the 17th EVD outbreak in the DRC since the first in 1976.[2]

This outbreak is caused by a rare strain of the Ebola virus, the Bundibugyo type, which had previously caused only two outbreaks: the 2007 outbreak in Bundibugyo province in western Uganda[3] and the 2012 outbreak in Isiro, Pawa, Dungu, and Province Orientale in the DRC.[4] There are two other types of the virus that caused most of the last outbreaks: the Ebola (Zaire) and Sudan viruses.

First transmitted from wild animals to humans, the virus can spread from person to person through close contact with an infected person's body fluids, leading to symptoms, appearing after two to 21 days, including fever, fatigue, myalgia, vomiting, diarrhoea, headache, and internal and external bleeding with high mortality up to 50%. Although two vaccine types have been approved for the Zaire strain of the virus, there is no vaccine for the Bundibugyo virus. We need one urgently.

Although the current outbreak is not considered a pandemic, the threat of serious regional spread of this virus is very high, thus necessitating the declaration of an international emergency. DRC and Uganda have activated their national disaster/emergency management mechanisms and establish emergency operation centers. The WHO and Africa CDC have sent teams into the countries to provide support. South Sudan has raised its emergency and surveillance levels amid ongoing monitoring of the situation in the DRC.

But why does the Ebola virus keep coming back? Is it because of the endemicity in fruit bats, which act as the reservoirs, and eating these bats allow the virus to cross into humans, makes it difficult to control? The DRC regions involved are rife with conflict, poverty, isolation, and inadequate health infrastructure. How can we conduct community prevention and disease surveillance more effectively in such conditions?

As the health authorities respond to the emergency, the outbreak reminds us to continually evaluate our work and develop new out-of-the-box, multipronged approaches to tackle this disease. Perhaps then we can break the cycle.

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Risk factors in glaucoma: Insights from a prospective case–control study, Belagavi, India

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ABSTRACT

Introduction: Glaucoma is an optic neuropathy and degeneration of retinal ganglion cells, causing irreversible visual damage and blindness. While raised intraocular pressure (IOP) is the most important established risk factor, the exact pathogenesis and other risk factors for glaucoma are not fully understood, particularly in developing countries. Early identification and management of risk factors are important for reducing incidence and burden. This study assessed the risk factors for glaucoma at Dr. Kodkany's Eye Center in Belagavi, India.

Method: This case-control study examined 24 cases with confirmed diagnosis of glaucoma and 20 age- and sex-matched controls. A pre-designed questionnaire was used to collect sociodemographic data along with detailed eye examination findings. All glaucoma participants underwent thorough ophthalmic examinations, including visual acuity, intraocular pressure (IOP), central corneal thickness, anterior segment abnormalities, anterior chamber angle, fundus photography, and visual field testing.

Results: Of the 24 cases, 14 (58.3%) were diagnosed with open-angle glaucoma, with bilateral involvement noted in 13(54.2%) cases. IOP was considerably higher in glaucomatous patients compared to non-glaucomatous (right eye: 27.86±8.97 vs 15.85±2.84 mmHg [Mean difference: 12.01 (95% CI: 8.24–15.78]; left eye: 28.27±8.75 vs.16.05 ± 3.02 mmHg; [Mean difference: 12.22 (95% CI: 8.49–15.95)] p<0.001 for both). None of the studied factors — age (OR=0.990, 95% CI: 0.937-1.045, p=0.705), female gender (OR=1.667, 95% CI: 0.500-5.559, p=0.416), or hypertension (OR=2.538, 95% CI: 0.697-9.240, p=0.160)—predicted glaucoma risk.

Conclusion: This study confirms that elevated IOP is a key characteristic of glaucoma. However, age, female gender, and hypertension were not recognised as important risk factors for glaucoma. This suggests that other risk factors might have contributed to the risk of glaucoma. Screening beyond traditional risk factors helps in identifying at-risk patients.

Keywords: case-control study, hypertension, incidence, open-angle glaucoma, risk factors

Introduction

Glaucoma is a major cause of irreversible vision loss and blindness, marked by progressive damage to the optic nerve. In 2020, approximately 76 million individuals worldwide were affected, including 4.5 million with moderate to severe visual impairment and 3.2 million with blindness, and the total number of individuals affected with glaucoma is projected to rise to 111.8 million by 2040.[1,2] Because the disease is often asymptomatic in its early stages, diagnosis typically occurs only after substantial optic nerve damage, leading to compromised quality of life.[1] Early detection and timely management are therefore essential to prevent further vision loss.[1,2]

Glaucoma is classified into multiple subtypes, such as primary open-angle glaucoma (POAG), primary angle-closure glaucoma (PACG), secondary glaucoma, and congenital glaucoma,[3] with their prevalence varying across ethnic and geographic populations. Established risk factors include modifiable factors (elevated intraocular pressure, hypertension, steroid use) and non-modifiable factors (age, sex, family history, thinning of the central cornea).[1,4] Additionally, systemic conditions like diabetes mellitus, hypothyroidism, and corticosteroid use may predispose individuals to secondary glaucoma. Identifying and addressing modifiable risk factors is critical in reducing disease progression and raising awareness among both clinicians and patients.[1]

While the epidemiology and clinical impact of glaucoma are well studied in developed nations, limited data exist for developing countries such as India.[5,6] Evidence suggests that patients in these regions present late with more advanced disease, face a higher risk of blindness, and may have a greater age-adjusted incidence compared to those in developed countries, though the reasons remain unclear.[5] This study sought to address this gap by assessing the incidence of glaucoma and evaluating associated risk factors in developing countries.

Method

This single-centre prospective case–controlled study was conducted over a one-year period in 2023 at the Department of Ophthalmology, Dr. Kodkany's Eye Center, Belagavi. It was designed to evaluate selected risk factors for glaucoma based on predefined objectives and feasibility, and does not aim to assess all known risk factors.

Adults aged ≥40 years with an intraocular pressure (IOP) >21 mmHg, vertical cup–disc ratio (VCDR) >0.6, or other glaucomatous optic disc changes such as polar notch, glaucomatous field defects (Anderson criteria), deep cupping, disc haemorrhages, thinning of the neuroretinal rim, or rim change (characteristic glaucomatous alterations of the neuroretinal rim) in both eyes were included as cases. A diagnosis of glaucoma was confirmed if at least two of these three criteria were present. Controls were recruited from patients aged ≥40 years without glaucoma, excluding those incidentally diagnosed during the study period.

All participants underwent clinical evaluation using a standardized protocol including visual acuity assessment, IOP measurement, and detailed systemic and ocular history. Glaucoma cases underwent a comprehensive ophthalmic examination as part of the diagnostic assessment, including central corneal thickness (CCT), anterior segment abnormalities, anterior chamber angle, fundus examination, and visual field testing. These detailed investigations were not uniformly performed in control participants, as they were recruited as individuals without clinical evidence of glaucoma and underwent standardized screening evaluation, including IOP measurement and clinical assessment, to reasonably exclude the presence of glaucoma.

Written informed consent was obtained from all participants. Ethical approval was obtained from the Institutional Ethics Committee of Prabhakar Kore's Basic Science Research Center, Belagavi. Sociodemographic and clinical details were recorded using a predesigned, pretested questionnaire.

Data were analysed using SPSS software version 21. Categorical variables were presented as frequencies or proportions and were analysed using the Chi-square test. Continuous variables are presented as Mean± standard deviation (SD). Normality of the data was assessed using the Shapiro-Wilk test and Q-Q plots. Independent-samples t-tests or Mann-Whitney U tests were used to compare continuous variables between groups, depending on normality. A p-value less than or equal to 0.05 indicates statistical significance.

Results

A total of 44 participants were included in the study, comprising 24 patients with glaucoma and 20 age- and sex-matched controls. Most participants in both groups were aged 56–65 years and predominantly male. Most were Hindus, married, had completed at least secondary

Table 1. Sociodemographic characteristics of study participants

Variable	Patients with glaucoma (N=24) n (%)	Patients without glaucoma (N=20) n (%)	p-value
Age			
45-55	5 (20.8)	5 (25.0)	0.929[c]
56-65	10 (41.7)	8 (40.0)	
66-75	5 (20.8)	5 (25.0)	
76-85	3 (12.5)	1 (5.0)	
>85	1 (4.2)	1 (5.0)	
Sex			
Female	9 (37.5)	10 (50.0)	0.404[c]
Male	15 (62.5)	10 (50.0)	
Religion			
Hindu	21 (87.5)	20 (100.0)	0.101[c]
Muslim	3 (12.5)	0	
Marital status			
Married	19 (79.2)	16 (80.0)	0.945[c]
Widowed	5 (20.8)	4 (20.0)	
Education			
Illiterate	3 (12.5)	4 (20.0)	0.319[c]
Primary	4 (16.7)	5 (25.0)	
Secondary	7 (29.2)	1 (5.0)	
Secondary and above	8 (33.3)	7 (35.0)	
Graduation	2 (8.3)	3 (15.0)	
Occupation			
Doctor	1 (4.2)	0.0	0.503[c]
Employed	1 (4.2)	1 (5.0)	
Farmer	3 (12.5)	2 (10.0)	
Housewife	5 (20.8)	6 (30.0)	
Housewife/ skilled	0.0	1 (5.0)	
Retired	6 (25)	3 (15.0)	
Semiskilled	0 (0.0)	1 (5.0)	
Shop	2 (8.3)	5 (25.0)	
Shop/Farmer	1 (4.2)	1 (5.0)	
Skilled/ employed	2 (8.3)	0.0	
Skilled/retired	1 (4.2)	0.0	
Unskilled	2 (8.3)	0.0	
Residence			
Rural	11 (45.8)	14 (70.0)	0.577[c]
Urban	13 (54.2)	6 (30.0)	

c - values calculated using the chi-square test.

Table 2. Comparison of intraocular pressure and systemic disorders in cases and controls

Variable	Patients with glaucoma (N=24)	Patients without glaucoma (N=20)	Mean Difference and 95% CI	p-value
Right eye (mmHg)	27.86 ± 8.97	15.85 ± 2.84	Mean difference: 12.01 (95% CI: 8.24–15.78)	<0.001*
Left eye (mmHg)	28.27 ± 8.75	16.05 ± 3.02	Mean difference: 12.22 (95% CI: 8.49–15.95)	<0.001*
Other systemic disorders				
Present	21 (87.5%)	7 (35%)	NA	0.003*[c]
Absent	3 (12.5%)	13 (65%)		

*- statistically significant. c - values calculated using the chi-square test.

education, resided in rural areas, and were either housewives or retired (Table 1). However, no significant associations were observed between sociodemographic characteristics and glaucoma risk.

IOP was significantly higher among glaucoma patients compared to controls in both eyes (right eye: 27.86±8.97 vs 15.85±2.84 mmHg [Mean difference: 12.01 (95% CI: 8.24–15.78]; left eye: 28.27±8.75 vs.16.05 ± 3.02 mmHg; [Mean difference: 12.22 (95% CI: 8.49–15.95)] p<0.001 for both) (Table 2). The presence of any systemic comorbidity (considered as a composite variable) was significantly associated with glaucoma (p < 0.05). Cataract

Table 3. Distribution of glaucoma types, affected eyes, and vision loss in the study participants

Variable	N = 24 n (%)
Diagnosis	
Disc suspect	2 (8.3)
Narrow angle glaucoma	1 (4.2)
Normal tension glaucoma	1 (4.2)
Open angle glaucoma	14 (58.3)
Ocular pulse amplitude	1 (4.2)
Primary open angle glaucoma	3 (12.5)
Pseudo exfoliation glaucoma	2 (8.3)
Affected eye	
Both eyes	13 (54.2)
Left eye	7 (29.2)
Right eye	4 (16.7)
Vision loss#	
Left eye	3 (60)
Right eye	1 (20)
Steroid induced	1 (20)
Central corneal thickness - Right eye (microns)	541.08 ± 18.82
Central corneal thickness -Left eye (microns)	542.42 ± 18.39
Cup to disc ratio -Right eye	0.771 ± 0.14
Cup to disc ratio - Left eye	0.719 ± 0.15
Visual field changes#	
Arcuate defect (BE)	1 (4.2)
Asteroid hyalosis (BE)	1 (4.2)
Centrocaecal scotoma (BE)	1 (4.2)
Complete depressed field (BE)	1 (4.2)
Congestion (BE), Deep cup thin (BE)	1 (4.2)
Deep cupping	1 (4.2)
Enlarged blind spot (RE), Vision loss (LE)	3 (12.5)
Generalized depression (BE)	1 (4.2)
Inferior arcuate scotoma (BE)	1 (4.2)
Mild congestion (BE)	1 (4.2)
Notching in (LE)	1 (4.2)
Rim loss (RE), Mild congestion in (LE)	1 (4.2)
Shallow anterior, vision loss (LE)	1 (4.2)
Superior arcuate scotoma (BE)	2 (8.3)
Superior arcuate scotoma Ben Notching (RE), Deep cupping (LE)	1 (4.2)
Superior arcuate scotoma (RE)	1 (4.2)
Superior hemifield defect (RE)	1 (4.2)
Total constriction (RE)	2 (8.3)

#, Data not available: data for vision loss and visual field changes were not available for all participants hence percentages are only calculated based on the number with available data.

Table 4. Comparison of available clinical and systemic parameters between glaucoma cases and controls

	Univariate analysis			
	Glaucoma (n=24)	**Control (n=20)**	**Unadjusted OR (95%CI)**	**p-value**
Hypertension	11 (45.8%)	5 (25%)	2.538 (0.697, 9.240)	0.160
Age	64.42 ± 11.17	63.15 ± 11.38	0.990 (0.937, 1.045)	0.705
Gender-Female	9 (37.5%)	10 (50%)	1.667 (0.500, 5.559)	0.416

OR – Odds Ratio, CI – Confidence interval

was found in both groups. Among glaucoma patients, six (25%) had only cataract, five (20.8%) had cataract with hypertension, and three (12.5%) had cataract, hypertension, and diabetes. Among non-glaucoma patients, two (10%) had only cataract, and one had cataract, hypertension, and diabetes mellitus.

IOP and systemic parameters were available for both cases and controls and were included in comparative analysis. However, detailed ophthalmic parameters, such as central corneal thickness and cup-to-disc ratio, were not uniformly recorded in control participants; therefore, comparative analysis of these variables could not be performed.

Regarding glaucoma subtypes, open-angle glaucoma was the most frequent diagnosis, observed in 14 (58.3%) patients. Other forms included primary open-angle glaucoma (12.5%), pseudo-exfoliation glaucoma (8.3%), and normal-tension glaucoma (4.2%). Bilateral involvement was noted in 13 (54.2%) patients, with the left eye more frequently affected than the right eye. (Table 3).

Central corneal thickness was comparable between right (541.08 ± 18.82 μm) and left eyes (542.42 ± 18.39 μm). The mean cup-to-disc ratio was 0.771 ± 0.14 in the right eye and 0.719 ± 0.15 in the left eye. Visual field changes varied, with superior arcuate scotoma (12.5%) and total field constriction (8.3%) being the most common defects (Table 3). Univariate analysis did not identify age, female gender, or hypertension as significant predictors of glaucoma risk ($p > 0.05$ for all comparisons) (Table 4).

Discussion

This case–controlled study demonstrated a significantly higher IOP in glaucoma patients compared with controls (show difference, CI, p-value) ($p < 0.001$), reaffirming its central role in glaucoma pathogenesis. Although univariate analysis indicated that female patients and those with hypertension had higher odds of developing glaucoma (1.6-fold and 2.5-fold, respectively), these associations were not statistically significant.

The majority of glaucoma patients in this study were aged 55 years or older, with a predominance of males (62.5%), consistent with earlier reports.[1,7] Our study shows that hypertension and diabetes mellitus are common systemic risk factors, while Talaat et al[7] similarly reported hypertension (60.8%) and diabetes (58.3%) as frequent systemic comorbidities among glaucoma patients

Cataract (49.1%) was the most common ocular condition.[7] In our cohort, primary open-angle glaucoma (POAG) was the most prevalent subtype (58.3%), with more than half of the patients showing bilateral involvement. Diverse visual field abnormalities, including arcuate defects, scotomas, and generalized field depression, were observed, highlighting the heterogeneous presentation of glaucomatous damage.[8,9]

In the present study, IOP was significantly higher in glaucoma cases compared to controls. In the context of pseudo-exfoliation, previous studies have similarly demonstrated that a 5 mmHg increase in IOP may increase the risk of primary open-angle glaucoma by up to fourfold.[5]

Interestingly, our study did not confirm associations with other established risk factors such as age, sex, or hypertension. This contrasts with meta-analytic evidence suggesting that advancing age markedly increases POAG risk and that females may have a lower overall risk than males. One possible explanation for this difference could be the relatively small sample size and limited statistical power of the present study, which may have reduced the ability to detect such associations.

Other studies have identified ocular biometric features (axial length, corneal curvature), older age, and elevated IOP as significant contributors to glaucoma risk.[10] Furthermore, hormonal influences, such as reduced oestrogen in postmenopausal women, have been implicated in increasing glaucoma susceptibility.[11] Longitudinal studies also support associations between systemic conditions—including hypertension, diabetes, and hyperglycaemia—and glaucoma development.[12] Additionally, research among Bangladeshi populations indicated a modest association between hypertension and elevated IOP, possibly mediated through increased sympathetic activity.[13,14] In contrast, our findings did not demonstrate a statistically significant link between hypertension and glaucoma.

Overall, this study reinforces IOP as the key modifiable risk factor in glaucoma pathogenesis. Routine IOP screening may therefore be more effective in identifying individuals at risk than monitoring systemic comorbidities alone. Nonetheless, certain limitations should be acknowledged. The relatively small sample size restricts the statistical power and may have precluded the detection of meaningful associations. Larger, well-designed case–control studies that use multivariate analyses to adjust for confounders are needed to clarify the contributions of systemic and ocular risk factors. Future research should also evaluate the roles of lifestyle factors (such as alcohol consumption,

smoking, and diet) and genetic predisposition in glaucoma pathogenesis.

Conclusion

This study reaffirms that IOP remains a defining and significant feature of glaucoma, underscoring its role as the most important modifiable risk factor in disease pathogenesis. Steroid use and other non-modifiable risk factors, including a VCDR >0.4 and inter-eye CDR asymmetry >0.2, should prompt physicians to further evaluate patients for glaucoma, even in the presence of normal intraocular pressure. Although age, female gender, and hypertension were evaluated, none showed a statistically significant association with glaucoma risk in this cohort. Early identification of individuals at risk, particularly in resource-limited settings where glaucoma often presents at an advanced stage, is critical to prevent irreversible vision loss.

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OV16 antibody seropositivity reveals persistent onchocerciasis transmission and cross-border risk in Magwi County, South Sudan: a population-based survey

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ABSTRACT

Introduction: Onchocerciasis, or river blindness, is the second leading infectious cause of blindness after trachoma. It is a parasitic disease caused by *Onchocerca volvulus*, a filarial worm transmitted by black flies. In 34 countries, 249.5 million people are at risk, of which 14.6 million are infected, including 1.15 million people who are visually impaired or have gone blind. Onchocerciasis remains endemic in many parts of South Sudan. Magwi is an onchocerciasis-endemic county in South Sudan bordering northern Uganda districts where onchocerciasis transmission has been suppressed. The study was conducted in Magwi County to determine the prevalence of onchocerciasis by testing for *Onchocerca volvulus-16* (OV16) antibodies to estimate the risk of cross-border reintroduction of onchocerciasis into northern Uganda.

Method: The study adapted a community-based cross-sectional serological survey in Magwi County of South Sudan. The study recruited children aged 6-9 years. The study used a stratified cluster sampling approach, informed by data on population distribution and the proximity of communities to rivers infested with blackflies. Blood samples were collected using filter paper as dried blood spots. ELISA testing was done in the Uganda Onchocerciasis Reference Laboratory to confirm OV16 antibodies. Analysis software was Stata v17. The ethical standards were adhered to.

Results: 3,290 children participated in the study. 1,746 (53.1%) were males, and 6-7 years were 1,723 (52.4%). The overall OV16 seropositivity was 0.9%. Among the children, those aged 8-9 years had the highest seropositivity prevalence of 17 (1.1%). Across the clusters, transmission varied statistically ($\chi^2 = 15.23$, $p < 0.001$), with a small effect size (Cramer's V = 0.068). Whereas most clusters had no positive cases, the highest seroprevalence was in Garamu (9.6%) which followed by Malakia Central (7.6%), Olikwi (4.2%), and Kamuli (2.7%).

Conclusion: Persistent onchocerciasis transmission in Magwi County poses a risk of cross-border transmission into Northern Uganda.

Key words: OV16 antibody seropositivity, onchocerciasis transmission, cross-border, population-based survey, Magwi County, South Sudan

Introduction

Onchocerciasis, or river blindness, is the second leading infectious cause of blindness after trachoma. It is a parasitic disease caused by *Onchocerca volvulus*, a filarial worm transmitted by blackfly bites. In 34 countries, 249.5 million people are at risk of which 14.6 million are infected, 1.15 million people are visually impaired and/or have gone blind.[1] Twenty-six African countries shouldered 96% of all global cases.[2]

In South Sudan, Rapid Epidemiological Mapping of Onchocerciasis identified 48 endemic counties out of total 80 counties.[3] These areas are inhabited by communities classified as priority areas requiring Community-Directed Treatment with Ivermectin (CDTI), areas not requiring treatment, and possible endemic areas that need further investigation. The main endemic foci are in Western Bahr El-Ghazal, Western Equatoria, Central Equatoria, and Lakes states. In Unity State, the prevalence was <20%. Despite the country shifting focus from control to elimination, Mass Drug Administration (MDA) with Ivermectin was carried out in 2022 in all the 48 identified endemic counties for onchocerciasis, of which 34 were treated for onchocerciasis with >5 effective rounds of MDA (≥80% coverage) and lymphatic filariasis/Oncho-LF (co-endemic), while 14 were treated for onchocerciasis only.[3]

Onchocerciasis MDA has been implemented since 2005. The aim is to achieve≥80% ivermectin coverage. The target set for 2027 on onchocerciasis is that 30% of counties should have suppressed transmission. The percentage of counties with suppressed transmission in 2023 was 0% and was used as the baseline; in 2025, it was 20% as a midterm.[3] Magwi County was selected for an onchocerciasis prevalence survey due to its proximity to northern Uganda districts where the transmission is suppressed. Additionally, population movements, farming near rivers, and environmental disruption maintain exposure to blackflies.

The *Onchocerca volvulus*-16 (OV16) antibody, specifically the human IgG4 subclass, is a serological biomarker used to detect exposure to *Onchocerca volvulus.* Monitoring this antibody is a critical component of elimination programs as it serves as an early marker of infection, often detectable months before the parasite's larvae (microfilariae) appear in the skin.[4]

The study was conducted in Magwi County to monitor the prevalence of onchocerciasis by testing for OV16 antibody to estimate the risk of cross-border reintroduction of onchocerciasis into northern Uganda.

Method

The study adapted a community-based cross-sectional serological survey design utilising a stratified cluster sampling technique.[5] The survey covered 32 clusters in Magwi County (Figure 1), selected based on proximity to Simulium breeding sites. The breeding sites were identified by walking along the rivers, locating fast-flowing sections with suitable submerged or trailing vegetation.

The survey included children aged 6-9 years, as they serve as a core indicator of recent transmission; resided in these clusters for at least 5 years; had guardians' or parents' consent; and assented. The exclusion criteria were individuals with temporary or recent (<5 years) residence in endemic areas; individuals with bleeding disorders or medical contraindications to finger-prick sampling.

The study engaged with community leaders and sensitisation on the survey objectives was carried out. Initial meetings were with community leaders and local government. Verbal and written sensitisation was done to inform communities about the survey. The study recruited children from house-to-house who met the inclusion criteria, recorded their demographic data, pricked their fingers to collect blood samples on filter paper, safely discarded sharps into safety boxes, and disposed daily other biohazardous waste in the nearest health facility's incinerators. Anti-OV16 ELISA testing was done in the Uganda Onchocerciasis Reference Laboratory.

The survey teams were trained on the study protocol with emphasis on community entry, sensitisation technique, ethical guidelines, tools for data collection, DBS sampling procedures, and sample handling. Indoor and outdoor practicums were conducted prior to the survey's commencement to ensure the quality of the survey team members.

Ethical consideration

The ethical standards were adhered to, with reference number RERB/A/75/2025 obtained from the Research and Ethical Review Board, Ministry of Health, South Sudan. Written consent was obtained from the responsible party, with assent from minors (children). As the names were de-identified, the participant codes and sample codes were the same for each participant.

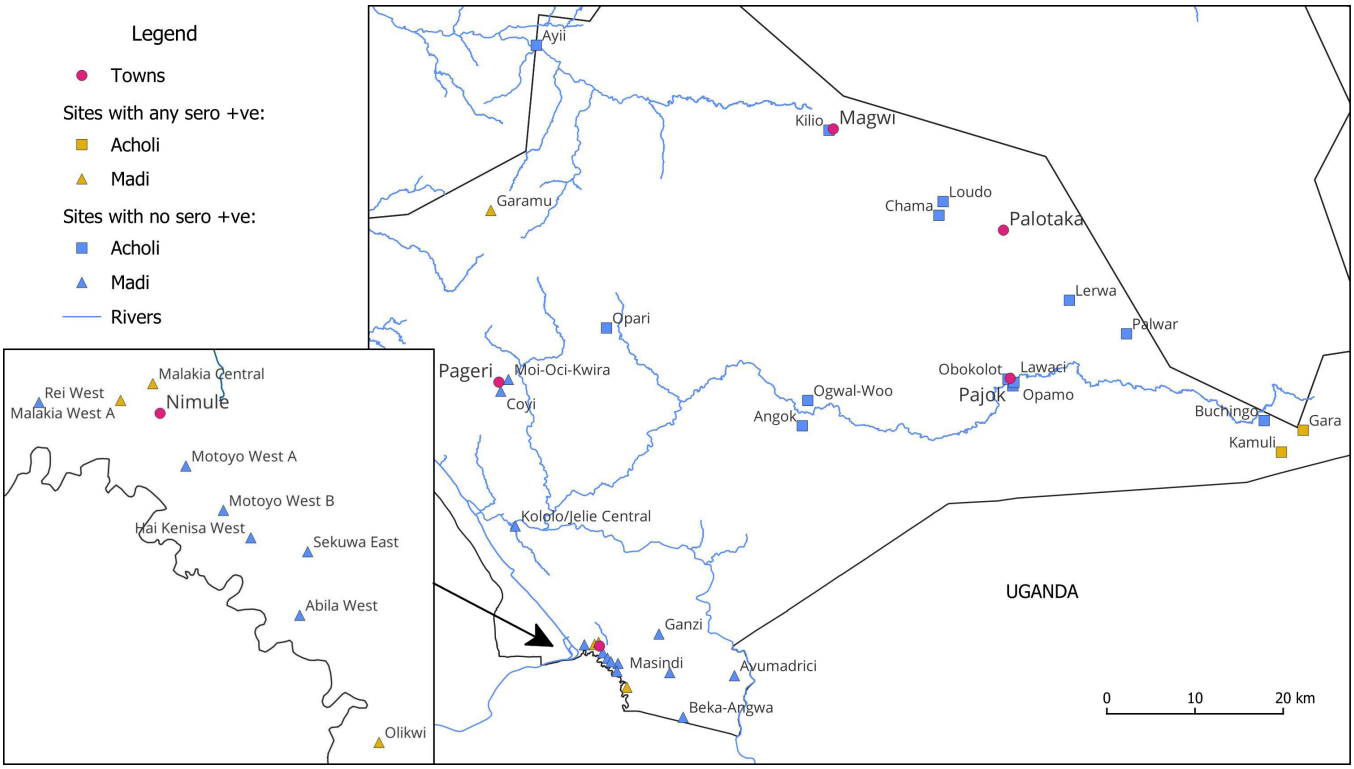

Figure 1. Location of sites within Magwi county, Eastern Equatoria State. Background data from the Humanitarian Data Exchange (https://data.humdata.org).

Data analysis

Field data were gathered using ESPEN Collect installed on mobile devices. Data collected included coded informed consent and demographic characteristics, and were submitted daily into the ESPEN-hosted server. The data were exported into Stata v17 software for Analysis. Descriptive statistics summarised participant characteristics, including age, sex, and cluster distribution. Seroprevalence of OV16 antibodies was calculated as proportions with corresponding percentages. Bivariate analysis was conducted to assess associations between OV16 seropositivity and categorical variables (age group, sex, and geographic clusters) using the chi-squared (χ^2) test. Effect sizes were estimated using Cramer's V to assess the strength of associations. Cluster-level seroprevalence was analysed to identify spatial heterogeneity and potential transmission hotspots. Statistical significance was set at $p<0.05$. Results were presented in tables and interpreted in the context of onchocerciasis elimination thresholds.

Results

Of the 3,290 children who participated in the study, males comprised 53.1%, 6-year-olds comprised 33.3%, and 42.1% were from Nimule Payam. The overall OV16 seropositivity was 0.9%. Among the children, those aged 8-9 years had the highest seroprevalence of 1.1%. Age and sex showed no statistical significance, indicating even exposure to the transmission. The effect size (Cammer's V) further confirms the absence of a strong relationship (Table 1).

Children residing in the Madi Corridor clusters had a higher seropositivity of 1.5% compared to 0.02% in the Acholi Corridor (Table 1). The highest seroprevalence was in Garamu (9.6%), followed by Malakia Central (7.6%), Olikwi (4.2%), and Kamuli (2.7%) (Table 2).

Discussion

Analysis of the ELISA findings revealed that 0.9%of the children aged 6-9 years tested positive for OV16 antibodies. This low seroprevalence aligns with results from similar surveys in hypo-endemic settings, indicating limited ongoing transmission of *Onchocerca volvulus* in the county, or, rather, in South Sudan.[6,7] The 0.9%

Table 1. Seropositivity of onchocerciasis in children by age, sex and location

	ELISA Test Results			Chi-squared	Cramer's V
	- ve n (%)	+ ve n (%)	Total n (%)	(p-value)	
Age in years				0.99 (0.319)	0.017
6-7	1710 (99.2)	13 (0.8)	1723 (52.4)		
8-9	1550 (98.9)	17 (1.1)	1567 (47.6)		
Sex				0.01 (0.977)	0.001
Male	1730 (99.1)	16 (0.9)	1746 (53.1)		
Female	1530 (99.1)	14 (0.9)	1544 (46.9)		
Clusters				15.23 (<.001)	0.068
Acholi Corridor	1601 (99.8))	4 (0.2)	1605 (48.8)		
Madi Corridor	1659 (98.5)	26 (1.5)	1685 (51.2)		
Total	3260 (99.1)	30 (0.9)	3290 (100)		

OV16 seropositivity exceeds the 0.1% WHO threshold for stopping MDA with ivermectin and indicates ongoing transmission in Magwi County.[5] Therefore, CDTI should continue in Magwi County and, where appropriate, be intensified, especially in identified hotspots, to prevent cross-border transmission into northern Uganda.

Children aged nine years exhibited the highest seropositivity compared to those aged 6-8 years. Despite this trend, the results showed no statistically significant differences, implying that age may not be a strong predictor of exposure in this population.[8]

Even though overall seropositivity is minimal, the detection of seropositive cases among these age groups reflects residual pockets of transmission. In East African foci, studies have revealed that low seropositivity can continue post-ivermectin MDA, necessitating targeted follow-up interventions.[9,10] The OV16 ELISA remains a sensitive and specific tool for detecting antibodies in these children, providing vital data to inform onchocerciasis elimination efforts.[11,12]

Seropositivity was homogeneously low across these age groups, extending from 0.4% to 1.4%. Similarly, the effects of age have been weak or absent in some endemic settings when analysis inquiry is restricted to a limited age group, whereas broader age ranges in adult populations, such as livestock or humans, show more often strong age gradients in seropositivity.[13,14]

Male and female children had similar seroprevalence (0.9%) with no statistically detectable association between ELISA status and sex. This contrasts with many occupationally mediated or sexually transmitted infections, where men often show higher seroprevalence or clustering,[13,15,16] and with brucellosis in cattle in South Sudan, where females had substantially greater likelihood of seropositivity than males.[14] The absence of variation suggests that exposure is likely transmitted through shared household or environmental factors rather than through sex-related behaviours.

Clusters were observed as strong determinants of transmission homogeneity (e.g. Garamu, Malakia Central, Malakia West A, Olikwi) showed seroprevalence between 3.1% and 9.6%. The higher seropositivity in the Madi Corridor may indicate favourable localised ecological factors for vector breeding or transmission. This is analogous to riverside villages in Cameroon, Nigeria, and Ethiopia, where higher biting and infection are documented.[17–20] This pattern is consistent with focal "hotspots" of transmission embedded in a largely low-risk landscape, as seen for HIV, brucellosis, and other infections where particular communities or locations account for a disproportionate share of ongoing transmission.[13–16] In such settings, spatially targeted interventions in high-prevalence clusters may be more efficient than uniform county-wide measures.

Several limitations were considered. OV-16 antibodies indicate exposure; however, they may persist after treatment or infection. Entomological investigations were not concurrently conducted. This limits direct inference about the intensity of the transmission. Mobility of population data may also affect interpretation. Despite these limitations, the significance of seroprevalence strongly indicates that transmission of onchocerciasis has not yet been interrupted.

Conclusion

Persistent transmission of onchocerciasis in Magwi

Table 2 Seropositivity of onchocerciasis in children by clusters within Magwi county

	ELISA Test Results		
	- ve n (%)	+ ve n (%)	Total n (%)
Acholi Corridor Clusters			
Angok	110 (100)	0 (0)	110 (3.3)
Ayii	109 (100)	0 (0)	109 (3.3)
Buchingo	111 (100)	0 (0)	111 (3.4)
Chama	110 (100)	0 (0)	110 (3.3)
Gara	109 (99.1)	1 (0.9)	110 (3.3)
Kamuli	107 (97.3)	3 (2.7)	110 (3.3)
Kilio	110 (100)	0 (0)	110 (3.3)
Lawaci	112 (100)	0 (0)	112 (3.4)
Lerwa	111 (100)	0 (0)	111 (3.4)
Loudo	110 (100)	0 (0)	110 (3.3)
Obokolot	110 (100)	0 (0)	110 (3.3)
Ogwal-Woo	110 (100)	0 (0)	110 (3.3)
Opamo	110 (100)	0 (0)	110 (3.3)
Opari	62 (100)	0 (0)	62 (1.9)
Palwar	110 (100)	0 (0)	110 (3.3)
Madi Corridor Clusters			
Abila West	123 (100)	0 (0)	123 (3.7)
Avumadrici	42 (100)	0 (0)	42 (1.3)
Beka-Angwa	64 (100)	0 (0)	64 (1.9)
Coyi	33 (100)	0 (0)	33 (1)
Ganzi	52 (100)	0 (0)	52 (1.6)
Garamu	75 (90.4)	8 (9.6)	83 (2.5)
Hai Kenisa West	138 (100)	0 (0)	138 (4.2)
Kololo/Jelie Central	99 (100)	0 (0)	99 (3)
Malakia Central	109 (92.4)	9 (7.6)	118 (3.6)
Malakia West A	125 (96.9)	4 (3.1)	129 (3.9)
Masindi	56 (100)	0 (0)	56 (1.7)
Moi-Oci-Kwira	34 (100)	0 (0)	34 (1)
Motoyo West A	148 (100)	0 (0)	148 (4.5)
Motoyo West B	149 (100)	0 (0)	149 (4.5)
Olikwi	113 (95.8)	5 (4.2)	118 (3.6)
Rei West	150 (100)	0 (0)	150 (4.6)
Sekuwa East	149 (100)	0 (0)	149 (4.5)
Total	3260 (99.1)	30 (0.9)	3290 (100)

County, South Sudan, poses a risk of cross-border transmission into Northern Uganda districts. The study underscores the importance of shifting programmatic interventions from broad, uniform approaches toward more specific, spatially updated strategies that address focal transmission, thereby consolidating gains accomplished and preventing resurgence in high-risk clusters.

Conflict of interest: None

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Prevalence of urinary schistosomiasis in communities along the River Niger Basin areas, North-Central Nigeria

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ABSTRACT

Introduction: Urinary schistosomiasis is a chronic, progressive disease caused by the parasitic bloodworms (trematodes) *Schistosoma haematobium*. Following infection, the adult worm develops in humans and resides in the veins supplying the bladder, leading to haematuria. Globally, there are approximately 240 million infected individuals with an estimated 534,000 fatalities annually. Urinary schistosomiasis has a higher prevalence in remote areas of Nigeria. This study aimed to determine the prevalence and intensity of urinary schistosomiasis in the riverine communities along the River Niger Basin Areas in North-Central Nigeria.

Method: Urine samples were collected from 3,475 people aged between 10 and 55 years from five communities along the basin areas of the River Niger and analysed using microscopy to detect the presence of *Schistosoma haematobium* eggs.

Results: The prevalence of urinary schistosomiasis was high (72.66%), and more males were significantly infected ($p<0.05$). The egg counts revealed moderate-to-heavy infections, with farmers and miners having a significantly higher prevalence than other occupations. This infection affects all ages, peaking between ages 25 and 29.

Conclusion: The prevalence of urinary schistosomiasis in this study is high, predominantly among farmers and gold miners, affecting all ages, primarily due to climate change and gold mining activities among participants. Therefore, there is a need for targeted interventions, including health education about schistosomiasis and mass drug administration to mitigate the burden of the disease in such communities across Nigeria and elsewhere.

Keywords: prevalence, intensity, schistosomiasis, riverine communities, Nigeria

Introduction

Schistosomiasis is a chronic, progressive disease caused by the parasitic bloodworms (trematodes). Urinary schistosomiasis is caused by *Schistosoma haematobium*, transmitted from one person to another when an infected person passes the ova

from urine into water bodies. The ova hatch immediately into miracidia, which are then ingested by a snail (in this case, *Bulinus spp*). Inside the snail intermediate host, the miracidia undergo metamorphosis into cercariae, which are then released and become free-swimming in the water, serving as the infective stage to man. The cercariae penetrate humans through the skin and the infective cercariae metamorphose and become adult worms in the human host and move to the predestined site, where, in this case, they reside in the veins supplying the bladder. There they continue to lay eggs, and these eggs are released into the bladder and do pass out with the urine into a water body, hence the life cycle continues.[1] The main presenting symptom of urinary schistosomiasis is haematuria.

Schistosomiasis poses a public health challenge second only to malaria globally. The prevalence of schistosomiasis infections ranks second among the major Neglected Tropical Diseases linked to poverty.[2] Globally, there are approximately 240 million infected individuals with an estimated 534,000 fatalities annually.[3] Although not causing early death, this disease has a severe, debilitating effect on individuals.[4] As in other African countries, urinary schistosomiasis has a higher prevalence in remote areas of Nigeria.[5] The prevalence within communities is linked to the presence of water reservoirs such as dams, rivers, or streams, which are crucial for meeting the domestic and recreational water needs of the local population.[6] The cercariae directly penetrate the skin of individuals engaged in water-related activities such as fishing, rice or other fadama (dry season irrigation) farming, gold washing (mining process), laundry, bathing, and swimming.[7] Individuals at the highest risk are those residing in or visiting areas where the disease is widespread.[8] In sub-Saharan Africa, more than 90% of schistosomiasis cases occur in Nigeria, with an estimated 29 million cases reported.[9] Data published in 2021 indicate approximately 29 million infected individuals, including 16 million children and young adults, with 101 million at risk in the country.[9] Given the identification of urinary schistosomiasis across various regions in Nigeria, with estimates of intensity (i.e., the number of eggs in urine samples) and prevalence rates, coupled with indications of increasing incidence,[10] the absence of current estimates underscores the need for updated information.

Nigerian school children and active young adults continue to face significant morbidity from schistosomiasis.[11] The highest infection intensities are typically observed in children aged 8 to 20 years in endemic areas but not restricted to these age groups in such endemic areas. Localized studies, such as those in Kwara State, have consistently reported high prevalence and intensity with no particular age pattern.[11] This study aimed to determine the prevalence and intensity of urinary schistosomiasis in riverine communities along the River Niger Basin Areas in North-central Nigeria.

Method

This study was carried out in riverine communities along the River Niger Basin Areas through Kwara and Niger states in North-central Nigeria. It lies within latitude 8°30′00″N and longitude 4°35′00″E, and the inhabitants in the study area are mainly civil servants, farmers, fishermen, traders, artisans, and individuals from the organized private sector.

This cross-sectional study included schools and communities and used a quantitative data collection method to assess potential predisposing risk factors. Individuals aged 10 to 55 years were randomly selected using the open research balloting system (to maintain objectivity and reduce bias in subject selection).

In addition, conditions, characteristics, outcomes, and exposure of pregnant women to malaria were studied.

The sample size was determined as described by Abdulkareem et al.[4]

Ethical approval was obtained from the Ethical Review Committees of the Kwara State and Niger State Ministries of Health.

Data collection

Semi-structured and standardized proforma were administered to participants with assistance from research staff. This proforma aimed to collect demographic data, including names, ages, genders, and educational backgrounds, prior to sample collection.

Sample collection and transportation

Sample collection was conducted between 10:00 am and 2:00 pm, a period when *Schistosoma haematobium* egg excretion peaks. Participants were then provided with disposable plastic cups labelled with a code and serial number. Hand soap and sanitizers were provided for all participants to disinfect their hands before and after sample collection. From the urine specimens, 10 ml was transferred into labelled universal bottles using a syringe. The samples were preserved by adding 10 ml of 70% alcohol and carefully stored in sturdy paper cartons,

secured with adhesive tape to prevent spills or displacement during transport to the laboratory.

Laboratory analysis and interpretation of results

Microscopic examination procedure for the urine filtration technique

The preserved urine samples were examined using the filtration technique with a 325 µm wire mesh. The samples were passed through the wire mesh filter, folded conically, and placed in small plastic funnels atop empty beakers or flasks. The sediment was transferred to a cross-hatched Petri dish and examined under a dissecting microscope at 20x magnification to identify characteristic *Schistosoma haematobium* eggs. Eggs were counted using a hand tally counter, and infection intensity was expressed as eggs per 10 ml of urine. The number of eggs per 10 ml of urine was counted and graded as follows: light (50-149), moderate (150- 499), and heavy (≥500). For quality control, precision, and accuracy, egg counts were performed twice. Only ova with a conspicuous terminal spine were counted.

Data analysis

All data were analysed using SPSS version 27.00, with descriptive statistics used to determine associations between observed variables, and conclusions were drawn at the 95% confidence level.

Results

This study examined 3,475 active young and old people in five communities along the River Niger in North-

Table 1. Prevalence of schistosomiasis by age, sex and other demographic variables in the study areas

Parameters	Indicators	No. Examined	Positive n (% of 3,475)	p-Value
Age (years)	10-14	222	210 (6.04)	p>0.05
	15-19	425	392 (11.28)	
	20-24	617	486 (13.99)	
	25-29	624	501 (14.42)	
	30-34	611	422 (12.14)	
	35-39	398	210 (6.04)	
	40-44	308	196 (5.64)	
	45-49	200	82 (2.36)	
	≥50	70	26 (0.75)	
	Total	**3,475**	**2,525 (72.66)**	
Sex	Male	2,611	2003 (57.64)	p<0.05
	Female	864	522 (15.02)	
	Total	**3,475**	**2,525 (72.66)**	
Educational Levels	Non-formal	428	264 (7.60)	p<0.05
	Primary	921	620 (17.84)	
	Secondary	1,281	1,016 (29.24)	
	Tertiary	845	625 (17.98)	
	Total	**3,475**	**2,525 (72.66)**	
Occupation	Trading	312	122 (4.83)	p<0.05
	Farming	1,212	980(38.81)	
	Fishing	423	386(15.29)	
	Mining	420	411 (16.28)	
	Civil Service	416	201 (7.96)	
	No particular occupation	692	425 (16.83)	
	Total	**3,475**	**2,525 (72.66)**	

Table 2. Intensity of infection by egg count among participants across communities in the study areas

Level	Intensity				ANNOVA (p-value)
		Light	Moderate	Heavy	
Score range	Infected (+ve)	1-149 eggs/ 10 mL urine	150-499 eggs/ 10mL urine	≥500 eggs/ 10mL urine	
Community A	503 (19.92)	184(7.29)	137(5.43)	182(7.21)	
Community B	506 (20.04)	167(6.61)	167(6.61)	172(6.81)	
Community C	504(19.96)	161(6.38)	171(6.77)	172(6.81)	0.01196
Community D	504 (19.96)	101(4.00)	199(7.88)	204(8.08)	
Community E	508 (20.12)	198(7.84)	166(6.57)	144(5.70)	
Total	**2,525 (100)**	**811 (32.12)**	**840(33.27)**	**874(34.61)**	

central Nigeria, and 2,525 (72.66%) tested positive for schistosomiasis, as shown in Table 1.

The infection rate peaked in the 25-29 age group (14.42%), followed closely by the 20-24 (13.99%) and 30-34 (12.14%) age groups. The age group with the lowest prevalence of infection was ≥50 years (0.75%). However, the differences in the prevalence across age groups were not statistically significant. Conversely, more males (57.64%) were infected than females (15.02%) (P<0.05). The prevalence by participants' educational level showed that individuals with secondary education had the highest prevalence (29.24%), followed closely by those with tertiary (17.98%) and primary (17.84%) education, with the lowest prevalence among those with non-formal education (7.60%).

Again, in Table 1, the difference in prevalence by participants' occupation was statistically significant, with the highest prevalence of 38.81% among farmers, 16.28% among miners, and 15.29% among fishermen, and the lowest (3.51%) among traders (P<0.05).

In all five communities where the study was conducted, the prevalence of infection was relatively similar, ranging from 5.43% to 7.84%. The small differences observed among the communities were not statistically significant (p>0.05). Also, there was an even distribution of infection intensity across the study areas (Table 2).

Figure 1 shows activities predisposing community members to schistosomiasis infection in the study areas.

In Figure 2, the numbers from 0 to 5 indicate the range of urine colours and haematuria levels across different areas of the study.

Discussion

Prevalence of schistosomiasis

The study finds that, proportionately, individuals in the communities have a significant schistosomiasis infection rate. The prevalence of urinary schistosomiasis among community inhabitants in the riverine areas was high, at 72.66%. This aligns with the World Health Organization's classification of the area as heavily endemic, highlighting the urgent need for intensified control measures.[3] This suggests that environmental and socio-economic factors significantly influence the transmission of urinary schistosomiasis in these communities, as previously reported,[5] emphasising that children and young adults living near rivers and lakes are more susceptible to infection. Joseph et al.[6] reported a prevalence rate of 8.9%, which is lower but still comparable in their study area.

This high prevalence rate from this study compares with previous findings in Kwara State, where Abdulkareem et al.[4] recorded a high prevalence of 45.6% and Bolaji[7] recorded 58.7% in similar communities, attributing the higher rate to the presence of extensive irrigation projects, water reservoirs, and frequent river contact, which significantly impact local socio-economic practices.

Prevalence by age groups

Although prevalence rates varied across age groups, the differences were not significant. The higher rate of infection seen among the 25-29 age group may be explained by this group being the most active in the study population,

Figure 1. Activities of participants in infected water that favour the spread of schistosomiasis (Credit: Amase Nyamngee)

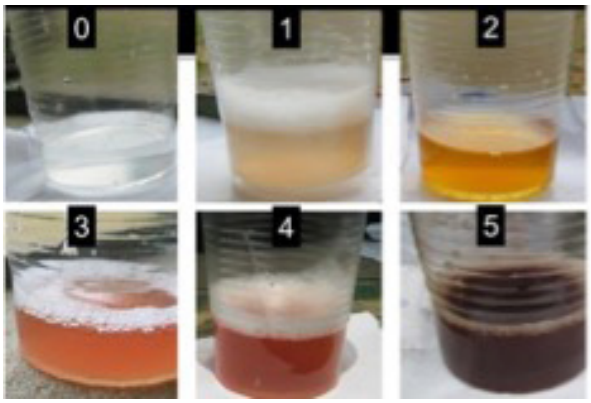

Figure 2. The appearances of different urine samples collected from participants

compared with the lower prevalence observed in the≥50 age group, who apparently have reduced water-contact activities. Similarly, findings from Muhammad et al.[8] recorded a high prevalence of 62.86%, and Obonogbigho et al.[9] also recorded a prevalence of 19.3% among similar age groups. According to them, the high prevalence was attributed to more frequent engagement in water-related activities such as swimming, mining, and playing in rivers.

Prevalence by sex

This study found that more males (57.64%) were infected than females (15.02%), and this difference was statistically significant. These data indicate that social stigma associated with open bathing may hinder females from actively participating in high-water-contact activities. The higher prevalence among males aligns with findings from Abdullahi & Ramatu,[10] who reported 38.2% among males and 15.0% among females. However, the prevalence observed among females may be due to indiscriminate farming activities in these communities that involve both males and females.

Quantification of eggs by schools in the communities

The quantification of Schistosoma eggs in urine samples provides critical insight into infection intensity among participants in these communities. This distribution of egg intensity was categorized as light, moderate, or heavy, with most infections falling into the heavy category. This high intensity in our findings is attributable to a lack of understanding of the biology of schistosomiasis transmission and of water-contact activities as a means of livelihood in these communities, which predisposes community members to repeated infection, resulting in a heavy egg load in their urine. The high egg-count intensity observed in our findings indicates that the transmission of infection to others, or even reinfection within the same group, is more likely, posing a severe risk of schistosomiasis spread in these communities.

Concusion

There is a very high prevalence of urinary schistosomiasis among community inhabitants in riverine areas along the river Niger in North-Central Nigeria. The intensity of this infection is also very high, affecting people of all ages, both males and females. We recommend targeted interventions to reduce water contact, improve sanitation, and introduce health education.

Conflict of interest: none

Authors' contribution: AN: Conception and design of the study, analysis and interpretation of data; drafting of the article. MJS: Literature search and assemblage of data. IRT: study design, field work, laboratory work. KYA: Provision, Collection, and assemblage of data. SMK: Literature search, Provision, Collection, and assemblage of data. AAA: Study design, revising the write-up, and administrative, technical, and logistic support.

Acknowledgments: We acknowledge the authorities of the University of Ilorin Teaching Hospital for allowing us access to their Laboratory.

Study Limitation: This was a community-based study; thus, there is a possibility of community overlap. Several of the participants did not know their exact age. However, we implemented a calendar of events to overcome this challenge.

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sources of assistance were personal contributions from the researchers.

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programme Guidance to Protect the Nutrition of Women and Adolescent Girls in Humanitarian Settings

This guidance has been created for nutrition cluster/sectors, programme staff of UNICEF and the World Food Programme (WFP), and other practitioners who are designing and/or implementing a nutrition response in humanitarian settings. These nutrition responses may include assessments and/or interventions for pregnant and breastfeeding women and adolescent girls in humanitarian settings.

Watch the webinar recording here.
https://www.unicef.org/documents/guidance-protect-nutrition-women-and-adolescent-girls-humanitarian-settings?utm_campaign=WINS%20%7C%20Maternal%20Nutrition%20ESARO%20%28Partners%29&utm_medium=email&utm_source=Mailjet

Developing a communicable and infectious diseases research agenda in South Sudan: A multi-stakeholder prioritisation approach

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ABSTRACT

Introduction: South Sudan faces a considerable health burden, including high rates of communicable, non-communicable, and maternal and child health concerns within a constrained health system and challenging humanitarian context. Our aim was to engage stakeholders to identify major health research gaps, apply the Africa Centres for Disease Control & Prevention (CDC) prioritization tool to rank disease programme areas and the health system based on context-specific criteria, and produce a ranked agenda to inform implementation plans.

Method: A multi-stakeholder, criteria-driven approach was used, adapting the Africa CDC research prioritisation tool. This involved a situational analysis, the identification of potential research questions, the scoring of topics against established criteria such as burden, equity, feasibility, impact, and cost-effectiveness, and a consensus-building workshop. The disease themes and health system components were on high, medium, and low set-scores.

Results: Several high-priority research themes and questions were identified. South Sudan remains heavily burdened by infectious diseases, with malaria a leading cause of morbidity and mortality. The highest probability conditions in this category were Human papillomavirus (HPV), respiratory syncytial virus, and staphylococcal infections. Health System Strengthening emerged as a cross-cutting challenge due to workforce shortages, weak infrastructure, and disease surveillance gaps.

Conclusion: Initiating the health research agenda with a national research plan that identifies lead institutions, potential funding sources, and timelines was considered essential. Investing in health research capacity strengthening and leveraging on stakeholders such as the Africa CDC is a call to action. Institutionalising and harmonising priority-setting mechanisms through a national health research prioritisation technical committee to ensure ongoing responsiveness to health threats and shocks was also realised as important.

Keywords: communicable, research agenda, Africa CDC prioritisation tool, South Sudan

Introduction

An effective health research agenda is fundamental for aligning research investments with national health priorities, particularly in developing and fragile contexts such as South Sudan. Research prioritisation informs the allocation of resources to health needs, supports the generation of appropriate evidence, and facilitates strategic coordination among stakeholders.[1] South Sudan faces acute and chronic burdens of communicable and non-communicable diseases. This report documents the process, prioritised health research themes and questions, and indicates the next priority steps in South Sudan, adapting, applying, and contextualising the Africa CDC research prioritisation tool.[2]

South Sudan faces numerous health system challenges: high maternal and newborn mortality, a scarcity of skilled health workers, disease outbreaks - for instance, cholera, Hepatitis E, and Mpox. There are only 7.6 skilled health workers per 10,000 population, when the minimum for universal health coverage (UHC) is 44 per 10,000 persons.[3] Priorities to achieve UHC include strengthening health security, improving population well-being, and reinforcing health information systems.[4]

These essential pillars necessitate targeted research to inform decision-making and interventions. Priority-setting processes are heavily influenced by external donor-driven agendas. Power asymmetries between donors and national health governance exist, affecting how priorities were set within the Health Pooled Fund (HPF models 1, 2, & 3) service-delivery contract framework, as well as the Health Sector Transformation Project (HSTP), a multi-donor funded project.[5]

Health financing and implementation gaps persist due to weak priority-setting mechanisms and governance.[6] A structured activity to prioritise health research in South Sudan is critical to ensure alignment of research with national priorities. The principal objectives were to engage key stakeholders to identify major health research priorities and apply and contextualise the Africa CDC prioritisation tool to rank research topics according to context-specific criteria, produce a ranked health research agenda that inform national research funding, partnerships, and implementation plans.

Method

The stakeholders from the Ministry of Health (MoH), academia, partners' agencies, national research institutions, civil society organisations and researchers, and health service delivery partners were brought together for a consultative workshop held 1-5 September 2025 in Juba, with 35 invited, 53 attended. Multidisciplinary experts from biomedical, public health, laboratory, epidemiology, biostatisticians, monitoring and evaluation, ethics and clinical fields to (a) review health systems and research needs in South Sudan; (b) apply clear and agreed criteria to prioritise research themes and questions; (c) agree on a ranked list of priority research topics; and (d) propose mechanisms for follow-up, including funding coordination, capacity-building, and knowledge translation. This aligns with the Africa CDC's emphasis on inclusive, multi-stakeholder consultative approaches.[7]

The Africa CDC Research prioritisation tool was adapted, with a framework developed from a discrete choice experiment, a conditional utility model, and weighted criteria to guide our research agenda. The tool was used to conduct a situational analysis of the research landscape and burden of disease; identify candidate research questions; apply layout criteria and a weighted scoring and ranking scheme for themes; and validate and build consensus.[7] Stakeholders were consulted, and invitations extended to MoH technical staff, implementing partners, academia, and researchers. A desk analysis was made of strategic documents and previous research to identify gaps and weaknesses. The participants agreed on prioritisation criteria and contextualized the Africa CDC research prioritisation tool.

Each proposed research topic was scored and ranked against the criteria. Topics were ranked by aggregate probability scores, then discussed to reach consensus. During the workshop, participants reviewed existing national health indicators, national databased (DHIS2), recent studies, and stakeholder inputs to develop a long list of potential research questions within thematic domains such as communicable diseases, eye defects, fungal infections, injuries, maternal and child health, mental health, neglected tropical, non-communicable, and zoonotic diseases. The list was then scored according to agreed-upon weighting and criteria, using disease thematic groups to score them, and a plenary session was convened to build consensus. Finally, the results were consolidated into a priority ranking.

A plenary session reviewed the ranked list, presented by each thematic area team lead, and proposed mechanisms for monitoring and translating research outputs into policy and practice. The invited health sector stakeholders endorsed the plan for coordinating research

implementation, capacity building for local researchers, and mechanisms for dissemination and uptake. An agreement was reached to consolidate the research priority framework, aligning short-term (1-2 years) and medium-term (3-5 years) research initiatives with the national health strategic plan. The Africa CDC prioritisation tool is not publicly available; its details can be found on their websites and in recent communications.

Results

Prioritised research themes and questions

Infectious diseases and outbreak preparedness are important pillars for global health security. Repeated outbreaks expose the vulnerability of public health systems and the need for investment in disease surveillance, prevention, and rapid-response mechanisms. Integrating infectious disease management within the broader health-security framework emphasizes not only biomedical interventions but also governance, coordination, partnerships, and resilience-building. Hence, epidemic preparedness is a key component of international health policy and regulation, demonstrating that the control and threats of infectious conditions are a scientific and strategic imperative for safeguarding population health.

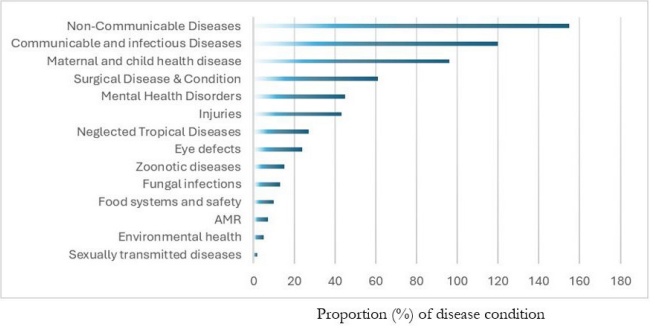

Figure 1. Situational context in Continental Africa: Diseases by thematic area

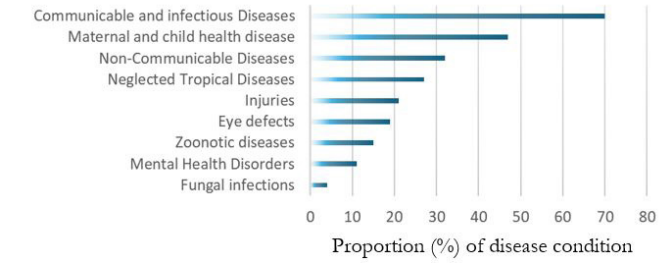

Figure 2. Situational context in South Sudan: Diseases by thematic area

Context in Continental Africa

Figure 1 shows Communicable and Infectious Diseases (CID) 120 and emphasises that, in Africa, infectious disease outbreaks remain substantial. For example, from July 2021 to June 2022, 112 of 130 acute infectious disease conditions reported in Africa were infectious disease outbreaks. The non-communicable disease (NCD) burden is rising, and so a "double burden" of infectious and non-infectious conditions demands attention.

Context in South Sudan

Health research in South Sudan is limited by low capacity and the translation of evidence into policy and practice. Many member states still under-invest in research.

The disease burden is complex, reflecting longstanding communicable and maternal/child health challenges, emerging non-communicable, zoonotic, injury, ocular, and mental-health conditions. Figure 2 provides the thematic breakdown of disease burden by proportion, starting from communicable and infectious diseases (70%), maternal and child health (47%), non-communicable (32%), neglected tropical diseases (27%), injuries (21%), eye defects (19%), zoonotic diseases (15%), mental health disorders (11%), and fungal infections (4).

Infectious diseases are a heavy burden in South Sudan. Malaria is a leading cause of morbidity and mortality. In 2021, it was estimated at ~3 million cases (incidence ~280 per 1,000) with ~7,344 deaths. In addition, there is a high incidence of HIV/AIDS, lower respiratory infections and diarrhoeal diseases. Thus, the figure "70" in Figure 2 shows the dominance of infectious-diseases. The latter is exacerbated by humanitarian crises, displacement, weak infrastructure, and outbreak risk.

The maternal, neonatal, and child health theme is an area of concern. The link between infections, poor immunisation coverage, malnutrition and maternal/child outcomes is clear in South Sudan. Poor vaccination coverage and disruption of services are major public health issues. The figure "47" in the Figure 2 reflects these matters.

NCDs are increasingly recognised in South Sudan, accounting for 28% of deaths in 2019. The probability of premature death from NCDs for ages 30-70 years was ~20% in 2020, higher than the sub-Saharan African average of ~13.7%. The figure "32" in Figure 2 signals the growing relevance of NCDs. There is limited surveillance of NCDs with low diagnostic capacity, shortages of essential medicines, and health information systems that focus on acute infections and maternal and child conditions. Thus,

while the number ("32") appears lower than infectious burdens, the impact of NCDs is under-estimated.

South Sudan has a challenging problem of neglected tropical diseases (NTDs). "It is endemic for all five NTDs amenable to preventive chemotherapy through mass drug administration (MDA) in 2021, reached 91% of the 6.6 million people targeted for treatment."[8] Number "27" in Figure 2 highlights the impact of NTDs.

In a country with decades of conflict and instability, injuries are a notable burden ("21" in Figure 2). Data on national injuries are sparse and represent a key area for public-health programming.

Ocular disorders receive poor attention in national health statistics but are considerable for disability-adjusted life years (DALYs). In South Sudan, eye defects are recognised as a substantial thematic area (see "19" in Figure 2). The broader disease burden, including sensory impairments and congenital anomalies, is important for integrated primary care and rehabilitative service planning.

Zoonotic diseases are an under-resourced area, given the livestock-based livelihoods, displacement, and outbreak risk. Figure "15" (Figure 2) indicates that zoonotic diseases require serious attention.

Although the number "11" (Figure 2) is relatively low, and probably an underestimation, mental health disorders are serious in the context of chronic and acute conflict, trauma, and limited-service availability. Specialised mental-health clinics are rare, aggravating the unmet need.

Fungal infections are frequently overlooked, particularly in settings like South Sudan. Figure "4" in Figure 2 is likely another underestimate, bearing in mind immunosuppression, malnutrition, and poor hygiene that predispose to fungal infections.

The coexistence of major communicable disease burden ("70") with an increasing NCD burden ("32") reflects the "double burden" of disease in low-income, fragile settings. The health system must adapt to address these changing circumstances.

Many thematic categories are under-reported. Health-information systems focus on infectious, maternal, and reproductive health, with chronic conditions under-recognised and underestimated and lack integration in healthcare provision.

The "neglected" categories (NTDs "27", eye defects "19", zoonoses"15", fungal infections "4") need a cross-cutting approach such as "One-Health" (a multi-professional body addressing zoonotic diseases). In this context improvement in cost-effective laboratory capacity is crucial.

In the South Sudan context, preventable infectious and

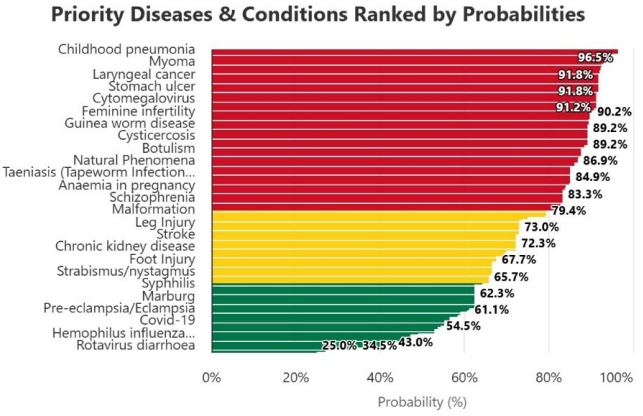

Figure 3. Diseases and health conditions in South Sudan context

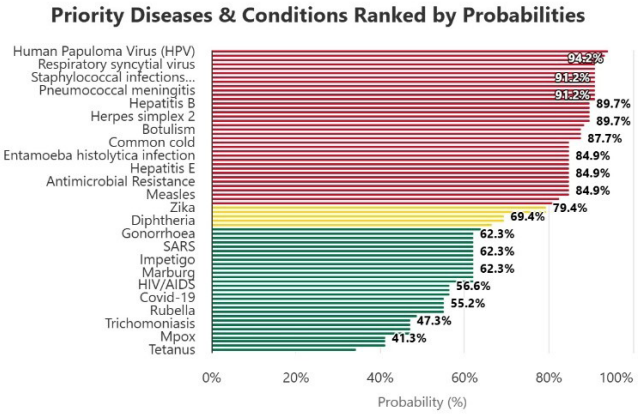

Figure 4. Priority communicable and infectious diseases

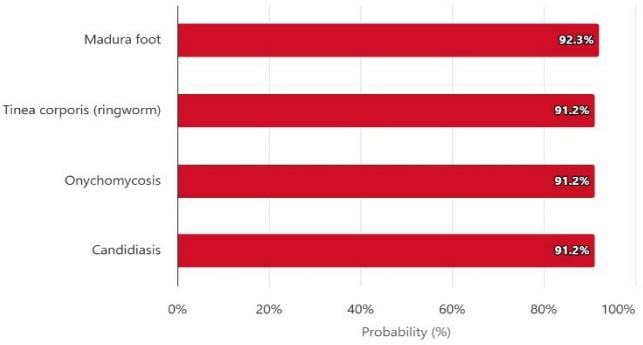

Figure 5. Priority fungal infectious diseases & conditions

maternal–child conditions, particularly pneumonia, diarrhoeal disease, vaccine-preventable bacterial infections, and the combination of malnutrition and maternal complications, represent the highest health threats in 2020-2025(EWARS/DHIS2 report). These threats are compounded by NTDs and episodic viral haemorrhagic disease risks, all amplified by conflict, displacement, food insecurity and weak health systems.

Pneumonia causes more under-5-year-old deaths than any other disease. High malnutrition and low vaccine coverage are serious issues in South Sudan. In addition, there is a high maternal mortality and low service coverage. Hypertensive disorders in pregnancy contribute substantially to maternal deaths. Addressing maternal health and nutrition is central to reducing maternal and child mortality.

Conditions such as cysticercosis and occasional human cases of dracunculiasis place NTD control on the priority list. A small number of human guinea-worm cases were documented in the early 2020s. The emergence of viral haemorrhagic fevers highlights ongoing outbreak risk and the need for cross-border preparedness.

Priority research questions

Communicable and infectious diseases (CID)

The bar chart presents a comparative analysis of various diseases and conditions according to their associated probabilities, expressed as percentages (Figure 4). The probabilities range from 41.3% to 94.2%, with the diseases grouped by colour to indicate relative priority or likelihood.

At the highest probability level (red), Human papillomavirus (HPV) ranks first with 94.2%, followed by Respiratory syncytial virus and Staphylococcal infections, both at 91.2%. Other diseases include pneumococcal meningitis, Hepatitis B, Herpes simplex 2, and botulism, all exceeding 84%.

The intermediate probability group (yellow) includes measles (79.4%), Zika (69.4%), and diphtheria, reflecting moderate probability/priority. The lower probability group (green), e includes diseases such as gonorrhoea, SARS, and impetigo (each at 62.3%), as well as Marburg (56.6%), HIV/AIDS (55.2%), rubella (47.3%), trichomoniasis (41.3%), Mpox, and tetanus.

Figure 5 presents four distinct medical conditions with similar probability percentages: Madura foot, *Tinea corporis* (ringworm), onychomycosis, and candidiasis.

Discussion

Broad and specific strategic research questions for CIDs

What is known about the distribution and determinants of communicable and infectious diseases in South Sudan?

The detailed, specific strategic research questions for different thematic areas are found in the health/diseases research prioritization agenda for 2025-2030. These research questions are categorized as short-, medium-, and long-term. The short-term questions include, but are not limited to, the following: (1) What are the structural and systemic factors influencing South Sudan's emergency preparedness and response capacity at national and subnational levels? (2) How do governance, financing, and coordination mechanisms influence the effectiveness of South Sudan's emergency health preparedness system? (3) What lessons can be drawn from South Sudan's responses to past public health emergencies (e.g., cholera, Ebola alerts, yellow fever, Mpox, Hepatitis-E virus, COVID-19) to strengthen resilience against future outbreaks? (4) How do humanitarian crises, displacement, and conflict dynamics shape emergency preparedness planning and implementation in South Sudan? For medium and long-term strategic research questions, four are selected, with two questions from each category. For example: (5) What are the cost-effectiveness outcomes of universal Hepatitis B vaccination programmes in South Sudan? (6) How does climate change influence the seasonal distribution of typhoid outbreaks? (7) What are the barriers to effective implementation of oral cholera vaccines in high-risk populations? (8) What is the role of antimicrobial resistance in the management of cholera cases?

Reflections on the prioritisation process

Through engaging stakeholders, broad participation ensured that multiple perspectives and opinions informed the agenda. However, some sub-national groups were under-represented. Feasibility and sustainability were prominent concerns. Participants emphasised that research should be adaptable to changing circumstances. It is acknowledged that donor funding and technical capacity drive research priorities.[5] The process uses explicit criteria and ranking as well as resources from Africa CDC, but the country's sustainability and ownership remained a challenge.

Aligning research priorities with national health policy and the health sector strategic plan ensures relevance.[4]

A recurrent theme was investment in national research capacity, data systems, and institutional infrastructure. The exercise confirms the applicability of the Africa CDC prioritisation approach in a developing context. The multi-stakeholder and criteria-driven process lends transparency to the setting of research priorities. Translating prioritized research into policy and practice requires institutional linkages, which should be deliberately constructed. A similar approach used in developing newborn and child health guidelines in African countries highlighted the importance of context-specific stakeholder engagement and consensus processes.[9]

Conclusion

The prioritisation activity represents a meaningful step toward systematically aligning health research with national health priorities in South Sudan. Hence, engaging diverse stakeholders, applying transparent criteria, and producing a ranked research agenda linked to policy documents, the groundwork has been laid for more strategic research investment. Nonetheless, the success of the agenda depends on sustained governance, capacity investment, funding alignment and translation of research into actionable health policies and programmes.

Recommendations

Operationalise the prioritized health research agenda by developing a national research plan identifying lead institutions, funding sources, timelines and responsible parties for each high-priority topic.

Invest in research capacity strengthened by leveraging relevant stakeholders, such as the Africa CDC's capacity-mapping initiatives, to build infrastructure, train researchers, strengthen ethical/regulatory frameworks, and embed research within service delivery.

Institutionalise priority-setting mechanisms by establishing a standing national research prioritisation committee that uses the Africa CDC tool to review and update across cycles, ensuring responsiveness to emerging health threats.

Strengthen translation of research into policy by creating pathways for uptake of research findings by the MoH and partner agencies, including policy briefs, knowledge-translation workshops, and institutional linkages.

Monitor and evaluate the impact of prioritised research by developing indicators to track funding flows, research outputs, policy uptake, and health outcomes tied to each priority topic.

Conflict of interest: Nil

Funding: Nil.

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Determinants of disaster preparedness among public health facilities in Juba City, South Sudan

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ABSTRACT

Introduction: In times of disaster, the primary duties of the health sector are to save lives, minimize permanent disability, deliver medical care to the injured, and mitigate the risks of disease and mortality from health hazards. The success in delivering these responsibilities relies on the uninterrupted functionality of health services. The study aimed to evaluate the influence of resource availability, health workers' capacity, technological integration, and institutional policy on disaster preparedness in public health facilities in Juba City, South Sudan.

Method: This study used a cross-sectional research design. The target population comprised healthcare and administrative workers at three major public health facilities in Juba City. The study used descriptive and inferential statistics to analyse the quantitative data.

Results: 148 participants responded to the study questionnaire out of a sample size of 162 respondents. Most respondents 123, (83%) disagreed that their facility had sufficient funding for disaster preparedness activities. Furthermore, 105 (71%) disagreed that specific budgets were allocated to improve disaster preparedness, and 99 (67%) believed that financial constraints significantly impact their facility's ability to prepare for and respond to disasters. A small proportion (71; 48%) reported that staff were regularly trained on the guidelines. The reported insufficient funding for preparedness activities was significantly associated with a facility's inability to initiate a response plan within the recommended timeframe ($\chi 2=15.24$, $p<0.001$).

Conclusion: The overall state of readiness is significantly hampered by systemic deficiencies, with the absence of formal institutional policies and severe financial constraints as the most profound challenges. These foundational weaknesses created a cascading effect, leading to inadequate material resources, challenges in maintaining stable, motivated human resources, and a disconnect in general information.

Keywords: disaster, health sector, resources, preparedness, Juba City, South Sudan

Introduction

Globally, health facilities are fundamental components of emergency response plans and must enhance their capabilities and capacities for emergency preparedness well before any disaster.[1] In times of disasters, the primary duties of the health sector include saving lives, minimizing permanent disability, delivering medical care to the injured, and mitigating the risks of disease and mortality resulting from illness or other health hazards.[2] Unfortunately, in many instances, health facilities are inadequately prepared for unforeseen disasters.

In Juba City, public health facilities were inadequately prepared for unforeseen disasters.[3] Chronic underfunding of the health sector by the government has worsened significantly over the past decade, negatively affecting the performance of public health facilities.[4] This study examined the factors influencing disaster preparedness in public health facilities in Juba City, South Sudan, which is a critical step towards enhancing health system resilience. The objectives of the study were to evaluate the influence of resource availability, health workers' capacity, technological integration, and institutional policy on disaster preparedness.

Method

This was a cross-sectional study. The target population was 270 healthcare and administrative workers at three public health facilities in Juba City. Yamane's formula, with a 5% margin of error, was used to calculate a sample size of 162 respondents.

A structured self-administered questionnaire was used to collect data on the study variables (independent variables: availability of resources, health workers' capacity, technology integration, and institutional policy; and dependent variables: Time to Initiate Response, Adherence to Regulatory and Standard Guidelines, and Performance in Simulations and Training Drills).

The collected data were sorted, cleaned, coded, and entered into SPSS version 25; p-values < 0.05 were considered significant.

The results were presented in descriptive tables and the results of bivariate and logistic regression analysis. Since the targeted population was heterogeneous, a stratified sampling method was used to select the three health facilities (PHCU, PHCC, and a hospital), thereby capturing variation across healthcare levels.

Results

148 participants responded to the study questionnaire. The largest proportion of respondents, 61 (41%), was within the 26-35 years age bracket. Disease outbreaks emerged as the most frequently reported event, cited by 76 (51%) respondents. A substantial proportion of health workers, 46 (31%), had less than one year of work experience. Most respondents 123, (83%) disagreed that their facility had sufficient funding for disaster preparedness activities. Furthermore, 105 (71%) disagreed that specific budgets were allocated for improving disaster preparedness, and 99 (67%) agreed that financial constraints significantly impact their facility's ability to prepare and respond during disasters (Table 1).

Regarding response initiation, although 99 (67%) of staff were aware of critical time objectives, only 70 (47%) facilities could initiate a response within the seven-day timeframe for detection, one day for notification, and seven days for response (Table 2). Regarding compliance with guidelines, a substantial majority, 108 (73%) of

Table 1. Demographic characteristics of respondents (N=148)

Characteristic	Category	n (%)
Sex	Male	70 (47)
	Female	78 (53)
Age (years)	19 – 25	18 (12)
	26 – 35	61 (41)
	36 – 45	42 (28)
	Above 45	27 (18)
Education	Certificate level	33 (22)
	Diploma level	52 (35)
	Graduate/Degree	44 (30)
	Postgraduate	16 (11)
	Others (First Aid)	3 (2)
Work experience (years)	Less than 1	46 (31)
	1 – 5	40 (27)
	6 – 10	38 (26)
	Over 10	24 (16)
Types of disasters	Flooding	25 (17)
	Disease outbreaks	76 (51)
	Heat wave	21 (14)
	Drought	2 (1)
	Wildfire	0 (0)
	Hailstorms	0 (0)
	Landslides	0 (0)
	Earthquakes	0 (0)
	Civil war	24 (16)
	Others (Specify)	0 (0)

respondents, agreed their facility consistently adhered to local and national Disaster Preparedness and Response (DPR) guidelines. Despite this high level of adherence, a smaller proportion, 71 (48%), reported that staff were regularly trained on these guidelines (Table 2).

Concerning training and drills, only 63 respondents (43%) agreed that staff were trained in disaster response and drills (Table 2). A notable 98 (66%) of staff members felt that participating in simulations and training drills significantly improved their preparedness for an actual disaster situation (Table 2). This observation suggests that, despite a relatively low frequency of reported training and drills, those that are conducted are highly valuable and effective for staff, indicating that increasing the frequency and scope of the simulations and drills could boost overall preparedness and staff confidence, even if other systemic issues persist.

Table 2. Descriptive statistics of the dependent variables on disaster preparedness (N=148)

Statements	Disagree n (%)	Agree n (%)
Time to initiate response		
The facility can initiate its DPRP within seven days, as recommended by local disaster management authorities 7-1-7 (investigate within 7days, report within a day, and respond within 7 days) timelines.	78 (53)	70 (47)
The time it takes for our facility to mobilize resources for disaster response is adequate to meet the needs of the situation.	88 (59)	60 (41)
The facility staff members are aware of the critical time objectives for initiating different phases of the disaster response.	49 (33)	99 (67)
Communication with external emergency services is established promptly according to our disaster response plan.	86 (58)	62 (42)
Compliance with guidelines		
The facility consistently adheres to local and national disaster preparedness and response guidelines.	40 (27)	108 (73)
The facility staff members are regularly trained on regulatory and standard guidelines relevant to disaster preparedness and response.	77 (52)	71 (48)
The disaster preparedness and response plans are regularly audited for compliance with regulatory and standard guidelines.	93 (63)	55 (37)
Feedback from compliance audits is effectively used to improve our disaster preparedness and response plans.	69 (47)	79 (53)
Training and drills		
Staff are trained in disaster response and in drills.	85 (57)	63 (43)
Participants in simulations and training drills demonstrate a high level of competence in their designated roles.	67 (45)	81 (55)
Simulations and training drills are realistic and cover a wide range of potential disaster scenarios.	72 (49)	76 (51)
The performance in simulations and training drills is systematically evaluated to identify areas for improvement.	69 (47)	79 (53)
Lessons learned from simulations and training drills are effectively integrated into our disaster preparedness and response plans.	80 (54)	68 (46)
Staff members feel that participating in simulations and training drills significantly improves their preparedness for an actual disaster situation.	50 (34)	98 (66)

Regarding staffing levels, only 69 (47%) agreed that there was sufficient staffing for emergencies (Table 3). Although a higher proportion, 85 (57%), indicated an adequate number of specialized healthcare workers for disaster response, a significant majority, 98 (66%), disagreed that staffing levels remain stable during emergencies, and only 57 (39%) agreed that staff allocation was effectively adjusted during a disaster (Table 3).

The material resources assessment indicated significant deficiencies, with 98 (66%) respondents disagreeing that their facility possessed adequate physical infrastructure to manage large-scale health emergencies (Table 3). A notable positive outlier in resource availability of reliable access to utilities (water and electricity), with the majority 101 (68%) agreeing. However, this contrasts sharply with the significant 94 (64%) disagreement on the availability

Table 3. Descriptive statistics of the independent variables on disaster preparedness (N=148)

Statements	Disagree n (%)	Agree n (%)
Health workers capacity		
The current staffing level at our health facility is sufficient to manage emergencies and disasters effectively.	79 (53)	69 (47)
The facility has an adequate number of specialized healthcare workers (e.g., Lab techs, Paediatricians, health experts) for disaster response.	63 (43)	85 (57)
The staffing levels in our facility remain stable and unaffected by emergencies or disasters.	98 (66)	50 (34)
The allocation of staff across various departments within our facility is effectively adjusted in response to a disaster.	91 (62)	57 (39)
Resources Availability		
The physical infrastructure of our facility (e.g., buildings, beds, wards) is sufficient to accommodate an influx of patients during a disaster.	98 (66)	50 (34)
The facility has reliable access to utilities (e.g., water, electricity) essential for disaster response.	47 (32)	101 (68)
Technology Integration		
The technology infrastructure in our facility adequately supports disaster preparedness efforts	94 (64)	54 (36)
The facility has sufficient access to the technological resources necessary for responding to disasters.	102 (69)	46 (31)
Technological tools are readily available in our facility for staff to use in disaster preparedness activities.	105 (71)	43 (29)
The facility has Data management systems in place that allow for efficient tracking and monitoring of public health risks.	44 (30)	104 (70)
Technology has improved the decision-making process in disaster preparedness and response at our facility	58 (39)	90 (61)
Technological integration supports a more coordinated approach to disaster management across different departments.	49 (33)	99 (67)
The use of technology facilitates the quicker adoption of public health strategies in the aftermath of a disaster.	63 (43)	85 (57)
Institutional policy		
The facility has a disaster preparedness committee.	100 (68)	47 (32)
The committee has a budget allocated for disaster preparedness.	109 (74)	35 (24)
The facility has a Disaster Preparedness and Response Plan (DPRP)	89 (60)	59 (40)

Table 4. Bivariate analysis

Independent Variable (Key Indicator)	Dependent Variable (Aspect of Preparedness)	Chi-square (χ^2)	p-value
Financial Resources (Sufficient Funding)	Ability to initiate response within 7 days	15.24	<0.001
Institutional Policy (Has DPRP)	Adherence to guidelines	18.51	<0.001
Health Worker Capacity (Staff Motivation)	Effectiveness of training drills	9.87	0.002

of reliable communication systems specifically for disaster response (Table 3).

While a high majority, 104 (70%), agreed that their facility had data management systems for tracking public health risks, only 54 (36%) agreed that the current technological infrastructure adequately supports preparedness, and even fewer, 46 (31%), agreed that access to technological resources, such as communication devices and early warning systems, was sufficient (Table 3). Additionally, only 43 (29%) agreed that technological tools were readily available for staff use. Furthermore, 90 (61%) agreed that technology had improved decision-making, 99 (67%) agreed that it supported a more coordinated approach, and 85 (57%) agreed that it contributed to the quicker adaptation of strategies (Table 3).

Regarding institutional policy, a significant majority, 100 (68%) of respondents disagreed that their facility has a disaster preparedness committee, and even fewer, 35 (24%) agreed that such a committee has a budget allocated for disaster preparedness (Table 3). Furthermore, 89 (60%) disagreed that their facility had a formal DPR Plan, indicating that disaster preparedness is largely informal or ad hoc rather than systematically integrated into the facility's operations (Table 3).

Both descriptive and inferential statistical analyses showed institutional policy and financial constraints had a strong, statistically significant negative association with a facility's inability to initiate a timely disaster response and mobilize resources adequately. This finding provides statistical evidence for the link between financial resources and preparedness outcomes. The reported insufficient funding for preparedness activities was significantly associated with a facility's inability to initiate a response plan within the recommended timeframe ($\chi2=15.24$, $p<0.001$). Similarly, the lack of formal policies was statistically linked to lower preparedness ($\chi2=18.51$, $p<0.001$).

Multiple binary logistic regression analysis

Multivariable binary logistic regression was employed to identify independent predictors of disaster preparedness, while controlling for other variables (Tables 4 and 5). For this analysis, the dependent variable, "Disaster Preparedness," was converted into a binary outcome (e.g., "Prepared" vs. "Not Prepared" using the Likert scale from the "Time to Initiate Response," "Compliance with Guidelines," and "Training and Drills" categories. Similarly, the independent variables from the Likert scale were transformed into binary categories (e.g., "Sufficient Funding" vs. "Insufficient Funding," "Has DPRP" vs. "No DPRP"). The Likert scale responses "strongly disagree and strongly disagree" were considered as disagree, while "agree, moderately agree, and strongly agree" were regarded as agree.

The descriptive and inferential statistics confirmed that institutional policies and financial resources were among the strongest independent predictors of preparedness. The Odds Ratios (OR) quantified the magnitude of influence for each determinant. The analysis revealed that facilities with a Disaster Preparedness and Response Plan (DPRP) had an Odds Ratio of 3.49 ($p=0.001$), indicating they were nearly 3.5 times more likely to be prepared than those without one, holding other factors constant. Similarly, the Odds Ratio for "Sufficient Funding" was 2.66 ($p=0.002$), indicating that facilities with adequate financial resources were 2.66 times more likely to be prepared than those with insufficient funding.

Discussion

Demographic characteristics: The largest proportion of respondents fell within the 26-35 age bracket, suggesting a workforce predominantly in its younger-to-middle career stages, balancing experience with potential for long-term development. In terms of education, diploma holders represented the largest group, 52 (35%), followed closely by graduate/degree holders, 44 (30%), indicating a varied educational background. A notable observation was that a substantial proportion of health workers, 46 (31%), have less than one year of experience, which could be indicative of a high turnover rate or a recent expansion

Table 5. Multivariate analysis

Variable	Odds Ratio	p-value
Institutional Policy: Has DPRP		
No Disaster Preparedness & Response Plan (DPRP) (ref)	1	
Has DPRP	3.49	0.001
Financial Resources: Sufficient Funding		
Insufficient Funding (ref)	1	
Sufficient Funding	2.66	0.002
Health Worker Capacity: Highly Motivated Staff		
Low Motivation (ref)	1	
Highly Motivated Staff	2.05	0.013
Technological Integration: Adequate Tech Infrastructure		
Inadequate Tech Infrastructure (ref)	1	
Adequate Tech Infrastructure	1.57	0.072
Significance P<0.05		

of the workforce.

Influence of resource availability on preparedness: Financial resources emerged as a major constraint on effective disaster preparedness, with 123 (83%) respondents reporting insufficient funding. This appeared to directly contribute to deficiencies in physical infrastructure and the procurement of adequate medical supplies. The bivariate and multivariate analyses confirm that financial deficiency is a significant negative predictor of overall preparedness, with facilities that have sufficient funding significantly more likely to be prepared. This aligns with a study conducted in Nigerian healthcare facilities that revealed inadequate funding, poor allocation, and mismanagement of available funds dedicated to disaster preparedness as critical barriers to acquiring necessary supplies and implementing disaster preparedness programmes. These findings suggest an urgent need for increased financial investment and improved financial management systems. [5,6]

Influence of institutional policies on preparedness: The absence of an institutional disaster preparedness policy is another critical finding, with 89 (60%) disagreeing that their facility has a formal Disaster Preparedness and Response Plan (DPRP). The binary logistic regression analysis confirmed institutional policies as one of the strongest independent determinants of disaster preparedness, with the presence of formal plans that provide a clear framework to drive preparedness efforts. This finding is supported by a study conducted in Ethiopian hospitals, which identified that the lack of formal plans and committees hindered disaster preparedness.[7,8]

Influence of health workers' capacity on preparedness: A significant concern is the overall staffing levels and their stability during emergencies, suggesting that staff retention during crises is lacking. Furthermore, the low reported motivation among health workers to participate in preparedness activities indicates that even when staff possess skills, a lack of motivation can lead to reduced engagement and reluctance to participate effectively. This is consistent with a study that identified insufficient staffing as a significant challenge in disaster management and maintaining quality of care.[9]

Influence of technological integration on preparedness: Despite the existence of data management systems and data security, a significant deficiency in overall technological infrastructure, access to communication gadgets and early warning systems, and the general availability of technological tools for staff use in disaster preparedness. This "digital divide" implies that while internal data management might be available, the ability to disseminate information in a timely manner, communicate in real time during crises, and provide proactive early warning is severely hindered. Other studies report disparities between basic ICT infrastructure and specialized disaster technologies in low- and middle-income countries.[10] Despite these infrastructure limitations, most respondents recognized that technology had improved decision-making, indicating that even the limited technological integration that exists is highly valued and recognized for its positive impact. This suggests that targeted investment in disaster-specific technological infrastructure could

significantly amplify preparedness benefits.[11,12]

Recommendations

The study first recommends an urgent need for policy formalization and the establishment of disaster-preparedness committees within each public health facility, with clearly defined roles and responsibilities. This recommendation aligns with the foundational principles of effective disaster management advocated in their guide for developing hospital disaster preparedness plans.[13]

Secondly, ensure dedicated financial investment for disaster preparedness activities. Highlighted financial constraints as a major barrier to disaster risk reduction in low- and middle-income countries.[14]

Thirdly, implement comprehensive workforce planning to ensure adequate staffing and retention, preventing the system from being overwhelmed during disasters. A study found insufficient staffing to be a major gap in disaster management.[15]

Conclusion

The overall state of readiness is significantly hampered by systemic deficiencies, with the absence of formal institutional policies and severe financial constraints as the most profound challenges. These foundational weaknesses created a cascading effect, leading to inadequate material resources, challenges in maintaining stable, motivated human resources, and a disconnect in general information.

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Conflict of interests: None

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South Sudan floods: the first example of a mass population permanently displaced by climate change?

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Abstract

Background: Breastfeeding is associated with short- and long-term beneficial effects on child health, including greater cognitive development, and enhanced immune programming. However, the underlying biological mechanisms are only partially understood, with epigenetics emerging as a potential contributor. In this study, we aimed to investigate whether breastfeeding practices are associated with differential DNA methylation (DNAm) in childhood blood.

Results: We conducted meta-analyses of epigenome-wide association studies (meta-EWASs) in 3421 children from eleven international population-based birth cohorts from the Pregnancy And Childhood Epigenetics (PACE) Consortium. Breastfeeding was assessed as "ever" being breastfed vs. "never", and duration of any and exclusive breastfeeding. DNAm was measured in childhood blood (ages 5-12 years) using the Illumina 450 K or EPIC arrays, with cord blood at birth used as negative outcome control. At False Discovery Rate (FDR) < 5%, positive associations at six cytosine-phosphate-guanine (CpG) sites were identified in childhood blood: four with duration of exclusive breastfeeding, and three with duration of exclusive breastfeeding of more than three months compared to never. **The annotated genes (ALAD, FNBP4, and CHFR) are related to developmental and immune processes. None of these CpG sites were FDR-significant in cord blood prior to breastfeeding.**

Conclusions: Breastfeeding was associated with differential DNAm in childhood blood at a limited number of CpG sites. Future studies in diverse populations are needed to examine the robustness of these associations, the sources of heterogeneity, and the generalizability of the findings.

https://pubmed.ncbi.nlm.nih.gov/41764488/

Evaluating the role of the health information system infrastructure in enhancing data quality in Central Equatoria State, South Sudan

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ABSTRACT

Introduction: A health information system (HIS) infrastructure is a critical foundation to produce high-quality routine health data for planning, monitoring, and decision-making, particularly in low-resource and fragile settings such as South Sudan. The aim of this study was to assess the influence of HIS infrastructure on the quality of the Health Management Information System (HMIS) data in public health facilities in Central Equatoria State, South Sudan.

Method: A cross-sectional study was conducted using a self-administered, structured questionnaire completed by health workers at the public health facilities. Descriptive statistics and Multivariate Analysis of Variance were produced using Stata software version 15.

Results: 139 health workers participated in the study. About half (50.4%) of respondents reported routine use of the District Health Information System version 2 (DHIS2); 30.2% of facilities had functional computers or tablets; and 53.2% lacked reliable internet connectivity. The HIS infrastructure factors collectively affect HMIS data quality, as shown by Wilks' Lambda = 0.507 ($p<0.001$).

Conclusion: Inadequate digital infrastructure, inconsistent training coverage, and limited system utilization undermine HMIS data quality in Central Equatoria State. Strengthening HIS infrastructure, alongside standardized capacity-building and improved reporting processes, is essential to improving routine health data quality in South Sudan.

Keywords: health information system, infrastructure, data quality, health facilities, South Sudan

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Introduction

Healthcare systems depend on reliable information from a well-established Health Management Information System (HMIS). As one of the health system building blocks, HMIS plays a significant role in collecting, storing and analysing data to support better decision-making.[1,2] For enhanced quality data, HIS infrastructures, such as availability of computers, Internet connectivity, and software, need to be adequate. This is because data quality impacts all aspects of a business, including operational efficiency, compliance, and customer engagement. In healthcare, poor-quality data leads to misallocation of resources, wrong decision-making,

and risks to patients' lives and safety.[3]

The HIS infrastructure refers to all components, including, but not limited to, hardware, software, networking, services, and policies that enable the collection, storage, and sharing of data.[4] The HIS infrastructure has two components: the Information Technology (IT), which deals with hardware and software, and the human resource infrastructure, which encompasses skills, training, and motivation.[5]

The rollout of the District Health Information System version 2 in 2019 was critical, establishing a robust HIS infrastructure that drives digital innovation.[6] Empirical evidence shows that robust HIS infrastructure has modernized the health service delivery in Ethiopia by enhancing health workers' response to patients and improving data quality.[7] This study examined how the HIS infrastructure, including the availability of computers/tablets, training on the HIS, and software, influences data quality at the public health facilities in Central Equatoria, South Sudan.

Method

Study population

This was a cross-sectional quantitative study. The target population included data clerks/monitoring and evaluation (M&E) officers, data managers, and other health cadres who were working at public health facilities in Central Equatoria State. We sampled 148 respondents. A self-administered questionnaire was completed by the health care workers between June and December 2025.

Data collection

Quantitative data were collected using a structured self-administered questionnaire covering demographic characteristics, training exposure, infrastructure availability, system utilisation, and perceived challenges in data entry and reporting.

Data analysis

Data were entered and analysed using STATA version 15. Descriptive statistics (frequencies and percentages) were generated. Additionally, a Multivariate Analysis of Variance (MANOVA) was performed to determine whether there were significant differences among infrastructural variables, such as facility electricity access and Internet connectivity, in the HMIS data quality dimensions (completeness, consistency, and timeliness).

Ethical considerations

Ethical approval was obtained from the Mount Kenya University Institutional Scientific and Ethics Review Committee (Reference: MKU/ISERC/4883) and the Ministry of Health Research Ethics and Review Board, South Sudan (Reference: MOH/RERB/P/A/15/8/2024-MOH/REBR/A/19-N/2024). Written, informed consent was obtained from all participants, and confidentiality was maintained throughout.

Results

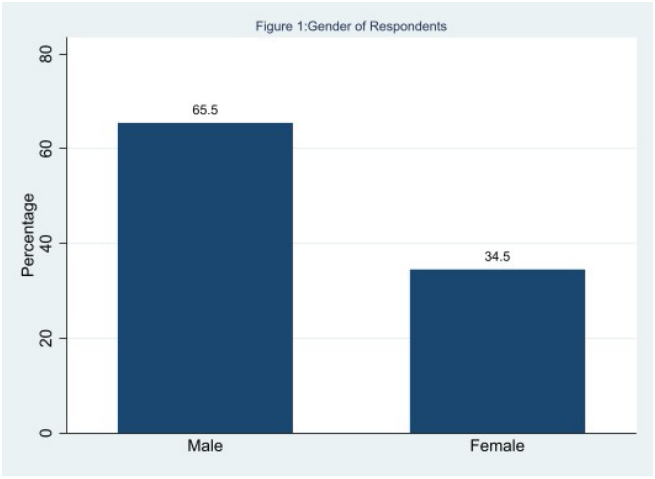
Figures 1-4 show the demographic characteristics of the 139 respondents out of 148 sampled (93.9% response rate): 65.5% were male, and 35% were female, with 45% aged 26-33 years, followed by 34-41 years (32.4%). The respondents' educational attainment varied significantly, with most holding higher education certificates (61.9%), followed by secondary education (38.1%). Most of the respondents studied social sciences (21.6%), health informatics (19.4%), clinical medicine (18.7%), and IT (17.3%).

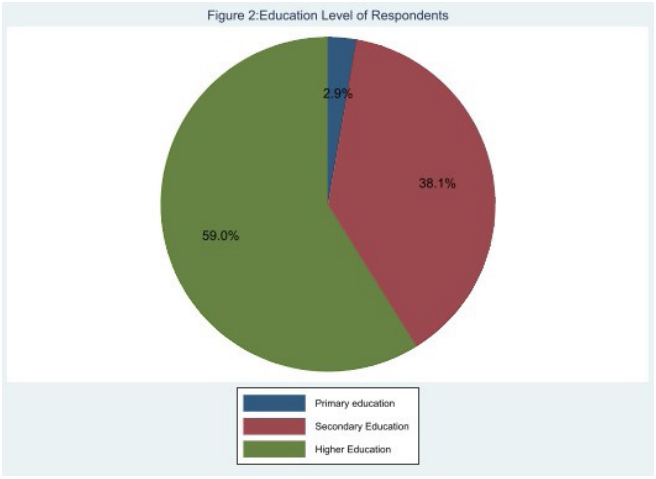
The descriptive statistics in Table 1 show the HIS infrastructure factors that influence data quality in the District Health Information Software (DHIS) system. The findings revealed that only 50.4% were using DHIS2, indicating a suboptimal rollout across health facilities. 63.3% of those using DHIS2 received training on the system, yet only 46% of those trained rated the training as adequate. Additionally, 50% of those who received training on DHIS2/HMIS covered all aspects of the training.

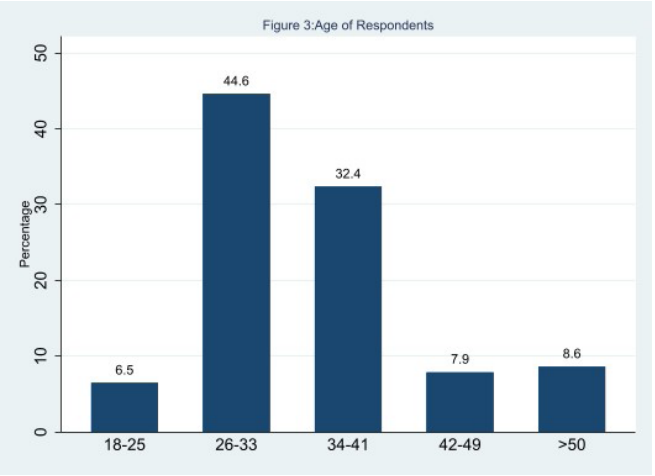
The system's ease of use was rated positively by most respondents, with 82.7% finding it easy to use. However, a small proportion (16.1%) of respondents struggled with the system, possibly due to interface complexities or technical limitations. The availability of computers or tablets in health facilities was reported to be limited: only 30.2% of respondents confirmed their presence, and 81% reported functionality.

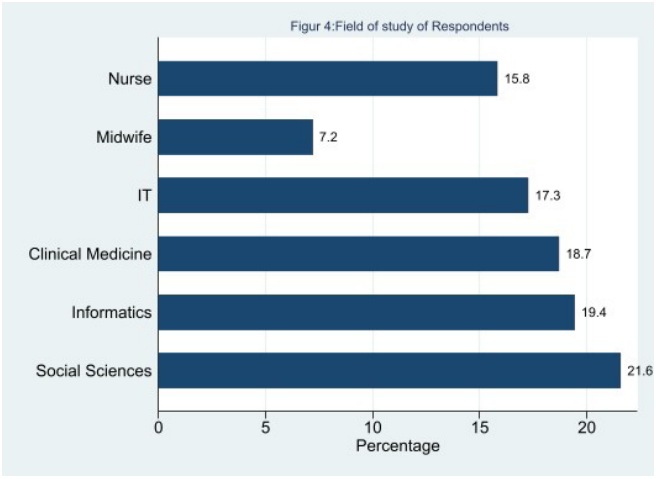
The major challenge reported by 53.2% of the respondents was poor internet connectivity and a lack of data bundles.

The MANOVA shown in Table 2 examines the HIS infrastructural determinants of HMIS data quality, assessing factors such as the DHIS2 system, training, tablets, reasons for delayed on-time data entry, and challenges facing the data entry process. The overall model was statistically significant (Wilks' $\lambda = 0.5072$, p









Figures 1-4. Demographic information of the respondents

= 0.0005), indicating that the HIS infrastructural factors jointly significantly affect the quality of HMIS data.

However, at the individual factor's level such as availability of DHIS 2 (Wilks' λ = 0.9562, p = 0.2707), training on the DHIS2/HMIS (Wilks' λ = 0.9394, p = 0.1405), the availability of computers/tablets (Wilks' λ = 0.9607, p = 0.3196) were not statistically significant, indicating that the above factors cannot individually impact on the quality of HMIS data.

Nevertheless, other factors, such as reasons for the delay in data entry, perhaps related to motivation, data entry protocols, or reporting procedures (Wilks' λ = 0.8082, p = 0.0266), challenges, such as internet connectivity (Wilks' λ = 0.7231, p = 0.0042), were statistically significant, confirming their potential for impacting the quality of HMIS data.

Discussion

In this study, there were more males than females. This sex disparity reflects employment ratios within the public health sector.[8] Conversely, a similar study in Benin found that 81.7% of respondents were female.[9] Our findings revealed that respondents' fields of study varied widely, with most having studied social sciences, health informatics, clinical medicine, and IT. This diversity emphasizes the multidisciplinary nature of, and the need required in, the public health workforce. A study conducted in Ethiopia in 2015 found that those tasked with data collection and reporting were nurses, accounting for 44% of the total respondents,[10] unlike in South Sudan, where the responsibilities for data recording and reporting rested with data clerks and M&E officers.

The use of DHIS2 in South Sudan, like other countries such as Uganda[6] is mandatory for all health facilities owned by the government, and is one of the HIS infrastructures upon which this study focused. The infrastructural determinants

Table 1. Descriptive statistics for HIS infrastructural determinants of quality of DHIS (N = 139)

Variable	Responses	n (%)
Datasets using DHIS 2 system for reporting?	Yes	70 (50.4)
	No	69 (49.6)
DHIS/HMIS training received	Yes	88 (63.3)
	No	51 (36.7)
Topics covered during the training	Data entry	20 (22.7)
	Data Analysis	8 (9.1)
	Data Quality Check	1 (1.1)
	All HMIS tools and DHIS2	18 (20.5)
	All of them	38 (43.2)
	Others	3 (3.4)
Adequacy of the HMIS/DHIS2 training	Inadequate	10 (11.5)
	Somehow adequate	22 (25.3)
	Adequate	40 (46.0)
	Very adequate	15 (17.2)
System use after HMIS/DHIS2 training	Very difficult	5 (5.8)
	Difficult	9 (10.3)
	Easy	59 (67.8)
	Very easy	13 (14.9)
	Missing value	1 (1.2)
Computers/tablets available at the facility	Yes	42 (30.2)
	No	97 (69.8)
Functionality of Computers/tablets	Yes	34 (81.0)
	No	8 (19.1%)
Other Means of reporting in case no computer/tablet	Reporting through CHD	74 (76.3)
	Using mobile phone	18 (18.6)
	Borrow computer from friends	5 (5.2)
Challenges facing data entry process	Poor system design	16 (11.5)
	Incomplete data system	20 (14.4)
	Inaccurate data	18 (13.0)
	Poor internet/ lack of bundles	74 (53.2)
	Others	11 (7.9)

assessed included the availability of HMIS reporting tools, such as HMIS registers, reporting forms, computers/ tablets, and the overall database. The investigation encompassed the training on DHIS2 or HMIS tools, the topic covered, and whether the training was adequate. The influence of infrastructural factors on the quality of HMIS data was assessed using logistic regression and MANOVA, with a significance level of 5%. The results showed that about 50% of respondents used the DHIS2 system and were familiar with HMIS tools, of whom about 60% had received training on the HMIS/DHIS2 system.

Despite many respondents having received training on DHIS2 and HMIS tools, the training was inadequate or not well integrated, as trainees didn't cover all essential topics as per the HMIS training manual, which could lead to differing levels of proficiency among users. A study on DHIS2 utilization in Uganda and Ethiopia reported utilization rates above 90% and 80%, respectively,[7,8] far higher than in South Sudan. Only 46% of those who received training found it adequate, casting doubt on its efficiency and effectiveness. The robust HMIS system is anchored in the skilled human resources trained on the system and its tools, a comprehensive system design, and reliable internet connectivity.[9,10]

As computers or tablets play a critical role in reporting and the utilization of the DHIS2 in general, their availability and functionality remain a major concern, as many health facilities do not have computers/tablets. This highlights a critical infrastructural gap that hinders data reporting and compromises the quality of datasets collected through the DHIS2 system.

Conclusion

HIS infrastructure was a key determinant of the quality of data generated at health facilities. Despite the adoption of DHIS2 as the national HIS, its utilization at the subnational level remains suboptimal, with 50% of the sampled facilities reporting through the county health department. It was also noted that most health workers who have received training on HMIS/DHIS2 have not been trained on all aspects of the curriculum, suggesting gaps in their knowledge. The limited availability of computers/tablets or HMIS tools for reporting and poor Internet connectivity further constrained the timely reporting of data into DHIS2. We recommend completing the rollout of the DHIS2 system, standardizing training, and increasing investment in HIS infrastructure.

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Table 2. Multivariate analysis of HIS Infrastructural determinants of quality of DHIS datasets

Source	Wilks' λ	df	F (df1, df2)	F	p-value
Model	W 0.5072	10	(30;256)	2.22	0.0005
Residual		89			
DHIS2	W 0.9562	1	(3;87)	1.33	0.2707
Training	W 0.9394	1	(3;87)	1.87	0.1405
Tablets	W 0.9607	1	(3;87)	1.19	0.3196
Reasons for delay	W 0.8082	3	(9;211.9)	2.15	0.0266
Challenges	W 0.7231	4	(12;230.5)	2.5	0.0042

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Research Article

Impact of developmental stimulation education on maternal knowledge and caregiving practices in stunting: a longitudinal study

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ABSTRACT

Introduction: Stunting is associated not only with impaired physical growth but also with suboptimal child development, partly influenced by inadequate caregiving and insufficient developmental stimulation. This study aimed to evaluate the impact of a developmental stimulation education programme on maternal knowledge and caregiving practices among mothers of children with stunting.

Method: A longitudinal quasi-experimental study with individual-level random allocation was conducted between January and November 2025 involving 87 mothers of children with stunting, of whom 80 completed follow-up and were included in the final analysis. Both groups received routine child health services; however, only the intervention group received a structured developmental stimulation education programme, which included age-appropriate guidance on motor, language, cognitive, and social stimulation integrated into daily caregiving activities and delivered through standardised sessions by trained facilitators. Maternal knowledge and caregiving practices were assessed at baseline, 1 month, 3 months, and 6 months. Data were analysed using generalised linear mixed models.

Results: Maternal knowledge and caregiving practices improved over time in both groups; however, the intervention group demonstrated significantly greater and more sustained improvements. The group-by-time interaction was statistically significant for both outcomes, indicating that the intervention altered the trajectory of maternal knowledge and caregiving practices beyond changes observed with routine care.

Conclusion: The developmental stimulation education programme produced sustained improvements in maternal knowledge and caregiving practices over six months. Integrating caregiver-focused educational interventions into routine maternal and child health services and community-based programmes may strengthen comprehensive stunting management and support early child development.

Keywords: stunting, developmental stimulation, maternal knowledge, caregiving practices, longitudinal study.

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Introduction

Stunting remains a major public health problem with long-term consequences for child health and development.[1,2] In addition to impaired physical growth, stunting is associated with delays in cognitive, motor, and socio-emotional development that may persist into adulthood.[3,4] Although undernutrition is a key determinant, inadequate psychosocial stimulation and suboptimal caregiving practices also contribute substantially to poor developmental outcomes.[5] Therefore, nutrition-focused interventions alone may be insufficient to address the broader developmental risks associated with stunting.

Caregiver-based developmental stimulation is particularly important during early childhood, a period of high neural plasticity.[6] Mothers, as primary caregivers, play a key role in providing stimulation through everyday interactions such as play, communication, and responsive care. However, limited maternal knowledge and suboptimal caregiving practices may reduce the effectiveness of such stimulation, especially among children affected by chronic undernutrition. Educational interventions targeting maternal knowledge and caregiving practices, therefore, represent a promising strategy to improve developmental environments for children with stunting.[7]

Stunting remains highly prevalent in low- and middle-income countries, where socioeconomic constraints and limited access to early childhood interventions persist.[8] Given its scale, even modest improvements in caregiving practices at the household level may produce meaningful population-level benefits. This underscores the need for interventions that are feasible, scalable, and capable of generating sustained developmental gains beyond short-term nutritional recovery. Previous studies on caregiver education for children with stunting have reported promising but inconclusive results, largely due to cross-sectional designs, short follow-up periods, and limited analytical approaches.[9] In addition, many studies emphasized child outcomes without adequately examining maternal knowledge and caregiving practices as proximal determinants of developmental change, thereby limiting causal interpretation.

This study evaluated the impact of a structured developmental stimulation education programme on maternal knowledge and caregiving practices among mothers of children with stunting using a longitudinal design with repeated measurements over six months. By applying a mixed-effects analytical approach, the study examined changes over time while accounting for individual variability, providing robust evidence on the effectiveness of caregiver-focused educational interventions in stunting-related developmental care.

Method

Study Design

This study used a longitudinal quasi-experimental design with individual-level random allocation, conducted between January and November 2025. Participants were recruited from multiple community health centres and randomly assigned to intervention and control groups; however, due to the absence of full trial control procedures (e.g., blinding), the study is described as quasi-experimental. The intervention group received a structured developmental stimulation education programme, while the control group received routine

care. Maternal knowledge and caregiving practices were assessed at baseline, one month, three months, and six months after the intervention (Figure 1).

Population and sample

The study included mothers of children with stunting registered at community health centres, defined as height-for-age below -2 standard deviations according to World Health Organisation growth standards. Eligible participants were primary caregivers who provided informed consent, while those with children with congenital anomalies, chronic illness, severe acute conditions, or multiple births (e.g., twins), as well as mothers with cognitive or severe mental health impairments, were excluded. A total of 87 eligible mother–child dyads were recruited and randomly allocated on an individual basis in a 1:1 ratio to the intervention (n = 44) and control (n = 43) groups, irrespective of community health centre. During follow-up, 7 participants were lost to follow-up, resulting in complete data for 40 participants in each group included in the final analysis.

Instruments

Maternal knowledge and caregiving practices were measured using structured questionnaires developed for this study based on established child development and stunting-related care guidelines. Content validity was confirmed through expert review (I-CVI 0.83–1.00; S-CVI/Ave 0.92), and both instruments demonstrated good internal consistency (Cronbach's alpha ≥0.80). The questionnaires assessed maternal knowledge of stunting and developmental stimulation, as well as caregiving practices across motor, language, cognitive, and social domains, and were administered at baseline and at one, three, and six months after the intervention.

Data collection

Data were collected sequentially, beginning with baseline assessment following recruitment and eligibility screening. Mothers completed the questionnaires under the supervision of trained research assistants, after which the intervention group received structured developmental stimulation education delivered by trained facilitators using standardized materials. Follow-up assessments were conducted at one, three, and six months using identical procedures in both groups to ensure measurement consistency. Both groups continued to receive the same routine child health services, including growth monitoring and standard community-based care. The only difference between groups was the provision of the structured developmental stimulation education programme to the intervention group.

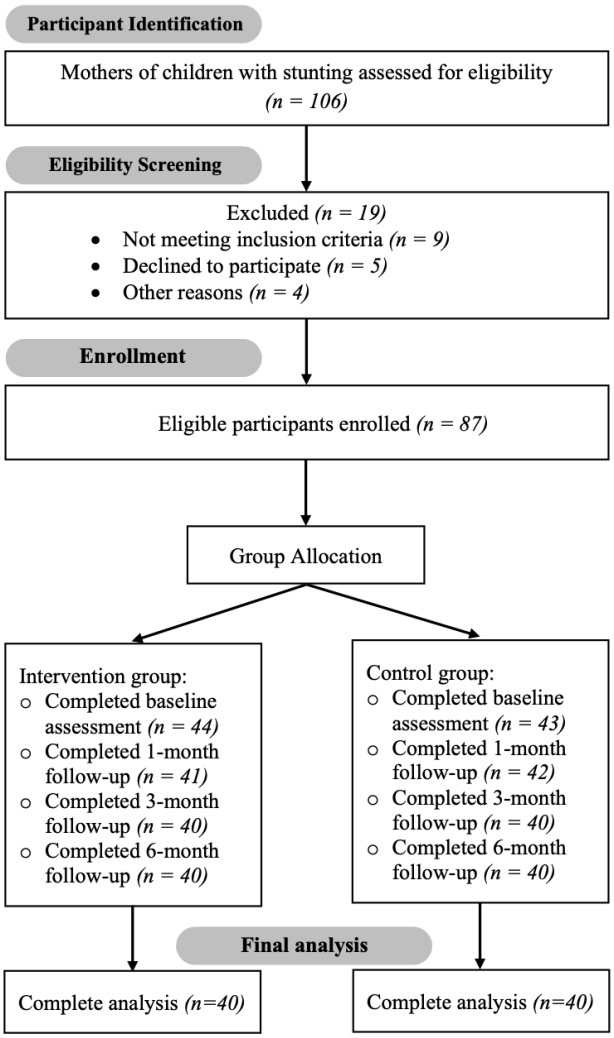

Figure 1. Adapted CONSORT-style flow diagram of participant recruitment, allocation, follow-up and analysis

The educational intervention was delivered over four sessions within a one-month period, with each session lasting approximately 30–45 minutes. Sessions were conducted weekly by trained facilitators using interactive methods, including demonstrations, guided practice, and simple visual aids (e.g., flipcharts). The content focused on age-appropriate stimulation activities across motor, language, cognitive, and social domains, which could be integrated into daily caregiving routines. The sessions were delivered in the local language to ensure comprehension, and mothers were encouraged to practice the activities at home. No formal standardized external programme was adopted; however, the intervention was developed based

on established child development and early stimulation guidelines.

Data analysis

Data were analysed using SPSS version 31, with descriptive statistics summarizing participant characteristics and outcome measures. Longitudinal changes in maternal knowledge and caregiving practices were examined using generalized linear mixed models with fixed effects for group, time (treated as a continuous variable coded as 0, 1, 3, and 6 months), and their interaction. The inclusion of both main effects and the interaction term followed the hierarchical modelling principle. A random intercept was specified to account for between-subject variability. Statistical significance was set at $p < 0.05$, with 95% confidence intervals reported where appropriate.

Ethical approval

Ethical approval was obtained from an institutional health research ethics committee (No. 248.6/II.3.AU/F/KEPK/VIII/2024), and the study was conducted in accordance with the Declaration of Helsinki; written informed consent was obtained from all participants, with confidentiality and the right to withdraw assured.

Results

Baseline characteristics of participants were comparable between the intervention and control groups (Table 1). Maternal age, child age, and educational levels were similar across groups, indicating no substantial baseline differences. As shown in Figure 1 (CONSORT flow diagram), 87 eligible mother–child dyads were recruited and randomly allocated to the intervention (n = 44) and control (n = 43) groups. Seven participants were lost to follow-up, resulting in complete data from 40 participants in each group at six months. These participants were included in the final longitudinal analysis.

Maternal knowledge scores increased over time in both groups, with greater and more sustained improvements observed in the intervention group compared to the control group (Table 2). Similarly, caregiving practices improved progressively in the intervention group, whereas changes in the control group were modest, indicating that the educational intervention was associated with concurrent improvements in maternal knowledge and caregiving practices Table 3).

The mixed-effects analysis (Table 4) showed a statistically significant group-by-time interaction for both maternal

Table 1. Baseline characteristics of participants

Variable	Intervention (n = 40)	Control (n = 40)
Maternal age (years), mean ± SD	29.4 ± 5.8	28.9 ± 6.1
Child age (months), mean ± SD	24.7 ± 8.3	25.1 ± 7.9
Maternal education, n (%)		
– No formal education	8 (20.0)	9 (22.5)
– Primary education	18 (45.0)	17 (42.5)
– Secondary or higher	14 (35.0)	14 (35.0)

Table 2. Maternal knowledge scores by group and time

Time point	Intervention group (Mean ± SD)	Control group (Mean ± SD)
Baseline	7.00 ± 0.00	6.50 ± 0.51
1 month	7.60 ± 0.78	7.18 ± 0.38
3 months	8.60 ± 0.84	7.83 ± 0.71
6 months	10.00 ± 0.00	7.83 ± 1.24

Table 3. Maternal caregiving practices scores by group and time

Time point	Intervention group (Mean ± SD)	Control group (Mean ± SD)
Baseline	6.00 ± 0.00	5.90 ± 0.45
1 month	7.80 ± 0.79	6.20 ± 0.41
3 months	9.00 ± 0.85	6.80 ± 0.60
6 months	10.00 ± 0.00	7.10 ± 0.74

Table 4. Generalised linear mixed model analysis of maternal outcomes

Fixed effect	Estimate (β)	SE	95% CI	p-value
Maternal Knowledge				
Intercept	6.82	0.09	6.64 to 7.00	<0.001
Group (Intervention vs Control)	0.24	0.13	-0.01 to 0.49	0.060
Time	0.20	0.02	0.16 to 0.25	<0.001
Group × Time	0.29	0.03	0.23 to 0.35	<0.001
Caregiving Practices				
Intercept	5.91	0.11	5.69 to 6.13	<0.001
Group (Intervention vs Control)	0.27	0.14	-0.01 to 0.55	0.058
Time	0.31	0.03	0.25 to 0.37	<0.001
Group × Time	0.42	0.04	0.34 to 0.50	<0.001

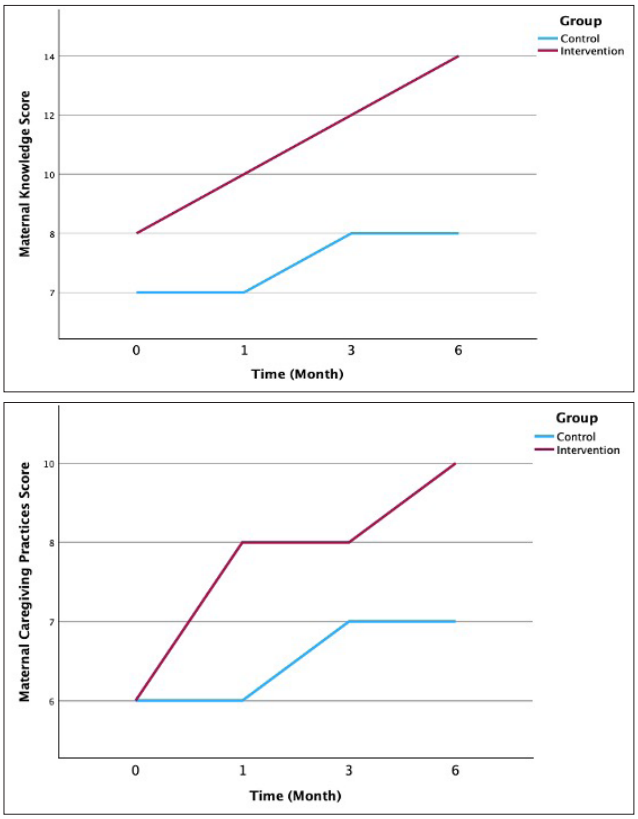

Figure 2a and b. Estimated marginal means from the generalized linear mixed models showing trajectories of maternal knowledge and caregiving practices over time. Note the non-linear scale of the X-axes

knowledge and caregiving practices, indicating different trajectories between the intervention and control groups. Mothers in the intervention group demonstrated greater and more sustained improvements over time compared with the control group, even after accounting for individual variability.

Figure 2 presents the model-predicted trajectories derived from the generalized linear mixed models rather than raw observed means. The mixed-effects models indicated meaningful between-subject variability in maternal outcomes, supporting the inclusion of random intercepts to account for individual differences (Table 4). This confirmed the appropriateness of the generalized linear mixed modelling approach for analysing longitudinal changes over time. Although the theoretical maximum score for both outcome measures was 10, model-predicted values from the generalized linear mixed models are not mathematically constrained to the instrument's scale limits. Values exceeding ten in the graphical representation reflect extrapolated model estimates rather than observed raw scores.

Discussion

This study demonstrated that a developmental stimulation education program produced sustained improvements in maternal knowledge and caregiving practices among mothers of children with stunting, consistent with previous evidence on the importance of caregiver-focused educational interventions.[3,10]

While earlier studies often relied on short-term or cross-sectional designs, the longitudinal findings of this study indicate that improvements in maternal knowledge were maintained over six months. These results suggest that structured caregiver education may support enduring cognitive and behavioural change rather than transient learning effects.[2,11]

The observed improvements in caregiving practices support previous evidence that caregiver knowledge can translate into behavioural change when educational interventions are practical, contextually relevant, and reinforced over time.[6,12] The significant group-by-time interaction demonstrated that the intervention altered the trajectory of maternal knowledge and caregiving practices rather than producing short-term effects, extending earlier findings by capturing longitudinal change and individual variability.[5,6,13] Overall, these findings corroborate existing literature by showing that structured developmental stimulation education can produce sustained improvements in maternal capacity, highlighting the importance of caregiver-focused strategies in stunting-related developmental care.[14,15]

Clinical and health system implications

The findings highlight the clinical value of caregiver-focused educational interventions in improving maternal capacity to provide developmentally supportive care for children with stunting. Integrating developmental stimulation education into routine maternal and child health services, particularly through nurses and community health workers, may extend care beyond nutrition toward comprehensive developmental support. At the health system level, caregiver education represents a feasible and scalable strategy that can complement existing stunting programs and support early intervention efforts.

Beyond clinical implementation, these findings have broader implications for public health programmes and policy. Integrating caregiver education into community-based child health initiatives, including early childhood development programmes, may enhance coverage beyond health facilities. Strategies involving community health workers, home-based education, and integration

with existing child development services may improve accessibility and sustainability. Further operational research is needed to adapt and scale such interventions in resource-limited settings.

Study limitations

This study has several limitations, including the quasi-experimental design without randomization and the use of self-reported measures, which may introduce residual confounding and social desirability bias. In addition, the study was conducted in a single community setting, potentially limiting the generalizability of the findings. Nevertheless, the longitudinal design, complete follow-up, and use of mixed-effects modelling strengthen confidence in the observed intervention effects.

Conclusion

This study demonstrated that a developmental stimulation education program produced sustained improvements in maternal knowledge and caregiving practices among mothers of children with stunting over a six-month period. Integrating caregiver-focused developmental stimulation education into routine maternal and child health services may strengthen stunting management by enhancing the developmental environment of affected children. Further, it is important that early stimulation education of the mothers and caregivers be incorporated into nutritional rehabilitation programmes and become part of standard nutritional care protocols.

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Author contributions: N.I. conceptualized and designed the study, coordinated data collection, and contributed to manuscript drafting. A.O. provided methodological input, supervised the research process, and critically reviewed the manuscript for intellectual content. S.K. contributed to instrument development, data interpretation, and manuscript revision. P.A.W.S. performed data analysis, interpreted the statistical findings, and contributed substantially to manuscript writing and revision. All authors reviewed and approved the final version of the manuscript.

Declaration of Generative AI and AI-assisted Technologies in the writing process

During the development of this manuscript, AI-assisted tools were utilized solely to support language refinement and clarity. All generated content was carefully reviewed, revised, and validated by the authors, who assume full responsibility for the accuracy and integrity of the final manuscript.

Conflicts of Interest: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval: The study was approved by the Ethics Committee of the Faculty of Health and Sciences, Universitas Muhammadiyah Gombong, Indonesia (Approval No. 248.6/II.3.AU/F/KEPK/VIII/2024). Written informed consent was obtained from all participants prior to study enrolment.

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Holding the line: lived experiences of mental health, moral injury, and organizational support among public-health professionals in the Rohingya Camp, Bangladesh — a phenomenological study

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ABSTRACT

Introduction: Public-health professionals in the Rohingya camps work amid chronic scarcity and ethical tension. This study examined their lived experiences of mental health, moral injury, and organizational support to identify practical, context-fit improvements.

Method: Qualitative hermeneutic phenomenology with fifteen semi-structured interviews across cadres. Data were audio-recorded, transcribed/translated, and analysed using a reflexive thematic analysis informed by a hybrid deductive–inductive approach, drawing on Job Demands–Resources, Conservation of Resources, moral-injury, and Perceived Organizational Support lenses. Trustworthiness was supported by analyst triangulation, an audit trail, and COREQ (Consolidated Criteria for Reporting Qualitative Research) guidance.

Results: Nine themes clustered into four domains: (1) demand–resource imbalance with spillover beyond shifts (sleep disruption, rumination) and in-flow micro-regulation; (2) moral injury under scarcity and constrained agency (stock-outs, early discharges, bureaucratic delays, indicator dominance); (3) organizational support as felt (reflective supervision, buddy rotations/micro-check-ins, protected micro-breaks, confidential on-roster counselling); and (4) policy–context fit (offline-first data entry, stable templates, locally empowered approvals).

Conclusions: Low-friction, context-fit methods can break loss spirals, reduce moral-injury assessments, and maintain safe, compassionate care, making staff well-being a design challenge.

Keywords: demands–resources, job, moral injury, phenomenology, public-health professionals, Rohingya.

Introduction

Prolonged humanitarian crises in Cox's Bazar expose health workers to extreme stress, ethical challenges, and resource scarcity.[1,2] Studies show humanitarian and

health workers face high burnout and secondary trauma due to continuous exposure to intense suffering, often mirroring distress experienced by displaced populations.[3] Recent studies show persistent anxiety and depression among workers, highlighting the need for systemic, context-sensitive interventions beyond individual resilience training.[4] Within mental health discourse, moral injury denotes psychological harm from witnessing or engaging in actions that violate one's moral values. Moral injury describes ethical distress from dilemmas or betrayal, extending beyond burnout to explain suffering not rooted solely in exhaustion.[5]

Supportive workplaces reduce ethical harm through supervision, peer support, and accessible counselling, strengthening staff resilience and long-term sustainability.[6] In under-resourced camp settings, well-being policies rarely translate into protected time, adequate support, or safe reporting, exposing gaps between policy and practice.[7]

In the Rohingya response, demand surges, infrastructure disruptions, and complex referrals often weaken the implementation of well-intended policy frameworks.[8] Conceptual clarity matters because organizational support includes diverse elements whose effects vary across roles, tasks, and work contexts. This study used phenomenology, the JD-R (Job Demands–Resources), and moral-injury frameworks to explore how public health professionals interpret their daily routines, ethical tensions, and personal experiences of burden and coping.[9] JD-R explains how high emotional and cognitive demands, combined with limited resources and support, drive either strain or engagement. Moral-injury frameworks link value conflicts and perceived transgressions to lasting psychological harm, guiding organizations to ethically support affected individuals.[10] Together, these lenses allow the study to connect subjective experience with modifiable features of work design and organizational climate.

This study also examined how public health professionals in Rohingya camps experience and manage work-related strain, ethical tensions, and organizational support. The JD-R model links high demands—caseloads, trauma, time pressure—to engagement or strain.[11] COR (Conservation of Resources) showed resource loss fuels further depletion, while small, consistent gains help mitigate these effects. POS (Perceived Organizational Support) connects individual experiences with organizational climate, shaping whether employees perceive policies as meaningful, supportive, and accessible during high-demand periods.

This phenomenological study explored Rohingya camp health workers' mental health challenges, moral injury, and perceptions of organizational support, providing evidence to inform staff well-being policies and to improve humanitarian organizational practices.

Method

In this study, a qualitative, hermeneutic phenomenological design was used to elicit and interpret the lived meanings of public health professionals. Ethical approval was obtained (Approval Code: ERCP-2026-0413-06), which guaranteed voluntary participation, informed consent, confidentiality, and anonymity. The participants had the freedom to drop out at any time. The researchers respected the accepted ethical principles of conducting research on human subjects.

Reporting was done according to COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines where necessary. Purposeful, maximum-variation sampling was employed to reflect heterogeneity across roles [e.g., public-health nursing, EPI (Expanded Programme on Immunization-focused on vaccinating children), surveillance, M&E (Monitoring and Evaluation), MHPSS (Mental Health and Psychosocial Support)/health promotion] and across organization types (government, INGO/NGO/UN). Purposeful sampling prioritizes theoretical relevance and rich data over representativeness; information power guides sample size, with fewer interviews needed for credible, detailed insights.[12] Conducted fifteen one-to-one interviews, meeting adequacy criteria, aligning with evidence that thematic patterns often stabilize within the first dozen interviews. Inclusion required ≥6 months in the Rohingya response, consent capacity, and diverse roles, sexes, and organizations; data were analysed using reflexive, hermeneutic thematic analysis. Used a mixed deductive–inductive approach to conduct the study. Two analysts double-coded~20–25% of transcripts, resolving discrepancies collaboratively. The remaining transcripts were single-coded and peer-reviewed for complex sections. Trustworthiness was ensured through triangulation, audit trails, reflexivity, COREQ-aligned reporting, and detailed contextual descriptions to support transferability.[13]

Results

Participant characteristics

Fifteen public-health professionals participated, spanning public-health nursing, EPI, surveillance, M&E, and MHPSS/health-promotion roles across government,

Table 1. Demographic characteristics of the respondents

Id	Age	Sex	Cadre/Role	Org Type	Duty Station (Code)	Time in current role	Typical schedule
1	29	Female	PHN (Public Health Nurse)	Govt	Camp 1E Health Post	2.5 yrs	6 days/week; rotating day/ evening
2	34	Male	EPI Focal Point	Govt	Camp 3 Clinic	4 yrs	5.5 days/week; campaign OT
3	31	Female	Surveillance Officer	INGO	Camp 5 Primary Health Care	3 yrs	6 days/week; on-call outbreaks
4	27	Female	MHPSS	NGO	Camp 7 Community Centre	1.5 yrs	5 days/week
5	36	Male	M&E Officer (Health)	UN	Camp 9 PHC	5 yrs	5 days/week; field visits 2x/week
6	30	Female	PHN (Nurse)	INGO	Camp 10 PHC	2 yrs	6 days/week; rostered weekends
7	33	Male	Surveillance Officer	Govt	Camp 12 Health Post	3.5 yrs	6 days/week; night alerts possible
8	28	Female	MHPSS	UN	Camp 14 Women-F Centre	2 yrs	5.5 days/week; outreach shifts
9	35	Male	EPI Focal Point	NGO	Camp 16 EPI Centre	4.5 yrs	6 days/week; campaign nights
10	32	Female	M&E Officer (Health)	INGO	Camp 18 Field Office	3 yrs	5 days/week; monitoring missions
11	29	Male	Surveillance Officer	UN	Camp 20 Health Post	2 yrs	6 days/week
12	26	Female	PHN (Nurse)	NGO	Camp 22 PHC	1.2 yrs	6 days/week; alternating weekends
13	38	Male	EPI Focal Point	Govt	Camp 24 EPI Hub	6 yrs	5.5 days/week; campaign surge
14	30	Female	MHPSS	INGO	Camp 27 Community Hub	2.8 yrs	5 days/week; evening youth sessions
15	37	Male	M&E Officer (Health)	Govt	*Bhasan Char* Health Sector	4 yrs	5 days/week; monthly island rotations

Table 2. Thematic analysis

Participant ID	Theme	Code	Excerpt (abridged)
P07	Chronic vigilance & emotional carryover	Sleep disturbance & hypervigilance	"I wake at 3 a.m. thinking about the patient I sent home…"
P12		Cognitive carryover	"Even at home the ward is in my head—voices, forms, queues."
P03	Momentary regulation in high-tempo care	Micro-resets between cases	"Three slow breaths and a sip of water—one minute to reset."
P10		Peer micro-check-ins	"A two-minute 'you, okay?' from my buddy helps…"
P05	Operational pressures & sense-making	Queue-induced triage tension	"When the waiting area swells…I start fast-tracking…"
P09		Documentation pressure	"Midday the registers win—I'm split between form and patient."
P01	Ethical friction at the interface	Resource-constrained refusals	"'Today we cannot provide this' sits heavy—did I fight hard enough?"
P06		Early discharge for capacity	"Discharging early to free a bed felt like betrayal."
P11	Systemic bottlenecks & bureaucratic drag	Protocol vs urgency	"We needed an alert but waited for authorizations."
P02		Procurement/approval delays	"Stuck between patients and purchase approvals."
P13	Metrication & narrative loss	Data–human story dissonance	"The dashboard wants numbers; my shift is stories."
P04	Scaffolded support & containment	Supportive supervision	"'How are you coping?' and rotation… I actually sleep."
P08		Protected micro-breaks	"A break is real when someone covers me… 20 minutes."
P14	Ambiguity & access gaps in care pathways	Unclear escalation ladder	"Without a clear referral ladder, every refusal becomes a fight…"
P15	Policy–context fit & implementation fidelity	Policy–context misfit	"Power cuts make uploads fail… re-enter late at night—exhausting."

INGO/NGO, and UN facilities in the Rohingya camps (Cox's Bazar, Bangladesh) – Table 1.

Thematic Analysis

Nine interlocking themes described how workers experience (1) mental health in daily camp work, (2) job demands and moral injury, and (3) organizational enablers/barriers (Table 2).

Chronic vigilance and emotional carryover

Participants reported lingering hyperarousal beyond shifts, marked by disrupted sleep, intrusive recollections of ethical dilemmas, somatic tension, and intensified distress following surge periods or complex clinical decisions.

> *"Sleep is never deep after a heavy clinic. I wake at 3 a.m. thinking about the patient I sent home—did I miss something?"* (P07)

> *"Even at home the ward is in my head—voices, forms, the queue moving too fast. I slow my breathing, but scenes keep replaying."* (P12)

These accounts reflect a demand–resource imbalance (JD-R) with inadequate recovery opportunities, producing work–home spillover. The pattern aligns with resource-loss spirals (COR)—loss of sleep/time/psychological safety begets further loss. Comparable elevations in distress among humanitarian/health workers are reported in Bangladesh and allied settings.[14]

Momentary regulation in high-tempo care

Staff narrated on-shift micro-regulation—brief breathing routines, one-minute pauses between patient clusters, micro-breaks with water/stretching—and boundary rituals (shower/journaling) to contain spillover. Peer micro-check-ins ("you, okay?") and task-swaps ("I'll finish the register if you handle the referral") were repeatedly described as small, usable buffers.

> *"Before the next cluster I do three slow breaths, sip water—one minute to reset my head."* (P03)

> *"A two-minute 'you, okay?' from my buddy helps more than a long meeting. It tells me I'm not alone."* (P10)

These micro-resources help interrupt loss spirals (COR) and partially rebalance the JD-R equation in real time. Their salience as felt supports dovetails with evidence that perceived organizational support (POS) via supervisor care, peer architecture, and protected recovery moments—attenuates strain and improves role sustainability.[15] In the Rohingya response, peer-based coping is consistent with regional reports of socially embedded support in constrained health systems.

Operational pressures shaping sense-making

Care delivery faced patient surges, documentation demands, and system failures, causing rapid triage, physical strain, and divided attention.

> *"When the waiting area swells, I start fast-tracking, but my body is tense—like I'm missing something while keeping the line moving."* (P05)

> *"Midday the registers win. I'm split between the form and the patient—both feel urgent."* (P09)

Dual clinical-reporting demands amplify cognitive load, worsening perceived quality and post-shift carryover—again a JD-R configuration of high demands with thin resources.[16] When reporting templates change mid-surge or systems lack offline resilience, workers experience "policy as friction," a mechanism linked to moral-distress appraisals in crisis care. Frontline accounts from Bangladesh similarly show how operational constraints interact with ethics and workload to shape mental-health outcomes.[17]

Policy context fit & implementation fidelity

Participants contrasted policies "on paper" with whether they are workable under outages, surges, and staffing constraints.

> *"The policy sounds good, but with power cuts the uploads fail, and we re-enter late at night—exhausting."* (P15)

> *"Changing the form mid-campaign created chaos. Keep it stable and offline-first; then policy helps, not hurts."* (P08)

Poor implementation fit amplifies cognitive load (JD-R), drains scarce resources (COR), and fuels ethical strain when compliance competes with care. Guidance that ignores field constraints risks epistemic and practical misalignment in humanitarian settings. Participatory, co-designed adjustments stable templates, offline-first entry, scheduled micro-breaks with cover—are supported by implementation literature in mental-health systems redesign.[18]

Discussion

This phenomenological study illuminates how public-health professionals in the Rohingya camps experience a persistent demand–resource imbalance that carries beyond the working shift (Themes 1–3), a pattern of moral injury

under scarcity and constraints (Themes 4–6), and a gap between policies on paper and supports as felt (Themes 7–9). Workers experienced disrupted sleep and rumination from ethical challenges, relying on peer support and in-the-moment coping, while systemic pressures worsened distress; structured support, micro-breaks, buddy systems, clear escalation, and confidential counselling proved protective, addressing daily mental-health experiences and organizational interventions. They also align with the study's integrated theoretical lens (phenomenology, JD-R, COR, moral injury, and POS).

Firstly, the work–home spillover and "always-on" vigilance map onto JD-R predictions that chronic emotional/cognitive demands with thin recovery resources generate strain and reduced engagement. Participants' descriptions of broken sleep, somatic tension, and intrusive replay also exemplify COR "loss spirals," in which depletion of time, sleep, and psychological safety makes subsequent strain more likely. Comparable elevations in humanitarian/health worker distress have been reported in Bangladesh and allied crisis contexts, supporting external validity.[19]

Secondly, the data differentiate moral injury from burnout, showing guilt, shame, and self-doubt stem from morally injurious events, such as care denial or procedural delays, aligning with research linking value-violation distress to constrained agency. Findings show operational issues—surge changes, online-only systems, unclear escalation—amplify moral residue among refugee-camp public health workers.

Thirdly, policy-context mismatches hinder implementation; effective execution demands participatory design, offline workflows, stable templates, and empowered local decision-making. Findings indicate that seemingly minor design decisions may produce disproportionate influence on perceived quality, moral stress, and recovery.

Conclusion

This study shows Rohingya camp health workers face chronic demand–resource imbalance and moral injury, but practical buffers—reflective supervision, buddy rotations, micro-breaks, clear referrals, and confidential counselling—help mitigate stress and support well-being. Implementation fidelity—stable templates, offline-first entry, and local approvals—is crucial to ensuring effective, low-cost support, reducing moral injury, and maintaining safe, humane care. Future research should test these adjustments through implementation evaluations and mixed-methods designs across cadres and settings.

Conflict of Interest: None

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Case Report

Endoscopic endonasal repair of post-traumatic sphenoid sinus cerebrospinal fluid leak with encephalocele

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ABSTRACT

While cerebrospinal fluid (CSF) rhinorrhoea due to a road traffic accident is uncommon, its occurrence is clinically important because of the serious complications involving the central nervous system, such as meningitis. Often, the management of a post-traumatic CSF leak requires a multidisciplinary strategic approach. We report a case of post-traumatic sphenoid-sinus CSF leak with meningocele successfully repaired using a transnasal endoscopic multilayer technique in a setting with scarce resources. The initial neurosurgical intervention consisted of decompression of a massive pneumocephalus, followed by a definitive endoscopic skull-base repair. This procedure resulted in the cessation of the CSF leak and complete recovery. This case report highlights what can be achieved with a multi-disciplinary approach in a resource-constrained setting, such as South Sudan.

Key words: cerebrospinal rhinorrhoea, sphenoid sinus fracture, meningocele, endoscopic endonasal repair, resource-limited

Introduction

Traumatic cerebrospinal fluid (CSF) leak is a recognized complication of head injury. It occurs in 1–3 % of closed-head traumas and 10–30 % of basilar-skull fractures.[1] Traumatic CSF rhinorrhoea accounts for about 90% of all CSF leaks, with 80% caused by motor-vehicle accidents or falls.[2] Accurate identification of the defect site and the presence of associated meningo-encephalocele are crucial before surgery. Localization can be aided by imaging and intra-operative fluorescein, though the sphenoid sinus remains a particularly challenging site. Persistent leaks lasting two to three weeks or more typically require surgical intervention, most effectively managed through an endoscopic endonasal approach.[3,4] We present a case of post-traumatic sphenoid-sinus CSF leak with encephalocele, managed collaboratively by ENT and Neurosurgery teams in Juba, South Sudan, demonstrating that complex skull-base repairs are achievable even in resource-limited environments.

Case Report

On 14th June 2025, a 37-year-old male sustained a severe head injury following a fall and presented three weeks later with a persistent clear nasal discharge

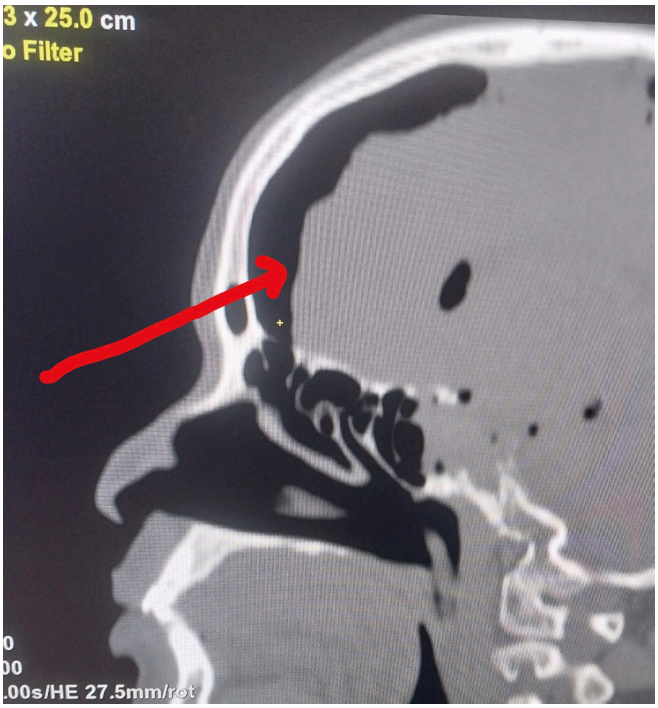

Figure 1. CT scan sagittal view of massive pneumocephalus (Credit: Dr Justin Rubena Luamaya)

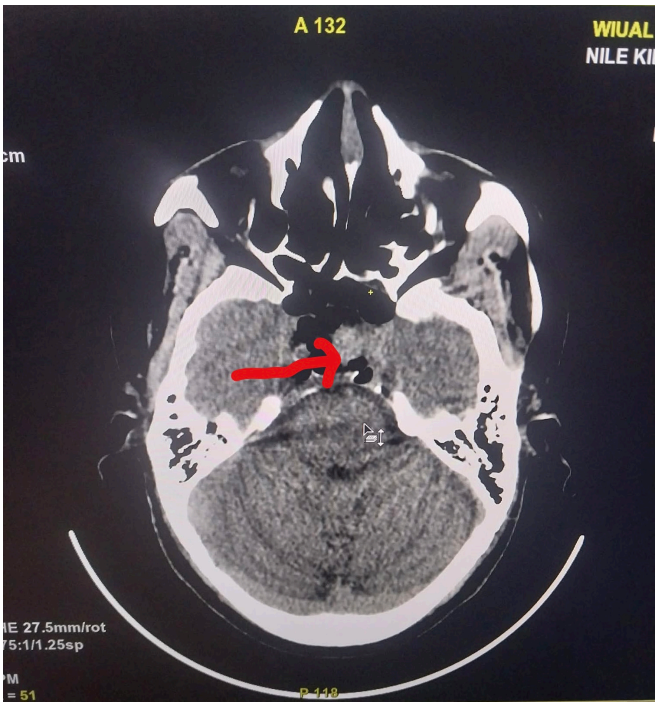

Figure 2. CT scan showing meningocele (hernia of the meninges and brain tissue through the lateral sphenoid sinus wall defect from the middle cranial fossa. (Credit: Dr Justin Rubena Luamaya)

from the left nostril and a constant severe headache. He was assessed clinically by a Consultant Neurosurgeon followed by CT imaging revealing a small fracture of the sphenoid bone with marked intracranial air collection - pneumocephalus (Figure 1). The CT scan in an axial view showed herniation of a meningocele from the left middle cranial fossa into the sphenoid sinus (Figure 2).

A burr hole was performed, with insertion of a drain to decompress the pneumocephalus, which led to gradual neurological stabilization and a reduction in headache. However, CSF rhinorrhoea persisted and one month later (24th July) rhinoendoscopy revealed, upon Valsalva manoeuvre, a gush of CSF from the left sphenoid sinus. CT imaging confirmed a posterolateral sphenoid-sinus defect with associated meningocele herniation, and endoscopic endonasal multilayer reconstruction was performed on the 2nd August.

A zero-degree scope (a rhinoscope with a camera allowing visualisation of the whole nasal cavity) was used to navigate through the nasal cavity alongside the medial attachment of the left superior turbinate to visualize the sphenoid opening. Blakesley forceps were used to do an uncinectomy (procedure to clear the uncimeatal complex) to expose the posterior rim of the maxillary ostium (Figure 3). During this exposure of the mucosa, a branch of the sphenopalatine artery was severed, but bleeding was controlled using bipolar cautery. The anterior wall of the sphenoid was removed using a Kerrison Rongeurs instrument. This exposed the CSF leak site and the meningocele, which was seen protruding and pulsating from the lateral sphenoid wall.

Approximately 80 % of the anterior sphenoid-sinus wall was removed to expose the lateral aspect of the defect. A bipolar cautery was used to shrink the herniated meningocele and delineate the defect.

Multilayer reconstruction was performed as follows:

1. Underlay tragal cartilage for structural support.
2. Autologous abdominal fat to obliterate dead space and seal the defect (Figure 4).
3. Surgicel and Gelfoam for additional reinforcement.
4. A vascularized naso-septal flap was rotated over the defect (Figure 5).
5. Additional layers of Surgicel, bone wax, and tetracycline-soaked gauze were applied to reinforce the closure.

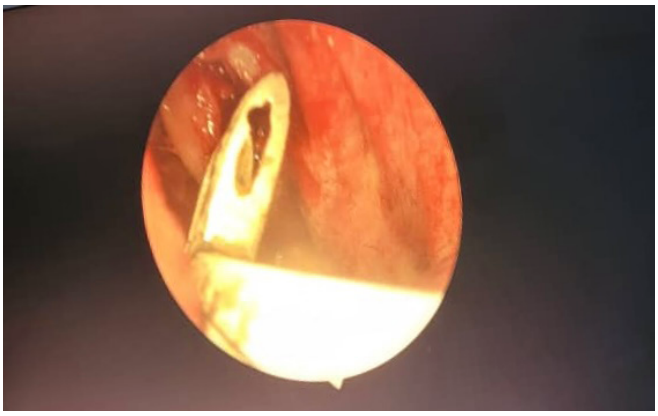

Figure 3. Removing the uncinate process to expose the posterior rim of the maxillary-ostium and the medial pterygoid plate to access proximity to the lateral wall of the sphenoid. (Credit: Dr Justin Rubena Luamaya)

Figure 4. Horizontal incisional site (6cm) to harvest the abdominal fat graft after seven postoperative days. (Credit: Dr Justin Rubena Luamaya)

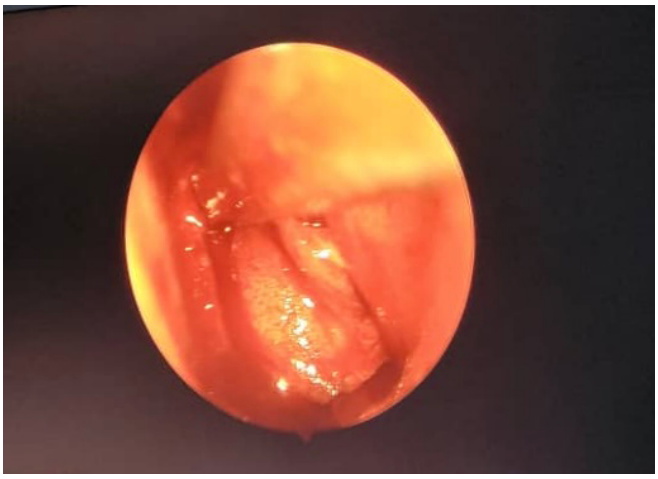

Figure 5. Placement of the vascularized naso-septal flap into the sphenoid defect. (Credit: Dr Justin Rubena Luamaya)

The bone wax and tetracycline gauze were removed four weeks post-operatively.

Post-operative recovery was uneventful. There was a complete cessation of CSF rhinorrhoea, without recurrence during follow-up, and no development of meningitis or pneumocephalus.

Discussion

Traumatic CSF leaks of the sphenoid sinus are rare but potentially life-threatening because of the risks of central nervous system complications like meningitis, recurrent pneumocephalus, and neurological deficits.[5] Initial conservative management is the standard management in selected cases. However, persistent CSF leaks of more than 2-3 weeks require surgical intervention.[6] The endoscopic endonasal approach is superior to transcranial methods because it provides a direct view of the skull base and, furthermore, is associated with lower morbidity and higher success rates.[7] To ensure a watertight seal after reconstruction, a multilayer technique using autologous cartilage, fat, and vascularized mucosal flaps is preferred. This approach also minimizes recurrence.[8,9,10]

In our case, the initial neurosurgical intervention involved burr-hole decompression with a drain. This resolved the pneumocephalus and stabilized the patient for safe endoscopic repair. This staged, collaborative strategy demonstrates that even in resource-limited environments, advanced skull-base surgery can be successfully achieved with appropriate expertise and teamwork.

Conclusion

Persistent post-traumatic CSF rhinorrhoea of the sphenoid sinus requires timely multidisciplinary management. The combination of neurosurgical decompression and endoscopic multilayer closure provides an effective, safe, and feasible solution, even in low-resourced African contexts. This case emphasizes the importance of enhancing ENT and neurosurgical collaboration and infrastructure in sub-Saharan Africa to manage complex skull base pathologies and prevent severe complications, such as meningitis and recurrent pneumocephalus.

Authors' contributions: RJ performed the endoscopic endonasal repair and drafted the manuscript. KC performed the initial neurosurgical evaluation and burr-hole decompression, and contributed to multidisciplinary planning. Others assisted during the surgical procedures.

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Teaching Hospital for their assistance and the patient and family for their cooperation and consent to publication.

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End TB

The World Health Organization (WHO) is urging countries to accelerate action to end tuberculosis (TB) and expand access to lifesaving services by using new innovations such as diagnostic tests that can be used near the point-of-care and tongue swabs that can help detect the disease faster reaching more people.

'The new guidelines on tests for TB that can be used near the point-of-care, issued by WHO, mark another step towards faster detection and treatment of one of the world's deadliest infectious diseases. These portable, simple-to-use tests bring TB diagnosis closer to where people routinely seek care. Available at less than half the cost of many existing molecular diagnostics, they can help countries expand access to testing. The tests can operate on battery power and deliver results in less than one hour, allowing patients to start treatment sooner...'

Guidelines: https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/diagnosis-treatment/npoc-tongue-swabs-and-sputum-pooling-for-tb

Extract from HIFA - Healthcare Information For All.

Case Report

A rare pathological feature of portal vein thrombosis complicated by portal hypertension and haematemesis

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ABSTRACT

Portal cavernoma is a rare cause of upper gastrointestinal bleeding resulting from complications of portal hypertension. We report the case of a 30-year-old woman admitted with haematemesis and splenomegaly. Imaging revealed a portal cavernoma associated with oesophageal varices. The patient received a blood transfusion, fluid resuscitation, and on discharge was put on propranolol for secondary prevention. Endoscopic ligation could not be performed due to service limitations. Diagnosis of portal cavernoma relies on imaging. Its management is complex in low-resource settings such as Niger.

Keywords: haematemesis, cavernoma, portal hypertension, Zinder, Niger.

Introduction

Portal cavernoma, or cavernous transformation of the portal vein, is a rare vascular anomaly characterized by the development of a network of tortuous venous collaterals that bypass an obstructed portal vein.[1,2] It causes non-cirrhotic portal hypertension.[3] The exact incidence is unknown, but increasing use of Doppler ultrasound and CT imaging has improved recognition.[4] The condition may remain asymptomatic for years and often presents through complications such as upper gastrointestinal bleeding caused by rupture of oesophageal varices.[4,5] Clinically, the picture is dominated by splenomegaly, hypersplenism, and signs of portal hypertension.[5] The diagnosis rests on imaging—mainly Doppler ultrasound and CT scan—which demonstrate the absence of flow in the main portal vein and the presence of multiple serpiginous collateral vessels.[1] We report a case of portal cavernoma discovered following haematemesis in a young woman with no previous medical history and managed in a resource-limited environment.

Case Report

A 30-year-old woman with no history of liver disease, surgery, or thrombophilia presented to the Hepatology and Gastroenterology Department of Zinder National Hospital with haematemesis associated with dizziness and fever. She reported no use of non-steroidal anti-inflammatory drugs, no chronic abdominal pain, and no known peptic ulcer disease.

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At admission, she was pale, febrile (38.5°C), tachycardic (120 bpm), and hypotensive (80/60 mm Hg). Physical examination revealed stage III splenomegaly according to Hackett's classification and melaena on rectal examination. Laboratory investigations showed microcytic hypochromic anaemia (Hb = 5.9 g/dL) and thrombocytopenia (67,000/mm³). The thick blood film was positive for *Plasmodium falciparum*, while liver and renal function tests and coagulation studies were normal.

Initial management consisted of intravenous crystalloids with saline at 5ml/kg/hour, fresh blood transfusion at 756 ml to a transfusion target of 8g/dL, and 80 mg of omeprazole daily. Antimalarial therapy orally by artemether was initiated.

Upper gastrointestinal endoscopy was performed after stabilization, which revealed grade III oesophageal varices without red signs. The latter, e.g., cherry-red spots, would warn of imminent bleeding from weak areas. Abdominal ultrasound showed a serpiginous vascular formation in the hepatic hilum, suggestive of a portal cavernoma (Figure 1). Colour Doppler confirmed a chaotic flow within the portal venous network (Figures 2–3). A CT scan demonstrated a portal cavernoma without a focal hepatic lesion, associated with homogeneous splenomegaly (Figure 4). No biliary dilatation or mass was noted. A diagnosis of portal cavernoma complicated by variceal bleeding in a non-cirrhotic patient was made. Due to limited resources, endoscopic variceal ligation was unavailable. Anticoagulation was not indicated due to the chronic, organized nature of the thrombosis, and further bleeding might have been precipitated. Weekly follow-up over one month showed progress with cessation of bleeding and improved haemoglobin (10 g/dL). The patient received 40mg propranolol long-term, oral iron for three months, and six-monthly follow-up visits. She also received oral iron supplementation for three months.

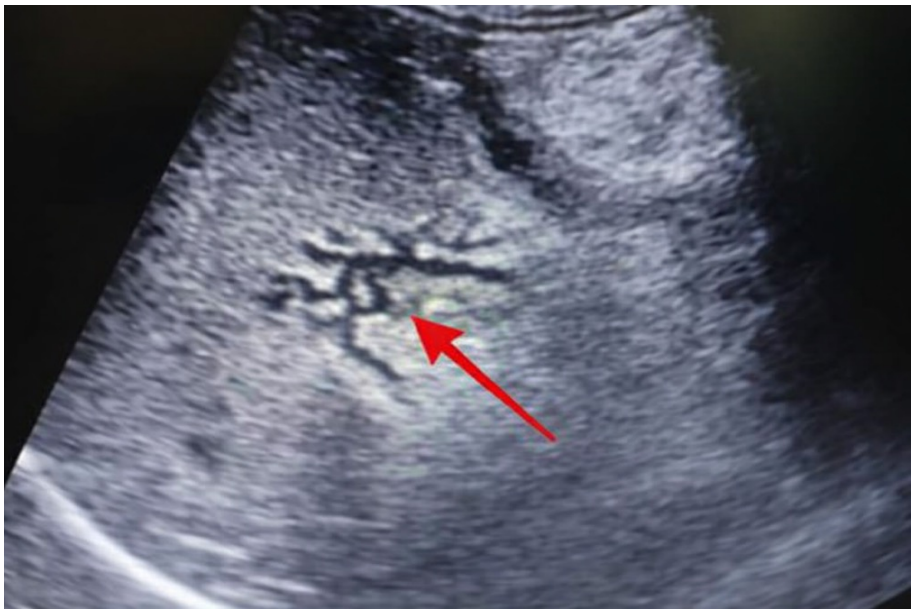

Figure 1. Abdominal ultrasound scan showing a serpiginous appearance at the hepatic hilum, in favour of a portal cavernoma.

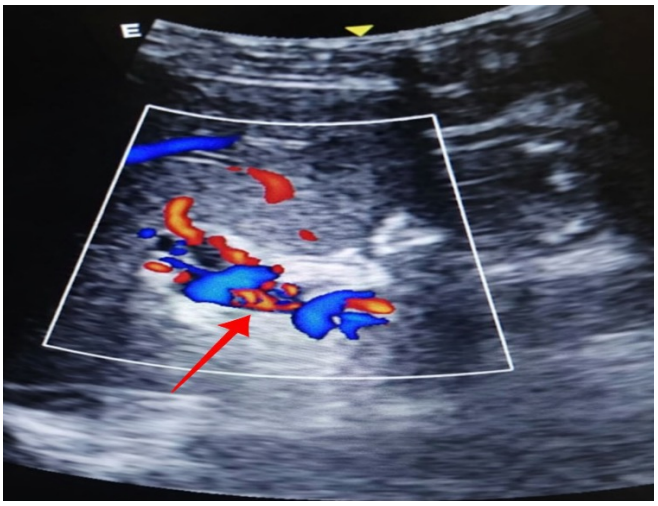

Figure 2. Doppler ultrasound illustrating a vascular malformation at the splenic vein level with heterogeneous flow, consistent with an ectopic vascular anastomosis.

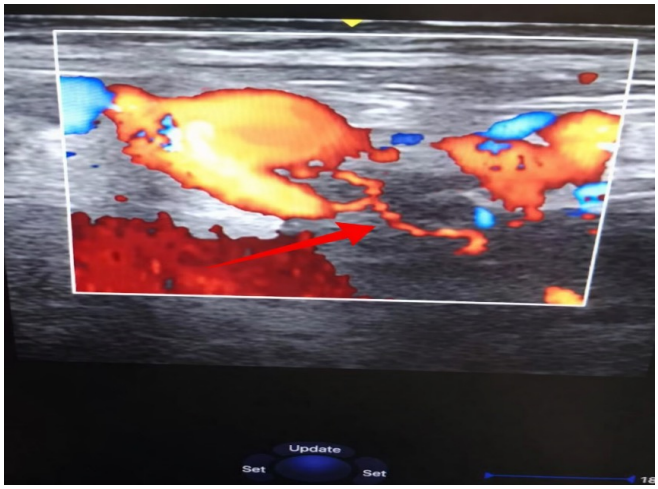

Figure 3. Doppler ultrasound showing the portal vein with a serpiginous appearance indicative of a portal cavernoma.

Figure 4. Axial abdominal CT scan showing a portal cavernoma with associated homogeneous splenomegaly.

Discussion

This is the first case of portal cavernoma reported at Zinder National Hospital. In Romania, Cazacu et al. found a prevalence of 14.8% among patients with portal thrombosis.[6] Despite its rarity, the condition is increasingly detected thanks to advanced imaging.

Our patient was 30 years old, within the range reported for non-cirrhotic portal vein thrombosis. In Senegal, Diallo et al. reported a mean age of 41 years (15–75 years), showing that the disease affects young adults. Although some series report a male predominance (M/F = 2.7: 1), gender differences may vary depending on underlying pro-thrombotic conditions sus as sickle cell disease.[5]

The causes of portal vein thrombosis are often multifactorial. Devika et al. in India identified local inflammatory factors (pancreatitis, abdominal infections such as diverticulitis) and systemic thrombophilia, such as hyperhomocysteinemia.[7] Resseguier et al. in France found in 24 of 32 cases, 15 haematological disorders (10 myeloproliferative syndromes, 2 antiphospholipid syndromes, 1 thalassaemia major, 1 hyperhomocysteinemia and 1 factor II mutation).[8] In children, umbilical vein catheterization is the main cause.[9] In our case, no aetiology was apparent, i.e. idiopathic (Elkrief et al.[3])

Upper gastrointestinal bleeding was the presenting symptom, as often described in the literature. Wei et al. highlighted variceal bleeding as the most common initial presentation.[10] Boccatonda et al. and Layton et al. also reported that variceal rupture is a typical manifestation of cavernous transformation.[1,2]

Splenomegaly is a classical sign of portal hypertension; its stage III presentation in our patient reflects advanced collateral circulation. Elkrief et al. emphasized that splenic hypertrophy is one of the most sensitive clinical indicators of chronic portal hypertension.[3] The presence of fever and malaria might have acted as a precipitating or aggravating factor for thrombosis.

Anaemia in our case was due to acute bleeding on chronic asymptomatic bleeding, while thrombocytopenia reflected hypersplenism secondary to portal hypertension. Cazacu et al. described similar haematological abnormalities, considering hypersplenism as a constant feature of cavernoma.[6] Normal liver function tests can help rule out cirrhosis.

Ultrasound scan remains the first-line diagnostic tool, especially in resource-limited settings. In our case, it showed serpiginous vascular structures in the

hepatic hilum. Colour Doppler revealed turbulent, multidirectional flow, characteristic of cavernous transformation. Marra et al. confirmed the high sensitivity of ultrasound for differentiating partial from complete portal thrombosis.[11] Kalra et al. emphasized that in chronic cases, the portal vein may disappear centrally and be replaced by a network of periportal collaterals.[12] A CT scan confirmed the diagnosis, showing multiple venous collaterals and splenomegaly without hepatic lesions. Mild biliary compression may occur, corresponding to portal biliopathy, a complication described in 5–30 % of cases.[13–14] Jha et al. reported that CT findings typically include non-enhancement of the portal vein, serpiginous collaterals, and absence of focal hepatic lesions in non-tumoral thrombosis.[15]

Endoscopy revealed grade III oesophageal varices. Boccatonda et al. also noted that large varices are common in cavernomas.[1] The absence of red signs suggests a lower immediate bleeding risk but requires secondary prophylaxis.

Management of portal cavernoma is challenging. Acute bleeding requires resuscitation, transfusion, and vasoactive or beta-blocker therapy after stabilization and correction of anaemia. We used propranolol for secondary prophylaxis. In chronic thrombosis, recanalization is often impossible, and the benefit of anticoagulation remains controversial. Boccatonda et al. argued against anticoagulation in fully organized thrombosis.[1] In well-equipped centres, endoscopic variceal ligation and trans-jugular intrahepatic portosystemic shunt (TIPS) are standard options for recurrent bleeding or refractory portal hypertension. However, these techniques were unavailable in our hospital, reflecting the therapeutic limitations in many African settings.

Prognosis depends on the control of variceal bleeding and the absence of complications such as portal biliopathy or intestinal ischaemia. Our patient showed favourable progress with improved haemoglobin and no recurrent bleeding after one month. Regular follow-up is essential to adjust beta-blocker dosage and consider further endoscopic evaluation.

Conclusion

Portal cavernoma represents the chronic evolution of portal vein thrombosis, often of unknown aetiology. Its discovery is usually prompted by complications of portal hypertension, such as variceal bleeding. Biological abnormalities are nonspecific, but imaging and endoscopy are key to diagnosis. Management must be multidisciplinary, combining resuscitation, beta-blockers, endoscopic treatment, and possibly TIPS or surgical shunts where available. In resource-limited environments, supportive care and close monitoring remain the cornerstone of management.

Conflict of interest: None

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Advocacy Training for Community Health Workers

A free digital advocacy training to elevate the voices of community health workers.

Community health workers (CHWs) are the most proximal and trusted care providers for millions worldwide. However, CHWs have historically been excluded from conversations and decision-making that influence their work and communities.

CHWs with advocacy training are **2-4x more likely** to engage in political, civic, and workplace advocacy. We worked with the **Community Health Impact Coalition** and an advisory group of CHWs from around the world to develop this training to equip CHWs with the skills to effectively share their personal stories and promote the health issues most important to their communities. All content is action-oriented and reflects the realities of CHWs' work.

The training is designed for individuals as well as group training and is flexible to fit existing training and work schedules. Videos, reading materials, and reflection exercises communicate the history and background of CHW programs, how to advocate for improved health care and working conditions, how to tell personal stories to advocate for change, and how to use technology tools to participate in global conversations.

The course is open-access and officially recognized as a **Digital Public Good** and a **Content Global Good**. This training includes four modules with nearly 40 videos, reflection exercises, Facilitator Guide, and Student Workbook. All materials are free for use under Creative Commons **CC-BY-NC-SA 4.0** license.
https://digitalmedic.stanford.edu/advocacy-training-community-health-workers

Interpersonal and community-level factors influencing intimate partner violence in South Sudan: a literature review

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ABSTRACT

The pervasive intimate partner violence continues to be perpetuated by entrenched gender norms, weak women's economic power, and post-war realities in South Sudan. In the face of global attention, South Sudan now considers gender-based violence not only as a health risk but also a human rights issue to safeguard. This study strived to identify and analyse interpersonal and community-level factors influencing intimate partner violence in South Sudan, from the existing literature. A systematic literature review was conducted using Heise's ecological framework, focusing on marital relations, household decision-making dynamics, and women's socio-economic status. The search engines utilised to obtain literature included PubMed, Medline, VU Library, Google Scholar, and the Ministry of Health's website. The research findings reveal that the genesis of intimate partner violence, in most cases, emanates from marital arrangements, including forced unions, polygamous setups, and bride price transactions. Importantly, women's exclusion from critical family decision-making processes exacerbates physical and sexual violence. Also, low educational attainment among women, as well as the levels of household poverty, unemployment, and peer influence, are strong predictors of violence in intimate relations. It is important to note that addressing intimate partner violence must be grounded in proper identification and understanding of the dynamics that perpetuate it. The interventions include a threshold for education above primary education, which is protective, women's empowerment, and poverty reduction at the community level.

Keywords: sexual violence, intimate partner violence, ecological model, marital dynamics, community factors, South Sudan

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Introduction

In South Sudan, intimate partner violence (IPV) is rooted in social traditions, norms, beliefs, marital dynamics, and post-civil war realities.[1,2] The legal framework presents ambiguities that perpetuate such violence, although the national constitution proclaims gender equality.[3] The constitution is glaringly contravened by customary laws that "legitimise" male dominance and female subservience.[3]

At the core of IPV lies the institution of marriage, considering how the union is initiated and the prevailing social structure.[4-8] Marital violence often results from forced unions, polygamy, and bride price transactions.[6-8] These practices commodify women and affirm the men's entitlement over their spouses. With the judicial systems grounded in the long-standing customs, norms, and cultures, women often find it hard to file for divorce and exit from abusive relationships.[1] Importantly, women are excluded, or rarely consulted, in decision-making regarding family matters, which are the prerogative of men.[9] The already sore marital dynamics are compounded by economic violence, which subjects women to dependency and acquiescence to harmful practices.[10]

IPV is usually perpetuated by socialised negative notions that emanate from peer networks, mental health disorders, and militant masculinities emerging from the legacy of conflicts.[11-13] In the face of economic marginalisation of women, violence is strongly manifested in post-conflict situations as a means of reasserting male dominance and shifting gender roles.[13] At the community levels, IPV is shored up and enabled by shocking levels of household poverty, unemployment, and financial hardships.[10]

This study undertook a multi-layered inquiry into IPV, examining how relational and community-level factors converge to perpetuate abuse within marital relationships.[18] This includes reimagining marital relations, gender roles, and accountability based on the rule of law.

Method

This research is a literature review that combines both peer-reviewed journals and grey literature. The search engines used to ascertain articles include PubMed, Medline, VU Library, Google Scholar, and the Ministry of Health websites to obtain relevant IPV literature in South Sudan and other relevant contexts. Articles published in the last ten years (2010 – 2019) in English were preferred as there is little change in attitudes, beliefs, and cultural norms related to IPV in South Sudan over this period.

The Heise's Integrated Ecological Framework was chosen for this review since it is more appropriate for the analysis of IPV in the context of South Sudan. However, the focus was on the analysis of interpersonal factors: marital conflict and types of marriages, women's decision-making status, educational level, community, and men's controlling behaviours. The remaining categories of the framework, such as the individual, society, and policies, were not within the scope of this study.[18]

Results

Interpersonal relations

The interpersonal factors include marital conflict and types of marriages, women's decision-making status, educational level, and men's controlling behaviours.

Marital conflict and types of marriages

In South Sudan, marital conflict was found to be a major predictor of IPV.[4] Girls who were once raped were forced to marry the perpetrators as a way of resolving stigma issues associated with the survivor of violence. This was found to result in parental conflict between the couples with physical and emotional IPV.[5] Women married through abduction, payment of dowry, or married into polygamous relationships were more at risk of IPV.[6-8]

A study of gender norms in low- and middle-income countries (LMICs) found that IPV was associated twice as often with multiple sexual partners or extramarital sex compared to women with single sexual partners.[19] In Uganda, physical IPV was associated with extra-marital sex by women in intimate partner relationships, while sexual IPV was related to women whose husbands were jealous of seeing their wives talk with other men. The jealous men accused women of unfaithfulness and severely restricted them from contact with strangers and family members, resulting in emotional IPV.[20]

A study in LMICs found that physical IPV was 2.6 times more common where women had conflict in marital relationships compared to women who had agreeable relationships.[21] Women who offered sex to their husbands were less at risk of sexual violence compared to women who denied sex.[22] Additionally, in Ethiopia, physical IPV was more likely to affect women whose husbands had girlfriends and thought there was nothing they could do about it.[23] The odds of IPV were doubled for women who refused sex compared to those who complied.[7]

A study found that HIV infection was a source of marital conflict and increased IPV in northern Uganda, where there are South Sudanese refugees.[24] It was recognized that IPV was higher among couples infected with HIV compared to those who were not infected.[25]

Women's decision-making status

In South Sudan, men were found to exclude women from important household decisions. Women were considered foreigners to their husbands' families.[9]

A multi-country study in conflict-affected settings, which included South Sudan, found that women were excluded from negotiating peace deals. Hence, peace accords failed to address violence against women and girls during the post-conflict period.[26] Women were not consulted or considered in decision-making that was related to politics or serious household issues.[27]

In Ethiopia, a study found a 50% reduction in IPV when women had equal decision-making power. There was also a 35% reduction in sexual IPV in women who equally shared in household decision-making processes with their husbands.[28]

A study in LMICs found that women in intimate partner relationships where men dominated decision-making were 8.2% more at risk of physical violence.[21] Additionally, joint spending of husbands' incomes was less associated with IPV.[21]

Educational level

In South Sudan, 84% of women were found to be illiterate and vulnerable to IPV.[4,29] Poor education of women was associated with economic violence in intimate partner relationships, as they were forced to be financially dependent on men for survival.[30] Physical IPV was associated with gender inequality in less educated women compared to highly educated women.[31]

A multi-country cross-sectional study indicated that increased educational levels were associated with 9% decreased odds of physical IPV and 85% reduction in sexual IPV in the Democratic Republic of the Congo.[31] Research has shown that secondary or higher education for both partners was associated with reduced risks of IPV, while there was no protective effect of primary education against IPV.[25]

A combined study in Ethiopia and Tanzania found a two-thirds decrease in IPV when both partners had completed secondary education.[25] Another study found that the risks of IPV were twice as likely for uneducated or only primary-educated women.[32] IPV was less prevalent among women who had achieved higher educational levels.[21]

However, women who were more educated than their husbands were at higher risk of IPV compared to women who had less or equal educational levels as their husbands. Also, women in marriages where couples were equally highly educated experienced the lowest levels of IPV in Uganda.[21,33] The odds of IPV were three times higher for uneducated women compared to educated women in intimate partner relationships.[21,34]

Men's controlling behaviours and mental disorders

In South Sudan, women whose husbands exercised controlling attitudes were more likely to suffer both physical and emotional IPV.[5] Women whose husbands threatened their well-being were more at risk of IPV compared to women who were not afraid of their husbands.[35] There was evidence that men who exercised controlling behaviour over women were more likely to be violent compared to men who acknowledged gender equality.[4,25] IPV was also associated with women whose husbands were rude or hostile.[21,35] Men in rural areas who are more controlling and possessive of women compared to men in the towns were at higher risk of inflicting violence in intimate relationships.[4,9]

A multi-country study found that the odds of IPV were 3.5 times higher where husbands had a history of physical fights.[21] Emotionally stressed women were also more likely to experience IPV, and women with mental disorders had double the risk of IPV compared to women with healthy minds.[21]

Community level

At the community level, factors that contribute to IPV include unemployment, poverty, and negative peer influence.

Poverty, socio-economic status, and unemployment

South Sudan's families with low socio-economic status were more associated with IPV compared to affluent families.[10] Women of high socio-economic status were less at risk of IPV compared to women of poor backgrounds.[5] IPV was associated with a low Human Development Index (HDI), with South Sudan ranking 169th out of 188 countries worldwide.[4] Women were found to be the poorest and most vulnerable to economic IPV than men.[3,29] Families headed by women were the poorest compared to families headed by men.[4] A study in South Sudan found that unemployed poor women were at risk of economic violence compared to women who earned salaries.[4]

In Uganda, couples living in poverty were more at risk of IPV, which is associated with the perpetuation of social vices such as transactional sex and infectious diseases like HIV, sexually transmitted infections, and tuberculosis.[24] A multi-country study found that a lack of women's empowerment was associated with negative cultural norms

that denied women the right to own land and property.[25] Poverty made men lose control over their families, resort to drinking alcohol, and engage in physical IPV.[31]

A cross-national study on gender norms found that women dependent on informal jobs or farming were more likely to experience IPV compared to women who worked in formal jobs.[21] IPV was less likely when husbands were employed. Women of low socio-economic status were more vulnerable to IPV compared to women of high socio-economic status.[21] Sexual IPV was more likely when women were economically dependent on men compared to women who were financially independent. There was a 50% reduction in IPV where women owned businesses.[21]

Negative peer influence

Multicountry studies have found that peer-group socialization is a major contributor to IPV.[25,36,37] Boys who socialized and oriented themselves negatively on how to handle women were more likely to inflict IPV compared to those who were not influenced through peer pressure.[21,38] Negative peer influence was associated with alcohol and drug abuse, resulting in IPV.[2] Intoxication with substances was found to trigger violence in the family, especially battery of women, compared to relationships in which couples were sober.[39,40]

Discussion

Interpersonal level

Marital conflicts should be addressed through couples' training and advocacy programmes aimed at raising awareness of human rights and women's rights. Skills that strengthen negotiation, conflict resolution, and leadership capabilities are important. Extreme patriarchal practices such as girl-abductions that are used to initiate marriages need to be addressed urgently, as are traditional practices such as polygamy that are rooted in gender inequality. Uganda's IPV prevention projects, such as Safe Homes and Respect for Everyone (SHARE) and Start Awareness, Support and Action (SASA), should also be adopted in South Sudan to confront household sexual violence and extra-marital sex or concurrent sex, which are associated with marital conflict and IPV. These strategies have proven to be effective in reducing IPV and concurrent sex associated with HIV infections.

Promoting girls' formal education is an important mechanism to ensure that more girls achieve secondary education, thereby reducing the risk of IPV. Women should also be given capacity-building programmes through vocational training to acquire lifelong skills that enable them to achieve economic independence, thereby reducing IPV. Higher educational attainment is also associated with improved socio-economic status, thereby increasing employability.

Community mobilisation with group training and advocacy through video show projects such as "Through Our Eyes" (TOE) are directed at improving women's decision-making abilities. Equal gender decision-making processes are associated with reduced levels of IPV and improved gender relations. This also raises awareness of women's rights to participate in decisions about important family matters.

Community level

The livelihood programmes, such as microfinance and cash transfers, coupled with skills training, are important interventions directed towards reducing women's poverty and vulnerability to IPV at community levels. Women who are economically empowered have increased ways of mitigating abusive relationships. Reduced household poverty levels also lead to satisfying reproductive and sexual lives, as women can access health services.

The livestock microfinance for peace in other sub-Saharan Africa is associated with decreased IPV and less poverty. These programmes should also be adopted in South Sudan where livestock (cattle and goats) is abundant, as a way of promoting peace, improving livelihood, and mitigating IPV.

Group training and advocacy for boys and men, engaging them in transforming negative attitudes towards women to reduce negative peer influence, is also a significant strategy for addressing IPV. The negative socialisation by men is seen to be associated with IPV at community levels. These training programmes should target gender norms and long-held traditional beliefs and practices that subjugate women.

Conclusion

The evidence demonstrates IPV in South Sudan is deeply rooted in interpersonal, socio-economic, and community factors. Addressing IPV, therefore, requires multi-layered interventions. At the interpersonal level, couples' training, advocacy, and conflict resolution programmes can mitigate marital discord. Expanding girls' access to secondary education and vocational training enhances women's

autonomy and reduces vulnerability. At the community level, livelihood initiatives such as microfinance, cash transfers, and livestock-based peacebuilding can alleviate poverty and empower women economically. Finally, engaging men and boys in transformative gender training is essential to dismantling harmful norms and reducing peer-driven violence.

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Letter to the Editor

RE: South Sudan Postgraduate Training Programme

12 February 2026

Dear Editor,

I agree with many of the concerns expressed by Dr E.A. Hakim, et al, regarding the need for a programme for postgraduate training in South Sudan (SSMJ Vol 19, No 1, February 2026). I feel it is important to point to other issues his letter exposes.

Firstly, most of the concerns expressed—high peripartum mortality, mortality in the first five years of life, all too common home deliveries— indicate the need to address medical issues outside of Juba. This is undermined by the misappropriation of funds supposed to flow through UNICEF to implementing partners at the county level. By all means, utilize professionals from outside countries to address the gaps in expertise in medicine in Juba, but from a practical standpoint, Link House will not make a significant impact on the issues expressed in his letter because most of those issues arise in the rural counties, not Juba.

Secondly, there is a great need for an element of humility at the Ministry of Health (MoH) in South Sudan. The vastly better outcomes in our East African neighbours reported by Dr. Hakim speak to the reality that the medical education systems in other countries in East Africa, including Uganda, Kenya, Tanzania, and Ethiopia, are more advanced. Their professionals, at all levels, are more highly qualified than ours. That is not surprising, given the reality that southern Sudan was engaged in a civil war with Khartoum while those other nations were finding their footing in government and education. It does our country no good to deny these facts. South Sudan needs help from our neighbours in order to improve the education of young medical professionals. During my years of association with the Rumbek Nurses Training School (RNTS), our goals of training nurses were undermined by restrictions imposed by the MoH in hiring instructors from outside South Sudan. The reality was there were not sufficiently trained mentors from South Sudan to accomplish the work, whereas numerous potential candidates were available and willing to come from Uganda and other countries.

Medical training is an apprenticeship based on science. To have well-trained doctors, nurses, clinical officers from South Sudan, we need experts in their fields to conduct the training. From my personal observations of being in Sudan/South Sudan for over 16 years, the best South Sudanese doctors at present were trained in Uganda or other East African countries. We must take advantage of the expertise in our neighbouring nations to provide mentorship for our young clinicians.

Thirdly, the desire to improve healthcare delivery nationwide points to the need to be able to hire the best qualified candidates for key positions in county hospitals and PHCC's. We are struggling to reopen a hospital that has been nonfunctional for over a decade. We are desperate for an excellent matron to oversee the process and an experienced laboratory technician to ensure high-quality and reliable test results. Numerous East Africans are available and desire to come, but the MoH will not allow those professionals to be employed because they are not South Sudanese. If the medical schools for Juba and Upper Nile University are ever to be comparable to those in Uganda and Kenya, it is essential to hire experienced clinicians and instructors who are best qualified to work with our medical colleagues and instruct the candidates, irrespective of their country of origin.

The healthcare of South Sudanese citizens is too important to be treated lightly. It is not sufficient to have the issues covered on paper. If we are to change the disastrous trends in South Sudanese healthcare where we are falling further behind our neighbours, we need to humble ourselves and address this glaring deficit.

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Letter to the Editor

Dr Eluzai A. Hakim Response

Dear Editor,

I refer to Dr McIntosh's letter, published in this issue in response to my article, "South Sudan Postgraduate Training Programme" in the SSMJ Vol 19, No 1, February 2026. Unlike Dr McIntosh, I contend that the Link House is a very important facility for supporting training in South Sudan especially in the initial stages of the evolution of the postgraduate programme to accommodate high-calibre South Sudanese specialists living abroad, and trainers from the developed world.

Dr McIntosh makes some very important points which require the attention of the South Sudan Ministry of Health (MOH), particularly regarding the development of a coherent National policy on a medical training programme. Recognising the lack of such a policy in 2008, I initiated the formation of a link between St. Mary's Hospital, Newport, Isle of Wight, and Juba Teaching Hospital (*The Juba Link).* The Link committee in the UK was made up of hospital consultants, senior nurses, a chief operating officer of the hospital trust, the manager of the St. Mary's Hospital Postgraduate Centre, a senior midwife, a hospital non-executive director and two interns. The two interns spent three months at Juba Hospital working alongside South Sudanese doctors for mutual experience. The corresponding Juba Committee was composed of a consultant surgeon, a paediatrician, a paediatrics registrar, and the hospital matron.

The aim of the Link was to harness the expertise of UK trainers to provide structured and regular on-site training for South Sudanese doctors in Juba to reduce costs. In addition, the link provided opportunities for South Sudanese doctors at various levels to visit UK hospitals for periods of six weeks to three months to experience different ways of clinical working in order to influence and, hopefully, improve healthcare delivery in South Sudan.

This scheme attracted much interest from Consultants in the Wessex Region of the United Kingdom, several of whom offered to travel to Juba at their own expense if accommodation was available. Encouraged by this enthusiasm by potential trainers, the Link committee launched a successful fundraising campaign on the Isle of

Wight which enabled the construction of a guest house called **the Link House** (see Figure) to accommodate visiting trainers. The MOH leased a plot of land on the premises of Juba Teaching Hospital where the *Juba Link* built a beautiful six ensuite-room guest house. Several trainers used the Link House on visits to Juba Hospital, saving the government appreciable amounts of money. A memorandum of understanding was signed between the MOH and the Juba Link to conduct trainer visits to Juba. Had it not been for the political upheaval in July 2016, the programme would have blossomed. The Link House was subsequently used for non-trainers as accommodation for hospital medical officers free of charge. This led to its rapid decline structurally without any maintenance! The Link House is available to support future trainers but needs renovation. I have taken steps to reactivate the Link with Juba Hospital through a London Hospital to support the postgraduate programme which I am determined to support.

To realise this objective the MOH must dedicate expertise and resources to developing a robust structured training programme as this cannot be solely achieved through voluntary effort. The Juba Link has ceased to exist through retirements of the trustees and lack of financial support.

Finally, the Consultants currently working at Juba Hospital cannot be bystanders but must bring pressure to bear on the MOH to develop this programme.

Dr Eluzai Hakim, FRCP Edin, FRCP

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News from the Gordon Memorial College Trust Fund

At the last annual Committee meeting of the Gordon Memorial College Trust Fund (GMCTF) on 19th March 2026, applications for postgraduate grants were considered.

The results are presented below:

Total number of individual applications submitted: **142**

Total number of individual applications approved: **31** (10 female)

- Applicants with Sudanese nationality: **4** (2 female)
- Applicants with South Sudanese nationality: **27** (8 female)

Total amount awarded **$101,100 USD**

- **$12,200** to Sudanese individuals ($5,000 to females)
- **$88,900** to South Sudanese individuals ($25,350 to females)

Breakdown of 27 South Sudanese grant recipients

Current location:

- 20 – Ethiopia
- 4 – Uganda
- 2 – South Sudan
- 1 – Kenya

Institution of study:

- 5 - Addis Ababa University
- 4 - Woliata Sodo University
- 3 - Jimma University
- 3 - Yekatit 12 Hospital Medical College
- 2 - Hawassa University
- 3 - St. Paul's Hospital Millennium Medical College
- 3 - Makerere University
- 1 - Adama Hospital Medical College, Ethiopia
- 1 – COSECSA (Juba Military Referral Hospital)
- 1 - Kampala International University
- 1 - University of Nairobi

Post-grad qualifications that will be gained include:

- Specialty Certificate - Internal Medicine
- Specialty Certificate - Obstetrics and Gynaecology
- Membership of COSECSA
- Master's degree in general surgery
- MD – Paediatrics
- MSc. Neurosurgery

Many applicants were either ineligible for the award of a grant or did not align well with GMCTF's published criteria on the charity website www.gmctf.org.

Potential applicants should closely follow the GMCTF guidance (including the information we require from referees) if they want to improve their chances of success. Recycling previous references is not acceptable. Those applying for extension of their grants must produce clearly written evidence from their Programme Directors and/or Deans of the relevant faculties that they have successfully completed the courses in the current year of study and have been deemed suitable to progress to the next level of the course.

Eluzai Abe Hakim, FRCP Edin, FRCP

Member, GMCTF Committee.

Is it Flu or Ebola?

Flu (influenza)

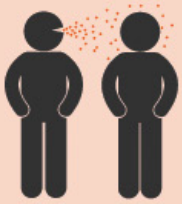
The **flu** is a common contagious respiratory illness caused by flu viruses. The flu is different from a cold.

Flu can cause mild to severe illness, and complications can lead to death.

Ebola

Ebola is a rare and deadly disease caused by infection with an Ebola virus. Sporadic outbreaks have occurred in some African countries since 1976.

How Flu Germs Are Spread



The flu is spread mainly by droplets made when people who have flu cough, sneeze, or talk. Viruses can also spread on surfaces, but this is less common.

People with flu can spread the virus before and during their illness.

How Ebola Germs are Spread

People get Ebola by direct contact with

- The body fluids of a person who is sick with or has died from Ebola.
- Objects contaminated with body fluids of a person sick with Ebola or who has died of Ebola.
- Infected fruit bats and primates (apes and monkeys)
- And, possibly from contact with semen from a man who has recovered from Ebola (for example, by having oral, vaginal, or anal sex)

Who Gets The Flu?

Anyone can get the flu.

Some people—like very young children, older adults, and people with some health conditions—are at high risk of serious complications.

Who Gets Ebola?

People most at risk of getting Ebola are

- People with a travel history to countries with widespread transmission or exposure to a person with Ebola.
- Healthcare providers taking care of patients with Ebola.
- Friends and family who have had unprotected direct contact with blood or body fluids of a person sick with Ebola.

Signs and Symptoms of Flu

The signs and symptoms of flu usually develop within 2 days after exposure. Symptoms come on quickly and all at once.

- **Fever or feeling feverish**
- **Headache**
- **Muscle or body aches**
- **Feeling very tired (fatigue)**
- **Cough**
- **Sore throat**
- **Runny or stuffy nose**

Signs and Symptoms of Ebola

The signs and symptoms of Ebola can appear 2 to 21 days after exposure. The average time is 8 to 10 days. Symptoms of Ebola develop over several days and become progressively more severe.

- ***People with Ebola cannot spread the virus until symptoms appear.***

- **Fever**
- **Severe headache**
- **Muscle pain**
- **Feeling very tired (fatigue)**
- **Vomiting and diarrhea develop after 3–6 days**
- **Weakness (can be severe)**
- **Stomach pain**
- **Unexplained bleeding or bruising**

For more information about the flu and Ebola, visit
www.cdc.gov/flu and www.cdc.gov/ebola.

May 4, 2015

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