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FACTORS ASSOCIATED WITH YAWS INFECTION IN CHILDREN UNDER 15 YEARS IN THE KINTAMPO NORTH MUNICIPALITY OF THE BRONG AHAFO REGION, GHANA

BY

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DECLARATION

I, Gabriel Korang declare, that except for the specific references which have been duly acknowledged, this dissertation is the result of my own original research work undertaken under supervision and that it has neither in whole or in part been presented for another degree in this university or elsewhere.

Signature…… Date…….....

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DEDICATION

To my wife, Mrs. Lois Nyarko Korang and children Afia Agyeiwaa Korang and Kwabena Amponsah Korang

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ABSTRACT

Background: Yaws is a treponemal infection in humans that is common in children who are less than 15 years of age. The causative organism of yaws – *Treponema pallidum* subspecies *pertenue* – is genetically related to *T. pallidum* subspecies, the causative agent of syphilis. Mostly, people who are affected by yaws live in poor socioeconomic conditions. Ghana seems to be the number one yaws endemic country in the WHO African Region, reporting over 20 000 cases annually. The Kintampo North Municipality is the most endemic district in the Brong Ahafo Region. The Municipality recorded 8,358 yaws cases between 2012 and 2016.

The aim of the study was conducted to determine the prevalence and the factors associated with yaws infection in the Municipality.

Methods: Descriptive cross-sectional design was used to conduct this study in the Kintampo North Municipality with a sample size of 270. Simple random sampling was used to select three of the seven circuits and three primary schools in each circuit for the study. In the selected schools, systematic sampling was used to select 30 pupils who are less than 15 years for the study. Only participants who gave assent and their guardians consented were interviewed. The data was then analysed using Stata 15 software. After the analysis all variables with p-value <0.05 were considered to be statistically significant with yaws infection.

Results: The prevalence of Yaws lesions in the study was found to be 23.53% (95% CI 18.84% - 28.97%). The personal factor identified to be associated with yaws infection is having a guardian who is a trader (UOR: 6.25, p = 0.015). The significant household factors identified include playing with a yaws case (UOR: 7.05, p = 0.005) and using river as the source of drinking water (UOR: 8.0, p = 0.009). Only 28.9% of the participants who had

yaws had ever visited the health facility for treatment. Because of financial problem, majority of the participants who had yaws infection but did not visit a health facility for treatment.

Conclusions: The prevalence of yaws lesions in the Municipality is high. The significant factors identified to be associated with yaws infection include playing with a yaws case, using river which is a source of drinking water and having a guardian who is a trader. Most people with yaws infection in the Municipality do not visit the facility for treatment because of financial problem. The Kintampo North Municipal Health Directorate should intensify education on the mode of transmission, risk factors and the need to seek treatment for yaws in Basic Schools within the Municipality.

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LIST OF ACRONYMS

AOR	Adjusted Odds Ratio
CHPS	Community Health Planning and Services
CI	Confidence Interval
FM	Frequency Moderation
GHS	Ghana Health Service
JHS	Junior High School
LA	Local Authority
MDA	Mass Drug Distribution
MOH	Ministry of Health
NTDs	Neglected Tropical Diseases
ODK	Open Data Kit
OR	Odds Ratio
PCR	Polymerase Chain Reaction
RC	Roman Catholic
SDA	Seventh Day Adventist
UNICEF	United Nations Children's Fund
UOR	Unadjusted Odds Ratio
WHO	World Health Organization

DEFINITION OF TERMS

Macule	A small discoloration on the skin that is flat (not raised) distinct and less than 1 centimeter in diameter
Papilloma	A small wart-like growth on the skin with a clear-cut borders that project above the surrounding tissue.
Papule	Papule is a solid, elevated lesion with no visible fluid which may be up to ½ cm. in diameter

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Yaws is a contagious treponemal infection in humans that is common in children who are less than 15 years of age (WHO, 2007). The causative organism of yaws – *Treponema pallidum* subspecies *pertenue* – is genetically related to *T. pallidum* subspecies, the causative agent of syphilis (WHO, 2016). According to WHO (2010), among the three endemic diseases, yaws is the most common.

Between 75% - 80% of those with the disease are children who are below 15 years. However, most cases occur in children aged between 6–10 years. Boys and girls can all be infected by the disease. Mostly, people who are affected by yaws live in poor socioeconomic conditions. These populations often live in isolated areas; at the "end of the road" where access to health care and other facilities are limited (WHO, 2016). Dzotsi and colleagues (2017) reported that overcrowding, contact or playing with an infected person, sleeping in the same room, sharing clothing or living with a yaws case in the same house were the risk factors of the disease in West Akim Municipality of Ghana. Also according to the World Health Organization (WHO, 2012a) being a household member, classmate, school mate or a close playmate of a yaws case increase risk of infection.

Transmission of the disease is through direct non-sexual contact with the fluid of an infected person through minor cuts. A greater proportion of Yaws lesions occur on the limbs where bacteria inoculation is common. The initial lesions of yaws are teems with the yaws bacterium and therefore are more infectious. The disease has an average incubation period of 21 days (WHO, 2016).

The disease has three clinical stages, namely primary, secondary, and tertiary (Rinaldi, 2008). In the primary stage, a yaws lesion called the “mother yaws” occurs as a papule, and after about 2-4 weeks it enlarges before ulcerating. Without treatment, healing occurs after 6 months. The second stage is characterised by papilloma or papules or macules that normally spread over the entire body. This is commonly referred to as the 'daughter yaws'. Sometimes all the three appear together. After some time, which can last several years without treatment, the third stage occurs in about ten percent (10%) of the cases and is characterized by bone and cartilage destruction and ulceration. Palmar and plantar skin thickening are common in this stage of the disease (Galadari, 2017; Walker & Hay, 2000; Rinaldi, 2008; Webber, 2005 & American Public Health Association, 2004).

If left untreated, the disease can lead to chronic destruction of bones and eventually lead to disability. According to WHO (2007), after about five to ten years, 10% of untreated cases will develop destructive lesions that affect bones, cartilages and skin that is similar to the signs in late stage of syphilis.

Diagnosis is mainly based on clinical features but a recent study have revealed that *Haemophilus ducreyi* ulcers are similar to that of yaws and therefore can make clinical diagnosis of the disease difficult (Mitjà et al., 2014). Syphilis test is mostly used to screen a population for the disease, but the test is not able to tell whether the cases are current and active or they previously treated and have been re-infected. A new “point-of-care dual syphilis test” have a sensitivity of about 95% and specificity of 97% (Marks et al., 2016) This no doubt will give impetus to the eradication of yaws. Other techniques like polymerase chain reaction (PCR) can also confirm the infection. However, studies are now ongoing to develop test that can be used for in large-scale community surveys (Cooley et al., 2016).

Although, Injection penicillin is still effective for treatment of the disease, according to WHO (2012a) oral azithromycin is preferred to benzathine penicillin. According to recent studies a

dose of oral azithromycin can treat the disease successfully within 4 weeks (Kwakye-Maclean, Agana, Gyapong, & Nortey, 2017; Asiedu, Fitzpatrick, & Jannin, 2014; Agana-Nsiire et al., 2014; Fletcher & Wilcken, 2012; & Mitjà et al., 2012).

Although the lesions of the disease may heal naturally, complications can occur. This includes bacterial infection and scaring. The damage to tissue that occurs in late stage of the disease cannot be reversed (Galadari, 2017).

The goal of the World Health Organization is to eradicate yaws globally by the year 2020 (WHO, 2012 & 2016). The WHO road map to the eradication of the disease indicates that all endemic countries including Ghana should interrupt the transmission by 2017 and report zero case for three consecutive years to confirm no further transmission of the disease in order to be certified yaws free. However, it appears this goal will not be met.

A recent estimate by Mitjà et al. (2015) shows that in the year 2012, more than 80 million individuals were living with the disease in districts that are endemic for yaws globally.

1.2 Problem Statement

Ghana is likely the country with a most of the yaws cases in the WHO African Region, reporting over 20 000 cases annually (WHO, 2012a). Mitjà et al. (2015) has revealed that during the year 2010-2013, 84% (215,308) of the global yaws cases reported to the World Health Organization were from Ghana, Papua New Guinea and Solomon Island. A 2008 Rapid Survey by National Yaws Elimination Programme showed prevalence rate of up to 20% among the under 15 years population in some rural communities in Ghana (WHO, 2012a). Also a study conducted by Agana-Nsiire and co. (2014) in three districts in Ghana revealed a high prevalence rate of more than 10% in three percent (3%) of the schools they surveyed.

The situation in the Kintampo North Municipality is not different. According to the Brong Ahafo Regional Health Directorate, of the 27 districts in the Region, the Kintampo North Municipality is rated as highly endemic for yaws (Ghana Health Service, 2016). Table 1 shows a five year trend of clinical cases in the Municipality.

Table 1: Five Year Trend of Reported Yaws Cases in the Kintampo North Municipality

Year	Number of Reported Cases
2012	4297
2013	3996
2014	49
2015	16
2016	0
Total	**8,358**

Source: Brong Ahafo Regional NTDs Office, 2017

From Table 1, for the past five years the Municipality has recorded 8,358 clinical cases of yaws. There is no evidence of any mass treatment that may have contributed to the drastic reduction in the number of cases in the Municipality. According to the Ghana Health Service (2011, p.24), "the drop in yaws cases detected in Ghana can be attributed to the decrease in the surveillance for yaws and poor reporting in some districts". It is therefore possible there are yaws cases in the Kintampo North Municipality but weak surveillance activities has made to appear like the district is now free from the disease.

Dzotsi and colleagues (2017) reported that overcrowding, contact or playing with an infected person, sleeping in the same room, sharing clothing or living with a yaws case in the same house were the risk factors of the disease in West Akim Municipality of Ghana. However, in the Kintampo North Municipality no study has been done on the disease. This study therefore seeks to identify factors associated with yaws infection among children less than 15 years in

the Kintampo North Municipality. The study will provide a baseline data for planning interventions for the eradication of the disease in the district.

1.3 Conceptual Framework

Yaws infection is determined by a number of interrelated factors. The factors of interest in this study are shown in the conceptual frame work (Figure 1). The framework explains the factors that influence an infection with *Treponema pertenue* in the Kintampo North Municipality. The factors are categorized into: socio-economic, individual and health service related factors.

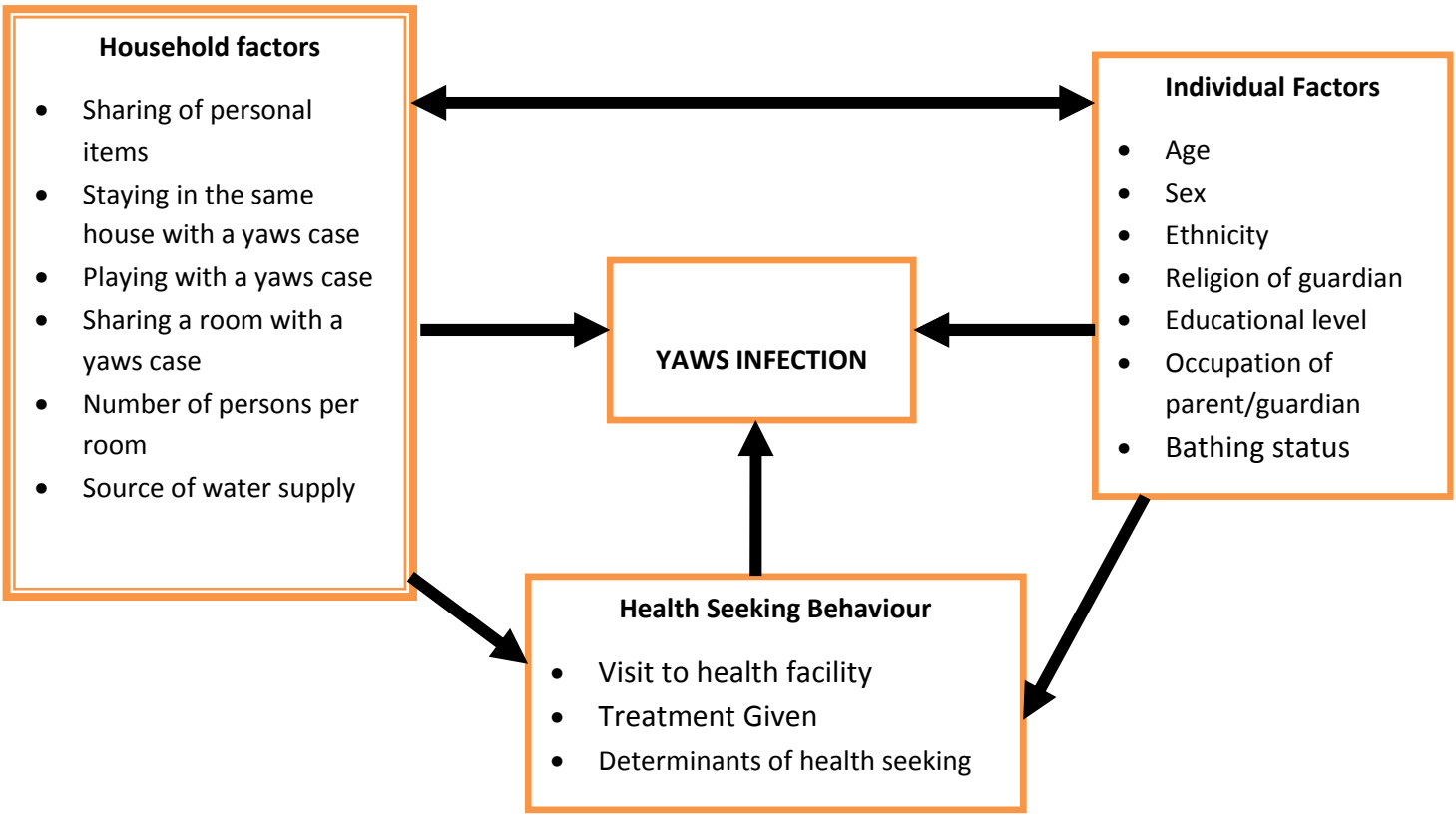

Figure 1: Conceptual Framework

These three factors independently and collectively affect the development of yaws infection in a person. An understanding of how these factors interrelated to increase the susceptibility

of an individual to yaws infection will greatly influence the development of a better control measures for the disease.

Socio-economic factors are the most important factors that can increase susceptibility to yaws infection in a population. Some of these factors include sharing of items (eg. sponge, towel, bedding, etc), staying in the same house with a yaws case, sleeping in the same room with a yaws case, playing with a yaws case and availability of water supply. Among famillies of low econmic status, it is a common phemenon for a number of children to share a room and sometimes bedding. Sometimes they may also share items such as towel, sponge and cloth. A number of yaws studies have established that such factors increase the risk of an infected person transfering the bacteria to an unifected person (Rinaldi, 2008 & Webber, 2005). Also according to the World Health Organization (WHO, 2012a) being a household member, classmate, school mate or a close playmate of a yaws case increase risk of infection.

Another socio-economic factor that can promote yaws infection is inadequate water supply. Regular bathing can help to reduce contact with *Treponema pertenue*. However, in areas where there is inadequate water supply, people will use the little water for cooking and drinking leaving nothing for bathing. This will promote poor personal hygiene and therefore increase contact with the bacteria.

Secondly, individual factors can also contribute to yaws infection. The age and sex of person will determine whether he/she will share items such as sponge, towel or bedding with a family member or whether he/she play with a yaws case. Also Muslims regularly wash their feet and hands before each of the five prayers in the day. This can promote personal hygiene and in effect limit contact with the yaws bacteria.

Lastly, the health seeking behaviour of people can affect their yaws infection status. People who visit the health facility for treatment have a greater chance of curing the disease than those who for various reasons do not. The personal and household factors of individuals can

determine whether they will visit health facility for yaws treatment. For example the age, sex, occupation and educational level of an individual can determine whether he/she will access health services.

1.4 Justification

For decades, Ghana has been a major yaws endemic country in West Africa (WHO, 2012c). According to the WHO because there is no official reporting system for the disease globally its cases have been under-reported in many countries (including Ghana) since the 1990s (WHO, 2017d). The Kintampo North Municipal Health Directorate has limited information on the extent of the disease in the population. This will therefore have a negative effect on the implementation of any effective intervention. Data is therefore needed on the prevalence of the disease and the factors associated with the disease in the district for effective planning of educational programmes to create awareness about the disease while working towards eradicating the disease as proposed by the World Health Organization.

This study will also serve as a reference material for further studies by researchers who are interested in yaws; a neglected tropical disease. The WHO has reported that about 75– 80% of all people with yaws are children less 15 years and the peak level of incidence is recorded in children aged 6–10 years (WHO, 2016). As such this study was limited to only children under 15 years.

1. 5 Research Objectives

1.5.1 Main Research Objective

The main objective of the study is to determine the factors associated with yaws infection in children less than 15 years in the Kintampo North Municipality.

1.5.2 Specific Research Objectives

1. To determine the prevalence of yaws among children less than 15 years in the Municipality
2. To determine the household factors associated with yaws infection in the Municipality
3. To determine the individual factors associated with yaws infection in the Municipality
4. To explore the health seeking behaviour of people with yaws infection in the Municipality

CHAPTER TWO

LITERATURE REVIEW

2.1 Global Yaws Epidemiology

The WHO launched the Global Yaws Programme in 1952. A treatment campaign by the WHO in the 1950s brought down the global burden of the disease by more than 90%, but was not able to eradicate the disease (Kazura, 2015). Cases re-emerged particularly in the 1970s and the year 2006. Today, more than 100 years after T. *pertenue* was discovered, yaws is still targeted for eradication (Walker & Hay, 2000). However, it is hoped that the disease can be eradicated in this latest attempt. Recent discoveries in the diagnosis and treatment of the disease have given the hope of eradication in the very near future. However, according to Stamm (2015) a number of road blocks must be removed to make this target achievable.

A records review of documents shows that more than 90 nations were regularly reporting yaws in the 1950s. However, since the 1990s, notification of the disease to the WHO has not been mandatory for countries and therefore the available data may be incomplete to give a clear picture of the global situation of the disease. According to the WHO, of 90 nations only 14 have data on yaws based on the routine reporting system. However, the data is just an indication of the existence of the disease and may not show its fullest extent of the disease burden (WHO, 2017b).

On the burden of the disease globally, the WHO estimates that more than 2 million cases of the disease were reported globally in the 1990s. The report indicates that more than 450,000 of the new cases have emerged since then and 99% of these cases were reported in central and West Africa (Santos, Faldetta, & Zaenglein, 2015). According to Mitjà et al. (2015), from the year 2010 to 2013, 256,343 cases of yaws were reported to the WHO from eleven countries. The countries include Ghana, Benin, Central African Republic, Cameroon, Côte

d'Ivoire, Republic of Congo, Democratic Republic of Congo, Papua New Guinea, Indonesia, Vanuatu and Solomon Islands. Togo & Timor- Leste is considered by the WHO as highly endemic nations (WHO, 2007).

Ghana appears to be one of the most endemic countries with yaws in the African. It has been reported that (84%) of all the yaws cases sent to the WHO between the year 2010 and 2013 were from Ghana and two other countries; Solomon Islands and Papua New Guinea (Mitjà et al., 2015).

However, Ghana can eradicate the disease like other countries have done. For example, extensive yaws control activities has led to the elimination of the disease in Ecuador and India recently (Kazura, 2015). The disease was officially eliminated in India in the year 2006. Ecuador also interrupted transmission of disease in the year 2003 (Santos et al., 2015).

2.2 Yaws Burden in the African Region

The full burden of the disease is unknown in Africa. However, according to WHO (2012a) the disease is present in more than ten countries in the region. In the Democratic Republic of Congo for instance, a yaws prevalence survey revealed that 32.6% of the population had lesions suggestive of yaws infection (Dhorda et al., 2009). In the 1950s a mass-treatment campaign in Cameroon reduced the burden of yaws in the country. Unfortunately, outbreaks occurred in the year 2007 and 2008 and affected hundreds of people in the eastern part of the country. According to Boock, Awah, Mou, & Nichter (2017) more than eight hundred suspected yaws cases were detected during these outbreaks.

In Benin, a study in 2012 among schoolchildren found the prevalence of yaws sign to be 1.1% and reactive serology of 2.4% (Kazadi, Asiedu, Agana, Mitja, & Mitjà, 2014). The yaws control programme in Central African Republic started in the year 2012. Recent survey indicated a prevalence of 11% *T. pallidum* infection among children in school and 85% prevalence of reactive serology (Kazadi et al., 2014). This implies, the yaws burden in the

country is quite high. The disease is also endemic in Côte d'Ivoire. In 2000 an estimated hospital based incidence of 0.58 per 1000 population was recorded. A another study revealed a prevalence rate 5 per 1000 population in the country (Touré, Koffi, Assi, Ake, & Konan, 2007).

The Republic of the Congo has three endemic regions but more than 19% of the districts in the country report yaws cases every year. The people who live in the forest part of the country are the people with most cases (Kazadi et al., 2014). In a screening exercise, Coldiron et al (2013) identified 8% clinical cases in the country.

Yaws has also been identified as a significant disease in Northern Region of Sierra Leone, requiring immediate public health action. According to Kazadi, Asiedu, Agana, & Mitja (2014) more than 90 cases were reported in the year 2003 in some rural communities of the country. No recent yaws survey has been conducted in the country and so there is no current data on the disease (WHO, 2014). In Togo, fifteen cases were reported in the southern region in the year 2010. However, in 1994, a study reported more than 5,000 cases among school pupils (Kazadi et al., 2014).

Also data collected by Marks et al.(2015) shows that the disease is highly endemic in the Solomon Islands. According to Marks et al. (2016), the Western part alone reported more 5,000 cases in 2013 which dropped to 2,252 cases in 2015.

Report from Indonesia indicates that presently, 18 of the 33 provinces report yaws cases. Five (5) of the 18 provinces are rated as highly endemic. The remaining provinces although were endemic in the past are now rated as having a very low burden of the disease. The Indonesian Ministry of Health (MOH) reported more than 700 new cases from some five provinces in October, 2009. Of them, 7400 of the cases were reported from active case search in some six (6) highly endemic districts. When trained health workers screened 169,571 villagers in 197 of these villages a case detection rate of 4.4% was reported in the year 2016 (WHO, 2017a).

2.3 Yaws Epidemiology in Ghana

According to Ghinai et al. (2015), in the 1950s and 1980s, two yaws control activities were carried out in Ghana using penicillin. This reduced the disease burden in the country significantly. However, the disease subsequently reappeared. Currently, Ghana is the main focus of yaws transmission in Africa reporting more than 20,000 yaws cases yearly from the year 2007 to 2010 (WHO, 2012a).

A 2008 survey in Ghana reported 0.68% as the prevalence of yaws lesions in the country; with a prevalence rate of about 20% in some rural communities (WHO, 2012a). According to Ghana Health Service (2015), between 2008 and 2014, the average number of clinical cases reported each year were over 16,000. The number of cases recorded in between 2008 and 2014 dropped by 92.7% from 28,080 in 2008 to 2037 in 2014. All regions in Ghana report yaws yearly; however, the Eastern, Ashanti, Brong Ahafo and the Western regions in the middle belt are the most endemic. The report again indicates that in 2012, 9,356 cases of yaws were reported out of which 534 were from the West Akim Municipality in the Eastern Region.

A survey conducted by Agana-Nsiire et al. (2014) in three districts in the Eastern Region of Ghana revealed that 1.92% of the children they examined had yaws lesions. Also 13% of the schools surveyed recorded prevalence between 5% - 10% while 3% recorded lower than 10% rate. Some schools had a prevalence rate as high as 19.5%. Fifty percent (50%) of the schools surveyed had cases.

An azithromycin mass drug distribution was conducted by Ghana for the control of trachoma between the period of 2001 and 2008 in two of the northern regions of the country. However, both regions are still routinely report cases of yaws to national office (Ghinai et al., 2015).

2.4 Attempts to Eradicate Yaws Globally

The attempt to eradicate the disease by the year 2020 is the second attempt to do away with the disease from human population. In 1950s, yaws was constantly reported in more than 40 countries. UNICEF and WHO therefore started a large scale treatment exercise using injectable penicillin. The large scale treatment was able to effectively interrupt transmission of the disease in some countries including Nigeria (Kazadi et al., 2014).

The campaign was however not sustainable owing to weak primary health systems and weak surveillance structures in resource- poor countries. Yaws reporting to the WHO was stopped by most countries and the official notification was abandoned in the 90s. This led to a resurgence of the disease in the 1970s. As at 1995, the WHO reported that there were still more than 2 million cases of endemic treponematoses around the globe (WHO, 2016).

Subsequently, a number of studies confirmed that a single oral dose of azithromycin can effectively clear the disease (Kwakye-Maclean et al., 2017, Mitjà et al., 2015, Maurice, 2014 and Mitjà et al., 2012) .The cure rate of oral azithromycin (>98%) has been found to be equivalent to that of a single intramuscular injection of long-acting penicillin (Kwakye-Maclean et al., 2017). This presented experts with a less costly form of treatment than the earlier form of treatment and a second opportunity to eradicate the disease.

India successfully eliminated yaws in the year 2006 (Narain, Jain, Bora, & Venkatesh, 2015). India is now a global icon for yaws eradication, demonstrating that yaws can be eradicated with intensified efforts.

2.5 Individual Factors Associated with Yaws Infection

Yaws affects mostly children between the ages of 2 to 15 years, who serve as the source of the infections. According to WHO (2016) majority of the cases are found in children aged 6 to 10 years. In Jamaica Saunders, Kumm, & Rerrie (1936) also reported similar findings. They reported the incidence of yaws in 10- 14 years to be 50% in the population studied.

The disease is common in males than females. This was also confirmed by Dzotsi et al. (2017). This difference is due to the fact that boys are very active therefore suffer more traumas than girls (Kazadi et al., 2014). In addition, in rural communities, the bushes around increase the risk of injury to the lower extremities of the body such as the legs and feet and therefore, as such there is more cases in the rural communities than the urban areas. An infected pregnant woman cannot transmit the disease to the unborn child.

Some studies have not been able to establish any association between educational level and yaws infection. Some researcher have showed that yaws cases declines with improved personal hygiene, more particularly regular bathing and good sanitation (Rinaldi, 2008).

2.6 Household Factors Associated with Yaws Infection

Household factors are an important factor in the transmission of yaws. A number of studies have established that overcrowding, poor personal hygiene and poor sanitation facilitate the spread of the disease. Dzotsi et al. (2017) established a statistically significant association between close contacts with yaws infected person and developing yaws infection. They identified that people who play with yaws cases, people who sleep in same room with yaws cases and people who lived with a yaw case in a same house were seventy times more likely to be infected with disease. The study also identified that sharing cloths and bedding with yaws case significantly increase ones risk of infection.

Rinaldi (2008) described yaws as a disease affecting populations living in poor rural communities with conditions of crowding, inadequate water supply, and poor sanitation and poor personal hygiene. Also according to WHO (2012a) being a household member, classmate, school mate or a close playmate of a yaws case increase risk of infection. In line with this, the WHO recommends that all close contacts of confirmed yaws cases should be treated in order to interrupt transmission of the disease in endemic communities.

2.7 Health Seeking Behaviour of People with Yaws Infection

Available data suggest that the transmission of the disease in some countries may be in some few “hard-to-reach populations” and communities. For instance, Fitzpatrick, Asiedu, & Jannin (2014) described yaws as disabling and disfiguring disease that "begins where the road ends". These communities have low standard of living, lack access to health facilities and personal hygiene and overcrowding is a typical feature. Delivery of health services to such communities can be challenging.

For instance, one of the highly endemic areas in Africa is the forested regions of DR Congo, Cameroon, Republic of the Congo and the Central African Republic. These areas are occupied by local people who live in distant communities with limited health care facilities (Kazadi et al., 2014). As such, it will be very difficult for people living in such areas to have access to health care for the disease.

Danso-Appiah et al. (2010) confirms that the perceived severity of neglected tropical diseases is very important in the health seeking behaviour of victims. For people to seek health care, they must consider the symptoms of the disease as a health threat and have resources available to attend a facility or buy drugs from the pharmacy. However, because yaws is not a fatal disease, most people with the disease may not report to any health facility for treatment. Most may consider it to be a normal sore and apply local treatment at home.

Again the cost of medicine, distance to hospital and user fees charged may also influence visit to a health facility for treatment. Most yaws endemic communities are very distant from health facilities; the affected people are very poor and may be able to travel to the facility for treatment. According to Marks et al. (2017) most of their study participants in Ghana reported that they would seek care from a doctor or nurse if they have yaws infections. Some participants preferred to buy drugs from the chemical shop or visit traditional healers for treatment rather than visiting the health facility. In their study, cost of treatment at the health

facility was the most common reason cited for not visiting the health facility for treatment of yaws.

A number of other studies have also reported on the factors associated with the health seeking behaviour of people with neglected tropical diseases. These factors include lack of knowledge on the infection's signs and symptoms (Mock, Acheampong & Koepsell, 1999), beliefs about supernatural cause of the disease (Marks et al., 2017 and Bosompem et al., 2004) and perception on the infection as untreatable because it is endemic in the area (Balen et al., 2007). People with higher educational attainments have also been identified to visit a health facility for treatment more often than those with lower educational attainments (Odogwu et al., 2006).

2.8 Summary of the Literature Reviewed

The reviewed literature provides knowledge and gaps on the global yaws situation. Notable among them is the fact that the global estimates of the burden of yaws are unclear. The true level of the disease is not known and may be higher than what is reported in most countries. This may be due to a number of factors, such as poor surveillance, underreporting and difficulties in diagnosis the disease in remote communities. Another key contributory factor may be the use of passive data for the estimation of the disease burden in most countries.

For example the WHO (2012a) has reported that Ghana seems to be the most yaws endemic country in the WHO African Region. However, this may not be the true because very few countries report yaws on their national surveillance system. Mitjà et al. (2015) has revealed that during the year 2010-2013, 84% of the global yaws cases reported to the WHO were from only three countries. They added that the incidence of yaws in 19 countries is unknown. The weaknesses of routinely reported data is a clear indication for countries to get an active surveillance system as used in the eradication activities for poliomyelitis and Guinea worm disease.

Although a number of studies (González-Beiras et al., 2017; Marks et al., 2016b; Marks et al., 2015; Mitjà et al., 2012) have proven that a dose of oral azithromycin can effectively treat yaws, the literature shows that in Ghana, some districts that undertook azithromycin MDA to eliminate trachoma between 2001 and 2008 still report cases of yaws (Ghinai et al., 2015). It is not clear whether these cases are due drug resistance or other causes.

The reviewed literature also considered number study methods. Some of the methods were not very practical for estimating the disease burden. For example in providing data on the global epidemiology of yaws, Mitjà et al. (2015) and Kazadi et al. (2014) used systematic review. Although this method helped to describe the global epidemiology of the disease, it was not able to identify the factors that determine the distribution of the disease globally. However, other studies such as Marks et al. (2017), Ghinai et al.(2015) & Nursalam (2014) used cross sectional study design to determine the factors that determine the spread of the disease in Vanuatu, Ghana and Solomon Island.

The elimination of the disease in India and Ecuador is a great success and a lesson for all countries reporting yaws like Ghana. The successful yaws elimination campaign in India has showed the world that yaws prevalence can be reduced to a zero level by using well planned activities by individuals, organizations and the government. It has again demonstrated that yaws eradication is a target within reach of most countries with the provision of sufficiently needed resources and political commitment (Narain et al., 2015).

Ecuador is also now a yaws-free country. This is the result of an intervention that lasted for more than 15 years. In order to achieve this goal, yaws control activities were integrated into already existing disease activities such as malaria and Onchocerciasis. Also the community intervention programme used local health workers who were trained on basic essential techniques of identifying the disease at the community level (Anselmi, Moreira, Caicedo, Guderian, & Tognoni, 2003).

Most of the yaws studies in Ghana are conducted in the Eastern Region (Dzotsi et al. 2017 and Agana-Nsiire et al. 2014). Although this region is among the most endemic regions in Ghana, data is also needed from the other endemic regions like Ashanti, Brong Ahafo and Western regions. In order to understand the yaws burden and its epidemiology in Ghana therefore, studies need to be conducted in the other regions.

CHAPTER THREE

METHODS

3.1 Study Design

The study was a cross-sectional study of selected basic schools in the Kintampo North Municipality. The design was used to collect data on the prevalence of yaws, factors associated with yaws infection in the Kintampo North Municipality including individual, health service, socio-economic and geographic factors. Yaws picture cards were used to collect data on the prevalence of yaws while a questionnaire was used to collect data on the factors associated with the disease.

3.2 Study Area

3.2.1 Location and Size of the Municipality

As shown in Figure 2, the Kintampo North Municipal is at the centre of Ghana and serves as a passage point between the northern and southern part of the country. Kintampo; the Municipal Capital is about 130km east of the Regional Capital. It is bounded by five districts. These districts are the Central Gonja to the North; Kintampo South to the South, East Gonja to the North-East; Bole to the West and Pru to the South- East. The Municipality has a land surface area of about 5,100km^2.

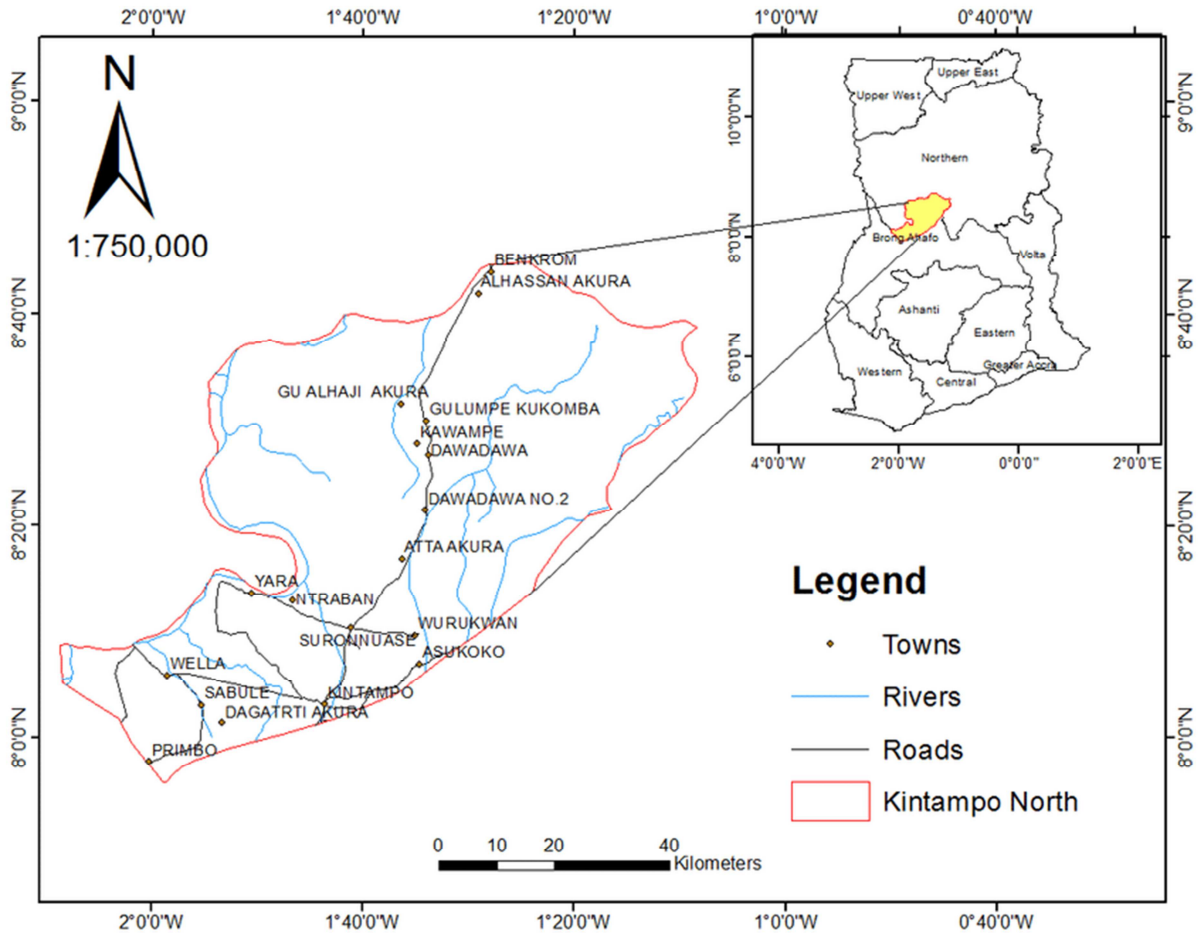

Figure 2: Map of Kintampo North Municipal

3.2.2 Population Size

The Kintampo North Municipality population is 95,480 comprising 47,302 (49.6%) male and 48,178 (50.4%) female. This population grows annually at a rate of 2.6%. The population density of the Municipality is estimated to be 21.75/km². Children who are less than 15 years form 42.4% (40,506) of the district population. The rural dwellers forms 43.2% of the population (Ghana Statistical Service, 2014)

3.2.3 Household Size

The average household size of the rural areas is 5.7 which is more than the urban average of 4.4 (Ghana Statistical Service, 2014). In the Municipality, children dominate in the members

of household population constituting 45% of household population. There are more male children (47.2%) than female children (42.7%) in the households (Ghana Statistical Service, 2014).

3.2.4 Health Facilities

The Kintampo North Municipality has one Hospital, two Health Centres and two Clinics. There are also nineteen CHPS centres and one Private Maternity Home in the Municipality. These facilities are anticipated to provide health care service to a population of 95,480 comprising 47,302 (49.6%) male and 48,178 (50.4%) female with a total land surface area of 5,108sq km. One Nurse is expected to provide health care to 4,781 Patients.

3.2.5 Source of Water

The main water sources in the district are protected wells (35.1%), Rivers/Streams (21.%), Borehole/pump/Tube well (12.0%), stand pipe and pipe borne water inside and outside dwelling are also important sources though they constitute less than 10 percent each. Majority of urban dwellers (51.4%) use water from a protected well while river/stream is the most common source for rural folks (42.2%).

3.2.6 Economic Activities

Farming is the principal occupation in the Kintampo North Municipal. Majority of the population are involved in agriculture and its associated activities. Yam is the major food stuff in the municipality and comprises the major income every community can boast of. Other farmers also engaged in the growing of Cassava, Plantain, Maize, Cowpea, Rice, Groundnut and Beans. Cashew and Mango are the main cash crops which have potentially increase the incomes of farmers in the area.

3.3 Variables of the Study

3.3.1 Dependent Variable

The dependent variable for this study was clinical signs of Yaws.

3.3.2 Independent Variables

The independent variables of interest are grouped into three categories; individual, household and health seeking behaviour. This is shown in Table 2 and how these variables were measured is shown in Table 3, Table 4 and Table 5.

Table 2: Factors Associated with Yaws Infection

Individual Factors	Household Factors	Health Seeking Behaviour
Age	Sharing of personal items	Visit to health facility
Sex	Staying in the same house with a yaws case	Treatment Given
Educational level	Number of persons per room	Determinants of health seeking
Ethnicity	Playing with a yaws case	
Occupation of guardian	Sharing a room with a yaws case	
Religion of guardian	Source of water supply	
Bathing status		

Table 3: Individual Factors and how they were be measured

Variable	Operational Definition	Scale of Measurement	Source of Data
Age	Age of respondent at last birthday	Continuous- (discrete in years)	Interview/Record Review
Sex	Biological make-up of respondent	Nominal	Observation
Educational level	Respondent class in primary school	Nominal	Interview
Ethnicity	Ethnic group of respondent	Nominal	Interview
Occupation of guardian	Occupation of respondent's guardian	Nominal	Interview
Religion	Religion of respondent	Nominal	Interview
Bathing status	Bathed before coming to school	Discrete	Interview

Table 4: Household Factors and how they were measured

Variable	Operational Definition	Scale of Measurement	Source of Data
Sharing of personal items	Sharing of personal items such as sponge, towel, cloth and bedding	Discrete	Interview
Staying in the same house with a yaws case	Staying together in the same house with someone with yaws	Discrete	Interview
Number of persons per room	Number of persons who share the same room in the household	Discrete	Interview
Playing with a yaws case	Having a playmate who is a yaws case	Discrete	Interview
Sharing a room with a yaws case	Sleeping in the same room with a yaws case	Discrete	Interview
Source of water supply	Source of water supply for the household	Nominal	Interview

Table 5: Health Seeking Behaviour and how they were measured

Variable	Operational Definition	Scale of Measurement	Source of Data
Visit to health facility	Visit to health facility for treatment after yaws infection	Ordinal	Interview
Treatment Given	Type of treatment given for yaws treatment	Nominal	Interview
Determinants of health seeking	The reasons why participants did not seek treatment at health facility	Nominal	Interview

3.4 Study Population

The study population was children under 15 years in primary school in the Kintampo North Municipality. This population was used for the study because the WHO report that about 75–80% of all people with yaws are children less than 15 years and the peak level of incidence is recorded in children aged 6–10 years (WHO, 2016).

3.5 Inclusion Criteria

All children aged less than 15 years and are in primary school in the Kintampo North Municipality during the study period were eligible to be enrolled in the study.

3.6 Exclusion Criteria

However, pupils who are in primary school and are more than 15 years were included in the study. Also very young children who could not talk were excluded from the study. Children who are in school but are very sick or hospitalized were also excluded from the study because of their inability to respond to the questionnaire.

3.7 Sample Size Determination

The sample size for the study was determined by adopting a sample size calculation formula for cross sectional surveys (Charan & Biswas, 2013). This formula is stated below:

$$Sample\ Size\ (n) = \frac{Z^2 p(1-p)}{d^2}$$

where:
Z = z statistic for a level of confidence
p = expected prevalence or proportion in the population based on previous studies
d = margin of error or precision

A nationwide survey by National Yaws Elimination Programme estimated a prevalence rate of up to 20% of clinical yaws among the under 15 years in some rural communities in Ghana (WHO, 2012a). Therefore with the prevalence of 20% in the under 15 year population in the Municipality, with a precision or margin of error of 5%, the sample size for this study was estimated to be:

$$\boldsymbol{n = \frac{1.96^2 x 0.20(1-0.20)}{0.05^2} = 245.9}$$

Accounting for 10% non-response rate, the total sample used is 270.

3.8 Sampling Method

Three of the seven (7) educational circuits in the Municipality were randomly selected for the study. The names of the seven circuits were written on pieces of papers. The papers were then folded and placed in a container and shuffled. After that three of the papers were selected at random without replacement. The three randomly selected circuits are Asantekwa, Kadelso and Kunsu.

In each of the selected circuit, a random sample of three (3) primary schools was taken. In order to get the schools, a list of the primary schools in each circuit was obtained from the Municipal Education Office and a random sample was taken. In the selected schools,

systematic sampling was used to select 30 pupils each. The following steps were followed to obtain the sample:

1. A sampling interval was determined by dividing the total number of pupils in the school by the sample size of 30.
2. The list pupils in each class register was put together and numbered to form the sampling frame.
3. To get the first sample, a random number between one (1) and the sampling interval was selected.
4. The subsequent samples were obtained by adding the sampling interval to the previous number selected.

In all cases, pupils whose names corresponded to the selected numbers were included in the study. In cases where the selected pupil was not in school or refuses to take part in the study, a replacement was made.

3.9 Data Collection Method and Tool

The pupils who agreed to take part in the study were interviewed using a structured questionnaire shown in Appendix C. The structured questionnaire contained items on individual factors, household factors and health seeking behaviour associated with yaws infection. In order to identify those pupils with yaws, any skin condition identified was compared with yaws pictures in the WHO Yaws Recognition Booklet (WHO, 2012b).

3.10 Data Management

The data was entered into electronic forms on smart phones with Open Data Kit (ODK) Collect version1.18.1. The Principal Investigator cleaned and crossed checked the data

collected by each data collector on daily basis for accuracy, consistency and completeness before uploading to the ODK Collect web server.

3.11 Data Analysis

First the data was exported from ODK Collect to Microsoft Excel spread sheet. It was then exported into Stata 15.0 (StataCorp, 2017) for cleaning, analysis and presentation of the results.

Descriptive statistics was first done by running frequencies and proportions. A continuous variable such as age was summarized into mean. Age was then categorized into two categories. Pearson chi-square test was done to determine the significance difference between yaws infection and the categorical variables and was presented as a contingency table with p-values. For variables with frequencies less than five, the Fishers exact test was done to determine the association. After this analysis, all variables with p-value <0.05 were considered to be statistically significant with yaws infection.

Such variables were then put into simple and multiple logistics regression to determine the strength of the association. The result was presented in a two by two table to display frequencies, crude and adjusted odds ratios, 95% confidence interval and p-values.

The yaws prevalence was estimated by school and by circuit and presented as point estimates with 95% confidence bands using the Stata 15.0 software.

3.12 Quality Control

Training was organized for data collectors (Disease Control Officer Trainees) from the College of Health and Well-Being, Kintampo on how to use the WHO Yaws Recognition Booklet to identify yaws cases and administration of the questionnaires. The content of training was included how to use Smartphone with ODK Collect (Open Data Kit) to collect

the data at the point of collection. The ODK application was installed on the phones of all the five data collectors.

To minimize errors during the data entry, checks were introduced on the questionnaire on smart phones to prompt data collectors on any errors. To minimize errors during the data entry, checks were introduced into the questionnaire to prompt data collectors about any errors or wrong entries. Some of these checks include skip patterns that did not allow the data collectors to enter data into any field that was not necessary or applicable. Again, a prompt message was given when an attempt was made to enter a number in a field that required text. The application also did not allow data collector to move to the next question unless all necessary fields are filled.

After the data on the ODK collect was exported to Microsoft Excel, the electronic forms were deleted from all the mobile phones of the data collectors and the excel file was password protected.

3.13 Ethical Consideration

Ethical approval for this study was sought from the Ghana Health Service Ethics Review Committee (GHSERC079/12/17) before the commencement of the study. Permission was also sought from the Kintampo Municipal Education Directorate before the commencement of the study in the selected primary schools.

Informed written consent was obtained from each child's parent or guardian, and assent was gained from the pupils through school teachers who are fluent in the local dialect of the child. Participation in the study was entirely voluntary and willingness to participate is was be confirmed by either signing or thumb printing a consent form. Respondents who agreed to take part in the study were at liberty to withdraw from the study at any point in time.

The study objectives and procedure for the data collection, as well as the benefits associated with participating in the study was explained to the study participants in the local language. All selected participants were given a consent form to be sent to their parent/guardian before participating in the study. Pupils whose parent/guardian agree for them to part in the study were made to sign/thumbprint and assent form before inclusion in the study. Pupils who did not obtain parental consent or personally refused to participate in the study and those who did not return their consent forms were not allowed to take part in the study. Study participants who did not understand the study upon several explanations were excluded from the study.

The privacy and confidentiality of the participants was ensured at all stages of the study. The questionnaire was administered to the study participants individually in an enclosed area. Also female data collectors only examined girls for their yaws infection status and male data collectors also examined only boys.

The questionnaire did not also make use of names of the participants but rather serial numbers. The data was analysed in aggregated fashion with no link to individual records to ensure confidentiality. No child was named in the report. All the information obtained from the participants was kept confidential and was used for the purpose indicated for this study alone. The participants were not paid or compensated in any form for participating in the study.

The researcher has no conflict of interest in the study and entire cost of the study borne by the researcher.

CHAPTER FOUR

RESULTS

4.1 Characteristics of Study Participants

A total of 272 children below 15 years were included in this study. These children were recruited from nine (9) basic schools in three educational circuits in the Kintampo Municipality. Three schools each were selected from the Asantekwa, Kadelso and Kunsu educational circuits. Among the 272 participants, 34.1% were from the Asantekwa Circuit, 33.5% from the Kadelso circuit and 32.4% from the Kunsu circuit.

As shown in Table 6, more than half (56.99%) of the participants were males. The ages of the study participants ranged from 5 years to 14 years with a mean age of 11 years (standard deviation=2). Out of the 272 participants, 37.17% were within the age group 5-10 years and the remaining participants were between 11-14 years.

More than half (54.41%) of the participants were in the lower primary and 50.37% of the guardian of the participants were Muslims and 45.59% of them were Christians. The predominant occupation of the guardian of the participants was farming which represented 78.68%. Also 12.13% were trading and 1.1% were government workers. On their ethnicity, 22.79% of them were Dargati, 23.79% Gonja, 15.07% Mo, 6.62% Sisala and 5.1% Konkomba.

Table 6: Characteristics of Study Participants

Variable	Number (N)	Percentage (%)
Sex		
Male	155	56.99
Female	117	43.01
Age in years (M±SD)	11 (± 2)	
Age Group		
5- 10 years	101	37.13
11 – 14 years	171	62.87
Class		
Primary One	63	23.16
Primary Two	35	12.87
Primary Three	50	18.38
Primary Four	50	18.38
Primary Five	43	15.81
Primary Six	31	11.4
Religion of guardian		
Christian	124	45.59
Muslim	137	50.37
Traditionalist	7	2.57
None	4	1.47
Ethnicity		
Akan	12	4.41
Mo	41	15.07
Konkomba	15	5.51
Gonja	65	23.9
Dagarti	62	22.79
Dagomba	15	5.51
Sisala	18	6.62
Others	44	16.18
Occupation of guardian		
Farming	214	78.68
Trading	33	12.13
Government Worker	3	1.1
Unemployed	5	1.84
Others	17	6.25

M: Mean, SD: Standard Deviation

4.2 Prevalence of Yaws

The prevalence of yaws lesions in the study was found to be 23.53% (95% CI 18.84% - 28.97%). As shown in Figure 3, the commonest sign among the yaws cases was macule

(32.81%) followed by papilloma (28.13%), ulcer (25.0%), hyperkeratosis (10.94%) and bone swelling (3.13%).

As shown in Table 7 the yaws prevalence in the schools studied ranged from 6.45% - 40%. The Kurawura Akura LA Primary School recorded the highest rate of 40%, followed by the Asantekwa SDA Primary (37.5%), Yabraso RC Primary (55.48%), and Kadelso LA Primary (33.33%). The lowest rate was recorded in the Alhassan Akura L/A Primary School (6.4%).

The yaws prevalence rate in the three circuits ranged from 10.23% in the Kunsu circuit to 33.33% in the Asantekwa circuit (Figure 4)

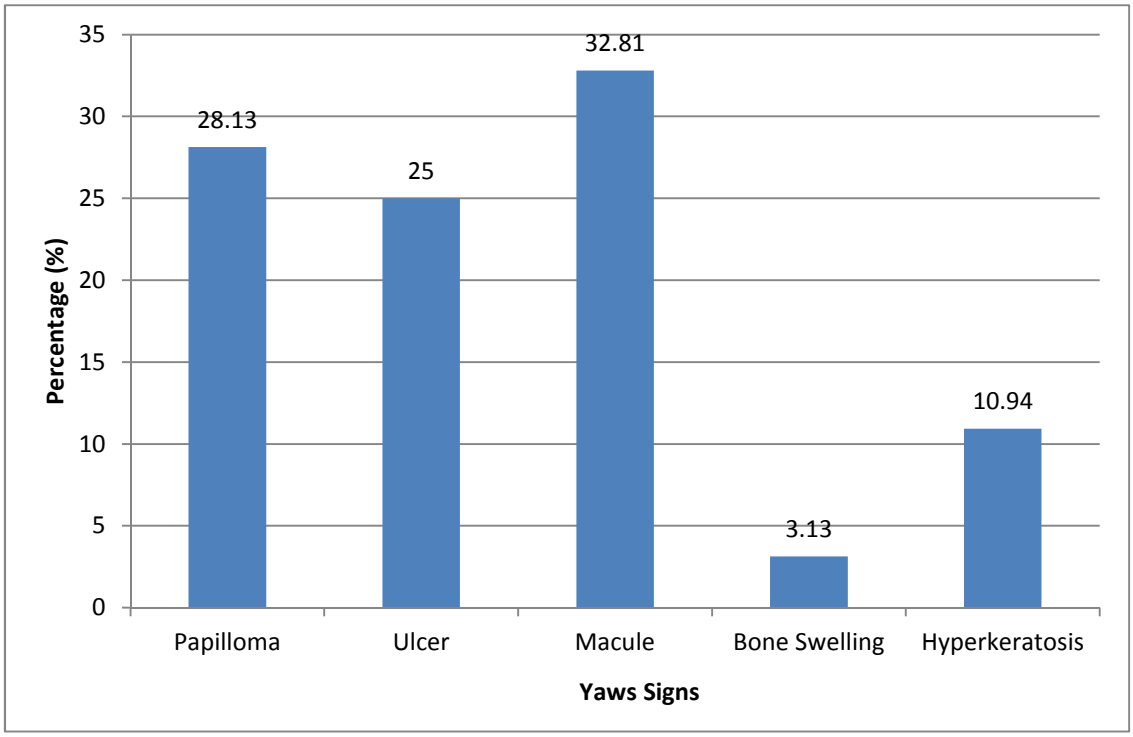

Figure 3: Signs of yaws present among those who were found to have yaws

Table 7: Yaws Prevalence by School

Name of School	Number (N)	Number Infected (%)
Alhassan Akura LA Primary	31	2 (6.45)
Asantekwa SDA Primary	32	12 (37.50)
Badu Akura RC Primary	30	2 (6.67)
Kadelso LA Primary	30	10 (33.33)
Kunsu Methodist Primary	28	4 (14.29)
Kurawura Akura LA Primary	30	12 (40.00)
Nyaabea LA Primary	30	8 (26.67)
Wurukwan LA Primary	30	3 (10.00)
Yabraso RC Primary	31	11 (35.48)

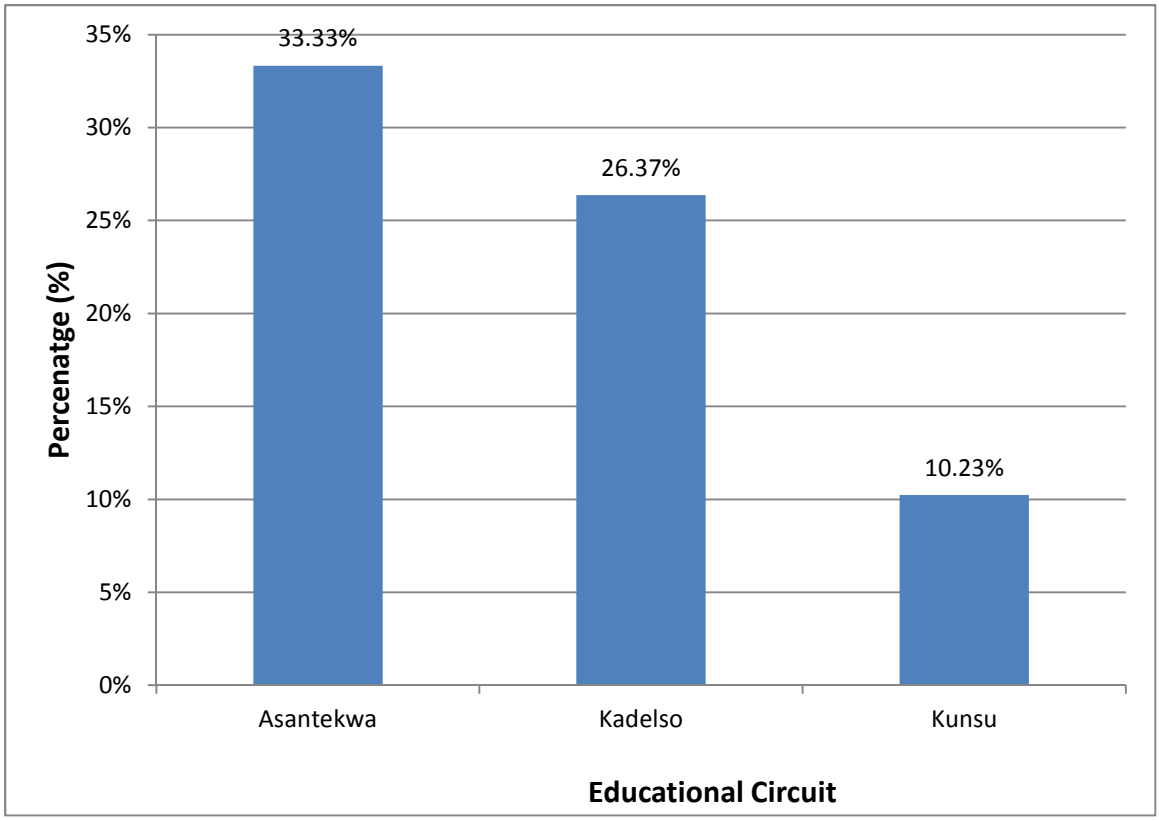

Figure 4: Prevalence of yaws by Circuit

4.3 Individual Factors and Yaws Infection

Table 8 shows the individual factors associated with yaws infection. Participants within the age group 5-10 years had more yaws infection (53.13%) than those aged 11-14 years (46.88%). Age was found to be associated with yaws infection ($\chi 2$: 25.83, p = 0.002). With respect to participants' class, the study showed that 37.50% of the yaws cases were in Class One, 18.75% in Class Three, 17.19% in Class Two, 10.94% in Class Four and 7.81% in both Class Five and Six. The class of the participant was found to be associated with yaws (p-value: 0.01). On the occupation of guardian of the participants and yaws infection, 68.75% of the yaws cases occurred among participants whose guardians were farmers, 23.44% among the children of traders and 4.69% among those of whose guardian were unemployed. No case was recorded among the children of government workers. The occupation of the guardian was found to be associated with yaws (p = 0.004).

Most of the participants bathed twice in a day (50.00%). The remaining (48.44%) bath once in a day and (1.56%) sometimes do not bath in day. The number of baths in a day was found to be statistically significant with yaws infection (p = 0.024).

Table 8:Chi-Square Analysis of the Individual Factors

Variables	Total (%)	Yaws Infection		$\chi 2$	P-value
		Yes (%)	No (%)		
Sex				0.53	0.465
Male	155(56.99)	39 (60.94)	116 (55.77)		
Female	117 (43.01)	25 (39.06)	92 (44.23)		
Age				25.83	**0.002**
5- 10 years	101 (37.13)	34 (53.13)	67 (32.21)		
11 – 14 years	171 (62.87)	30 (46.88)	141 (67.79)		
Class				**Ψ**	**0.01**
Primary One	63 (23.16)	24 (37.5)	39 (18.75)		
Primary Two	35 (12.87)	11 (17.19)	24 (11.54)		
Primary Three	50 (18.38)	12 (18.75)	38 (18.27)		
Primary Four	50 (18.38)	7 (10.94)	43 (20.67)		
Primary Five	43 (15.81)	5 (7.81)	38 (18.27)		

Primary Six	31 (11.40)	5 (7.81)	26 (12.5)		
Religion of guardian				**Ψ**	0.313
Christian	124 (45.9)	25 (39.06)	99 (47.60)		
Muslim	137 (0.37)	36 (56.25)	101 (48.56)		
Traditionalist	7 (2.57)	1 (1.56)	6 (2.88)		
None	4 (1.47)	2 (3.13)	2 (0.96)		
Ethnicity				**Ψ**	0.079
Akan	12 (4.44)	2 (3.13)	10 (4.81)		
Mo	41 (15.19)	8 (12.5)	33 (15.87)		
Konkomba	15 (5.56)	6 (9.38)	9 (4.33)		
Gonja	65 (24.07)	18 (28.13)	47 (22.6)		
Dagarti	62 (22.96)	11 (17.19)	51 (24.52)		
Dagomba	15 (5.56)	8 (12.5)	7 (3.37)		
Sisala	18 (6.67)	4 (6.25)	14 (6.73)		
Other	42 (15.56)	7 (10.94)	37 (17.79)		
Occupation of guardian				**Ψ**	**0.004**
Farming	214 (78.68)	44 (68.75)	170 (81.73)		
Trading	33 (12.13)	15 (23.44)	18 (8.65)		
Gov. Worker	3 (1.10)	0 (0.00)	3 (1.44)		
Unemployed	5 (1.84)	3 (4.69)	2 (0.96)		
Other	17 (6.25)	2 (3.13)	15 (7.21)		
No. of baths in a day				**Ψ**	**0.024**
None	3 (1.10)	1 (1.56)	2 (0.96)		
Once	95 (34.93)	31 (48.44)	64 (30.77)		
Twice	174 (63.97)	32 (50.00)	142 (68.27)		
Bathing on interview day				**Ψ**	0.999
Yes	269 (98.90)	64 (100.00)	205 (98.56)		
No	3 (1.10)	0 (0.00)	3 (1.44)		
Bathing with soap on the day of interview [§]				4.09	0.129
Yes	256 (9.17)	58 (90.63)	198 (96.59)		
No	13 (4.83)	6 (9.38)	7 (3.41)		

χ2 – chi-square, Ψ- Fishers exact, Bolded p values means statistically significant difference, § - excludes those who did not bath on the day of interview, Gov. Worker –government worker.

4.4 Household Factors and Yaws Infection

Table 9 shows association between household factors and yaws infection. Majority of the participants has never shared underwear (90.63%). The sharing of underwear was found to be statistically significant ($\chi 2$: 15.44, $p < 0.001$). Most (92.19%) of the yaws cases had ever shared bedding. The sharing of bedding was found to be associated with yaws ($\chi 2$: 6.23, $p < 0.013$). Sleeping in the same room with a yaws infected person was found to be associated with yaws ($\chi 2$: 32.69, $p < 0.001$). Most (65.63%) of the yaws had never slept in the same room with an infected person. Playing with an infected person was statistically significant with yaws infection ($\chi 2$: 44.42, $p < 0.001$). Most of the yaws cases (64.06%) had ever played with a yaws case. Of the 64 yaws cases, 60.94% had never stayed in the same house with yaws case. Staying in the same house with an infected person was also found to be associated with the disease ($\chi 2$: 27.78, $p < 0.001$). Majority (29.69%) of the cases use borehole as their source of drinking water, 23.44% use pipe borne water and 18.75% use well. The source of drinking water was found to be statistically significant ($p = 0.001$).

Table 9: Chi-Square Analysis of the Household Factors

Variables	Total (%)	Yaws Infection		$\chi 2$	P-value
		Yes (%)	No (%)		
Sharing Sponge				1.44	0.231
Yes	148 (54.41)	39 (60.94)	109 (52.40)		
No	124 (45.59)	25 (39.06)	99 (47.60)		
Sharing Towel				0.52	0.47
Yes	138 (50.74)	35 (54.69)	103 (49.52)		
No	134 (49.26)	29 (45.31)	105 (50.48)		
Sharing Cloth				0.19	0.662
Yes	25 (9.19)	5 (7.81)	20 (9.62)		
No	247 (90.81)	59 (92.19)	188 (90.38)		
Sharing Shirt/dress				0.50	0.478
Yes	20 (7.35)	6 (9.38)	14 (6.73)		
No	252 (92.65)	58 (90.63)	194 (93.27)		
Sharing Underwear				15.44	**<0.001**

Yes	7 (2.57)	6 (9.38)	1 (0.48)		
No	265 (97.43)	58 (90.63)	207 (99.52)		
Sharing Bedding				6.23	**0.013**
Yes	222 (81.62)	59 (92.19)	163 (78.37)		
No	50 (18.38)	5 (7.81)	45 (21.63)		
No. of persons sharing one room				1.44	0.487
01-Feb	57 (20.96)	10 (15.63)	47 (22.60)		
03-Apr	100 (36.76)	25 (39.06)	75 (36.06)		
5 and above	115 (42.28)	29 (45.31)	86 (41.35)		
Ever slept in same room with yaws infected person				32.57	**<0.001**
Yes	36 (13.24)	22 (34.38)	14 (6.73)		
No	236 (86.76)	42 (65.63)	194 (93.27)		
Ever played with a yaws infected person				44.42	**<0.001**
Yes	83 (30.51)	41 (64.06)	42 (20.19)		
No	189 (69.49)	23 (35.94)	166 (79.81)		
Ever stayed in same house with yaws infected person				27.78	**<0.001**
Yes	47 (17.28)	25 (39.06)	22 (10.58)		
No	225 (82.72)	39 (60.94)	186 (89.42)		
Source of drinking water				**Ψ**	**0.001**
Pipe borne	55 (20.22)	15 (23.44)	40 (19.23)		
Borehole	115 (42.28)	19 (29.69)	96 (46.15)		
Well	45 (16.54)	12 (18.75)	33 (15.87)		
Dam	11 (4.04)	3 (4.69)	8 (3.85)		
River	12 (4.41)	9 (14.06)	3 (1.44)		
Stream	34 (12.5)	6 (9.38)	28 (13.46)		

χ2 – chi-square, Ψ- Fishers exact, Bolded means statistically significant difference,

4.5 Associations Identified with Logistic Regression

Table 10 shows the univariate and multivariate logistic regression analysis of the Individual factors associated with yaws infection. At the univariate analysis level, the odds of

participants aged 5-10 years developing yaws is 2.39 times higher than that of participants aged 11-14 years (CI: 1.35 – 4.22, p = 0.003). Also the odds of participants in Primary One developing yaws is 3.20 times the odds of a Primary Six participant (CI: 1.08 – 9.46, p = 0.035). The odds of the participants whose guardian is a trader developing yaws is 6.25 compared with the odds of participants whose guardian is a government worker (CI: 1.23 – 31.80, p = 0.027). Participants whose guardian is unemployed also have 11.25 times the odds of participants whose guardian is a government worker (CI: 1.11 – 114.37, p = 0.041). The Table also shows that odds of participants who bath once in a day developing yaws is 2.20 times the odds of those who bath twice daily (CI: 1.24 – 3.91, p = 0.007). Sharing underwear was significantly associated with yaws infection. Participants who share underwear had 24.41 times higher the odds of developing yaws compared with those who do not share underwear (CI: 2.52–181.45, p = 0.005). Also sharing bedding, sleeping in the same room with an infected person, playing with a case and staying in the same house with a case were significantly associated with the disease. Participants who sleep in the same room with a yaws case had 7.26 times odds of developing the disease compared to those who do not sleep with a case (CI: 3.43–15.34, p < 0.001) and those who played with a case had 7.05 times higher odds than those who do not play with a case (CI: 3.81–13.80, p < 0.001). Participants who use river as a source of drinking water recorded 8 times odds of developing the disease compared to those who use pipe borne water (CI: 1.90–33.60, p = 0.005).

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However, at the multivariate analysis level the factors that remained significant include trading (AOR: 13.64, CI: 1.65 – 112.61), playing with a yaws case (AOR: 3.54, CI: 1.47 – 8.54), river as a source of drinking water (AOR: 11.85, CI: 1.87 – 75.17) and participants who use stream as source of drinking water had 83% reduced odds as compared to those who use pipe borne water (AOR: 0.17, CI: 0.04 – 0.74) .

Table 10: Logistic Regression Analysis of the Factors Associated with Yaws Infection

		Unadjusted			Adjusted		
Variable	**N**	**OR**	**95% CI**	**P value**	**OR**	**95% CI**	**P value**
Age							
5- 10 years	101	2.39	1.35 – 4.22	**0.003**	2.48	0.93 – 6.61	0.069
11 – 14 years (Ref)	171	1.00					
Class							
Primary One	63	3.20	1.08 – 9.46	**0.035**	1.79	0.31–10.36	0.517
Primary Two	35	2.38	0.72 – 7.86	0.154	1.83	0.34– 9.85	0.481
Primary Three	50	1.64	0.52 – 5.22	0.401	1.33	0.28 – 6.39	0.725
Primary Four	50	0.85	0.24 – 2.94	0.793	1.13	0.21 – 5.98	0.884
Primary Five	43	0.68	0.18 – 2.60	0.578	1.22	0.23– 6.37	0.817
Primary Six (Ref)	31	1.00					
Occupation of guardian							
Gov. Worker (Ref)	3	1.00					
Trading	33	6.25	1.23 –31.80	**0.027**	13.637	1.65–112.61	**0.015**
Farming	214	1.94	0.43 – 8.81	0.39	2.7137	0.39– 19.08	0.316
Unemployed	5	11.25	1.11 -114.3	**0.041**	5.3858	0.25–112.76	0.279
Others	17	1					

Number of baths in a day							
Twice (Ref)	174	1					
Once	95	2.2	1.24 – 3.91	**0.007**	2.07	0.93 – 4.60	0.075
None	3	2.23	0.20 –25.40	0.517	0.5	0.03 – 8.86	0.633
Sharing Underwear							
Yes	7	21.414	2.52–181.45	**0.005**	14.437	0.73 –284.04	0.079
No (Ref)	265						
Sharing Bedding							
Yes	222	3.2577	1.23 – 8.60	**0.017**	2.9639	0.74 – 11.84	0.124
No (Ref)	50						
Ever slept in same room with yaws infected person							
Yes	36	7.2585	3.43 – 15.34	**<0.001**	1.2299	0.28 – 5.33	0.782
No (Ref)	236						
Ever played with a yaws infected person							
Yes	83	7.05	3.81 – 13.80	**<0.001**	3.54	1.47 – 8.54	**0.005**
No (Ref)	189						
Ever stayed in same house with yaws infected person							
Yes	47	5.42	2.78 – 10.58	**<0.001**	2.64	0.64 – 10.83	0.178
No (Ref)	225						
Source of drinking water							
Pipe borne (Ref)	55						
Borehole	115	0.53	2.44 – 1.14	0.104	0.54	0.19 – 1.51	0.241
Well	45	0.97	0.40 – 2.36	0.946	0.75	0.24 – 2.33	0.616
Dam	11	1.00	0.23 – 4.28	1.000	0.41	0.04 – 4.01	0.444
River	12	8.00	1.90 – 33.60	**0.005**	11.85	1.87 – 75.17	**0.009**
Stream	34	0.57	0.20 – 1.65	0.302	0.17	0.04 – 0.74	**0.017**

N: Number, Ref: Reference, CI: Confidence Interval, UOR: Unadjusted Odds Ratio, AOR: Adjusted Odds Ratio,

Bolded p values means statistically significant

4.6 The Health Seeking Behaviour of Yaws Cases

Of the 64 children who had signs of yaws infection, only 21.9% had been sent to a health facility for treatment. The remaining majority of 78.1% had not visited any health facility for treatment of the condition. Of those who had not visited any health facility, 86.0% bought drugs from the drug store, 12% did not use any treatment and 2% used local treatment. For those who had not attended any health facility, the following reasons (Figure 5) were cited for not visiting a health facility.

Majority of the respondents in this study cited financial problem (30%) as the main hindrance for not visiting the health facility for treatment. Other reasons cited include busy schedule (18%), long distance to health facility (12%) and parents refusing to send child for treatment. It is also important to note that 4% did not visit a health facility because they considered the condition as a normal.

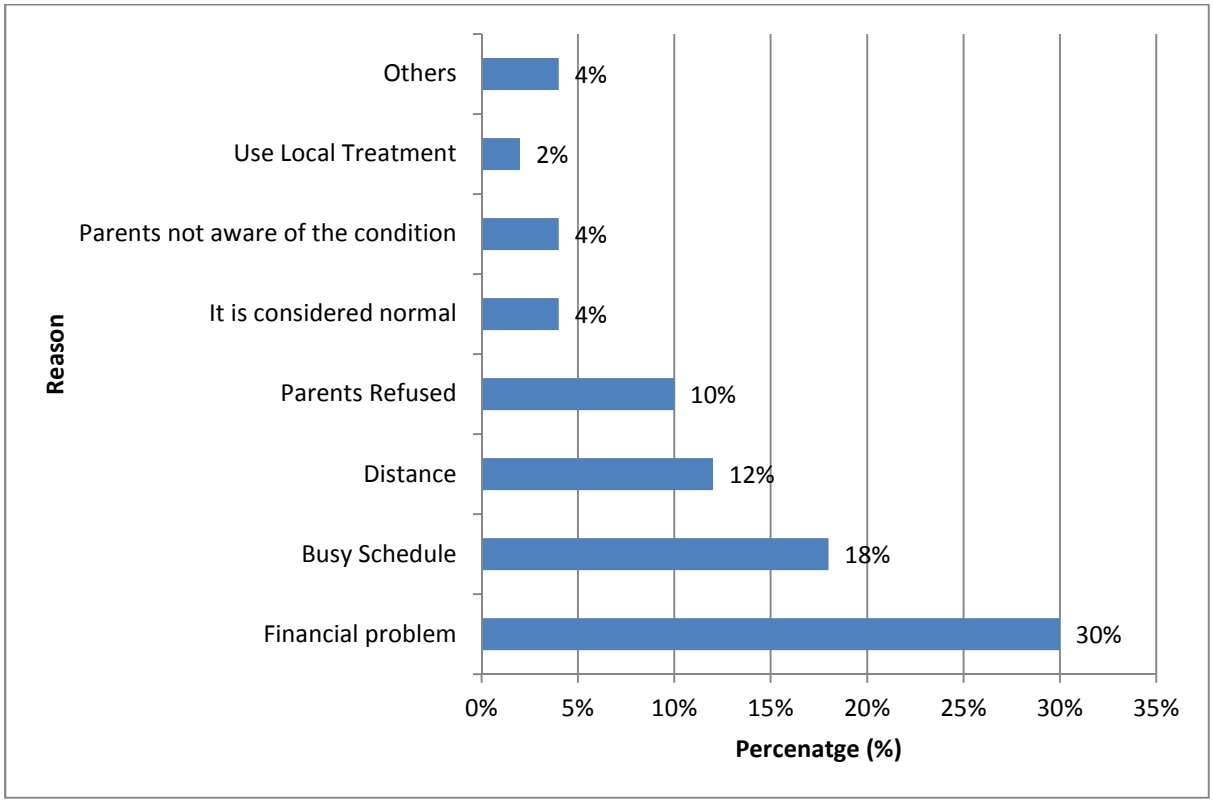

Figure 5: Reasons for not visiting a Health Facility for the treatment of yaws

CHAPTER FIVE

DISCUSSIONS

5.1 Yaws Prevalence

This study revealed a yaws prevalence of 23.53% in the Kintampo North Municipality. This figure is very high if compared to recent studies in other parts of Ghana and elsewhere where the disease is endemic. For instance, Agana-Nsiire et al. (2014) reported a prevalence of 1.92% (95% CI: 1.86–1.98) in three districts in the Eastern Region of Ghana. Also Kazadi et al. (2014) reported 1.1% among school children in Benin.The high prevalence of yaws in this study may be attributed to the fact that the study was conducted in rural communities. This confirms the WHO (2016) report that yaws cases are more common in the rural communities where access to health service and other social amenities are limited. It is therefore important for health professionals in the various health facilities in the municipality, more especially those in the rural communities, to be trained on yaws diagnosis so that they can easily identify and treat children with the disease.

However, the prevalence of yaws identified in this is low compared to other studies elsewhere. In the Democratic Republic of Congo for instance, a yaws prevalence of 32.6% was reported by Dhorda et al. (2009) and Marks et al. (2016b) reported 27.5% in the Solomon Islands.

The common signs seen among the cases identified in this study were macule (32.8%), papilloma (28.1%), ulcer (25.1%), hyperkeratosis (10.9%) and bone swelling (3.1%). This finding implies that 86% of the yaws cases identified in this study are infectious and as such more school children stand the risk of becoming infected with the disease. Health authorities in the Municipality therefore need to take immediate action to stop the spread of the disease.

5.2 Factors Associated with Yaws Infection

The multiple logistic regression analysis showed that the factors that independently explain the cause of yaws infection in the Municipality are having a guardian who is a trader (p = 0.015, 95%CI: 1.65–112.61), ever played with a yaws infected person (p = 0.005, 95%CI: 1.47 – 8.54), and the usong river (p = 0.009, 95%CI: 1.87 – 75.17) or stream (p = 0.017, 95%CI: 0.04 – 0.74) as the source of drinking water.

According to Tettey (2009), the occupation of a parent or guardian is a significant determinant of yaws infection in the household. Most people in the Kintampo North Municipality are traders who commute to the Municipal capital, Kintampo every Wednesday for trading. Such Traders who are parents or guardian may have little time for the personal hygiene of their children and therefore increase their risk of getting the disease.

Children who have ever played with a yaw case have an increased their risk of coming in contact with an infected sore and therefore becoming infected with yaws. The World Health Organization has stated in a number of its publications that being a playmate with a yaws case increase ones risk of acquiring the disease (WHO, 2017; WHO, 2016; WHO, 2012a & WHO, 2010). This finding confirms the need to treat all contacts in yaws eradication programmes. The WHO new treatment policies for yaws eradication emphasizes a pragmatic method to deal with cases and all possible household, school or community contacts in order to interrupt transmission in a reasonably short time, leading to the total eradication of the disease (WHO, 2012a).

Although Dzotsi et al. (2017) reported that inadequate water supply at homes was not significantly associated with yaws infection, this study shows that the source of drinking water is significantly associated with the infection. Households that use river or stream as the source of drinking water may not have enough water during certain periods in the years. In

such homes, people will use the little water they have for cooking and drinking leaving litle or nothing for bathing. It therefore important to provide portable water for these communities to reduce their risk of the infection.

5.3 Health Seeking Behaviour of People with Yaws Infection

On the health seeking behaviour of the participants with yaws, this study revealed that only 21.9% of the participants who had yaws had sought treatment at a health facility. Of those who had not visited any health facility, 86.0% bought drugs from the drug store, 12% did not use any treatment and 2% used local treatment. Marks et al., (2017), however, reported that most of the participants in their study reported they would seek care at a health facility for yaws treatment. This study was conducted in a rural setting where access to health care is limited. The only available means of healthcare in most of the villages is private chemical sellers. This may be the reason why most of the participants prefer to buy drugs from the chemical shop rather than visisting the health facility.

Majority of the respondents in this study cited include financial problem (30%) as the main hindrance for not visiting the health facility for treatment. Other reasons cited include busy schedule (18%), long distance to health facility (12%) and parents refusing to send child for treatment.

It is also important to note that 4% of those with the disease did not visit a health facility because they considered the condition as a normal. This is an indication that the condition is endemic in the community. Possibly because children with the condition see a number of their schoolmates, playmates or household members with the condition, they consider as normal with the community and may not seek treatment for it (Balen et al., 2007). This suggests that there is an urgent need for intensive education on the disease in the Municipality.

Further studies should be conducted with a much larger sample size to look at the factors aasociated with yaws infection in the Kintampo North Municipality and also identify and test all suspected cases to achieve yaws elimination in the Municipality.

5.4 Limitations of the Study

The study had some limitations. Notably, the study included only children less than 15 years who are in primary school. It is possible some children who are out of school and those in Junior High School may have yaws skin lesions but the study did not include them because of limited finances and time for the study. This may therefore affect the estimated prevalence of yaws in the selected schools.

Secondly, cases were diagnosed clinically with no laboratory confirmation. Since yaws lesions are similar to many other skin diseases such as scabies, buruli ulcer and leprosy, it is possible some misdiagnosis may have occurred.

Also since this is a cross-sectional study that simultaneously assessed exposure and outcome of yaws infection, causal relationships cannot be drawn from this study.

Despite these limitations, this study is likely the first yaws study in the Kintampo North Municipality. The findings will help the Ghana Health Service, WHO and other partners, who are currently estimating the yaws burden in the country to get data for this decision.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The yaws disease is present among school children in the Kintampo North Municipality but most do not visit health facility for treatment because of financial problem and long distance to health facilities. The risk factors for yaws infection include, ever playing with a yaws case, using river as a source of drinking water and having a guardian who is a trader.

6.2 Recommendations

1. The Kintampo North Municipal Assembly should provide portable water for communities that do not have.
2. The Kintampo North Municipal Health Directorate should intensify education on the mode of transmission, risk factors and the need to seek treatment for yaws in Basic schools within the Municipality.
3. The Kintampo North Municipal Health Directorate should resource CHPS centres in the Municipality with Azithromycin for the treatment of yaws.
4. Further studies should be conducted to identify and test all clinical yaws cases and apply the WHO new treatment policies to ensure elimination of the disease in the Municipality.

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APPENDIX A: CONSENT FORM FOR PARENTS/GUARDIANS

Title of Study: Factors Associated with Yaws in Children less than 15 years in the Kintampo North Municipality of the Brong Ahafo Region

Principal Investigator: Gabriel Korang

Address: School of Public Heath, University of Ghana, Legon.

General Information about the Study

Yaws is a skin disease that mostly affects children less than 15 years. The disease can disrupt school attendance and contribute to the poor performance of school children. Report from the Kintampo North Municipal Health Directorate suggests that some children in the Municipality have the disease. The purpose of this research is to physically examined school children to identify those who have the disease and also identify the factors that increase their chance of a acquiring the disease. This information will help the Municipal Health Directorate to plan appropriate measures to control the disease.

All children selected will be physically examined and interviewed within 20 minutes on the day of the data collection. Your child has been selected to take part in this study.

Possible Risks and Discomforts

This research will not will not bring any discomfort to your child. However, data collectors will physically examine each child. This may require that your child will have to remove the shirt or dress for the examination. However, male data collectors will not examine girls and females will not also examine boys.

Possible Benefits

All children who will be identified with the disease will be referred to Kintampo Municipal Hospital for treatment. They will also be educated on how they can prevent the disease. It will also help the Kintampo North Municipal Health Directorate to know the number of school children who have the disease and plan an appropriate intervention to control the disease.

Confidentiality

We will protect information about your child to the best of our ability. Your child will not be named in any report, publication or dissemination of the study findings. All the information obtained from this study will be kept confidential and used for the purpose indicated for this study alone.

Compensation

You or your child will not be paid or compensated for participating in the study.

Cost of Participation

If a child is identified with the disease, the parent(s)/guardian will bear the cost of treatment at the Kintampo Municipal Hospital.

Voluntary Participation and Right to Leave the Research

Participation in this research is voluntary and your child can withdraw without any penalty to him or her.

Contacts for Additional Information

If you have any further questions regarding this study, you may contact Gabriel Korang on telephone number: 0203777309 and Dr. Bismark Sarfo (Supervisor) Head of Department, Epidemiology and Disease Control, School of Public Health, University of Ghana on Tel. 0269343169.

Your Child's Rights as a Participant

This research has been reviewed and approved by the Ghana Health Service Ethical Review Committee. If you have any questions about your child's rights as a research participant you can contact Hannah Frimpong (GHS-ERC Administrator) on 0243235225 or 0507041223 email addresses: *Hannah.Frimpong@ghsmail.org*

VOLUNTEER AGREEMENT

I certify that the purpose, risks and benefits of this study involving my child has been explained to me. All my questions have been answered satisfactorily. I therefore agree that my child should participate in this study as a volunteer.

_____ _____

Date Name and signature or mark of parent or guardian

If Parent/Guardian cannot read, a witness must sign here:

I was present while the benefits, risks and procedures of this study were read to the child's parent or guardian. All questions were answered and the child's parent has agreed that his or her child should take part in the research.

_____ _____

Date Name and signature of witness

Investigator's Statement

I certify that this parent has been given ample time to read and learn about the study. All questions and clarifications raised him/her have been addressed.

_____ _____

Date Name Signature of Person Who Obtained Consent

APPENDIX B: CHILD ASSENT FORM

Introduction

My name is Gabriel Korang and I am from the Epidemiology and Disease Control Department, School of Public Health at the University of Ghana. I am conducting a study entitled **Factors Associated with Yaws in Children Under 15 years in the Kintampo North Municipality**. I am asking you to take part in this research study because information from the Kintampo North Health Directorate Indicates that some school children have the disease. This study wants to verify that information.

If you agree to take part in this study, you will have to answer some questions. Some of the questions may be a little embarrassing. Also you will be physically examined to see if you have yaws. This interview will take only about 10-15 minutes.

Possible Benefits

Your participation in this study will help you to know whether you have the disease or not. It will also help you to acquire more information on the disease to protect yourself from acquiring in future. It will also help the Kintampo North Municipal Health Directorate to know the number of school children who have the disease and plan an appropriate intervention to control the disease.

Cost of Participation

If you are identified with the disease, your parent(s)/guardian will bear the cost of treatment at the Kintampo Municipal Hospital.

Possible Risks and Discomforts

This study has no anticipated risk. However, data collectors will physically examine you and may require that you remove your shirt or dress. However, male data collectors will examine boys and vice versa.

Voluntary Participation and Right to Leave the Research

You can decide not to take part in the study and if you decide to take part, you can also stop participating at any time if you feel uncomfortable. No one will be angry with you if you do not want to participate.

Confidentiality

Your information will be kept confidential. No one will be able to know how you responded to the questions and your information will be anonymous.

Consent from your Parent/Guardian

Please talk about this study with your parents/guardian before you decide whether or not to participate. I will also ask permission from your parents before you are enrolled into the study.

Your rights as a Participant

This research has been reviewed and approved by the Ghana Health Service Ethical Review Committee. If you have any questions about your child's rights as a research participant you can contact Hannah Frimpong (GHS-ERC Administrator) on 0243235225 or 0507041223 email addresses: *Hannah.Frimpong@ghsmail.org*

VOLUNTARY AGREEMENT

This assent form which describes the benefits, risks and procedures for the research titled *Factors Associated with Yaws Infection in the Kintampo North Municipality* has been read and or explained to me. I have been given an opportunity to ask questions about the study and they have been answered to my satisfaction. I agree to participate.

Child's Name:……

Child's Mark/Thumbprint……

Date: ……...

Investigator's Statement

I certify that this child has been given all the necessary information about this study. All questions and clarifications raised him/her have been addressed.

_____ _____

Date Name Signature of Person Who Obtained Consent

APPENDIX C: QUESTIONNAIRE

RESPONDENTS IDENTIFICATION

Interviewer Code:		Circuit:	
Name of School:		Name of Community:	
Pupil's ID No.			

INDIVIDUAL FACTORS ASSOCIATED WITH YAWS

Item No.	Item	Options	Code	Skip Pattern and additional instruction
1.	Age			
2.	Sex	Male Female	[1] [2]	
3.	Class	Primary One Primary Two Primary Three Primary Four Primary Five Primary Six	[1] [2] [3] [4] [5] [6]	
4.	Religion of guardian	Christian Muslim Traditionalist None Other (Specify)	[1] [2] [3] [4] [5]	
5.	Ethnicity	Akan Mo Konkomba Gonja Other (specify)	[1] [2] [3] [4] [5]	
6.	Occupation of guardian	Farming Trading Government Worker Unemployed Other (specify)	[1] [2] [3] [4] [5]	
7.	How many times do you usually bath in a day?	None Once Twice Other (specify)	[1] [2] [3] [4]	
8.	Did you bath before coming to school today?	Yes No	[1] [2]	If No Skip Q9.
9.	Did you bath with soap?	Yes No	[1] [2]	

HOUSEHOLD FACTORS ASSOCIATED WITH YWAS

Item No.	Item	Options	Code	Skip Pattern and additional instruction
10.	Ever shared any of the following items with someone?	Sponge Towel Cloth Shirt/dress Underwear Bedding None	[1] [2] [3] [4] [5] [6] [7]	Select all that applies
11.	Number of persons per room	1-2 3-4 5+	[1] [2] [3]	
12.	Ever slept in the same room with someone who has yaws?	Yes No	[1] [2]	
13.	Ever played with someone with yaws?	Yes No	[1] [2]	
14.	Ever stayed in the same house with someone who has yaws?	Yes No	[1] [2]	
15.	Primary source of water	Pipe borne Borehole Hand dug well Dam River Stream Other (specify)	[1] [2] [3] [4] [5] [6] [7]	

YAWS INFECTION STATUS AND HEALTH SEEKING BEHAVIOUR

Item No.	Item	Options	Code	Skip Pattern and additional instruction
16.	Child has signs of Yaws	Yes No	[1] [2]	Physically examined the pupil (If Yes, take of photo of the sign but if No End Interview)
17.	Type of yaws signs	Papilloma Ulcer Macule Bone Swelling Hyper-keratosis	[1] [2] [3] [4] [5]	
18.	Have you ever been sent to the health facility for treatment of the disease?	Yes No	[1] [2]	
19.	If No, were did you seek treatment?	Drug store Traditional healer Local treatment Other specify	[1] [2] [3] [4]	
20.	What treatment were you given?	Tablets Topical treatment Concoction Other specify	[1] [2] [3] [4]	
21.	Why haven't your parents sought for treatment at a health facility for you?	Distance Financial problem Busy schedule No medicine at the facility Poor attitude of staff Other specify	[1] [2] [3] [4] [5] [6]	