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Lambaréné, Gabon
Michael Amoh,
University of Health and Allied Sciences,
Ghana

*CORRESPONDENCE

Alfred Kwesi Manyeh
✉ akmanyeh@uhas.edu.gh

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The hidden burden of female genital schistosomiasis: a cross-sectional study of knowledge, attitudes, and practices in Ghanaian communities

Alfred Kwesi Manyeh^{1*}, Rosemond Akpene Ekey²,
Rukaya Dongu Kamaldeen¹, Dorothy Fosu¹,
Saviour Edem Vidzro¹ and Maxwell Dalaba¹

¹Institute of Health Research, University of Health and Allied Sciences, Ho, Volta Region, Ghana, ²Shai Osudoku District Health Directorate, Ghana Health Service, Dodowa, Greater Accra Region, Ghana

Background: Female genital schistosomiasis (FGS) is among the most neglected of tropical diseases. FGS remains underreported, under and misdiagnosed and mostly untreated. This neglected epidemic disproportionately affects communities already burdened by HIV and cervical cancer. The study aims to assess FGS knowledge, attitude, and practices and associated factors in communities in the Shai-Osudoku District of Ghana.

Method: The study employed an analytical cross-sectional design, utilizing quantitative methods for data collection from 161 community members. Analysis was conducted using STATA 18, included both descriptive statistics and simple logistic regression.

Results: About half (50.31%) of the respondents demonstrated poor knowledge of FGS. Furthermore, 65.84% of the respondents exhibited a poor attitude towards FGS. Poor practice related to FGS were also observed in 60.25% of the respondents. Regression analysis showed significant associations between various factors and knowledge, attitudes, and practices regarding FGS. Specifically, married women were found to have 54% lower odds of possessing good knowledge about FGS compared single women. (AOR=0.46, 95%CI= 0.22-0.94). Respondents with poor socioeconomic status displayed 76% higher odds of engaging in good practices compared to respondents those in the poorest socioeconomic status. (AOR=0.24, 95%CI=0.06-0.96).

Abbreviations: FGS, Female Genital Schistosomiasis; MDA, Mass drug administration; NTD, Neglected tropical diseases; HIV, human immunodeficiency virus.

Conclusion: Comprehensive, context-specific interventions are necessary to address the multifaceted challenges associated with FGS. Targeted education and awareness campaigns are crucial to improve understanding of FGS, and addressing socio-economic factors that influence attitudes and practices related to the disease is essential.

KEYWORDS

female genital schistosomiasis, knowledge, attitude, practice, Ghana, neglected tropical diseases

Background

Female genital schistosomiasis (FGS) is a neglected tropical disease prevalent in sub-Saharan Africa, caused by the parasitic flatworm *Schistosoma haematobium*. FGS is characterized by the deposition of schistosome eggs in the genital tract, leading to a range of gynecological and reproductive health complications (1). The burden of FGS is exacerbated by its association with other major public health challenges such as HIV (2). Furthermore, the socio-economic impact of FGS is substantial, with implications for productivity, quality of life, and healthcare costs (3).

Despite the significant impact of FGS on the health and well-being of affected individuals, the disease remains underreported, underdiagnosed, and largely untreated, and there is a notable lack of awareness and understanding of FGS among both affected communities and healthcare providers (1, 3).

The Shai-Osudoku District, located in the Greater Accra Region of Ghana (4), represents a setting where FGS is prevalent, yet knowledge, attitudes, and practices related to the disease remain poorly understood. This study aims to address these knowledge gaps by conducting a comprehensive assessment of FGS knowledge, attitudes, and practices, as well as the socio-economic impact of the disease, within communities in the Shai-Osudoku District.

The findings of this study are expected to contribute to a deeper understanding of FGS and its socio-economic impact, and to inform the development of targeted education, awareness, and intervention programs that are context-specific and responsive to the needs of the affected communities in the Shai-Osudoku District.

Method

Study design

This study used a quantitative analytical cross-sectional design. The researchers used this study design to get comprehensive understanding of the FGS knowledge, attitude, and practices and associated factors in communities in the Shai-Osudoku District of Ghana to inform future studies, interventions, and public health strategies.

Sampling strategy

In the Shai Osudoku district of Ghana, four communities (Asutsuare, Domelam, Kadjanya and No-Smoking) with the highest prevalence of schistosomiasis were purposively selected for this study. Using the Expanded Program for Immunisation (EPI) cluster sampling technique, 40 clusters were systematically chosen (10 clusters per community) with at least 7 women or girls aged 18 years or older per cluster. Then, a simple random sampling method was applied to select 4 participants from each cluster. This was done by writing 'Yes' or 'No' on pieces of paper, folding them, and placing them in a container. The container was shaken, and the women and girls picked one paper at a time. Those who picked 'Yes' were included in the study.

The sample size was calculated using the formula $n = Z^2pq/d^2$, where n is the sample size, Z is the standard normal deviation at the desired confidence level (set at 1.96 for a 95% confidence level), p is the estimated prevalence of schistosomiasis in the district (set at 90%), q is $1-p$, and d is the desired level of precision (set at 5%). The sample size was increased by 17% to compensate for nonresponse and missing data.

$$\begin{aligned} n &= (1.96)^2 \times 0.9 \times 0.1 / (0.05)^2 \\ &= 138 \end{aligned}$$

$$\begin{aligned} \text{A further 17\%} &= 138 \times 0.17 \\ &= 23 \end{aligned}$$

$$\begin{aligned} \text{Hence, the actual sample size} &= 138 + 23 \\ &= 161 \text{ Women} \end{aligned}$$

Data collection

Data was collected using a structured questionnaire that was administered to selected adult community members (18 years and older) between November and December 2023. The questionnaire was developed based on a review of the literature on FGS knowledge (5, 6) attitudes (6, 7), and practices (5, 7), and was pretested in a

sample of households in the district prior to the start of data collection. The questionnaire includes questions on socio-demographic characteristics, knowledge of FGS, attitudes towards FGS, and practices related to FGS prevention and treatment. The questionnaire also includes questions on the socio-economic impact of FGS, including its effect on productivity, quality of life, and healthcare costs. Five graduate level data collectors were recruited and trained for 3 days for the data collection.

Females aged 18 years and above in the selected communities who agreed to participate in the study were included.

Female Genital Schistosomiasis is defined in this study as an untreated and complicated *Schistosoma* infection in women, which has progressed to cause damage and complications in the female genital tract.

Data analysis

Data was entered into EpiData and exported to STATA 18 software for cleaning and analysis. Descriptive statistics were used to summarize the socio-demographic characteristics of the study population, as well as their knowledge, attitudes, and practices related to FGS. Univariable analysis was used to examine the association between socio-demographic factors and FGS knowledge, attitudes, and practices. Multivariate logistic regression analysis was used to identify factors associated with FGS knowledge, attitudes, and practices, while controlling for potential confounding variables. Only variables statistically significant at 95% confidence level at the univariable analysis level were included in the multivariable model.

Measurement of knowledge, attitude and practice variables

These variables were measured by correct answers to signs associated with FGS, FGS prevention methods, and how FGS is acquired.

The variables used for the knowledge score include awareness of FGS, source of information, knowledge of transmission, causes, symptoms, and treatment. Variables for attitude includes history of testing, confidence in recognizing signs and symptoms, encountering cases in clinical practice, interest in participating in prevention and control programs and health seeking behavior.

Ethical considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ghana Health Service Ethic Review Committee (GHS-ERC 004/03/23). Informed consent was obtained from all study participants prior to their inclusion in the study. Participants were assured of their right to refuse participation or to withdraw from the study at any time without penalty. All data was kept confidential and anonymous and was used for the purposes of this study only.

Results

Socio-demographic characteristics of respondents

The study included 161 females from 4 communities in the Shai Osudoku District of the Greater Accra Region of Ghana. The mean age of the participants was approximately ± 32.5 , and the comparative majority (39.1%) were 26-39 years old. Most of the participants were married (50.9%) and had completed Junior High School (39.8%). The majority (61.5%) of the respondents belonged to the Dangme ethnic group and (94.4%) of them were Christians. Approximately 35.4% of the participants were traders (Table 1).

TABLE 1 Background characteristics.

Variable	Frequency (n=161)	Percentages (%)
Age category		
18-25	48	29.8
26-39	63	39.1
40-82	50	31.1
Marital status		
Single	79	49.1
Married	82	50.9
Education		
None	21	13.0
Primary School	37	23
Junior High School	64	39.8
Senior High School	30	18.6
Tertiary Education	9	5.6
Ethnicity		
Dangme	99	61.5
Ewe	40	24.8
Others	22	13.7
Religion		
Christian	152	94.4
Others	9	5.6
Occupation		
Unemployed	45	27.9
Farming	17	10.6
Artisan	24	14.9
Public/Civil Servant	7	4.4
Trading	57	35.4
Others	11	6.8

Knowledge of FGS

Among the 161 participants in the study, (92.5%) said they had heard of urinating blood disease.

About 42.1% believe that FGS is caused by worms in streams, and most of them (61.6%) indicated blood in urine as a sign of FGS. A majority (54.9%) of them said that swimming in infested water is the most recognized mode of infection, while 43.1% recognized preventive measures as avoiding contact with infested water. Most of the participants (59.6%) said it could be treated with hospital medicine (praziquantel). The majority (66.2%) believe that FGS does not cause infertility in women (Table 2).

Attitude and practices towards FGS

Of the 161 respondents in the study, 63.8% agreed that FGS is a serious disease that affects women and young girls of reproductive age. The majority (78.2%) disagree that FGS is a disease that affects women who cheat on their husbands. Most of the participants (80.8%) disagree that FGS is a disease that is spiritual and caused by the gods. A substantial majority (72.7%) agree that FGS can be cured using a hospital drug, praziquantel. Almost 81% of them express a positive attitude, agreeing that they would tell their partner or relative if they suspected they had FGS symptoms (Table 3).

Practices of female genital schistosomiasis

The majority (58.7%) of the respondents said they do not have contact with water. Among those who reported having contact with a water body, the majority (31.3%) stated that they have contact every day (Table 4).

Socio-economic impact

Of the 161 participants, 87% of them do not have a fixed amount of income while 38.5% of them have their primary source of

TABLE 2 Continued

Variable	Frequency	Percentages (%)
Cause of FGS		
Worms in the streams (waterbody)	64	42.1
Other	19	12.5
How to get FGS infection		
Don't know	46	30.5
Drinking dirty water infested with the	12	8.0
Swimming in infested water	83	54.9
Fetching water from the river	3	2.0
Sexual intercourse	4	2.6
Other	3	2.0
FGS sign and symptoms		
Don't know	45	29.8
Blood in urine	93	61.6
Vagina discharge	7	4.6
Other	6	4.0
FGS prevention.		
Don't know	51	33.7
Avoid contact with infested water	65	43.1
Avoid urinating and defecating in water	11	7.3
Other	24	15.9
FGS treatment		
Don't know	49	32.5
Herbal medicine	6	3.97
Hospital medicine (praziquantel)	90	59.6
Worm medicine	2	1.3
Other	4	2.6
Can FGS cause infertility in woman		
No	100	66.2
Yes	51	33.8

TABLE 2 Knowledge of FGS.

Variable	Frequency	Percentages (%)
Heard of urinating blood disease		
No	12	7.5
Yes	149	92.5
Cause of FGS		
Don't know	58	38.2
Bacterial from sexually transmitted disease	5	3.3
Poor personal hygiene	6	3.9

(Continued)

income from government or private jobs. In addition, 38.5% of respondents have their total combined income for 12 months to be >4500 Ghana cedi (338USD). Most (67.1%) of the respondents pay for their healthcare expenses using both insurance and out-of-pocket.

Nearly half (46.0%) of respondents reported living with 2-3 females, and the majority (95.0%) of them indicated that one (1)

TABLE 3 Attitude towards FGS.

Variable	Frequency	Percentages (%)
FGS is a serious disease that affects women and young girls of reproductive age		
Agree	95	63.8
Disagree	54	36.2
FGS is a disease that affects women who cheat on their husbands		
Agree	33	21.8
Disagree	118	78.2
FGS is a disease that is spiritual and caused by the gods		
Agree	29	19.2
Disagree	122	80.8
FGS can be cured using a hospital drug (praziquantel)		
Agree	109	72.7
Disagree	41	27.3
I would tell my partner or relative if I suspect I have FGS symptoms		
Agree	121	80.7
Disagree	29	19.3

TABLE 4 Practices towards FGS.

Variable	Frequency	Percentages (%)
Frequent contact with stream, pond, and lake		
No	91	58.7
Yes	64	41.3
Frequency of contact with the water bodies		
Every week	17	26.6
Everyday	20	31.3
Monthly	17	26.6
Once in more than a month	10	15.5

TABLE 5 Socio-economic impact.

Variable	Frequency	Percentages (%)
Is your household monthly income a fixed		
No	140	87.0
Yes	21	13.0
Primary source of income		
Unemployed	2	1.2
Artisan	16	9.9

(Continued)

TABLE 5 Continued

Variable	Frequency	Percentages (%)
Primary source of income		
Farming	40	25.0
Trading	41	25.4
Government/Private job	62	38.5
12 months total combined income		
<1000	47	29.2
1000-4500	52	32.3
>4500	62	38.5
Payment of healthcare and medical expenses		
Both	108	67.1
Insurance	36	22.4
Out of pocket	17	10.5
Number of females per household		
0-1	45	28.0
2-3	74	46.0
4-10	42	26.0
Number of females who ever had schistosomiasis in a household		
1	153	95.0
2	7	4.4
3	1	0.6
Main household's source of water for washing/bathing/cooking		
Borehole	2	1.2
Pipe water	108	67.1
River/Lake	51	31.7
Main household's source of drinking water.		
Pipe water	100	62.1
River/Lake	12	7.5
Sachet water	49	30.4
Primary type of roof material?		
Concrete	5	3.1
Metal	146	90.7
Wood	10	6.21
Wealth Quintile		
Poorest	51	31.7
Poor	25	15.5
Middle	80	49.7
Richest	5	3.1

female had ever had FGS. The majority (67.1%) of the respondents reported that their main source of water for washing/bathing/ cooking and drinking (62.1%) was pipe water.

Nearly all (90.7%) of all the respondents have metal as their primary roof material. A larger proportion (49.7%) of the respondents belonged to the middle wealth category and none belonged to the rich category (Table 5).

Association between knowledge and socio-demographic variables

The regression analysis revealed significant associations between various factors and knowledge/practices related to FGS (Table 6). Specifically, married respondents had 54% lower odds of knowledge on FGS compared to single participants (AOR=0.46,

TABLE 6 Association between knowledge and socio-demographic variables.

Variable	Knowledge Score (Poor)	Knowledge Score (Good)	COR (95%CI) p-value	AOR (95%CI) p-value
Age Group				
18-25	28 (58.3)	20 (41.7)	Ref	
26-39	32 (50.8)	31 (49.2)	1.36 (0.64;2.89) 0.43	1.91 (0.80;4.57) 0.14
40-82	21 (42.0)	29 (58.0)	1.93 (0.87;4.32) 0.11	2.40 (0.90;6.41) 0.81
Marital Status				
Single	33 (41.8)	46 (58.2)	Ref	
Married	48 (58.5)	34 (41.5)	0.51 (0.27;0.95) 0.03*	0.46 (0.22;0.94) 0.03*
Education				
None	13 (61.9)	8 (38.1)	Ref	
Primary School	14 (37.8)	23 (62.2)	2.67 (0.89;8.05) 0.08	3.43 (1.05;11.43) 0.04*
Junior High School	35 (54.7)	29 (45.3)	1.35 (0.50;3.69) 0.56	1.64 (0.52;5.11) 0.40
Senior High School	15 (50.0)	15 (50.0)	1.63 (0.52;5.05) 0.40	2.23 (0.58;8.61) 0.25
Tertiary Education	4 (44.4)	5 (55.6)	2.03 (0.42;9.89) 0.28	2.53 (0.41;15.55) 0.32
Ethnicity				
Dangme	50 (50.5)	49 (49.5)	Ref	
Ewe	23 (57.5)	17 (42.5)	0.75 (0.36;1.58) 0.46	0.80 (0.36;1.77) 0.58
Others	8 (36.36)	14 (63.6)	1.79 (0.69;4.64) 0.23	1.74 (0.61;4.99) 0.30
Religion				
Christian	76 (50.0)	76 (50.0)	Ref	
Others	5 (55.6)	4 (44.4)	0.8 (0.21;3.09) 0.75	0.73 (0.17;3.11) 0.25
Occupation				
Unemployed	25 (55.6)	20 (44.4)	Ref	
Farming	7 (41.2)	10 (58.8)	1.79 (0.58;5.53) 0.32	1.47 (0.40;5.32) 0.56
Artisan	14 (58.3)	10 (41.7)	0.8 (0.33;2.43) 0.83	0.94 (0.32;2.81) 0.92
Public/Civil Servant	4 (57.1)	3 (42.9)	0.94 (0.19;4.68) 0.94	0.58 (0.09;3.78) 0.57
Trading	26 (45.6)	31 (54.4)	1.49 (0.68;3.27) 0.32	1.22 (0.50;2.97) 0.67
Others	5 (45.5)	6 (54.5)	1.5 (0.40;5.64) 0.55	1.21 (0.29;5.01) 0.80
Wealth Quintile				
Poorest	26 (51.0)	25 (49.0)	Ref	
Poor	19 (76.0)	6 (24.0)	0.33 (0.11;0.96) 0.04*	0.24 (0.06;0.96) 0.04*
Middle	50 (62.5)	30 (37.5)	0.62 (0.31;1.27) 0.19	0.52 (0.21;1.29) 0.16
Richest	2 (40.0)	3 (60.0)	1.56 (0.24;10.14) 0.64	2.13 (0.13;34.36) 0.59

(Continued)

TABLE 6 Continued

Variable	Knowledge Score (Poor)	Knowledge Score (Good)	COR (95%CI) p-value	AOR (95%CI) p-value
Have contact with stream, pond, or lake frequently				
No	50 (54.95)	41 (45.05)	Ref	
Yes	25 (39.06)	39 (60.94)	1.90 (0.99;3.64) 0.05	2.10 (0.99;3.64) 0.55
Frequency of contact with stream, pond or lake.				
Every week	6 (35.3)	11 (64.7)	Ref	
Everyday	11 (55.0)	9 (45.0)	0.45 (0.12;1.69) 0.23	0.45 (0.12;1.69) 0.23
Monthly	4 (23.5)	13 (76.5)	1.77 (0.40;7.93) 0.45	1.77 (0.40;7.93) 0.45
Once in more than a month	4 (40.0)	6 (60.0)	0.82 (0.16;4.09) 0.81	0.82 (0.16;4.09) 0.81

COR, Crude odd ratio; AOR, Adjusted odds ratio; CI, Confidence interval; Ref, Reference Group. * statistically significant.

95%CI=0.22-0.94). In contrast, those with primary level education were over three times more likely to have knowledge of FGS compared to those with no formal education (AOR: 3.43, 95% CI=1.05-11.43). Additionally, poor participants were 77% less likely to have good practices compared to the poorest participants (AOR: 0.33, 95%CI=0.11-0.96). Notably, frequent contact with water was associated with poor knowledge, with participants being 1.90 times more likely to have poor knowledge compared to those without frequent contact (COR=1.90, 95%CI=0.99-3.64).

Discussion

Schistosomiasis, a neglected tropical disease caused by parasitic worms, persists as a significant public health challenge in Ghana, particularly in the Shai-Osudoku District. This study investigated the knowledge, attitudes, and practices (KAP) surrounding Female Genital Schistosomiasis (FGS), as well as the socioeconomic impact of the disease in local communities. The findings offer valuable insights into the understanding of schistosomiasis, revealing that a high percentage of participants were familiar with the disease, mostly associating it with specific symptoms and modes of transmission, thereby shedding light on the factors influencing its prevalence and impact in the region.

Furthermore, Kjetland et al. (2012) conducted a study in Zimbabwe and South Africa, highlighting the importance of addressing socio-economic factors and cultural beliefs in improving knowledge and practices related to FGS. Their findings revealed that cultural taboos and stigmatization were significant barriers to seeking care for FGS (1).

A systematic review revealed that there is a lack of awareness and knowledge about FGS among affected communities (1). This lack of knowledge often results in misconceptions and stigmatization, impacting the attitudes towards the disease. Additionally, the study found that the practices related to FGS, such as seeking treatment and preventive measures, were influenced by the level of knowledge and the prevailing attitudes towards the disease (1).

Efforts to raise awareness and improve knowledge of FGS are essential for addressing the impact of the disease on women's health. This includes integrating FGS screening and treatment into existing reproductive health programs, as well as providing education and training for healthcare providers on the diagnosis and management of FGS as suggested elsewhere (8).

The study's findings reveal a mix of positive and negative attitudes and practices regarding FGS within the study population. While most participants acknowledged the disease's severity and expressed willingness to seek treatment, a significant proportion held poor attitudes and practices, highlighting the need to address misconceptions and promote positive health-seeking behaviors. This aligns with previous research by Kjetland et al. (2012), which found that women with FGS symptoms often sought treatment from traditional healers due to cultural beliefs and stigma surrounding the disease (1). To combat this, community-based education and awareness campaigns, coupled with increased access to diagnosis and treatment, are essential to improve attitudes and practices related to FGS, ultimately reducing the disease's burden and promoting better health outcomes.

The need for increased awareness and education to address FGS in vulnerable population has been emphasized (9). Community-based interventions like health education programs and mass drug administration campaigns can improve attitudes and practices related to FGS. Similarly, a comprehensive review of neglected tropical diseases in sub-Saharan Africa highlights the importance of addressing attitudes and practices related to FGS through increased awareness and education, as well as improved access to diagnosis and treatment (10). By implementing community-based education and awareness campaigns, and increasing access to diagnosis and treatment, attitudes and practices related to FGS can be improved, ultimately reducing the disease's burden on affected communities and enhancing overall health outcomes.

FGS has a profound socio-economic impact on affected individuals, families, and communities, as evident in the current study's findings on income, healthcare expenses, living conditions, and access to basic amenities. The high reliance on out-of-pocket healthcare expenses and prevalence of low-income households

highlight the need for targeted interventions to address socio-economic barriers to schistosomiasis prevention and treatment (11). The socio-economic impact of FGS is further exacerbated by increased healthcare costs, reduced productivity, and the burden of managing FGS and HIV co-infection (2), emphasizing the need for integrated approaches to address both diseases and their consequences. Studies in Zimbabwe, Zambia (12), and sub-Saharan Africa (10) have consistently shown the significant socio-economic implications of FGS on women and girls, including impacts on reproductive health, quality of life, and productivity, underscoring the need for increased control measures, awareness, and holistic approaches to mitigate the socio-economic burden of FGS and other neglected tropical diseases on affected communities.

The socio-economic impact of FGS, including its association with increased healthcare costs, reduced productivity, and implications for reproductive health and overall well-being cannot be overemphasized. Addressing the socio-economic burden of FGS requires integrated control measures, awareness campaigns, and targeted interventions to improve the quality of life and economic prospects for affected individuals and communities.

The study's regression analysis revealed significant associations between knowledge, attitudes, practices, and socio-demographic factors, including lower odds of knowledge on FGS among married participants and a link between practices and socio-economic status. These findings align with Mazigo et al.'s (2010) study, which showed that marital status and socio-economic status influenced knowledge and practices related to schistosomiasis/FGS (13). The current study highlights the need for targeted educational interventions for married individuals and addressing economic barriers to accessing preventive and treatment measures. It also underscores the importance of tailored interventions considering the specific socio-demographic characteristics of the target population, and comprehensive educational campaigns and community-based interventions to improve awareness, change attitudes, and promote appropriate practices for FGS prevention and management in affected populations, particularly in rural Sub-Saharan African communities.

The study has limitations, including a small sample size from a specific geographic area, which may not be representative of the broader population. The methodology may not fully capture the socio-economic impact of FGS, and potential confounding variables may not have been accounted for. These limitations should be considered when interpreting the findings and highlight opportunities for further research to address these gaps.

Conclusion

The study revealed that there is a significant lack of knowledge, poor attitudes, and practices related to female genital schistosomiasis among the participants in the Shai-Osudoku District of Ghana. The findings underscore the urgent need for comprehensive, context-specific interventions to address the multifaceted challenges associated with FGS. Additionally, targeted education and awareness campaigns are crucial to improve understanding of FGS, while addressing socio-economic

and cultural factors that influence attitudes and practices related to the disease is essential. The study's results highlight the importance of tailored public health efforts to effectively combat FGS and improve the overall well-being of the communities in the region.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Ethics statement

The human study was approved by Ghana Health Service Ethic Review Committee. The study was conducted in accordance with the local legislation and institutional requirements. Study participants provided their written informed consent to participate in this study.

Author contributions

AM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. RE: Conceptualization, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing. RK: Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – review & editing. DF: Conceptualization, Data curation, Formal analysis, Investigation, Project administration, Writing – review & editing. SV: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. MD: Conceptualization, Formal analysis, Investigation, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer MA declared a shared parent affiliation with the author(s) to the handling editor at the time of review.

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