

Patterns of Noma (Cancrum Oris), in Ethiopia: a Retrospective, Multicentric,
Cross-Sectional Study



Lealem Tilahun GELAW (PLASTIC, RECONSTRUCTIVE AND HAND
SURGERY RESIDENT)

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Patterns of Noma (Cancrum Oris), in Ethiopia: A Retrospective, Multicentric cross-sectional study,

By: Lealem Tilahun Gelaw, MD, 5TH Year Plastic, Reconstructive and Hand Surgery Resident

Advisor: 1. Mekonen Eshete MD, PHD, FCS (ECSA), FACS

Associate Prof. of Surgery CHS, AAU

Consultant Plastic and Reconstructive Surgeon

2. Getaw Alamne, MD, FCS (ECSA),

Consultant plastic and Reconstructive Surgeon

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ABSTRACT

Background: Noma is a polymicrobial infectious disease affecting mostly malnourished children under the age of 10. It is a gangrenous disfiguring disease of the orofacial tissue and the tissue gangrene or necrosis starts in the mouth and eventually spreads intraorally with the destruction of soft and hard tissues. If not controlled, 90% of cases, the disease is lethal because of systemic sepsis. The natural course of the condition leads to perforation through the skin of the face, creating a severe cosmetic and functional defect. The resulting disfiguring facial appearance results in patients being disabled and socially isolated.

Objectives: The main objective of this study was to determine the pattern of Noma, risk factor, the sequela and severity of Noma survivor patient treated, with the support of Facing Africa, in different hospitals in Ethiopia.

Methods: : Hospital based retrospective cross-sectional study done on patients treated, with the support of Facing Africa between 2007 up to 2020. The study population was Noma patients treated during the study period. The data retrieved from Facing Africa database, cleaned, coded and entered with Epi-data version 7 and further analyzed using SPSS version 25.

Result: The data of 103 patients was retrieved for this study, 53 males and 50 females. The age ranged between 1 and 62 years, the majority were between 16-29 years. Most came from rural area (74.8%) mainly from Amhara and Oromia region and most are Muslim and Orthodox by religion. 54% are single and (60.2%) do not have formal education and farmers by occupation(41.7%). (47.6%) use tap water, 83.5% do not have any addiction, (83.5%) do not have any co morbidity and 66% do not know their vaccination status. 93(90.3%) is not happy with their appearance and 77(74.8%) suffer from bullying. 62(60.2 %) cover their face in public. 14(13.6%) of patients were unable to go in public. Difficulty of eating occur in 80(77. %), difficulty of communication or speech in 56(54.4%), difficulty of mouth opening 40 (38.8%), visual problem in 19(18.4%) and difficulty of breathing in 10(9.7%). Of the total procedures performed, Sub mental flap done for 51(49.5%) and radial forearm free flap done for 21(20.4%) patients. Wound infection occur in 23(22.3%) of patients and flap failure occur in 17(16.5%) of patients. Secondary procedures like scar revision was done for 68 (66%) patients, commisuroplasty for 33 (32%) patients and debulking for 23(22.3%).

Conclusion: This study indicates that patients typically present in their late adolescence after experiencing various forms of discriminatory and psychosocial harassment, which negatively impacts their literacy and financial status. These results imply that Noma reconstruction is a challenging procedure that needs multiple stages and revisions, and that there are still some problems and challenges. Thus, surviving Noma is a testament to human resilience, but the journey does not end with recovery.

Keywords: Noma, Cancrum oris

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Abbreviations

ANUG	Acute necrotizing ulcerative gingivitis
ALT.....	Anterolateral thigh flap
BMI.....	Body mass index
CVD.....	Cardiovascular diseases
DM.....	Diabetes mellitus
FA	Facing Africa
LD.....	Latissimus dorsi flap
SPSS.....	Statistical package for social science
SD.....	Standard deviation
TMJ.....	Temporo -mandibular joint
TRAM.....	Transverse rectus abdominis flap
RVI.....	Retroviral infection
WHO	World health organization

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CHAPTER- 1: INTRODUCTION

1.1. Background

Noma is a polymicrobial, necrotizing and disfiguring condition of the orofacial and para-oral structures [1]. The disease starts to develop from simple anaerobic infection, acute necrotizing ulcerative gingivitis (ANUG) [2]. ANUG is a non-contagious infection associated with the proliferation anaerobic bacteria like, *borrelia vincentii* and fusiform bacteria [3, 4]. The condition primarily affects malnourished children under the age of 10 years [3]. The common risk factors for Noma in children's includes, malnutrition, diarrheal diseases, measles infection, lack of proper sanitation, and poor living conditions. Predisposing risk factors in young adults includes, those who serve in the military and poor oral hygiene, smoking, viral respiratory infections, and immune suppression, like HIV/AIDS [5–7]. Features of early Noma/ ANUG include gingival bleeding, pain from gingival ulceration, bad breath, and changes in taste. Other manifestos include ulceration of the gingival papillae, pain, and sometimes the presence of grey pseudo membranes [8].

Untreated Noma rapidly progresses to gangrenous stomatitis and gingival ulcer [9]. It spreads to adjacent hard and soft tissues by disrupting anatomical barriers, causing lysis and necrosis of bones and muscles of the orofacial region. Noma affect and disfigures the cheek (maxilla & mandible), the floor of the mouth, head and neck, the infra-orbital region, and the nose [10]. Mostly, the defect is well defined, cone-shaped with unilateral, yellowish, necrosis and foul-smelling purulent discharge. Fetid odor, significant pain, fever, malaise, tachycardia, tachypnea, anemia, leukocytosis, and regional lymphadenopathy are common clinical findings or frequently occur. Additional lesions, in the scalp, neck, ear, shoulders, chest, perineum, and vulva also may occur in distant sites [11]

Noma is associated with very high morbidity and mortality (80-90%) [9]. The causes of death is due to associated septicemia, intracranial infection, and pneumonia. The few survivors(10%), presented with prominent facial disfigurement, ankyloses of the temporomandibular joint, and extensive muscle and skin contracture. This leads to the difficulty of opening and closing of the mouth, thereby, trouble in mastication and swallowing, oral incontinence, and speech difficulties [12]. Difficulty of mastication and swallowing further exacerbate or cause malnutrition and as a result, many young patients experience significant stunting of growth [13]. Patients with advanced Noma, the lesions and contractures often lead to growth disturbance and result in

further facial disfigurement and functional impairment [14]. Usually, Noma begins as an ulcer of the mucous membrane in the mouth, which causes an edematous face; the condition extends from within out; it rapidly destroys the soft and hard tissues of the face [15]. The acute phase of the disease has a high mortality and affects the mouth with denudation of bone, spontaneous exfoliation of teeth, necrotizing fasciitis, and lips and myonecrosis of cheeks [16]. The evolution of the acute phase is exceptionally rapid, causing the loss of soft and bony facial tissues within days [17, 18]. Transfusion of blood and intravenous fluids, administration of antibiotics, a high protein diet supplement, and debridement of necrotic areas are some of the treatment options of acute Noma. [19]. Surgical intervention is usually initiated 6 to 18 months after a period of quiescence/ tissue maturity [20]. Despite sophisticated interventions (particularly reconstructive and plastic surgeries), Noma is associated with considerable morbidity and mortality, and, understandably, psychosocial impacts on the patients remain substantial [21]. Often, Noma survivors are not only severely disfigured, but also rejected from family and society [22]. However, these longer-term sequel, including psychosocial aspects, are incompletely understood and an area for further study [23].

As a summary. Noma is a rapidly progressing infection of the oral cavity, with a reported 90% mortality rate within weeks after onset, if left untreated [24]. Mostly, Noma affects disenfranchised children who lack access to basic nutrition, hygiene services, and health care. It is also reported in immunocompromised adults [1]. Although, the pathogenesis of Noma is poorly understood .broad-spectrum antibiotics can treat the early reversible stages of Noma [1. 24]. Once it progresses past these stages, the sequelae of Noma are numerous and include difficulty in eating, drinking, seeing, and breathing [24]. For those who seek care for these sequelae, it requires long hospitalization with multistage surgical treatments that can take years to complete. In conclusion, Noma is associated with a high degree of morbidity for survivors, and this often has a significant impact on family members given the long-lasting and often permanent sequelae. It is also an important public health issue, and its existence is a painful reminder of the existing global inequalities in food distribution, health care access and living conditions [24].

1.2 Statement of the problem

Noma is an important public health issue, WHO estimates that approximately 140,000 peoples are affected globally each year by Noma, and its existence is a painful reminder of the existing global inequalities in food distribution, health care access and living conditions. (24)

Ethiopia, countries in the Noma-belt region, where people, particularly children, are profoundly affected by the disease. However, attention and resources dedicated to this devastating condition remains inadequate (31)

In Ethiopia, Noma survivors were treated by a visiting expert team consisting of reconstructive surgeons, maxillofacial surgeons, and other professionals, with the help of Facing Africa (FA) (www.facingafrica.org), a UK-based non-governmental organization, focusing on the treatment of the disfiguring and malfunctioning sequelae of Ethiopian Noma survivors. Approximately 20 new patients were operated each year in Ethiopia. The first surgical mission was conducted in 2007, at Yekatit 12 Hospital Medical College. After that, a yearly surgical mission was conducted at Yekatit 12, which later expanded to MCM Korean Hospital, Cure Hospital, Hallelujah and Nordic Medical Center in Addis Ababa. Postoperatively, patients were seen annually after the surgery. All patients' data were entered into a Facing Africa database at the time of surgery and during follow up.

The pattern and magnitude of Noma in Ethiopia is not known. The nonexistent of relevant information regarding Noma in Ethiopia, led to the inadequate allocation of resources and poor medical care

1.3 Significance of the study

Noma, a polymicrobial infectious disease that destroys the Oro-facial tissues and neighboring structures. It has fulminating course, and has a mortality rate as high as 70–90% if not promptly treated (27). Noma was known since Hippocrates, Galen, Celsus, and Aretaeus of Cappadocia, and was widely reported in European and North American writings of the 18th and 19th centuries (27). It virtually disappeared from developed countries in the 20th century except for several cases found in the concentration camps of Belsen and Auschwitz,(28), and in association with intense immunosuppressive therapy, in patients with human immunodeficiency virus (HIV) infection/acquired immunodeficiency syndrome(AIDS), as well as in Native American children with underlying severe combined immunodeficiency syndrome.(28). In contrast, Noma is an escalating public health problem in impoverished children in the developing world, particularly in sub-Saharan Africa where the frequency in several countries is estimated to be 1–7 cases per 1,000 population, and as many as 12 cases per 1,000 in the most affected communities (29).

This study was conducted to assess, the pattern, the sequela and severity and surgical outcomes of Noma in Ethiopia. It is conducted using the facing Africa database which is the only well-organized data base concerning Noma patients in Ethiopia. The findings of the study can also be used as a baseline for further investigation and help to fill the current knowledge gap.

CHAPTER 2: Literature Review

Noma (cancrum oris) is a rapidly progressing, invasive, and debilitating orofacial disease that affects the most vulnerable, marginalized populations worldwide. First descriptions of the disease date back to antiquity (30).

Noma is a neglected disease affecting poor people globally. The mortality rate varies between 85–90%, 10–15% of survivors permanently suffers from severe facial deformities. Most cases of Noma are from the so-called Noma belt, located south of the Sahara and runs across Africa from Senegal to Ethiopia. The updated world map indicates that patients with Noma were diagnosed in at least 23 countries with most cases being reported from only a few countries in West Africa (31).

Ethiopia is one of the countries in the Noma-belt region where people, particularly children, are significantly affected by the disease, therefore, assessing the severity and sequela of Noma in Ethiopia is crucially essential to lay bare the burden of the disease and increase the overall understanding of the condition among different stakeholders. (32).

Noma survivors generally suffer from its sequelae, including serious facial disfigurement, trismus, oral incontinence, and speech problems. WHO classified Noma into five stages: stage 0, simple gingivitis; stage 1, acute necrotizing gingivitis; stage 2, oedema; stage 3, gangrene; stage 4, scarring; and stage 5, sequelae (24).

Study done in Ethiopia at 2022 in Yekatite 12 Hospital to assess the anatomic area affected by Noma, 163 medical records was reviewed. Of those, 52% (n = 85) and 48% (n = 78) have reported left-sided and right-sided facial defects, respectively. Most commonly affected facial structures include ,Cheek, upper lip, lower lip, nose, hard palate, maxilla, oral commissure, zygoma, infra-orbital region, mandible, and chin. Complete loss of upper lip, lower lip, and nose were also identified as a sequela of Noma. (32).

Study done in Northwest of Nigeria in 2019, it was 12 years Hospital based retrospective cross sectional study to assess the pattern and risk factors of Noma, fresh Noma were diagnosed in 9(8.3%) of the 1923 patients admitted to the hospital from January 1999 to December 2011. The mean age of the patients was 3.0 +/-1.4 years. The commonest risk factors identified were measles (47.2%) and protein energy malnutrition (42.1%) (33). The study concluded that, a high

burden of Noma in Northwest Nigeria, mostly among children aged 1-5 years, and with soft tissue lesions involving multiple sites. Measles and malnutrition were the major risk factors identified, and the disease trend showed a wave –like pattern (9, 33).

Noma is a devastating and often fatal condition but it is preventable and requires urgent basic medical care in the early stages of disease. Once the disease reaches the last stage, survivors require expert surgical care, usually difficult to access as most cases of Noma occur in resource-limited settings (30).

A scoping review of the literature published on Noma was done in 2021 to understand the size and scope of available research on the disease and to identify research priorities. The oldest manuscript identified was from 28th March 1843 and the most recently published manuscript was from 3rd June 2021. Their review showed that Noma has been reported in the literature for hundreds of years; however, several major gaps in knowledge still exist. The review recommends, the focus of future research should be to study the burden and distribution of disease; the true mortality rate, and the pathogenic cause(s) and the factors that influence prognosis and outcomes after treatment. (30, 31).

They reviewed 147 articles, the majority (n = 94, 64%) were case reports. Most papers (n = 81, 55%) were published in the 2000s, 49 (33%) were from the 1900s and 17 (12%) from the 1800s. The main areas of the study title identified were the history and epidemiology of the disease, Noma’s clinical progression and etiology, treatment regimens, mortality rates and the risk factors for the development of Noma (31).

A diagnosis of Noma is established clinically and criteria differ across stages. In the differential diagnosis of Noma stage four to five, congenital malformations, such as cleft lip, as well as ulcerous and necrotizing infections with shared characteristics have to be considered, including a granulocytic angina, malignant oral lesions, midline granuloma of the face, and syphilis. Noma neonatorum mainly affects preterm or low-birthweight infants, in most cases with *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella* spp, or *Staphylococcus* spp infections. Almost all patients who have Noma neonatorum succumb to the disease following sepsis. Noma neonatorum and other common ulcerous and necrotizing infections are readily distinguished from well-established Noma in children (33).

The treatment of Noma is dependent on the disease stage. Stage one and stage two Noma can be cured relatively easily with antibiotics directed against opportunistic infections, with improved

oral hygiene, using chlorhexidine mouthwash, and nutritional support. Third and fourth stage, treatment of lesions and debridement of necrotic tissues are required to prevent sepsis. Stage four and five, physiotherapy is essential for muscular contractures (eg, trismus) and ankylosis prevention. Most survivors of Noma need reconstructive surgery (24).

Noma prevention depends on the elimination of key risk factors related to poverty, such as unsafe water, insufficient sanitation, and malnutrition. Effective preventive activities should focus on surveillance and early diagnosis on the basis of awareness raising among parents and health personnel (24).

Chapter 3

Objectives

3.1. General Objective

The general objective of this study is to assess the pattern of Noma (Cancrum oris) using the Facing Africa data base

3.2 Specific objective

- To assess the sociodemographic distribution of treated patients
- To assess risk factors for their disease
- To assess the anatomic area affected
- To assess the surgical intervention and the outcomes

Chapter 4

Methods and Materials

4.1 Study area and period

The study was conducted using data of patients operated at Yekatit 12 Hospital Medical College, MCM Hospital, CURE Hospital and Nordic Medical Center from 2007 to 2020. The data of all operated patients with the support of Facing Africa was prospectively entered into Facing Africa database, which included demographic data clinical findings the management provided including outcome and follow-up. These data includes all Noma patients operated during the study period at the mentioned centers. The patients came from every corner of the country. . Since these patients were malnourished and not able to feed properly because of the complication of Noma (locked jaw, absent of teeth etc.) were rehabilitated preoperatively and postoperatively at a rehabilitation center in Addis Ababa and made sure that their wound healed and the patients were able to feed properly before they were sent back to where they came and followed annually for years. Each year, approximately 20 new patients are operated on in Ethiopia, since the first mission in 2007 the data of the operated patients were entered prospectively in to Facing Africa database, which is going to be used for this study.

4.2. Study design

Hospital based retrospective cross-sectional study was used

4.3 Source and study population

4.3.1 Source population

All patients treated with the support of a charity organization Facing Africa

4.3.2 Study population

Data of Noma patients treated with the support of Facing Africa

4.3.3 Eligibility criteria

Inclusion criteria

Data of all Noma patients' treated during the study period and whose data found complete.

Exclusion criteria

Patients with incomplete chart/database recording

Patients for whom surgery is deferred

4.4. Sample size and sampling technique

I used convenience-sampling technique and included data of all Noma patients treated during the study period and whose data found complete

4.5 Variables

4.5.1 Dependent variables

Noma

4.5.2 Independent variables

-Age

-Sex

-Marital status

-Occupation

-Educational status

-Income

-Ethnicity

-Diet

-Mental illness

4.6 Data collection Procedure

Data collected with standardized questionnaires, which is prepared on English language.

All the available information about patients was retrieved from the database.

4.7 Data quality assurance

All data was checked and regular supervision of data collection process done regularly. The principal investigator retrieved all the available information about the patients from the database.

4.8 Data analysis

All data checked for consistency and completeness manually, and coded and entered into Epi-data version7. Statistical data analysis done using SPSS version 25.0. Descriptive statistics like frequency and percentage used to describe the finding. .Categorical variables will be expressed as percentage and continuous data as +/- SD.

4.9. Operational /Standard definition

Noma /Cancrum oris - The word 'Noma' is derived from a Greek word which, loosely translated, means 'to devour', for a rapidly spreading ulceration originating in wet soft tissues 'typical of the mouth.

Facing Africa (FA) - a UK-based non-governmental organization focusing on the treatment of the disfiguring and malfunctioning sequelae of Ethiopian Noma survivors

4.10. Ethical consideration

Ethical clearance was obtained from the Surgical department School of Medicine College of Health Sciences AAU, research ethics review committee and data sharing agreement was signed between the investigator and Facing Africa.

4.11. Dissemination of the result

The findings of this research will be disseminated using society's Annual conferences. Ethiopian Society of Plastic and Reconstructive surgery annual conference will be a good forum. It is also going to be submitted for publication at peer-reviewed journals for publication. It. The finding will be also reach other stakeholders working in line through document sharing and scientific presentation in conferences, workshops and seminars. Efforts will also be made to reach scientific community through publications.

4.12. Limitation of the study

This study is a retrospective hospital based study. It depended on review of charts that were originally not designed to collect data for research, because of this some very important information is missing, and this is a limitation.

5. RESULT

5.1. Socio demographic characteristics

103 patients, who fulfilled the inclusion criteria, were recruited for this study. Of which, 53(51.5%) were males and 50(48.5%) were females. The age of the patients ranged between 1 and 62 years, with mean of age 27.43 SD 13.47(45.6%) of patients were in the age range of 16-29. The majority of the patients are Muslim (38.8%) followed by Orthodox (37.9%) religion followers. 39(37.9%) of the patients were from Amhara region 22(21.4%) from Oromia region, and 17(16.5%) were from Southern Nation Nationalities region. The remaining 25 (24.3%) were from other regions. Most of the patients (74.8%) were from rural areas and 14.5% were from urban and (10.7%) from refugee camps. The majority of the patients 60.2%, do not have formal education. More than 54% of the patients are single, 38% are married 4(3.9%) divorced, and another 4(3.9%) widowed. The family size of most of the victims ranged from 4-6. The majority of the patient are farmers by occupation and their monthly income is not more than 500 Ethiopian birr. (table1).

Table 1: Sociodemographic pattern of Noma

Variable	Categories	Frequency	Percent
Sex	Male	53	51.5
	Female	50	48.5
Age	0-5	4	3.9
	6-15	14	13.6
	16-29	47	45.6
	30-44	23	22.3
	45-59	10	9.7
	>60	5	4.9
Religion	Orthodox	39	37.9
	Muslim	40	38.8
	Protestant	19	18.4
	Catholic	4	3.9
	Other	1	1

Ethnicity	Amhara	34	33
	Oromo	22	21.4
	South	17	16.5
	Somali	13	12.6
	Gambela	9	8.7
	South Sudan	3	2.9
	Tigray	2	1.9
	Addis Ababa	1	1
	Afar	1	1
	Benishangul Gumz	1	1
Place of residency	Rural	77	74.8
	Urban	15	14.6
	Refugee camp	11	10.7
Educational status	No formal education	62	60.2
	1-4 grade	15	14.6
	5-8 grade	17	16.5
	9-10	6	5.8
	11-12	1	1
	Diploma	0	0
	Degree and above	2	1.9
Monthly income	<500 birr	62	60.2
	501-1000 birr	26	25.2
	1001-2000birr	14	13.6
	>2001 birr	1	1
Occupation	Farmer	43	41.7
	Student	16	15.5
	No job	15	14.6
	House wife	11	10.7
	Daily laborer	8	7.8
	Children	5	4.9

	Merchant	4	3.9
	Government employee	1	1
Marital status	Single	56	54.4
	Married	39	37.9
	Divorced	4	3.9
	Widowed	4	3.9
Family size	1-3	26	25.2
	4-6	59	57.3
	7-10	14	13.6
	>11	4	3.9

5.2 Risk factor assessment

From 103 patients recruited in the study 49(47.6%) use tap water ,42(40.8%),river water and 12(11.7%) well as water source. 83.5% of the patient do not have any addiction ,only 10.7% of patient uses alcohol ,3.9% uses chat and 2% are smokers. Most of the patients do not have any co morbidity 86(83.5%) ,but 2(1.9%)had retroviral infection.66% of patient didn't know their immunization history, but 21.4 % take vaccination and 12.6% didn't .(table 2).

Table 2: Assessment of risk factor for the development of Noma patients treated by Facing Africa mission in Ethiopia, 2007-2020

Variable	Categories	Frequency	Percent
Water source	Tap	49	47.6
	River	42	40.8
	Well	12	11.7
Addiction to/ use of	None	86	83.5
	Alcohol	11	10.7
	Khat	4	3.9
	Smoking	1	1
	Smoke and alcoholic	1	1
History of co morbidity	None	89	86.4
	Malaria	6	5.8

	RVI	2	1.9
	Renal disease	2	1.9
	Other	4	3.8
Immunization history	Un known	68	66
	Vaccinated	22	21.4
	Un vaccinated	13	12.6

5.3 Patient acceptance of the problem

93(90.3%) of the patients were not happy with their appearance and 77(74.8%) suffer from bullying and teasing. Most of the patient 62(60.2 %) cover their face in public. Only 14(13.6%) of the patient were unable to go in public 89(86.4%) manage to go out in public. (Table 3).

Table 3: Acceptance of their deformity

Problem		Count	Percent
Go out in public	Yes	89	86.4
	No	14	13.6
Cover face	Yes	62	60.2
	No	41	39.8
Suffer from bully	Yes	77	74.8
	No	26	25.2
Happy with appearance	Yes	10	9.7
	No	93	90.3

5.4 Clinical presentation of Noma patients

Noma survivors suffer many problems, among which difficulty of speech, mouth opening, and eating, breathing and visual problem is to mention a few. Difficulty of eating occur in 80(77.0%), difficulty of communication or speech in 56(54.4%), difficulty of mouth opening 40 (38.8%), visual problem in 19(18.4%) and difficulty of breathing in 10(9.7%).(table 4).

Table 4: Clinical presentation of Noma patient's treated by Facing Africa mission in Ethiopia, 2007-2020

Clinical presentation		Count	Percent
Difficulty of	Yes	56	54.4

communication , speaking	No	47	45.6
Difficulty of mouth opening	Yes	40	38.8
	No	63	61.2
Difficulty of eating	Yes	80	77.7
	No	23	22.3
Difficulty of breathing	Yes	10	9.7
	No	93	90.3
Visual problem	Yes	19	18.4
	No	84	81.6

5.5 Anatomic area involved by Noma

The anatomic area affected by Noma includes, lip, cheek, nose, eye and TMJ area. Upper lip is involved in 74(71.8%), outer lining of cheek in 66(64.1%), inner lining of cheek in 59(57.3 %), lower lip in 53(51.5%), trismus 33(32%) and nose in 32 (31.1%). Visual loss and tooth loss also occur in the studied patients. (Table 5).

Table 5: Anatomic area affected by Noma in the studied patients

Anatomic area affected		Count	percent
Nose involvement	Present	32	31.1
	Absent	71	68.9
Upper lip involvement	Present	74	71.8
	Absent	29	28.2
Lower lip involvement	Present	53	51.5
	Absent	50	48.5
Outer lining cheek involvement	Present	66	64.1
	Absent	37	35.9
Inner lining cheek involvement	Present	59	57.3
	Absent	44	42.7
Trismus	Present	33	32.0
	Absent	70	68.0

5.6 Surgical procedures done on Noma patients.

.83 (80.6%) of patients were reconstructed using local flaps, 33(32%) were reconstructed with free flaps, for 12(11.7%) patients primary commisuroplasty was done. Only three (2.9%) patients were reconstructed using distant flaps. (Table 6).

Table 6: Surgical procedures performed for Noma patient's treated by Facing Africa mission in Ethiopia, 2007-2020

Procedures	Count	Percent
Commissuroplasty	12	11.7
Local flap	83	80.6
Distant flap	3	2.9
Free flap	33	32

5.6.1 Type of surgical procedure performed.

Sub mental flap done for 51(49.5%) and radial forearm free flap done for 21(20.4%) patients. ALT, LD, TRAM and Para scapular free flaps are the other free flaps performed in the studied patients. (table 7).

Table 7 Type of Surgical procedures performed

Type of procedure	Frequency	Percent
Anterolateral thigh free flap	3	2.9
Delto pectoral flap	1	1.0
Deltopectoral flap, RFF	1	1.0
Estlander and submental flap	1	1.0
Failed Alt, Radial forearm	1	1.0
Failed mc gregor flap, RFF	1	1.0
Fujimori gate flap	1	1.0
Latissimus dorsi flap	1	1.0
Local advancement flap	1	1.0
Mustarde flap	1	1.0
Para scapular flap	1	1.0
Pectoralis major flap	1	1.0
Post op pneumonia	1	1.0
Postponed	1	1.0
Radial forearm , Alt	1	1.0
Radial forearm free flap	21	20.4
Rotation flap	11	10.7

Scar release and lower lip reconstruction	1	1.0
Sub mental flap	51	49.5
Surgery after rehab	1	1.0
TRAM flap	1	1.0
Total	103	100.0

5.7 Surgical outcomes of Noma patients

Some of the complications that occur after the surgery include wound infection, flap failure and a need for revision surgery like scar revision, commissuroplasty and debulking. Wound infection occurred in 23(22.3%) of the patients and flap failure occur in 17(16.5%) of the patients.

Secondary procedures like scar revision were needed for 68(66%), commissuroplasty for 33 (32%), and debulking for 23(22.3%)(table 8).

Table 8: Surgical outcomes of Noma patient's treated by Facing Africa mission in Ethiopia, 2007-2020

Surgical outcomes	Count	Percent
Wound infection	23	22.3
Flap failures	17	16.5
Scar revision	68	66
Commissuroplasty	33	32
Debulking	23	22.3

6. DISCUSSION

Estimates indicate that only 10–15% of those affected by Noma access health care (33). This delay is explained by both health system and patient related factors. The weak health systems detection is due to, the rapid progression of the disease and its high fatality, the absence of dedicated or integrated surveillance systems and limited or no recognition of Noma by health-care workers. Patient related factors include unawareness of the disease's severity by caretakers, difficult access to health care for the people most affected by Noma and active hiding of Noma survivors because of social stigmatization (33).

The data of the patients included in this study showed that the majority of the patients were females 51.5%. Young adults between the ages of 16-29 years accounted for (45.6%). The majority came from rural areas (74.8%) and 60.2% of the patients had no formal education. The late presentation for the surgery dependent on evidence that Noma affects marginalized and destitute populations with very limited access to often rudimentary health services. This limited Healthcare access further supported by our study, 78.6% of the patients unvaccinated and / or did not know their immunization history, which may indicate a lack of access to health care and preventive services. In contrast a research done in North west Nigeria where majority of them were in mean age 3.0 +/-1.4 years which is 139(87.3%).(25).

Moreover, we found that 40.8% of the patients used river water as their water source, which may increase the exposure to contaminated water and pathogens. These findings suggest that there is a need for more awareness and education on the importance of immunization, hygiene, and nutrition to prevent Noma.

This study showed that 90.3% of the patients were not happy with their appearance and 74.8% suffered from bullying. We also found that 60.2% of the patients covered their face in public and 13.6% were unable to go out in public. These findings indicate that Noma survivors suffer from psychological distress and social stigma, which may affect their self-esteem, mental health, and quality of life. Noma leads to stigmatization and resultant social isolation of the patients and

their family members from their communities. Similarly, several studies have highlighted the importance of including social and psychological support for Noma patients and their families. (17, 19, 32).

The clinical presentation of Noma patients showed that 77.7% of the patients had difficulty of eating, 54.4% had difficulty of communication, 38.8% had difficulty of mouth opening, 18.4% had visual problem, and 9.7% had difficulty of breathing. These findings showed that Noma causes severe functional impairment, affecting various aspects of daily life.

The pattern of Noma/post-Noma soft tissue defects in patients treated in Yekatit 12 hospital. Ethiopia includes varying degree of deformities involving the upper lip, outer lining of cheek, inner lining of cheek, lower lip and nose in decreasing order of occurrence (32). Our finding is similar with the pattern of Noma presentation observed in Dakar Senegal in which the upper lip then cheek were quoted as the two most common sites affected by the Noma defect (33). In contrast, most common site of distribution observed in north central Nigeria was a nose involvement (25).

If patients survive the acute illness, they can live into adulthood but often require extensive reconstructive surgery and intensive physiotherapy to improve the resulting structural and functional defects that often require a number of surgical treatments. The manifestation of each Noma case is unique, and as such, the surgical procedures used to treat each Noma case differ. We found that most patients underwent local flaps (80.6%), followed by free flaps (32%), as the main surgical procedures. We also found that some patients underwent primary commisuroplasty (11.7%) and distant flap (2.9%).

Complications, such as wound infection (22.3%) and flap failure (16.5%), occurred after the surgery. We also found that some secondary procedures, such as scar revision (66%), commisuroplasty (32%), and debulking (22.3%), were performed to improve the aesthetic and functional results. These findings suggest that Noma reconstruction is a complex and challenging process, which requires multiple stages and revisions, and that some complications and challenges still exist.

7. CONCLUSION

This study indicates that patients typically present in their late adolescence after experiencing various forms of discriminatory and psychosocial harassment, which negatively impacts their literacy and financial status.

These results imply that Noma reconstruction is a challenging procedure that needs multiple stages and revisions, and that there are still some problems and challenges. Thus, surviving Noma is a testament to human resilience, but the journey does not end with recovery.

8. Recommendation

There should be a greater emphasis on educating the public and providing community health professionals with training on early detection and treatment of Noma.

Comprehensive care, including physical rehabilitation, psychological support, and community acceptance, is crucial for improving the lives of Noma survivors

Since each form of Noma presentation is different, the surgical technique is difficult and requires a hospital setup that is well equipped and staffed with experts.

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10. Annex 1

10.1 English version questionnaires of sociodemographic, risk factor, clinical presentation, surgical management and outcomes assessment of Noma patients

SN	Part 1, Sociodemographic information		
1	Age in years		
2	Sex	A. Male B. Female	
3	Religion	A. Orthodox B. Muslim C. Protestant D. Catholic E. Other	
4	Educational status	A. No formal education B. 1-4 grades C. 4-8 grades D. 8-10 grades E. 10-12 grades F. Diploma G. First Degree H. Second degree	

		I. Third degree	
25	Marital status	A. Single B. Married C. Divorced D. Widowed	
6.	Occupation	A. Student B. Farmer C. Merchant D. Governmental worker E. other	
7.	Place of Resident	A. Urban B. Rural	
8	Ethnicity	A. Amhara B. Oromo C. Tigray D. Somali E. South F. other	
9.	Monthly income		
10	Family size		
Risk factor assessment			
11	Water source	A. River B. Tab C. Well D. other	

12	Addiction to/Use of	A. Smoking B. Alcohol C. Khat D. Other	
13	History of comorbidity	A. RVI B. Childhood illness C. CVD D. Respiratory E. Renal F. Endocrine G. other	
14	Immunization history	A. Vaccinated B. Un –vaccinated C. Un known	
Patient acceptance to the problem			
		A. Yes	B. No
15	Go out in public		
16.	Cover face		
17.	Suffer from bully		
18	Happy with appearance		
Clinical presentation			
		A.YES	B. NO
19.	Difficulty of communication/ speaking		
20.	Difficulty of mouth opening		
21.	Difficulty of eating		

22.	Difficulty of breathing		
23	Visual problem		
Anatomic area affected			
		A. YES	B NO
24	Nose		
25.	Upper lip		
26	Lower lip		
27.	Outer lining of cheek		
28.	Inner lining of cheek		
29.	Trismus		
30	Others		
Surgical management			
		A Yes	B NO
31.	Commisuroplasty		
32	Local flap		
33	Distant flap		
34	Free flap		
Outcome of Surgery			
		A. Yes	B. No
35.	Wound infection		
36	Flap Failure		
37	Scar revision		
38	Commisuroplasty		
39	Debulking		
40.	Others		

Annex: 2

10.2 Assurance of principal investigator

I understand and agree to accept responsibility for the scientific ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the research publications office in effect at the time of grant is forwarded as the result of this application.

Name of the student: Dr. Lealem Tilahun (Plastic, Reconstructive and Hand Surgery Resident)

Date..... Signature

Approval forms of advisors

Name of primary advisor

Signature Date

Name of secondary advisor.....

Signature Date.....

Annex:3

10.3 Research project proposal submission form

Name of investigator	Dr.Lealem Tilahun Gelaw
Name of advisors	Dr.Mekonen Eshete
Title of research project	Pattern of Noma (Cancrum Oris) treated by Facing Africa in Ethiopia, 2007-2018: Retrospective, Multicenteric cross-sectional study
Duration of the project	9 month
Study area	Hospitals in Addis Ababa
Total cost of the project	34,535 Ethiopian birr
Address of investigator	Lealent7@gmail.com +251967086276
Address of primary investigator	+251911254170 Mekonen.eshete@aau.edu.et
Address of secondary investigator	+251925276430 getawalamne.md@gmail.com