BMJ Public Health

Healthcare workers' knowledge, attitudes, perceptions and practices of noma in Northwest Nigeria: a cross-sectional study

Michael Olaleye ,[1] Mohana Amirtharajah,[2] Elise Farley ,[3] Mark Sherlock,[2] Joseph Samuel,[1] Moses Malual,[1] Miriam Njoki Karinja,[4] Kenneth Enwerem,[1] Deogracia Kabila,[4] Beverley Stringer,[5] Cono Ariti,[6] Taiwo Abdurrazaq,[7] Shafi'u Isah,[8] Adeniyi Semiyu Adetunji,[8] Fatima Saleh ,[9] Chikwe Ihekweazu,[9] Emmanuel Benyeogor,[9] Gregoire Falq[5]

To cite: Olaleye M, Amirtharajah M, Farley E, *et al*. Healthcare workers' knowledge, attitudes, perceptions and practices of noma in Northwest Nigeria: a cross-sectional study. *BMJ Public Health* 2026;**4**:e003968. doi:10.1136/bmjph-2025-003968

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/bmjph-2025-003968).

Received 9 September 2025
Accepted 9 December 2025

For numbered affiliations see end of article.

Correspondence to
Dr Michael Olaleye; michaelolaleye2802@gmail.com

ABSTRACT

Introduction Noma is a rapidly progressing oral infection with a 90% mortality rate if untreated. Early identification by healthcare workers is critical, but limited knowledge can delay diagnosis and timely treatment, leading to severe outcomes. This study assessed healthcare workers' knowledge, attitudes, perceptions and practices related to noma in northwest Nigeria to inform training and strengthen early detection and response.

Methods We conducted a cross-sectional study via interviewer-administered questionnaire in randomly selected health facilities across Sokoto and Kebbi states, Nigeria. Healthcare workers were recruited via convenience sampling. Noma knowledge was assessed using 15 questions, and respondents were categorised based on their scores: very poor (<25%), poor (25–49%), fair (50–74%) or good (≥75%).

Results A total of 419 healthcare workers participated in the study. The majority of respondents (n=231, 55%) worked in secondary healthcare facilities. Most of the 419 respondents were community health officers/community health extension workers (n=203, 48%) or nurses (n=177, 42%). Almost all (n=405, 96%) respondents were interested in learning more about noma.

Of those who had heard about noma before the study (n=280, 66%), most had poor (25–49% score, n=165, 59%) or fair (50–74% score, n=100, 36%) knowledge about noma. Few (n=55, 19%) respondents reported ever treating noma patients. Most healthcare workers reported that early-stage noma treatments were available in their facilities: antibiotics (n=255, 91%), nutritional support (n=213, 76%) and wound debridement (n=199, 71%).

Conclusion Our study highlights a significant knowledge gap about noma among healthcare workers in northwest Nigeria, despite limited clinical experience. Encouragingly, there is strong interest in learning and acceptance of educational tools. This presents a valuable opportunity to enhance training and early detection. Strengthening awareness and capacity is crucial, as timely intervention during the early, reversible stages of noma can greatly reduce associated morbidity and mortality.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Noma is a rapidly progressing and often fatal infection that primarily affects malnourished children in low-resource settings. Early detection and treatment are critical for survival, yet knowledge of noma among healthcare workers is often limited. Despite longstanding efforts to address noma in Sokoto state, awareness and understanding among frontline health workers remain inconsistent.

WHAT THIS STUDY ADDS

⇒ This study provides a detailed assessment of healthcare workers' knowledge, attitudes and experience with noma across Sokoto and Kebbi states. It reveals that while awareness of the disease is relatively abundant, comprehensive understanding and practical experience in diagnosing and managing noma are limited, particularly among nurses, community health officers (CHOs) and community health extension workers (CHEWs) in secondary care settings.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings highlight a critical gap in frontline healthcare training on noma and emphasise the need for targeted educational interventions. Results can inform the development of state and national training curricula, guide capacity-building efforts and strengthen referral systems for earlier diagnosis and improved management of noma. This evidence can also support advocacy for integrating noma into broader public health and neglected tropical disease strategies.

INTRODUCTION

Noma is a rapidly progressing infection of the oral cavity, which can cause necrosis of the cheek, lip, nose and/or eye.[1] Without treatment, noma has a reported 90% mortality rate within weeks of symptom onset.[2] Treatment in

the early reversible stages of the disease with antibiotics, wound debridement and nutritional support can greatly reduce morbidity and mortality.[3 4] Access to timely treatment requires early identification by healthcare workers. Two notable studies from sub-Saharan Africa, one in Zambia[3] and another in Burkina Faso,[5] have shown that healthcare workers' knowledge on noma and the correct treatment procedures for each stage of the disease are suboptimal. This knowledge gap can contribute to delays in the diagnosis and treatment of noma with severe consequences for patients.

Nigeria has produced far more reports and declared far more cases than any other country, especially Sokoto state where the specialised Noma Children's Hospital (NCH) is located.[6–12] Effective intervention efforts should focus on surveillance for noma, early detection of cases, and prompt treatment and referral. These initiatives require training of healthcare workers across various sectors of the health system. In Nigeria, the health system is divided into three main sections: primary (village health centres managed by the Local Government Area administrations), secondary (general hospitals managed by the state) and tertiary (hospitals run by the Federal Ministry of Health) facilities.

The NCH is one of the few hospitals worldwide dedicated to noma, operating since 1999, with Médecins Sans Frontières collaborating with the Nigerian Ministry of Health there since 2014, together running a comprehensive noma prevention and treatment programme.[13] As part of our ongoing noma operational research programme, we conducted a two-phased cross-sectional study assessing the noma-related knowledge, attitudes, perceptions and practices (KAP) of healthcare workers. Phase 1 focused on healthcare workers in primary, secondary and tertiary level facilities in Sokoto and Kebbi states, while phase 2 involved members of the nationwide Nigerian surveillance team. This report presents the findings from phase 1.

METHODS

Study design and data collection

From 12 January to 28 February 2022, we conducted a cross-sectional study via interviewer-administered questionnaire to assess healthcare workers' knowledge, attitudes, practices and perception of noma.

Data collection was conducted by two teams, each comprising a leader and five to six research assistants. The primary investigator trained the two teams for 3 days, followed by a 1-day pilot of the tools.

This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines (see online supplemental material)

Setting

The Noma Children's Hospital in Sokoto was the base for the study team, but the study was conducted at healthcare facilities in rural and urban areas of Sokoto and Kebbi states.

Sokoto and Kebbi, neighbouring states in northwestern Nigeria, share borders with Niger and Benin Republics. Sokoto has a land mass of approximately 25 973–27 825 square kilometres, while Kebbi features short-grass savanna drained by the Niger River system. Both states have economies primarily based on agriculture and are home to diverse, predominantly Muslim ethnic groups. In 2006, Sokoto's population was 3 702 676, and Kebbi's was 3 238 628, with Sokoto's population exceeding 6.3 million by 2022.[14 15]

Sokoto and Kebbi states lack sufficient and well-distributed healthcare workers, particularly community health extension workers (CHEWs), nurses and doctors.[16] This shortage hampers primary healthcare delivery, especially in rural areas.

Study population

We included staff from primary health centres (village health centres), secondary health centres (state general hospitals) and tertiary hospitals (Usman Dan Fodio Teaching Hospital (UDUTH) in Sokoto and Federal Medical Centre (FMC) in Birnin Kebbi).

Inclusion criteria were as follows: (1) aged 18 years or older at the time of interview; (2) employed as a healthcare worker at the chosen healthcare centre (nurse, doctor, dentist, community health officer (CHO), junior community health extension worker, CHEWs, dental surgery technician, dental technician, dental therapist); and (3) be willing to give informed consent for participation in the study.

Sample size

The sample size calculation was based on the following parameters: an anticipated proportion of good or fair knowledge scorers per strata of 50%, confidence limits of 5% and a 10% non-response rate. A stratified random selection was initially conducted, with strata 1 comprising all primary healthcare facilities and strata 2 including secondary and tertiary facilities. Our original stratified sample aimed to include 384 healthcare workers per stratum or 423 from per stratum accounting for the non-response rate.

Sampling

Healthcare workers were chosen on a convenience sampling basis within randomly chosen health facilities in each stratum. These were drawn from Sokoto and Kebbi states using data from the Nigerian Ministry of Health website.[17] In the study area, there are 1048 primary facilities, 74 secondary facilities and three tertiary facilities.[18] Based on available evidence, it was estimated that there was one doctor for every four primary healthcare centres, five doctors per secondary level facility and 62 doctors in tertiary level institutions,[16] and the ratio of doctors to nurses in health centres was 1:3.[16] Based on these estimates, each primary centre was assumed to have

3 healthcare workers, each secondary facility 20 workers and each tertiary facility 248 workers. In strata 1, three workers per primary centre were sampled, including 141 primary facilities (423/3=141). In strata 2, 10 workers per facility were sampled, including 43 facilities (41 secondary and 2 tertiary). Among the three tertiary facilities, the Birnin Kebbi FMC in Kebbi and UDUTH in Sokoto were chosen. The Noma Children's Hospital was excluded from the sampling given that it is a specialised centre for noma treatment. To reduce interviewer bias, data collectors received a standardised training on questionnaire administration and data were collected using a piloted tool (see online supplemental appendix 1). Although sampling was convenience-based, diverse facility types and cadres were included to enhance representativeness.

Upon arrival at health centres, study team leaders met with hospital leaders to explain the study, address questions and seek permission to conduct the survey. After verbal approval, healthcare workers were selected using convenience sampling. Informed consent was obtained before interviewer-administered questionnaires were conducted.

At tertiary facilities, participants were recruited from dental and paediatric departments, who are the most likely medical professionals to encounter noma patients in that facility. When the required number of participants was not met, the team moved to the nearest health centre.

Due to security concerns, phone interviews were conducted with participants working in health centres (n=31 from secondary, n=37 from primary) in security compromised Local Government Areas. Participants were selected via convenience sampling by facility heads.

Data collection

We conducted face-to-face interviews, during which research assistants, proficient in English and Hausa, asked a set of questions to respondents. Our questionnaire was based on two similar studies, one in Zambia[3] and the other in Burkina Faso,[4] which showed that healthcare workers' knowledge on noma and the correct treatment procedures for each stage of the disease were suboptimal.

Variables collected using close-ended questions included demographic data: age, sex, education level, occupation title, type of health centre working in; daily activities: number of patients seen each day, number of children aged 0–5 years seen in the previous month that have oral health issues (problems with their teeth and/or gums including dental caries, periodontal disease, tooth loss, oral cancer, oro-dental trauma[19]); questions assessing the respondents' knowledge on noma; and questions exploring the respondents' attitudes and perceptions about noma.

We used the Kobo Collect mobile data collection tool. Questions were asked in either Hausa or English, depending on the language the respondent felt most comfortable using for the interview. We piloted the questionnaire with 10 healthcare workers at the Noma Children's Hospital. The pilot indicated that only minor adjustments to the survey were necessary. Once these were made, the pilot database was migrated to a live database which was used during the data collection period.

Only those who stated that they had heard of noma before were asked the knowledge, attitudes and perceptions questions.

Case scenario questions adapted from a previous KAP study[3] were used to evaluate healthcare workers' knowledge of diagnosing and treating noma and related conditions. These scenarios presented realistic clinical situations requiring respondents to identify probable diagnoses based on key symptoms:

Case 1: a mother sought care for her 4-year-old child presenting with spontaneously bleeding gums and foul-smelling breath. This scenario aimed to assess how to early identify noma.

Case 2: a 7-year-old patient presented with tooth pain persisting for 6 months, accompanied by fever and sensitivity to hot and cold temperatures. This scenario aimed to assess the presence of a dental abscess which is amenable to minor surgical intervention.

Case 3: a 3-year-old child presented with a dark, greyish-black mark on the chin and a partly gangrenous plaque that had been present for 6 days. This scenario aimed to assess consequences of advanced noma (late stages).

These case scenarios served as a practical tool to assess diagnostic accuracy and knowledge of appropriate treatment pathways among healthcare workers (see online supplemental appendix 2).

Analysis

We conducted a descriptive analysis, presenting categorical variables as frequencies and percentages, and continuous variables as means and SD. Noma knowledge was assessed through 15 questions, with responses categorised into four groups: (1) very poor (<25%), (2) poor (25–49%), (3) fair (50–74%) and (4) good (≥75%). Respondents were further grouped into binary categories: 'low' (very poor and poor) and 'high' (fair and good) knowledge scorers. Comparisons of noma treatment practices of healthcare workers in primary healthcare facilities and secondary and tertiary facilities were made using Pearson's χ^2 tests, as were associations between knowledge scores and sociodemographic characteristics. P value <0.05 was chosen as the level of statistical significance. Missing responses were excluded from percentage calculations across all analyses to reflect only valid responses. Missing data were reported separately, and no imputation was performed. All data analysis was conducted with Stata 17 (StataCorp LP, College Station, Texas, USA).

RESULTS

Sociodemographic characteristics

The team visited 141 primary healthcare centres, 41 secondary and 2 tertiary facilities. All 667 healthcare workers who were approached consented and were

Table 1 Noma education of healthcare workers enrolled in the KAP study, 2022

	N=419	%
In your opinion, where do parents first seek care if their children have oral health problems?		
Government health centre	204	49
Traditional healer	121	29
Street chemist	66	16
Private health centre	18	4
Pharmacy	4	1
Other, specify:	6	1
Before today, have you heard about a disease called noma or cancrum oris?		
No	139	33
Yes	280	67
Would you be interested in learning more about noma?		
Yes	405	97
No	11	3
Don't know	3	1
Have you attended any training or educational programme on noma? (N=280)		
Yes	51	18
No	227	81
Don't know	2	1
Was noma taught to you during your medical/nursing studies? (N=51)		
Yes	44	86
No	7	14
Best platforms for learning about noma (multiple choice)		
Weekend course by specialists	247	59
Paper guidelines	180	43
Interactive internet-based	160	38
Apps	154	37
More data on local noma studies	96	23

KAP, knowledge, attitudes, perceptions and practices.

enrolled in the study. Of those enrolled, 248 did not meet the inclusion criteria and were therefore excluded from the analysis. Among the 419 remaining participants (see online supplemental tables 1 and 2), 280 (67%) had heard of noma before the interview and so were asked the noma KAP questions (tables 1–2) (see online supplemental table 1).

Most respondents were CHO or CHEW (n=203, 48%) or nurses (n=177, 42%). Just over half (n=222, 52%) were male, and the cohort's mean age was 37 years (SD=10 years). Just over half (n=238, 56%) worked in Kebbi state. The majority of respondents (n=231, 55%) worked in secondary healthcare facilities. On their last working day, the majority of respondents saw fewer than five children aged 0–5 years, with a combined 59% reporting between 1 and 10 children (see online supplemental table 2).

Noma education

A third (n=139, 33%) of respondents had never heard of noma prior to the introduction of the study, and 18% (n=51) had attended a training on noma.

Almost all (n=405, 96%) respondents were interested in learning about noma. The most acceptable methods for knowledge transfer were the following: weekend courses (n=247, 58%), paper guidelines (n=180, 42%) and internet courses (n=160, 38%) (table 1).

Noma knowledge

Of those who had heard about noma before the study was introduced, most had poor (25–49% score, n=165, 58%) or fair (50–74% score, n=100, 35%) knowledge about noma. Most respondents knew that noma affected the face (n=277, 99%), that the disease can be prevented (n=252, 90%) and what the risk factors for infection are (malnutrition n=244, 87% correct; poor oral hygiene n=266, 95% correct). Knowledge of noma stages (n=56, 20% correct) and mortality rate (n=8, 3% correct) were poor. Nine per cent (n=25) of respondents diagnosed acute necrotising gingivitis correctly (case 1a), and 17% (n=48) diagnosed gangrene correctly (case 3a) (table 2).

Noma attitudes, perceptions and practices

Respondents thought that patients with oral health problems sought care first at government health centres (n=204, 48%) and traditional healers (n=121, 28%). Almost all respondents declared they would examine the mouth of children if they present with measles (n=272, 97%) and malnutrition (n=260, 93%); 79% when presented with a child with HIV (n=221), and just over half said they would if a child presented with malaria (n=164, 59%). Almost all respondents stated that they thought the best way to prevent noma in the individual patient is through improved oral hygiene (n=268, 96%) and nutrition (n=248, 89%); a third (n=105, 38%) said vaccinations could be used as a preventative measure. Respondents agreed that the following community measures were useful in preventing noma: improved access to healthcare (n=170, 61%), improved referral systems between health centres (n=143, 51%), improved living conditions (n=119, 43%), and a third thought that setting up partnerships with traditional healers would be effective (n=83, 30%) (table 3).

Noma patient treatment information

Among the respondents who knew noma, few (n=55, 19%) reported ever treating noma patients; of those, most had treated less than two patients (n=35, 66%). Most healthcare workers reported that early-stage noma treatments were available in their facilities: antibiotics (n=255, 91%), nutritional support (n=213, 76%) and

Table 2 Healthcare workers' knowledge of noma, Nigeria, 2022 (only answered by those who had heard of noma)

	N=280	%
Knowledge score categories		
Very poor noma knowledge <25% of the total score	8	3
Poor noma knowledge = 25–49% of total score	165	59
Fair noma knowledge = 50–74% of the total score	100	36
Good noma knowledge = ≥75% of total score	7	3
Knowledge score categories (binary)		
Low (very poor/poor)	173	62
High (fair/good)	107	38
For Knowledge questions 1 to 15, data on correct responses are presented		
Knowledge 1—What part of the body does noma affect? (Face)		
Correct	277	99
Knowledge 2—What are the three stages of noma? (Any 3 WHO stages)		
Correct	56	20
Knowledge 3—Can noma be prevented? (Yes)		
Correct	252	90
Knowledge 4—Mortality rate for untreated noma (90%)		
Correct	8	3
Knowledge 5—How long does it take noma to progress from gingivitis to gangrene? (less than 2 weeks)		
Correct	54	19
Knowledge 6—Is malnutrition a reported risk factor for noma? (Yes)		
Correct	244	87
Knowledge 7—Is high blood pressure a reported risk factor for noma? (No)		
Correct	206	74
Knowledge 8—Is poor oral hygiene a reported risk factor for noma? (Yes)		
Correct	266	95
Knowledge 9—Is smoking a reported risk factor for noma? (No)		
Correct	104	37
Knowledge 10—Case 1 diagnosis (A 4-year-old child who has a sudden onset of bleeding gums and foul smelling breath. What would be the probable diagnosis?)		
Correct	25	9
Knowledge 11—Case 1 treatment (What treatment would you prescribe?)		
Correct	202	72
Knowledge 12—Case 2 diagnosis (A 7-year-old child with 6 months history of tooth pain, fever and sensitivity to hot and cold drinks. What would be the probable diagnosis?)		
Correct	60	21
Knowledge 13—Case 2 treatment (What treatment would you prescribe?)		
Correct	12	4
Knowledge 14—Case 3 diagnosis (A 3-year-old child whose chin has a dark, greyish/black mark with partly gangrenous plaque which has been present for 6 days. What would be the probable diagnosis?)		
Correct	48	17
Knowledge 15—Case 3 treatment (What treatment would you prescribe?)		
Correct	136	49

wound debridement (n=199, 71%). Availability of these early-stage noma treatments did not differ between primary and secondary/tertiary facilities; however, the availability of treatments for later-stage noma did differ between facility types (physiotherapy available at primary n=7, 6% vs secondary/tertiary facilities n=42, 25%, p≤0.001; surgical treatment available at primary n=22, 20% vs secondary/tertiary facilities n=97, 57%, p≤0.001). Respondents from secondary/tertiary facilities were more likely to have offered noma patients certain early-stage treatments in comparison with healthcare workers at primary facilities (wound cleaning offered

Table 3 Noma attitudes, perceptions and practices

	N=280	%
If a parent seeks care for a child below 5 years of age due to the problems stated, I would examine the child's mouth. (Answers reflect those who said yes)		
Measles	272	97
Malnutrition	260	93
HIV	221	79
Malaria	164	59
What do you think is the cause of noma?		
Unknown	28	10
Bacteria	78	28
Virus	10	4
Other	164	59
Do you think that noma is contagious?		
Yes	64	23
No	200	71
Don't know	16	6
Which of the following do you think are the best ways to prevent noma in an individual patient? (multiple choice)		
Improve oral hygiene	268	96
Improved nutritional status	248	89
Vaccinations	105	38
What is the best way you might plan to prevent noma in society? (multiple choice)		
Improve access to healthcare	170	61
Improve referral systems between health centres	143	51
Improve living conditions	119	43
Set up partnerships with traditional healers	83	30
Do you think noma is a neglected disease?		
Yes	207	74
No	67	24
Don't know	6	2

at primary facility n=2, 13% vs secondary/tertiary n=16, 53%, p=0.007; wound dressing at primary facility n=1, 6% vs secondary/tertiary n=17, 57%, p=0.001; and wound debridement at primary n=0, 0% vs secondary/tertiary n=10, 33%, p=0.009) (see online supplemental table 1).

There was no difference in knowledge based on healthcare worker background, with perhaps a trend towards those working in Sokoto to have higher knowledge (table 4).

DISCUSSION

Our study revealed that nearly a third of the healthcare workers surveyed had never heard of noma, and among those familiar with it, most exhibited poor or fair knowledge. This finding is consistent with trends seen in similar studies across various contexts, though the exact levels of knowledge varied. For example, in our study, 62% of respondents scored in the low knowledge category, which aligns with findings from studies in Nigeria[20] and Zambia,[3] where a significant proportion of healthcare workers demonstrated poor knowledge of noma (respectively 51.3% and 89%). However, our cohort showed fewer respondents in the "very poor" category (3%) compared with the Zambian study (66%), possibly due to differences in participant composition and questionnaire design. In contrast, a study in Burkina Faso[5] reported better knowledge levels, with 55% of respondents scoring 'good' or 'optimal'. This discrepancy may stem from the professional profiles of respondents, as the Burkina Faso study included only nurses, whereas our study involved a broader range of healthcare workers, including CHOs and CHEWs.

Knowledge scores in Nigeria seem to reflect the healthcare system's decentralised structure, with tertiary healthcare workers typically better informed than those at primary levels. The limited exposure of CHOs and CHEWs to specialised training on noma likely explains the lower knowledge scores in our study. Furthermore, the relatively lower scores in our cohort compared with the dental and medical students in the Nigerian study[20] may reflect differences in educational backgrounds and access to academic resources.

Table 4 Comparison between Nigerian healthcare workers' noma knowledge scores and demographic characteristics, Nigeria, 2022 (only answered by those who had heard of noma N=280)

	Low knowledge (N=173)		High knowledge (N=107)		χ^2
Healthcare worker type					
CHO/CHEW	80	46%	43	40%	
Dentist/dental technician	3	2%	7	7%	
Doctor	14	8%	12	11%	
Nurse	76	44%	45	42%	0.13
Sex					
Female	80	46%	39	36%	
Male	93	54%	68	64%	0.11
Age (categories in years)					
18–35	68	40%	44	41%	
36–45	57	33%	31	29%	
46–65	47	27%	32	30%	0.76
Missing	1				
Which state do you work in most of the time?					
Kebbi	88	51%	42	39%	
Sokoto	85	49%	65	61%	0.06
Workplace					
Primary health centres (village health centre)	72	42%	38	35%	
Secondary health centres (state general hospital)	92	53%	63	59%	
Tertiary hospital (UDUTH in Sokoto and FMC in Birnin Kebbi)	9	5%	6	6%	0.59

CHEW, community health extension worker; CHO, community health officer; FMC, Federal Medical Centre; UDUTH, Usman Dan Fodio Teaching Hospital.

Oral health practices and clinical assessments for noma varied significantly across contexts. In our study, 97% of respondents reported examining children with measles, 93% for malnutrition and 79% for HIV, consistent with practices reported in Zambia[3] and Burkina Faso.[5] However, the routine inclusion of oral examinations remains underutilised, as indicated by the limited number of respondents performing detailed mouth examinations during routine care (see online supplemental table 2). This gap underscores a need to emphasise oral health screenings, particularly for children under 5 with risk factors of noma, as part of routine medical checks.

The role of traditional healers in early noma detection and referral has been highlighted in a study from Mali where 10% had some knowledge of noma. While our findings indicated that 29% of respondents viewed partnerships with traditional healers as essential, this low percentage contrasts with evidence that traditional healers are often the first point of contact for noma survivors.[21] This suggests an untapped opportunity for collaboration to bridge gaps in early detection and improve referral pathways.

Training on noma was notably lacking across studies, with 10% of our cohort having attended prior training, highlighting the need for training as other studies also suggest.[5 22] This low figure reflects a broader trend, as many healthcare workers in similar contexts report minimal exposure to noma education, such as Brattström-Stolt *et al*'s Burkina Faso study where 26% of the study participants were only trained 1 month prior to data collection[5] and only one respondent had been in a noma training in Ahlgren *et al*'s[3] Zambia study. The content of such training must include information on noma stages, diagnostic methods and treatment protocols for early-stage noma, which are widely available at healthcare facilities. Additionally, prevention methods, including the importance of vaccinations and the integration of noma screenings into routine health checks, should be emphasised. Training formats such as weekend courses, paper guidelines and online resources, like the WHO's OpenWHO noma course, provide acceptable avenues for knowledge dissemination in this setting.

The limitations of our study highlight challenges that are common across KAP studies on noma. These include difficulties in recruiting adequate samples, particularly at primary healthcare centres, where healthcare workers were often unavailable, which has hindered us from reaching our planned sample size, thereby widening the

CI of percentages and decreasing the power of the test for inferential analysis. Social desirability bias may have influenced responses regarding interest in noma training and self-reported practices. Additionally, the exclusion of respondents unfamiliar with noma from diagnostic and treatment-related questions likely limited insights into their baseline knowledge and skills. Nevertheless, our study offers a comprehensive look at the knowledge, attitudes and practices of healthcare workers regarding noma, providing a foundation for targeted interventions.

Future research should aim to standardise methodologies and explore strategies to overcome the gaps in training, early detection and treatment of noma. By addressing these issues, we can enhance the capacity of healthcare workers to manage this devastating yet preventable disease effectively.

CONCLUSION

Our study revealed a significant gap in knowledge about noma among healthcare workers in northwest Nigeria, with few reporting any experience treating noma patients. However, there was a strong willingness to learn more about the disease, and the acceptance of existing educational tools suggests a promising opportunity to enhance knowledge and improve practices in this population. Increased awareness raising and training on noma are needed for healthcare workers in northwest Nigeria, especially as the items needed to effectively treat noma patients are available. These findings underscore the importance of integrating noma-focused training and awareness into oral health and neglected tropical disease programmes in northwest Nigeria. Increasing awareness about how to diagnose and treat the disease in the early, reversible stages could greatly reduce morbidity and mortality.

Author affiliations
[1]Medical, Medecins Sans Frontieres Operational Centre Amsterdam, Sokoto, Sokoto, Nigeria
[2]Medical, Medecins Sans Frontieres Operational Centre Amsterdam, Amsterdam, Netherlands
[3]Medical, The International Noma Network, Cape Town, South Africa, Cape Town, South Africa
[4]Medical, Medecins Sans Frontieres Operational Centre Amsterdam, Abuja, Abuja, Nigeria
[5]Manson Unit, Medecins Sans Frontieres Operational Centre Amsterdam, London, UK
[6]Oxon Epidemiology SL, Madrid, Community of Madrid, Spain
[7]Usmanu Danfodiyo University College of Health Sciences, Sokoto, Sokoto, Nigeria
[8]Clinal Services, Noma Children Hospital, Sokoto, Sokoto, Nigeria
[9]Nigeria Centre for Disease Control and Prevention, Abuja, Federal Capital Territory, Nigeria

Acknowledgements Thank you to the participants in this study. A big thank you to the study team for all their hard work and dedication to this project. We would also like to thank all the health care workers who are advocating for and treating noma patients

Contributors Conceptualisation: MA, MS, EF. Methodology: MA, MS, EF, GF. Investigation: MO, KE. Data curation: EF, MO. Formal analysis: EF, CA, GF. Project administration: MO, JS, MM, KE. Supervision: MO, JS, MM, KE. Writing—original draft preparation: MO. Writing—review and editing: all authors. Guarantors: MA, MO.

Funding This study was funded, designed, conducted and written by Médecins Sans Frontières Operational Centre Amsterdam (MSF-OCA) (grant/award number: not applicable). MSF bore sole responsibility for all aspects of the study, including protocol development, data collection, data analysis and manuscript preparation. No competing financial interests exist.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, conduct, reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. The MSF Ethics Review Board (ERB) (2093), Kebbi Ministry of Health ERB (MOH/KSREC/VOL.I/56), Usman Danfodiyo University Teaching Hospital Health Research and Ethics Committee in Nigeria (NHREC/30/012/2019) and the Sokoto Ministry of Health ERB (SMH/1580/V.IV) approved the study protocol. Participants were asked to sign an informed consent form after reading/hearing the information provided on the information sheet. The information sheet and the informed consent forms were written in English and Hausa.Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data are available on request. MSF has a managed access system for data sharing that respects MSF's legal and ethical obligations to its patients to collect, manage and protect their data responsibility. Ethical risks include, but are not limited to, the nature of MSF operations and target populations being such that data collected often involves highly sensitive data. The dataset supporting the conclusions of this article is available are available on request in accordance with MSF's data sharing policy (available at: https://nexo.msf.org/). Requests for access to data should be made to data.sharing@msf.org.

ORCID iDs
Michael Olaleye https://orcid.org/0009-0003-4101-8469
Elise Farley https://orcid.org/0000-0003-4457-4068
Fatima Saleh https://orcid.org/0000-0002-2246-0169

REFERENCES

1 Ashok N, Tarakji B, Darwish S, *et al*. A Review on Noma: A Recent Update. *Glob J Health Sci* 2015;8:53–9.
2 WHO. Information brochure for early detection and management of noma. 2017. Available: https://apps.who.int/iris/handle/10665/25457979%0AAdditional
3 Ahlgren M, Funk T, Marimo C, *et al*. Management of noma: practice competence and knowledge among healthcare workers in a rural district of Zambia. *Glob Health Action* 2017;10:1340253:1340253:.
4 Farley E, Mehta U, Srour ML, *et al*. Noma (cancrum oris): A scoping literature review of a neglected disease (1843 to 2021). *PLoS Negl Trop Dis* 2021;15:e0009844.
5 Brattström-Stolt L, Funk T, Sié A, *et al*. Noma-knowledge and practice competence among primary healthcare workers: a cross-sectional study in Burkina Faso. *Int Health* 2019;11:290–6.
6 Weledji EP, Njong S. Cancrum Oris (Noma): The Role of Nutrition in Management. *J Am Coll Clin Wound Spec* 2015;7:50–2.
7 Eipe N, Neuhoefer E, Rosee GL, *et al*. Submental intubation for cancrum oris: a case report. *Pediatric Anesthesia* 2005;15:1009–12.

8 Oginni FO, Oginni AO, Ugboko VI, *et al*. A survey of cases of cancrum oris seen in Ile-Ife, Nigeria. *Int J Paediatr Dent* 1999;9:75–80.
9 Osuji OO. Necrotizing ulcerative gingivitis and cancrum oris (noma) in Ibadan, Nigeria. *J Periodontol* 1990;61:769–72.
10 Denloye O, Aderinokun G, Lawoyin J, *et al*. Reviewing trends in the incidence of cancrum oris in Ibadan, Nigeria. *West Afr J Med* 2004;22:26–9.
11 Oji C. Cancrum oris: its incidence and treatment in Enugu, Nigeria. *Br J Oral Maxillofac Surg* 2002;40:406–9.
12 Adeniyi SA, Awosan KJ. Pattern of noma (cancrum oris) and its risk factors in Northwestern Nigeria: A hospital-based retrospective study. *Ann Afr Med* 2019;18:17–22.
13 Isah S, Amirtharajah M, Farley E, *et al*. Model of care, Noma Children's Hospital, northwest Nigeria. *Trop Med Int Health* 2021;26:1088–97.
14 Sokoto | Nigeria, Map, & Population | Britannica. 2025. Available: https://www.britannica.com/place/Sokoto-state-Nigeria
15 Kebbi | Nigeria, Map, & Facts | Britannica. 2025. Available: https://www.britannica.com/place/Kebbi-state-Nigeria
16 Nigerian Ministry of Health. National human resources for health strategic 2008 to 2012. 2007. Available: www.who.int/workforcealliance/countries/Nigeria_HRHStrategicPlan_2008_2012.pdf
17 Health NM. Nigeria health facility registry. 2023. Available: https://hfr.health.gov.ng/facilities/hospitals-search?_token=H9Gx1g7xeau6HCuJXO5opOsfru5pcGdO5sRJ8JIe&state_id=121&ward_id=0&facility_level_id=0&ownership_id=1&operational_status_id=1®istration_status_id=0&license_status_id=0&geo_codes=0&service_type=0
18 Makinde OA, Azeez A, Bamidele S, *et al*. Development of a Master Health Facility List in Nigeria. *OJPHI* 2014;6:e184.
19 World health organisation (who) and hilfsaktion noma. Oral health key facts [Internet; 2018. Available: https://www.who.int/news-room/fact-sheets/detail/oral-health
20 Ul J, Eg O, Ov O, *et al*. Attitude and Perception of Noma among Medical and Dental Students in Nigeria. *Nig J Med Dent Educ* 2023;21–2.
21 Farley E, Lenglet A, Abubakar A, *et al*. Language and beliefs in relation to noma: a qualitative study, northwest Nigeria. *PLoS Negl Trop Dis* 2020;14:e0007972.
22 Mujtaba B, Chimezie CB, Braimah RO, *et al*. Knowledge, Attitude and Practices of Health Care Workers towards NOMA in a Tertiary Institution in North-western Nigeria. *Nig J Dent Res* 2022;7:110–5.