SPATIAL PATTERNS OF MYCOBACTERIUM ULCERANS INFECTION (BURULIULCER) IN THE AKWAPIM SOUTH DISTRICT

BY

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A THESIS SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY AND RESOURCE DEPARTMENT, UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PHILOSOPHY (M.PHIL) DEGREE

AUGUST 2001
Dedication

I dedicate this work to my brother-in-law Mr. John Opoku, Miss Evelyn Ohene Kesson and other brothers and sisters for their immense contribution towards my education. May the Lord bless you.
Declaration

I, Ohene Kesson Edmund hereby declare that except where references were duly cited and acknowledged, this document is an outcome of my own research initiative supervised by Naa Professor John. S. Nabila and Dr. S. Agyei-Mensah. It has neither been presented in whole or in part to any examining body for another degree.

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Acknowledgement

I thank the Lord Almighty for His divine care and seeing me through this stage of my academic career. I owe a special debt of gratitude to my supervisors, Naa Professor John. S. Nabila and Dr. S. Agyei-Mensah for their guidance, advice and comments throughout the various stages of writing this thesis.

I am also grateful for the kindness and help offered by Dr. Frank Bonsu of the Disease Control Unit of the Korle Bu Teaching Hospital and Dr. Tinkorang, the District Director of Health Services, Akwapim South District. Others are Mr. D. K. Opare, the District Environmental Health Officer, Akwapim South, the health personnel at the Buruli Ulcer Dressing Centre at Pakro and the staff of the Disease Control Unit of the Ministry of Health, Nsawam. I am also thankful to Mr. Ebenezer Ntiri for his immense assistance during the fieldwork at Buokrom. Others who helped in this direction were the women’s leader at Tabankro, Madam Esi, and Yaw Asrabgo also of Tabankro and not forgetting all the chiefs or regents who granted permission for the exercise to take place in their communities.

My sincerest thanks also go to Dr. R. Koffie of the Council for Scientific and Industrial research Institute (CSIR), Accra, for his pieces of advise.
Abstract

This study is about the spatial patterns of the Mycobacterium ulcerans infections (Buruli ulcer) in the Akwapim South district. The Triangle of Human Ecology model was used to account for the observed spatial patterns of the disease.

The spatial distribution of the disease was mapped through the residential addresses of the patients as shown in the district medical records. The endemic communities were stratified into three segments namely the high, low and non-endemic areas or zones. The settlements for the study were then randomly selected from each stratum. This was proceeded by the selection of the target population according to the research objectives. Primary data were collected from three sources namely the household heads, Buruli ulcer patients and the health personnel (including the District Director of Health Services). Besides this, direct personal observation of the natural environment as well as interviews with certain individuals yielded primary information this study.

The study looked out for the magnitude of the problem, the underlying factors of the spatial patterns and the socio-economic impact on the populace. Children were found to be more vulnerable to infection than adults. Thus prevalence decreased with age with an overall slight female predominance in incidence. It was further discovered that the quality of the natural environment to a very large extent influenced the spatial variations of the disease. It was more prevalent along watercourses and low-lying areas but non-existent on high grounds with better drainage. This confirms the research proposition and findings elsewhere that the disease is more prevalent along water bodies.
Low patronage of health care facilities influenced by the socio-economic status of the respondents and the skewed distribution of such facilities was observed to have contributed to the incidence of the disease in the communities. For it is believed that accessing a health facility for advice earlier could have lessened the scourge. Restricted access to health facilities thus varies from place to place and this reflects in the spatial patterns of the disease.

The disease, it was discovered had adversely affected the socio-economic lives of the patients themselves and their families due to prolonged treatment. This supports the fact by some scholars that prolonged treatment or hospitalization can bring untold hardships to both patients and their families.

Efforts by the health authorities in the district to check the spread of the disease were thwarted resource constraints. The study concludes that the disease is a socio-economic problem, thus recommendations have been made, which if implemented will reduce incidence in the future.
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CHAPTER ONE

1.0 Research Problem and Conceptual Framework

1.1 Introduction

Buruli ulcer is an emerging disease caused by mycobacterium ulcerans (from the family of bacteria, which cause tuberculosis and leprosy). It brings about severely deforming ulcers, mainly in children and women who live in rural areas near rivers or wetlands. The disease in recent years, has become a significant source of human suffering in many parts of the world, especially in West Africa where there has been a large number of cases in the last ten (10) years (WHO, 1998; Asiedu, 1999). This situation finds expression in the words of the World Health Organisation's (WHO) Regional Director for Africa, that "the incidence of Buruli ulcer is rapidly growing in West Africa, and that almost all countries along the Gulf of Guinea are now affected" The disease has been reported in at least twenty-seven (27) countries around the world, mostly in the humid tropics (Asiedu, 1999). Currently, 25 percent of all infection end up with a permanent disability (WHO, 2000).

It is ranked as the third most common mycobacterium disease among humans after tuberculosis and leprosy (WHO, 1998; Asiedu, 1999). The World Health Organisation (WHO) estimates that the growing incidence of the disease in Africa will one day surpass the scourge of leprosy. In some regions, it already poses more of a health care problem than tuberculosis (WHO, 1998). For instance in an endemic area in La Côte d’Ivoire, new cases increased more than threefold between 1987 and 1991 (Marston et. al., 1995). Approximately ten thousand cases have been recorded since 1978 in Ivory Coast, and up to 16% of the population in some villages are
Over two thousand three hundred cases have been reported since 1989 in Benin, and in Ghana up to 22% of villages are afflicted in some areas (WHO, 1998). In addition to a large increase in new cases documented in Benin between 1986 and 1996, there has been an outward spread of the disease from initially restricted foci (Aguiar et. al., 1997). This suggests that the disease is more endemic in some areas than others.

Buruli ulcer most commonly affects poor people in remote areas with limited access to health care, poor transportation system and lack of potable water (Asiedu, 1999). The problem is particularly tragic because it is children who are the most vulnerable. It is difficult to assess the burden of the disease at the global and national levels. Therefore there is a huge under-reporting of it. This makes the reported cases seem like the tip of an iceberg (Johnson, 1999). Awareness of the disease is generally low in the medical community and the general public alike (WHO, 2000). Though the disease is dreadful, seeking medical care is delayed partly due to poverty, difficult geographic access to health facilities, attribution of the illness to superstition, low literacy level, stigmatisation and failure to make a diagnosis at the early stages. These factors combine to worsen affliction caused by the disease (Asiedu, 1999).

The disease apart from its medical implications has social, economic and cultural dimensions. The impact on health services and scarce health resources is great. The high cost of care can affect health institution's ability to recover cost. Complications are frequent and severe, and hospitalisation is prolonged and costly. Treatment cost per patient far exceeds per capita health spending.
Socially, prolonged periods of hospitalisation can disrupt a child's schooling and the working lives of adults. A patient's income generating ability could be adversely affected. This in turn can affect the health and welfare of children in the family.

In the long-term, people deformed by the disease may be rendered unemployed and will have to depend on family members for sustenance. In the midst of the growing incidence of the disease and the associated complications, it could have adverse substantial effect on rural populations where it is very common. This is because their main economic activities would be severely affected.

Recognising Buruli ulcer as an emerging public health threat, the WHO in 1997 established the Global Buruli Ulcer Initiative with the aim of raising awareness about the disease, mobilising support to assist endemic countries, promoting and co-ordinating scientific research and bringing together all interested parties. In this regard, the WHO in 1998 held an International Conference on Buruli ulcer in Yamoussoukro, La Côte d'Ivoire. Its aim among other things was to share information and further develop a global strategy for Buruli ulcer control and research. Heads of state, health ministers, scientists and representatives of international organisations attended the conference. Representatives from more than twenty (20) countries who attended the conference signed the Yamoussoukro Declaration on Buruli ulcer and pledged to control further spread of the disease. The remarks made by the then Director-General of the WHO that “we have an enormous task ahead as we begin the fight against this disease (Buruli ulcer)” underscores the gravity of the situation. Considering the gravity of the situation on hand, participants
at the conference pledged to intensify action against Buruli ulcer as part of the primary health care, provide simple surgical facilities for the treatment of the disease in its early stages, and improve and sustain health education programmes at all levels. The initiative has so far focused on three West African states: Ghana, Benin and La Côte d’Ivoire (WHO, 2000).

It is worth noting that, before an individual can be adequately motivated to learn and accept better health practices, that person must appreciate a definition of existence of disease, evaluate such a disease as constituting a threat to personal and public well-being and take positive steps to alleviate such a threat. Unfortunately, most illiterates as well as some literate individuals do not believe that poor hygienic conditions can lead to an outbreak of epidemics, which can impact adversely on the population in terms of diseases. Diseases caused by insanitary conditions will be reduced if and when communities have enough safe water and practice good hygiene. This really poses a big problem to countries experiencing Buruli ulcer.

From the national situation of the Buruli ulcer, it can be concluded that the disease, if not checked now, will in the future pose a serious health threat to the Ghanaian society. It is against this background that this research focuses on the spatial patterns of the disease in the Akwapim South District.

1.2 Statement of the problem

The first case of Buruli ulcer in Ghana was reported at the Korle-Bu Teaching Hospital in Accra in 1971 (Bayley, 1971). Since then, cases have been described in riverine rural areas in the country. Ninety-six cases were described in the Asante
Akim North District (van der Werf et al., 1989) and ninety cases in the Amansie West District (Amofa et al., 1993 & 1998). Thus the number of reported cases has been increasing since 1993, with its attendant socio-economic and health implications. Between 1993 and 1997, nearly two thousand cases were reported. Six of the ten regions and thirty-five of the one hundred and ten districts of the country were affected but the exact magnitude of the problem is not yet known. This points to the fact that the disease is emerging as a big threat to society and something ought to be done in order to reduce its incidence. Table 1.1 shows the reported cases of Buruli ulcer by administrative regions of Ghana between 1993 and 1997

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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Upper West</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Upper East</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>370</td>
<td>262</td>
<td>244</td>
<td>213</td>
<td>795</td>
<td>1884</td>
</tr>
</tbody>
</table>

Source: Ministry of Health, 1998

The situation as it was between 1993 and 1997 has changed significantly. Results of the National Buruli Ulcer Case Search, conducted by the Ministry of Health in 1999 showed an appreciable increase in the incidence and prevalence of the disease. Reported cases according to the survey results now stand at over six thousand. It showed an increasing geographical spread of the disease. Cases have so far been recorded in all the ten administrative regions. All but eighteen of the one
hundred and ten districts in the country reported incidence of the disease (Ministry of Health, 1999). This is shown in Figure 1.1.

Table 1.2 shows the districts in Ghana reporting incidence of the disease according to the results of the National Case Search for Buruli ulcer, Ghana, 1999. This distribution as shown on the map (Figure 1.1) indicates a uniform regional distribution but not so at the district level.

Table 1.2: Number of districts reporting cases of the Buruli ulcer per region in 1999

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of districts</th>
<th>Number reporting cases</th>
<th>Number reporting zero cases</th>
<th>Number reporting less than 5 cases</th>
<th>Number reporting 5 or more cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashanti</td>
<td>18</td>
<td>15</td>
<td>3</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Brong Ahafo</td>
<td>13</td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Central</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Eastern</td>
<td>15</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Greater Accra</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Northern</td>
<td>13</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Upper East</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Upper West</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Volta</td>
<td>12</td>
<td>9</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Western</td>
<td>11</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>90</td>
<td>20</td>
<td>13</td>
<td>77</td>
</tr>
</tbody>
</table>

Source: Ministry of Health, Accra, 1999
FIG. 1.1  NATIONAL BURULI ULCER CASE SEARCH, 1999.
DISTRIBUTION OF CASES BY DISTRICT

BURULI CASES
- 0
- 1 – 4
- 5 – 50
- 51 – 100
- 101 – 500
- 501 – 1200

LEGEND
- International Boundary
- Regional Boundary
- District Boundary

The statistics shown in Tables 1.1 and 1.2 show the geographical distribution of the disease. They exhibit significant regional differences. Interestingly, it is prevalent in rural areas where it is believed, conducive environmental conditions prevail for the microbe to thrive. This uneven spatial trend suggests an association between the disease and the environment (natural and social). Differences in the environment partly explain much of the spatial variations in the geographical distribution.

Besides the spatial trend, the disease further exhibits demographic patterns. Children and women are the most vulnerable group. However, the sex ratio is not static. It varies from region to region. Results of the National Case Search Survey undertaken in 1999 revealed a slight male dominance in the cases analysed. This information is shown in Table 1.3. It is interesting to note that the prevalence rate in Ghana decreases with age.

**Table 1.3: Sex distribution of cases by regions in 1999**

<table>
<thead>
<tr>
<th>Region</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashanti</td>
<td>705</td>
<td>698</td>
<td>1403</td>
</tr>
<tr>
<td>Brong Ahafo</td>
<td>159</td>
<td>181</td>
<td>340</td>
</tr>
<tr>
<td>Central</td>
<td>658</td>
<td>556</td>
<td>1214</td>
</tr>
<tr>
<td>Eastern</td>
<td>238</td>
<td>172</td>
<td>410</td>
</tr>
<tr>
<td>Greater Accra</td>
<td>567</td>
<td>597</td>
<td>1164</td>
</tr>
<tr>
<td>Northern</td>
<td>81</td>
<td>74</td>
<td>155</td>
</tr>
<tr>
<td>Upper East</td>
<td>36</td>
<td>61</td>
<td>97</td>
</tr>
<tr>
<td>Upper West</td>
<td>42</td>
<td>52</td>
<td>94</td>
</tr>
<tr>
<td>Volta</td>
<td>97</td>
<td>106</td>
<td>203</td>
</tr>
<tr>
<td>Western</td>
<td>207</td>
<td>153</td>
<td>360</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2790</td>
<td>2650</td>
<td>5440</td>
</tr>
</tbody>
</table>

*Source: Ministry of Health, Accra, 1999*

The incidence of the Buruli ulcer as it is in the other parts of the world, is very high in rural areas in Ghana. Some of these areas lack basic social amenities such as
health facilities, potable water and good transportation system to mention a few. Lack of these facilities to some extent deters people from seeking medical care when the need arises. That apart, poor transportation system hinders spatial accessibility patterns to health facilities.

Buruli ulcer has caught the attention of medical personnel in the Akwapim South District in recent times. It is becoming a serious public health problem in the district. It exhibits a patchy spatial pattern with high incidence in the remote parts of the district. It was first detected in August 1998 with over seventy cases in one of the five administrative sub-districts. A total of seventy-six cases were recorded in the district at the end of that year. This has branded the area as the Buruli ulcer endemic zone. These initial disease foci have spread to other communities in the remaining sub-districts by the beginning of 1999. However, the incidence of the disease in these new areas is not as high as it is in the initial foci. In other words, the magnitude in those areas is not as much as it is in the Pakro-Dego sub-districts. Thus some communities are described as more prone to the disease than others. Despite the number of cases reported so far, there are others who have the disease but are yet to report at any of the various health facilities for medical attention. This makes the reported cases seem like the tip of an iceberg in the district.

By the end of April 2000, over one hundred cases had been registered in the whole district. These include clinical observations, pathological data and socio-demographic information as a means of establishing the geographical distribution of endemic communities.
The spread of the foci into other areas suggests a correlation between the disease and the environment. It is interesting to note that all the foci of the disease are located mainly in the remote rural areas of the district characterised by lack of health facilities, poor transportation system and lack of good drinking water.

The disease, apart from its spatial variations also exhibits demographic patterns. It has affected people aged between three (3) and seventy (70). Most of the cases involve children or teenagers aged between three (3) and eighteen (18) years. The prevalence rate decreased with age; for over half of the reported cases involved people aged less than twenty years. Interestingly, there is a slight male dominance. In addition to these demographic facts, no seasonal variations in incidence were observed perhaps due to the accumulated cases over time.

The incidence of the disease has been associated with lack of safe water in the areas designated as endemic. This is because some of the communities that have the disease do experience water shortage due to drying up of major water bodies as a result of deforestation. In addition to the drying up of water bodies during the dry season, some of the areas with the disease do not have adequate pipeborne water as an alternative source of safe water supply. This compels the people to depend on unprotected ponds as the main source of water supply.

Considering the serious health, social and economic impact associated with the disease, it is seen as a big threat to the economic and social lives of the people in these areas. Socially, children are the most vulnerable group afflicted. They may lose their education since treatment is prolonged or they may be compelled to work to support their ailing parents or guardians. This will result in loss of manpower in the
future. The economic activities of affected adults will be crippled and this will impact negatively on the family in diverse ways.

Ever since the disease was first detected in the district, serious efforts have been made to alleviate the plight of the afflicted and to halt its further spread. The Disease Control Unit of the Ministry of Health in the district, in collaboration with the Village Health Committees are prevailing upon those with the disease to show up for treatment yet response to the call according to the health workers is not encouraging. The question to address is why people with the disease are not showing up for treatment.

It can be concluded from the discussion that although the disease is on the increase, its spatial distribution continues to be uneven. In addition, the Akwapim South District has a majority of its population engaged in agriculture. Unfortunately, this dreadful disease is threatening the well being of the people, which if not checked, will in the future grind all economic activities to a halt. Hence, the disease is worth studying so as to understand the spatial patterns of the disease in order to come out with recommendations that will help alleviate the socio-economic problems that it brings about.

From the discussion so far the research questions are as follows:

1. What is the socio-economic impact of the disease on the communities?
2. Oral evidence gathered in the endemic communities indicates that the disease has been in existence for decades. The question then is, how come the disease did not receive attention from both health personnel and the public until recently.
3. What mechanism has been put in place by the District Health Management Team to identify unreported cases for treatment?

The lack of any study on the spatial patterns of the Buruli ulcer in the Akwapim South District makes this study relevant. Existing work on the disease has focused attention on the mode of transmission of the causative microbe and who is affected. This interests medical scientists, epidemiologists and demographers who are currently researching Buruli ulcer. Not much interest has been shown in the identification of Buruli ulcer origins to highlight variations in socio-demographic and ecological factors that seem to promote differentials in Buruli ulcer incidence. The geographer's interest in the region, disease ecology, location and allocation of health resources, the use of appropriate health interventions and the use of maps for illustration are therefore needed to make a more meaningful contribution to health planning and development.

The research assumes that the principal underlying factor in the spatial patterns of the disease in the Akwapim South District is the natural environment, which may show variation among the different sub-districts within the district. The identification of high- and low-risk Buruli ulcer areas in the district is the subject of study. The results of this investigation, it is envisaged will help health authorities in the district and elsewhere to adopt strategies to curb the disease.

1.3 Literature review

1.3.1 Meaning of Buruli ulcer

Buruli ulcer is a skin ulcer caused by infection of the skin by Mycobacterium ulcerans (van der werf et al., 1989; Asiedu, 1999). It has various geographic names
such as Baimsdale ulcer, Kasong ulcer, Kakerifu ulcer, Tora ulcer, Mexican ulcer, and Kumusi ulcer just to mention but a few (Asiedu et. al., 1998).

The causative organism was first described by MacCallum, who discovered acid-fast bacilli in a biopsy from a leg ulcer in a young child from Baimsdale, Australia in 1940 (Asiedu et. al., 2000). Before 1948, the disease was already known in Africa. Large ulcers, caused by mycobacterium ulcerans, were described by Sir Albert Cook in 1897 (van der Werf et. al., 1989; Asiedu, 1999; Asiedu et. al., 2000). In the period 1923 to 1935, Kleinschmidt, a missionary physician in north-east Congo, observed undermined skin lesions in acid-fast bacilli (Meyers et. al., 1974).

In Africa, the history of Buruli ulcer can be divided into two main periods namely before 1980 and after 1980 (Asiedu et. al., 2000). There were many important publications before 1980 on the disease in several African countries namely Cameroon, the Democratic Republic of the Congo, Gabon, Ghana, Nigeria and Uganda. There were suspected cases in the Central African Republic, Kenya, Sudan and Tanzania, but these were never confirmed (Asiedu et. al., 2000). The most significant contributions came from the Democratic Republic of Congo and Uganda.

A new focus of Buruli ulcer emerged in West Africa, after 1980 (Asiedu et. al., 2000). There has been a growing incidence of Buruli ulcer in several West African countries, especially in Benin, La Côte d'Ivoire and Ghana.

The geographic area in Uganda having the first large number of identified patients gave these lesions their popular appellations, Buruli ulcer (Dodge and Lunn, 1962; Asiedu, 1999; Asiedu et. al., 2000). Geographic names for the disease are useful only in local foci. This is because the word "Buruli" for instance, cannot be
applied to all parts of the world that are not situated in the Buruli district in Uganda. To this end, a non-geographic name is preferred to the large numbers of the synonyms. Thus, Pradinaud et al., (1998) proposed non-geographic names such as Cutaneous ulcer caused by Mycobacterium Ulcerans or Skin Ulcers caused by Mycobacterium ulcerans or perhaps better, Mycobacterium ulcerans skin ulcers. These non-geographic names will be acceptable to all irrespective of geographic location.

It (Buruli ulcer) affects people in remote rural areas with restricted access to health facilities. About 70% of cases are children up to fifteen (15) years (Asiedu, 1999). Any part of the body can be affected, however, the disease is most common in the limbs or the exposed parts of the body. It can also affect any racial group.

1.3.2 Clinical manifestation of the disease

The disease starts as a painless swelling in the skin as shown in the plate. A firm and painless nodule one to three centimetres in diameter (Asiedu 1999; WHO, 1998) develops under the skin teeming with mycobacteria. Unlike other mycobacteria, Mycobacterium ulcerans produces a toxin, which destroys tissue and suppresses the immune system (WHO, 1998; Travis, 1999). The nodule, when raptures initiates the development of the ulcer. Sometimes bones, breasts, genitalia just to mention but a few are destroyed causing grossly deforming ulcers, peculiar to Buruli ulcer and easy to recognise. When lesions heal, scarring may cause restricted movement of limbs and other permanent disability.

Three different clinical stages of development of the disease can be described. These are the pre-ulcerative stage marked by painless and sometimes
itchy nodule. Second, the ulcerative stage involves the development of lesions and the post-ulcerative stage which is a complication resulting directly from the disease such as contracture deformities, loss of sight and amputation. Plates 1 and 2 show development of Buruli ulcer at early and advanced stages respectively.

Treatment with antibiotics has been disappointing (Sciencenews, 1999) especially where there is an extensive ulceration. The futility of some past antibiotic use may reflect the fact that Africans or people with the disease generally do not visit physicians until far into the disease’s progression. To this effect, early diagnosis of Mycobacterium ulcerans infection is crucial especially when scientists suspect that the microbe may sometimes reside in the body for months or years before it starts to eat away tissues.

Now, the only available treatment for Buruli ulcer is surgery to cut out the lesion, with a skin graft if necessary. In severe cases (for instance when bones
Stages of development of *Mycobacterium ulcerans* infection

Plate 1: Early stage in the development of ulcer.

Source: Asiedu, 1999

Plate 2: Late ulcer, characterized by extensive laceration

Source: Asiedu, 1999
are destroyed) amputation may be necessary. Thus early detection and surgical removal of small nodules could prevent complications (Asiedu, 1999). Not many people die from the disease.

1.3.3 Mode of transmission

The route of transmission of the causative organism (Mycobacterium ulcerans) is poorly understood. However, considerable evidence suggests that direct or indirect trauma on the skin provides a passage for the organism into the skin. In support of this hypothesis, most cases occur on exposed surfaces, particularly over bony parts of the body and in children who have higher (conscious or unconscious) trauma rate and less tough skin than adults. It has been found out that it does not occur on the trunks of Caucasians who usually keep that part of their body covered. It rather occurs mainly on the lower leg Radford (1974). This suggests that incidence rate is high in the exposed parts of the body.

Further evidence by Meyers et. al., (1974) supports the direct entry by the causative organism into the skin. It was reported in that study that 8% of the patients surveyed in the Bas region in Zaire remembered an event of specific trauma at the ultimate site of the lesion.

Lastly, the disease is rarely transmitted from one patient to another. However, the possibility of case-to-case transmission person cannot be ruled out (Bruce, 1998).
1.3.4 Spatial variation of the disease

Buruli ulcer shows an interesting patchy distribution around the tropical as well as in the temperate areas of Australia (van der Werf et al., 1989). It occurs in isolated foci where it may be common, separated by large areas in which it is rare or absent. This suggests lack of even spatial spread of the disease. The disease is commonly found in remote rural villages near slow-flowing or marshy parts of the tropical and sub-tropical regions of Africa, Asia, Latin America and the Western Pacific (WHO, 1998; Asiedu, 1999). Because all major endemic foci are in wetlands of tropical or sub-tropical countries, environmental factors must be seen to be playing a crucial role in the survival of the aetiology agent. It can therefore be concluded that the disease is associated with riverine rural areas. However, the association is not very clear (Bruce, 1998; Asiedu et al., 2000).

Muelder (1988) noted that the more families depend on surface water for their daily needs, and the closer they live to it, the more probable infection becomes. In a review of all identified cases of Buruli ulcer in Uganda in 1970, Barker noted that all the five hundred and seventy-two (572) cases lived within thirty miles of the river Nile, especially around water-courses, or swamps where the river flowed through flat and swampy lands. In the same study but reported elsewhere, there was evidence of a progressive fall in incidence with increasing distance from the river Nile in two districts. It was then postulated that there was an initial focus of infection beside the river Nile, which gradually spread away from the river after major floods, which occurred in Uganda between 1962 and 1964 (Bruce, 1998).
The spatial spread of the disease has also been associated with environmental changes. There have been focal outbreaks followed from flooding and man-made topographical modifications such as dams (Asiedu et. al., 2000; WHO, 1998). This goes further to buttress the fact that the disease is associated with slow-flowing and stagnant water-bodies.

According to Hayman and Asiedu (2000), infection occurs only after significant environmental changes or disturbance. In the Bairnsdale district in Australia where first cases were diagnosed, there had been the worst floods in the district, when all roads and rail links were cut. Furthermore in Uganda, Barker examined cases of Mycobacterium ulcerans infection in the Busonga district on the east of the Victoria Nile, north of Lake Victoria (Barker, 1972). Although cases were known in other parts of the country, there were no known cases in that district before 1965. It was then postulated that the outbreak was related to unprecedented flooding of the lakes in Uganda between 1962 and 1965 as a result of heavy rainfall (Hayman and Asiedu, 2000; Lunn 1962).

Evidence from Nigeria also indicates that infections have occurred among Caucasians living on the campus of the University of Ibadan after 1965 (Oluwasanmi et. al., 1976), when a small stream flowing through the campus was dammed to make an artificial lake. The first case reported in La Côte d’Ivoire was a seven-year-old French boy who lived beside Lake Koussou, an artificial lake in the centre of the country. Evidence from Liberia has it that there have been cases in the north of the country following the introduction of a swamp rice field to replace an upland one Ziefer et. al., (1981). The agricultural change was accompanied by the construction of
dams on the Mayor River to extend the wetlands. In Papua New Guinea, the disease occurs mainly near the Sepik and Kumusi rivers. The disease in Papua New Guinea spread after the flooding and devastation that followed the eruption of Mount Lamington in 1951 (Asiedu et al., 2000).

The outbreak of the disease on the Philip Island in Australia was temporally associated with the formation of a small swamp that backed up behind a newly constructed vehicle track Veitch et al., (1998). Improved drainage in this area was followed by a cessation of cases in the immediate vicinity of the marsh. The following year, cases continued to occur close to a kilometre away to the west of the swamp on a golf course near a spray irrigation system that used a mixture of recycled sewage and ground water.

In the Ashanti Region of Ghana, all the three districts through which the river Offin flows have reported cases of Buruli ulcer. Similarly, cases of the disease have been recorded in the river Densu and Afram basins. Whilst the former has made rural areas in the Greater Accra Region more prone to the disease than farther away from it, the latter predisposes some sections of the Afram Plains to infection.

Lastly, it is believed that deforestation and increased agricultural activities may have significantly contributed to the recent marked increases in the incidence of mycobacterium ulcerans infections especially in West Africa. From the instances cited, it can be said that the disease has a strong water connection.

It has been observed that the disease prevalence in areas with environmental changes is about 180 per 100,000 population, while in those areas without environmental changes, it is about 20 per 100,000 (Portaels, 1998).
so far points out that topographical modifications indirectly induce flooding and the accompanying stagnation swampy conditions.

1.3.5 Consequences of the disease

Buruli ulcer has serious economic, health and social impacts (WHO, 1998; and Asiedu, 1999). Therefore with the growing incidence of the disease and the complications currently associated with it, the long-term socio-economic impacts of Buruli ulcer on the rural economy could be substantial (Asiedu and Etuaful, 2000). The World Health Organization estimates that 25 per cent of all infection end up with a permanent disability. For instance, Asiedu and Etuaful (1996) observed ten limb amputations, twelve contracture deformities, one patient lost the sight in one eye, and two deaths due to tetanus. These observations were made out of 102 reported cases at the Agoroyesum Catholic Hospital in the Amansie West District between 1994 and 1996. This makes economic and social cost of the disease very high.

The economic cost of the disease can be divided into direct and indirect based on a study into the socio-economic implications of the Buruli ulcer in Ghana (Asiedu and Etuaful, 2000). The former comprises the cost of treatment and the latter, the productivity losses incurred by both the patient and the healthy attending relative, the cost of feeding the patient and the attending relative, and other miscellaneous expenses. They concluded from their study that Buruli ulcer is very expensive to treat since the average cost of treatment per patient is far more than what most people can afford let alone the poor. Besides this, it exerts enormous stress on health resources. This is so because the Yamoussoukro Declaration on Buruli ulcer tasks
governments to provide free medical care to those afflicted by the disease, as is done for those suffering from tuberculosis and leprosy (Asiedu, et. al., 2000). Free medical treatment will hamper a health facility's ability to recover cost.

Treatment of the disease in its advanced stages of development requires a prolonged hospitalisation of the patient. Asiedu and Etuaful (1996), in a study into the socio-economic implications of the disease in Ghana, observed that the average hospitalisation was 186 days in 1994, 103 days in 1995 and 102 days in 1996. Hospitalisation of a patient requires concomitant 'hospitalisation' of a healthy relative to provide indirect care such as cooking and washing of the patient's clothing just to mention a few (Asiedu et. al., 2000). Clearly, the issue of hospitalisation is a huge burden on the patients and their families. In countries without social programmes to take care of the disabled, families constitute the social safety net and, in case of illness and disability, the burden falls on the poor family. The long-term care of people disabled by the disease by the family could lead to great loss of productivity and poverty (Asiedu and Etuaful, 2000).

The indirect consequences of the sickness in adults are that children have to drop out of school or are forced to work to support the family. This could also happen to adults suffering from Buruli ulcer. This is because hospitalisation of a patient requires the need to have an attendant relative, usually a woman. The indirect effect this has on the children is the lack of parental care of those left behind at home.

The majority of those affected by the disease are children up to fifteen years. Prolonged morbidity often leads to serious disruption of school or even discontinuation of schooling. Also, complications such as amputations and
contracture deformities are frequent, and children disabled by the disease would not be able to work in the field. Those children would grow into adulthood and become a burden to society.

Liefooghe et al., (1995) concluded in a study on the consequences of tuberculosis in Pakistan that this disease may lead to stigmatisation. Similarly, Buruli ulcer with its cosmetic problems could lead to stigmatisation, social isolation, diminished marriage prospects and divorce particularly among women. Since women play enormous roles in rural economies, their contributions could be reduced considerably if they are left with a permanent disability because of the disease. Such disability could potentially limit their ability to carry out activities such as trading, farming, obtaining water and breast-feeding (Asiedu and Etuafui, 2000). The inability to perform these tasks could negatively reduce their income generating potential and the health and welfare of their children.

1.3.6 Factors underlying spatial variation of diseases

Apart from environmental exposures, there are other factors that could influence the spatial variation of diseases. According to Davey and Wilson (1964), faulty habits of living are important factors in maintaining diseases in a community. Low economic and social levels are associated with apathy, ignorance and low standards of personal hygiene. These faulty habits as raised by Davey and Wilson (1964) facilitate contact between human beings and pathogens, to make certain localities or seasons more unhealthy than others. Health and for that matter disease
problems are thus environmental problems and as such are amenable to techniques of spatial analysis used by geographers (Howe, 1990).

There are two main ways of seeking explanation for spatial variations in the occurrence of diseases. The first method involves the identification of the natural foci of the disease. This presupposes environmental factors such as climate, biotic and biological conditions, which suggest "disease regions". This method primarily determines the importance of environmental factors in the development and survival of the disease agent. It can therefore be concluded here that features of the natural environment account for some of the spatial variation in diseases. Diseases can therefore be associated with specific natural environment. For instance, there was a link between marsh fever and stagnated waters in the southeast England (Dobson, 1992).

The second method emphasises secondary disease agents, which are usually related to human or host factors (Iyun, 1983). By this, health hazards can be interpreted by the association of artificial factors, that is, properties of differential living conditions rather than the 'natural' foci of disease. (Shannon and Spurlock, 1976). The socio-economic characteristics which contribute greatly to the cause and spread of many diseases may for that matter include age, gender, ethnicity, behaviour and life-style (Iyun, 1983). These factors therefore influence the patterns of morbidity and could be responsible for spatial variations in morbidity and mortality levels.

In a study in Nigeria, Iyun (1983) asserts that low-income earners suffer particularly from communicable, poverty and ignorance associated diseases.
Besides, age group, religion and life styles appear to be important determinants of differences in the level of illness of disease's victim. Buruli ulcer is a type of illness that always takes its victims unaware due to how it starts coupled with poor knowledge about the disease among the public and even health personnel. Its start is deceptive thus, people tend to underestimate its potential as a serious affliction.

Shannon and Spurlock (1976) and Iyun (1983) have it that, it is of utmost importance to hammer on secondary factors such as differential living conditions rather than natural biological factors in interpreting health hazards. These factors are very crucial in determining the prevalence and distribution of Buruli ulcer in the Akwapim South District. Several socio-economic variables such as age gender, literacy level, health seeking, community problems, variations in living conditions in the sub-districts have been put forward as important co-factors responsible for variations in Buruli ulcer prevalence in the Akwapim South District. It is worth mentioning that these social, economic and cultural variables vary from place to place. This will therefore lead to variation in spatial patterns of the disease, which is the subject under study.

1.3.7 Evidence of disease and the natural environment

According to Dobson (1992), the idea that the atmospheric and environmental influences might affect patterns of disease and mortality is particularly associated with Hippocrates. The Hippocratic concept of 'airs, waters, and places' received significant and renewed attention in the seventeenth and eighteenth centuries (Dobson, 1992). Physicians began to ask why disease varied according to locality or season, why
certain environments seemed more conducive to ill-health than others, and, in turn, whether such knowledge could be used to intervene, ameliorate, manage or avoid unhealthy sites (Jordanova 1979; Riley, 1987). The meaning of this assertion is that the natural environment appears to influence and impinge on the health and well being of a locality and its residents. Thus, diseases were associated with the environment. For instance, 'bad airs' and its association with marshland topography were blamed for the cause of marsh fevers in Southeast England (Dobson, 1992).

Mortality levels in marshland localities were reckoned unusually high and residents and visitors complained bitterly about the marsh fevers they encountered in such localities. It was concluded that the noxious stenches that emanated from the stagnant marsh waters were primarily responsible for such hazardous conditions (Dobson, 1992).” The natural environment and ecological features have been proved to be critical determinants of the patterning of morbidity and mortality in southeast England (Dobson, 1992).

The discussion so far suggests that there is a correlation between the natural environment and disease. That is cause and effect of disease occurrence. Later, attention was shifted away from the natural environment, and focused on attributes of man-made environment in conjunction with the conditions of the population (Dobson, 1992). This change of focus suggests a shift from ecological cause and effect (that is associating diseases with the natural environment) to a situation which takes into account, elements of human behaviour as well as the quality of the ‘human' environment. This provides a broader environmental framework that could be extended to explain and include disease pathways associated with all sorts of insanitary
conditions. All ranges of foul habitats, and any number of hazardous practices and crowded occasions that would have brought together humans and their disease pathogens to make certain localities or seasons more unhealthy than others. The broader environmental framework suggests that for one to seek for a unidirectional relationship between one factor, such as climate, and morbidity data, in real terms runs counter to what is known to be the complexity of local and individual disease patterns and their environmental influences.

1.4 Conceptual Framework

1.4.1 An elaboration of the Human Ecology Model

The Triangle of Human Ecology of disease, propounded by Meade et. al., (1988), provides clues as to why human diseases and health vary over the surface of the earth. It has proved very useful in accounting for the spatial patterns of diseases such as elephantiasis in Northern Ghana (Hunter, 1996). Three variables namely: habitat, population and behaviour form the vertices of the triangle that encloses the state of human health. It is shown in Figure 1.2.
Habitat is that part of the environment within, which people live and which directly affects them. It is composed of houses and workplaces, naturally occurring biotic and physical phenomena, health care services, transportation, and government. Elements of population composition include age structure, ethnicity and literacy. Behaviour on the other hand, is the observable aspect of culture. It springs from cultural precepts, economic constraints, social norms, and individual psychology. It includes mobility, roles, cultural practices and technological interventions.

People through their behaviour are able to create habitat conditions, which expose them to or protect themselves from habitat conditions, and move elements of the habitat from one place to another. The habitat therefore offers opportunities and hazards to the population, which can modify its behaviour.
Spatial patterns of the mycobacterium ulcerans infection (Buruli ulcer) are interplay of factors. An understanding of these spatial patterns like any other disease, makes imperative an understanding and interpretation of the ecological factors prevalent in the diseased environment. In the case of Buruli ulcer, the environment (both physical and non-physical) is the most important factors in accounting for the incidence and its spatial spread.

The development of human ecology has been associated with the application of the ecological approach in several specialized areas. Human ecology denotes the pattern of human interaction with the physical environment, such as behaviour and the environmental interactions. Based on the definition of human ecology, cultural and environmental factors become part of the concept (human ecology), and they provide clues to the spatial patterns of diseases including Buruli ulcer. The environment is therefore relevant to this study into the spatial patterns of the disease in the Akwapim South District. This is based on the assumption that the observed spatial patterns of the disease are the result of the interplay of different ecological factors some of which have general significance throughout the area while others have limited reference, applying merely to specific locations where Buruli ulcer may be more prevalent.

McKenzie (1961) classified these ecological factors generally into four namely: geographical, economic, cultural and political-administration. The geography includes topography and drainage as it pertains in this study. The economic component is made up of a wide range of phenomena such as occupational distribution and standards of living of populations. The cultural aspects cover the arts, moral attitudes that influence the distribution of population and services while the political -administration includes
measures such as rules governing local utilities. From the discussion above, McKenzie's ecological classification is seen as a dilation of the three vertices of the Triangle of Human Ecology.

Although the geography, economic and cultural factors differ in the Akwapim South District, it is the geography of the district which significantly manifests in the spatial variation of Buruli ulcer.

1.4.2 Justification of the model for the study

According to May (1954, 1958), the incidence of a disease requires the co-existence of some causative organism and a host simultaneously. This will create the foci of a disease. In order to understand the health and disease therefore, it is necessary to go beyond the biological determinants of disease. That is disease aetiology would be better understood in a broader context since diseases have both biological and social meanings. To this end, much epidemiological and geographical researches accept the biological definition of disease but extends the biomedical model {which considers disease as internal malfunctioning of the body Kelvyn and Moon (1987)}, by considering explanations that involve social and environmental causes. Failure on the part of a research to incorporate these two variables may not yield fruitful explanation for spatial occurrence of disease. In as much as social and environmental factors vary spatially, disease patterns are likely to vary.

Focusing narrowly on the biological determinants of disease aetiology is to ignore multiplicity of factors namely habitat, population and cultural behaviour that affect disease patterns. The relevance of the Triangular Model of Human Ecology to
this study therefore is that, it captures other dimensions of disease that would have been ignored by a pure biological study. Since this study goes beyond the biological determinants of the disease, the model as discussed above will be relevant to the study. The disease ecology model has been used to explain the patterns of a large number of diseases. For instance, the correlation between stagnant water and malaria in Southeast England (Dobson, 1992) was established. It has also provided a theoretical framework for understanding the aetiology and, spatial patterns of elephantiasis in northeast Ghana (Hunter, 1992).

This study considers how the habitat, population characteristics and the cultural behaviour interact together in an evolving and interactive system to explain the spatial patterns of Buruli ulcer in the district. The environment for the purposes of this study is classified into physical and social.

The habitat as implied in this study consists of the physical or the natural component and the built environment. The former is concerned mainly with the topography and the quality of drainage and how it influences the geographical distribution of the disease in the study area. The natural habitat provides favourable conditions for the causative organism to survive. The constructed part of the natural environment is concerned with the availability and accessibility of health facilities and health personnel. It also considers the transportation system as a means of connecting communities without health facilities in the study area. Accessibility of health facilities is considered from two angles namely physical accessibility and economic accessibility. It must be noted that health facilities are concentrated in the urban areas of the district thereby depriving the rural areas the opportunity of easy physical access. Effective
transportation system is therefore required to connect these remote villages to the health facilities. Economic accessibility is also influenced by the income of the populace. A problem arising from physical and economic access may adversely affect the health status of the populace that cannot patronize such health facilities.

The relevance of the model to the study again lies in the fact that it highlights the socio-economic characteristics of the populace. Such population characteristics as age structure and sex affect so many dimensions of health status. The socio-economic background of the population in the district is not uniform. Consequently, it is likely to create differential living conditions that can influence the incidence of the disease in the district.

Lastly, the study considers how cultural behaviour of the populace can expose them to infection by Mycobacterium ulcerans in the study area. The creation of habitat conditions such as poor hygiene in some communities predispose the population there to infection. In addition, people are engaged in so many socio-economic activities such as agriculture and swimming that involve hazards. Education as a component of behaviour can improve the health status of an individual. Health education by health personnel about the disease can reduce harmful exposures to infection in the study area.

It can therefore be concluded that the environment both physical and social could play a very important role in the geography of Buruli ulcer in the district. The human ecology of disease model considers factors as outlined in accounting for the spatial variation of diseases.
1.5 Research Objectives

The main objective of the study is to examine the problem of Buruli ulcer in the Akwapim South District and the factors that underlie its spatial trend. Specifically, the study addresses the following:

1. To find the nature and magnitude of the disease as it varies temporally and spatially in the Akwapim South District, and to map out the observed spatial patterns of variation in the prevalence of the Buruli ulcer.
2. To investigate the underlying factors of its spatial variation in the district.
3. To examine measures that have been put in place to minimise the incidence of the disease.
4. To ascertain the consequences of the disease on the population and the perception of the people on Buruli ulcer in relation to causes.
5. Recommend measures that could help prevent further spread of the disease.

1.6 Research propositions

The study was guided by the following propositions:

1. The natural environment is a determinant factor in the spatial variation of Buruli ulcer in the Akwapim South District.
2. Socio-economic factors influence the incidence of Buruli ulcer in the district.
3. Bad hygienic practices are a predisposition to infection by mycobacterium ulcerans, the causative organism of the disease.

1.7 Justification of the study

Current data largely focus on the medical aspect of the disease, which interests medical scientists. Lack of socio-economic data therefore makes this study relevant. The study besides its academic purpose has practical implications. This is because such information is very important for health managers in planning for Buruli ulcer surveillance to identify cases at their embryonic stage of development. A successful establishment of a permanent, ongoing surveillance system requires a survey (if data do not exist) to establish the extent and burden of the disease. With this data in hand, health managers can easily identify a more cost-effective strategy for active surveillance in endemic areas at a reduced cost.
CHAPTER TWO

2.0 The Study Area and Research Methodology

2.1 Introduction

It is imperative to know the physical and the socio-economic background of the area where the study was undertaken. This could help one to establish a link between the disease and the physical and socio-economic characteristics of the study area. In this chapter therefore, the physical background, distribution of health facilities, population, the economy and the infrastructural development of the study area have been outlined. The chapter also focuses attention on the research methodology.

2.2 The study area

2.2.1 Location and size

The Akwapim South District is located south-south-east in the Eastern Region of Ghana, between latitudes 5° 45'N and 5°58', and longitude 0° 07'W and 0° 27' W as shown in Figure 2.1.

Administratively, it is one of the fifteen districts in the Eastern Region. In terms of size, it covers an area of about 103 square kilometres. It shares a common boundary with the Akwapim North District in the north and Suhum- Kraboa Coaltar and West Akim Districts in the west. Its eastern and southern neighbours are the Ga and Tema Districts respectively. The district capital is Nsawam.
2.2.2 Vegetation

The study area falls within the moist semi-deciduous and the coastal savanna vegetation zones. The moist semi-deciduous forest was once a part of the closed forest but human activities have degraded it into secondary forest. The main characteristic of this forest is that the trees shed their leaves during the dry season as a defensive mechanism against loss of moisture. Frequent use of farmlands within the forest has resulted in the appearance of grass species in the vegetation zone (Dickson and Benneh, 1988).

2.2.3 Climate

The climate is the wet-semi equatorial type. This climatic zone experiences two exceptional periods of rainfall. The mean annual rainfall is between 125 and 200 cm (Dickson and Benneh, 1988). The rainy seasons occur after the two equinoxes, and this encourages two farming seasons based on the rainfall regime.

The months of March and April record the highest temperatures of about 30°C (average monthly). The lowest is recorded in the month of August, about 26°C. During the rainy season, average monthly relative humidity is high between 75-80 % and lowest of 70-80 % during the rest of the year. The dry season in this area is quite sharp.

2.2.4 Topography and drainage

Mountains and lowlands dominate the topography. That is the district generally shows a rolling land with hills and ridges. Its relief falls into three broad divisions: the
Densu Plains, the Pompon narrow land and the Akwapim-Togo ranges (Dickson and Benneh, 1988). The Densu plains comprise almost the entire southern half of the Densu basin. They are broad and strongly undulating with occasional isolated peaks such as Amama hill and Nyanao Hill (Dickson and Benneh, 1988). Bordering the Densu plains on the east are the Akwapim-Togo ranges which run in a south-west to north-east direction. A westerly projection from these ranges forms the watershed for the Densu River.

The relief pattern makes for significant differences in soils. In low-lying areas, the soils are deep, well supplied with moisture and sometimes waterlogged near the rivers. The soils are shallower, drier and often stony on the top of the Akwapim-Togo ranges (Dickson and Benneh, 1988). Streams and rivers drain the area. The prominent among them is the Densu River and its tributaries.

2.2.5 Soils and ecological zones

The principal soil type is forest ochrosols. However, the relief patterns make for significant local differences in soils. In lowlands and valleys, the soils are generally well supplied with moisture and sometimes waterlogged near the rivers. On the top and sides of the ridge and hills, the soils are shallow, dry and often stony.

2.2.6 Population

The population is predominantly rural. The main occupation of the people is farming. Settlers are of diverse ethnic extraction. The major ethnic groups are Akwapims, Ewes, Akims and Gas. However, over 90 per cent of the population speak
the Akan language. The total population of the district according to the 1984 Population and Housing census was ninety thousand, nine hundred and fifty-two (90952). The provisional report of the 2000 Population and Housing census put the total population at one hundred and twenty thousand, five hundred (120,500). The population distribution is fairly even among the sub-districts. However, the district capital alone has a larger population than the other settlements. In all, there are three hundred and forty-one (341) communities in the district.

2.2.7 Health facilities

The district has a number of health facilities. These facilities fall into two categories namely public and private. The public health facilities on one hand comprise the district hospital at Nsawam, Health Posts, Maternal and Child Health/Family Planning Centres and Clinics. The private health institutions on the other hand are made up of four registered clinics that offer general medical care. There are other specialised health facilities such as a herbal centre, an orthopaedic centre, three Eye Clinics and three Maternity Homes. Most of these facilities are located in the urban areas particularly Nsawam. It is estimated that over 40% of the rural population do not have access to these facilities mainly due to bad roads, lack of vehicles and high cost of transport fares. Lastly, there are Village Health Committees in all the communities. They carry health information to the populace in the communities.

The main diseases in the district include malaria, respiratory tract infections and gynaecological disorders. Malaria is the commonest as revealed by a Baseline
study in 1995. The causes of these diseases could be attributed to poor environmental situation in the district especially the inadequate potable water supply, toilet facilities and low community participation in health educational programmes. In spite of the prevalence of diseases especially water-borne and water-related diseases in the district, health facilities are poorly patronized.

2.2.8 Water and sanitation

The major source of water supply in the urban areas of the district is pipe-borne which serves almost 60% of urban dwellers in the district. The only exception is Aburi, which does not enjoy regular water supply owing to low-pressure problem. Sakkyikrom and Dobro though classified as rural settlements have access to pipe-borne owing to their nearness to the water works at Adoagyiri. A greater proportion of rural and urban dwellers in the district who do not have access to pipe-borne water rely on streams or rivers, wells and boreholes for their supply of water.

However, the streams, wells and rivers dry up during the dry season. In addition, boreholes frequent breakdown of the boreholes compounds the already poor state of water supplies in the district.

Sanitation situation in the district leaves much to be desired. However, the situation is quite better in the rural areas than in the urban areas due to high community spirit among the inhabitants.
2.2.9 Structure of the local economy

The productive sectors can be classified into three namely primary, secondary and tertiary economic activities. The primary sector includes agriculture, quarrying and hunting. Secondary economic activities involve turning the raw materials extracted at the primary stage into finished and semi-finished products (processing). This includes manufacturing, construction and all forms of processing. The tertiary economic sector, which involves the provision of services, includes financial services, distribution of goods and transportation.

2.2.10 Economic activities

Agriculture is the principal occupation in the rural areas of the district. It employs a greater proportion of the potential labour force.

The industrial sector appears to be making modest gains. Whereas some industrial establishments are doing well, others have suffered setbacks, especially in the face of trade liberalisation and privatisation.

The service sector has overtaken the crops and livestock sectors. It now employs majority of the labour force particularly in the urban areas. Economic activities in this sector include trade, hotels and restaurant/drinking bars, transport and communications financial services and services provided by government in public administration. Its share of the labour force has increased over the years. Trading has become the major economic activity in the district (Baseline Survey, 1995). This is because of increasing interaction with Accra. Agricultural produce is the main item of trade followed by food selling. This trade has been made possible by the transport
sector. Hotels, restaurants and financial services are the least developed. However, the hotels and restaurants sub-sector is now showing signs of growth especially at Aburi where tourist activities thrive most.

2.2.11 Transportation networks

There is the need for an appreciable degree of interaction within and between settlements that constitute an economy to enhance development. The nature and condition of the communication system, particularly transportation, is therefore necessary. Transportation networks, which refers to the distribution and level of road and transport systems affects the utilisation of health facilities and marketing in the district. The transportation network assumes a radial shape originating from the Nsawam-Adoagyiri conurbation to virtually all parts of the district.

The only highway in the district is that of the Accra-Kumasi highway which passes through the district capital, Nsawam. It links the southern and northern parts of the district and the entire nation. All the other roads in the district link the highway at either Nsawam or Adoagyiri. Its total length within the district is about sixteen kilometres. Second class roads in the district cover a total distance of about forty and a half kilometres. Most parts of these roads have good surface conditions. Third class roads connect the rest of the district. Roughly measured, they cover a total length of about sixty (60) kilometres. Interestingly, all these class three roads have no bitumen surface. They also abound with potholes and bumps due to erosion and rainwater deposits on them. During the dry season they get dusty whilst water deposits and surface erosion conditions are heightened during the longer rainy seasons. Both
periods render usage of these roads impassable. Aside all these are myriad of access roads not well developed and used occasionally by vehicles. There is no doubt that the poor road network would not badly affect transportation system. Lastly, the Accra-Kumasi railway line passes through the district.

2.3 Research methodology

2.3.1 Sources of data

Data for the study were obtained from primary and secondary sources. The primary data collected were obtained from questionnaires (interviews and self-administered questionnaires in the field), personal interviews and direct field observation. The secondary data on the other hand, were derived from the Internet, published books, articles, medical reports, and maps. However, a substantial proportion of the data for the study was obtained from the field survey. A preliminary survey preceded the actual fieldwork. The essence of this initial survey was to make sure that the study was feasible and to decide on which sampling techniques and questionnaire design to use.

2.3.2 Research instruments and target population

Questionnaires were the main research instrument. The administered questionnaires consisted of self-administered ones and interview schedules for illiterates and semi-literate since they could not complete it by themselves. The questionnaires consisted of open-ended and closed-ended questions. Other primary source of information was the direct personal observation of the natural environment.
and some cultural practices. This formed the basis for drawing inferences in relation to the geography of the disease.

The target population to whom the questionnaires were administered was household heads, health administrators and patients with active ulcers. Besides, some community leaders were also interviewed using questionnaires with questions on their communities.

2.3.3 Sampling design and size

Faced with limited time and financial constraints, it was impossible to cover the entire district. The settlements were therefore stratified into different zones of endemicity based on the available medical records on the disease in the district which were obtained from the Disease Control Unit of the Ministry of Health, Nsawam. The administrative sub-districts formed the basis of this classification. Aided by a district base map, and available medical statistics on the prevalence of the disease, the settlements were categorized under their respective administrative sub-districts. It is from these statistics that the geographical distribution of the patients was established. Patients from outside the district were ignored because their inclusion would not give the accurate picture of the geographical distribution of the disease in the district. Based on this classification scheme, three levels or zones of endemicity were arrived at, namely high, low and non-endemic or "Buruli ulcer" free area.

In all, eight settlements were selected for the study. Four settlements were then randomly selected from the high endemic areas while three settlements were
drawn from the low endemic area. Only one settlement was randomly chosen from the low area. This is shown in Table 2.1.

Table 2.1: Buruli ulcer endemic areas by sub-district and reported cases.

<table>
<thead>
<tr>
<th>Level of endemicity</th>
<th>Sub-district</th>
<th>Settlement</th>
<th>Reported cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Pakro-Dego</td>
<td>1. Tabankro</td>
<td>105*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Asaasiansa</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Buokrom</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Pakro</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1. Pokrom</td>
<td>1. Okobeyeye</td>
<td>24*</td>
</tr>
<tr>
<td></td>
<td>2. Nsawam</td>
<td>2. Ahodwo</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Panpanso</td>
<td>3. Pokrom</td>
<td></td>
</tr>
<tr>
<td>Non-endemic area</td>
<td>1. Aburi</td>
<td>1. Aburi</td>
<td>--</td>
</tr>
</tbody>
</table>


Owing to time and resource constraints a sample of two hundred (200) household heads were randomly chosen for the exercise. Twenty-five (25) household heads were randomly drawn from each of the eight selected settlements. The dispersed nature of the houses necessitated the use of the simple random sampling technique. This is because no linear arrangements of houses were observed.

The total population of the selected communities according to the 1984 Population census was ten thousand, seven hundred and thirty-five (10,735). Equal sample size of twenty-five (25) heads of household in each settlement was drawn for interview. This is shown in Table 2.2.
Table 2.2: Selected settlements and sample size for the study

<table>
<thead>
<tr>
<th>Name of Settlement</th>
<th>Total Population (1984)</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tabankro</td>
<td>425</td>
<td>25</td>
</tr>
<tr>
<td>Asaasiansa</td>
<td>120</td>
<td>25</td>
</tr>
<tr>
<td>Buokrom</td>
<td>498</td>
<td>25</td>
</tr>
<tr>
<td>Pakro</td>
<td>1425</td>
<td>25</td>
</tr>
<tr>
<td>Okobeyeye</td>
<td>101</td>
<td>25</td>
</tr>
<tr>
<td>Ahodwo</td>
<td>191</td>
<td>25</td>
</tr>
<tr>
<td>Pokrom</td>
<td>490</td>
<td>25</td>
</tr>
<tr>
<td>Aburi</td>
<td>7495</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10745</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>

Source: Compilation based on 1984 Population Census

Apart from the questionnaires, which were administered to the heads of household, forty-seven (47) medically diagnosed Buruli ulcer patients who were receiving medical attention during the time of the study, were purposely sampled. This was done in order to throw more light on the effect the disease had had on them. This category of respondents includes some of the household heads.

2.3.4 Data analysis and presentation

Data analysis was mainly qualitative. Analytical techniques involved the use of simple descriptive statistics such as frequency distribution and percentages and inferences drawn from the direct field observations. The use of cross-tabulation techniques was also employed to show association between variables. These relationships include the spatial distribution of the disease and the physical environment. Tables and graphs were used in the data presentation. Furthermore, the spatial patterns of the disease were shown on a map.
2.3.5 Data limitations

Everywhere people seek medical care outside the formal sector of the medical system, and the case is no exception in the Akwapim South District. Therefore, it is possible that there are people with infections have not yet shown up at any health facility for treatment, and consequently information on them may be lost. This means that, this group of people were not covered by the scope of the data. Thus, using medical records on reporting cases as a means of mapping and generalisations on the prevalence of Buruli ulcer in the district may give a wrong impression that may lead to wrong conclusions. Despite the outlined weakness, it is considered useful to make use of what is available in the study in order, to approximately determine the spatial patterns of Buruli ulcer in the Akwapim South District. This is because the geographical distribution of Buruli ulcer as established using the secondary data still gives an idea about where the incidence of the disease is serious. Similar studies using secondary data have been undertaken on the geographical distribution of cancer in the French Polynesia (Vinson, 1974).

Secondly, due to illiteracy of some of the respondents and poor geographic access of some villages, it became necessary to engage assistants at some cost to translate and interpret the research questions into the local language. The possibility of some bias being introduced into the responses cannot be ruled out. Illiteracy on the parts of some respondents may also have affected the understanding of some questions, particularly those on attitudes and perception. This may eventually mar the quality of the data obtained. In addition, some of the respondents were unwilling to divulge information. This was so with those who had active ulcers due perhaps to
shyness. It is hoped that the existence of relevant variables in mapping out Buruli ulcer in the district may reduce distortions that may arise out of ignoring several unreported and unknown cases.

These limitations may affect the quality of work done. In the light of the above, criticisms are welcomed. Therefore, the researcher recommends further studies on the subject to improve upon what has been covered in this study.
3.0 The Magnitude and Spatial Patterns of Buruli Ulcer

3.1 Introduction

The chapter discusses the magnitude of the disease and the associated risk factors. It further discusses the geographical distribution of the disease and the socio-demographic characteristics of the observed patients.

3.2 The Magnitude of The Problem

Compared to malaria, diarrhoeal diseases, and other endemic tropical diseases in the Akwapim South District, Buruli ulcer appears to be insignificant in terms of prevalence, incidence, and mortality. However, its high morbidity and debilitating and crippling effects on the afflicted makes it a disease of serious public health in the Akwapim South District.

According to the survey results of the 1999 National Case Search for Buruli ulcer in Ghana, ninety out of the one hundred and ten districts had recorded cases of the disease. This shows an appreciable increase in the reporting of cases over the period 1993-1997, when six out of the ten regions were known to have recorded incidence and prevalence of the disease. This information has already been shown in Table 1.1.

According to the survey results of the National Buruli ulcer Case Search in Ghana in 1999, all the administrative districts in the Eastern Region reported cases of the disease. The Akwapim South District ranked second in terms of incidence and prevalence to the Kwahu South District also in the Eastern Region (MOH, 1999).
Some districts were more severely affected than others. This information is represented in Table 3.1.

Table 3.1: Reported Buruli ulcer cases per district in the Eastern Region, 1999.

<table>
<thead>
<tr>
<th>District</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwahu South</td>
<td>73</td>
<td>59</td>
<td>132</td>
</tr>
<tr>
<td>Akwapim South</td>
<td>66</td>
<td>63</td>
<td>129</td>
</tr>
<tr>
<td>Suhum-Kraboa Coaltar</td>
<td>41</td>
<td>28</td>
<td>69</td>
</tr>
<tr>
<td>Fanteakwa</td>
<td>15</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>Manya Krobo</td>
<td>17</td>
<td>10</td>
<td>27</td>
</tr>
<tr>
<td>West Akim</td>
<td>16</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>New Juaben</td>
<td>15</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Birim South</td>
<td>9</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Asuogyaman</td>
<td>8</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>East Akim</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Birim North</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Yilo Krobo</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Akwapim North</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Kwaebibirem</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>


The incidence of Buruli ulcer caught the attention of the district medical authorities during the second half of 1998. The year recorded seventy-six accumulated cases from one out of the five sub-districts that constitute the administrative district. Sporadic cases were however, reported in other parts of the district except the Aburi sub-district. However, the extent of the scourge in the new areas is not as severe as it is in the original foci of the disease Pakro-Dego sub-district, which accounts for 81% or one hundred and four (104) reported Buruli ulcer cases in the district.

Incidence is more prevalent in the remote and difficult to reach rural areas of the district, notably the Pakro-Dego sub-district. One hundred and twenty-nine Buruli ulcer cases involving all the communities had come before the district health
authorities by the end of March 2000, with twenty-six deformities (Hospital statistics, Nsawam, 2000). Incidence is higher in some communities than others. According to Table 3.2, Tabankro, Pakro, Asaasiansa and Buokrom are the most severely affected settlements in the district. These settlements are all located in the river Densu basin. This trend has continued to the present. The least affected communities include Panpanso and Okobeyeye.

Table 3.2: Some ten communities with high cases of the Buruli ulcer in the Akwapim South District in 1999

<table>
<thead>
<tr>
<th>Community</th>
<th>Number of reported cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tabankro</td>
<td>15</td>
</tr>
<tr>
<td>Pakro</td>
<td>9</td>
</tr>
<tr>
<td>Buokrom</td>
<td>6</td>
</tr>
<tr>
<td>Asaasiansa</td>
<td>6</td>
</tr>
<tr>
<td>Adesa</td>
<td>5</td>
</tr>
<tr>
<td>Adjimase Zongo</td>
<td>4</td>
</tr>
<tr>
<td>Asikabew</td>
<td>4</td>
</tr>
<tr>
<td>Okobeyeye</td>
<td>3</td>
</tr>
<tr>
<td>Panpanso</td>
<td>3</td>
</tr>
<tr>
<td>Okanta</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58</strong></td>
</tr>
</tbody>
</table>

Source: Ministry of Health, Nsawam 1999

Available medical statistics on the incidence of the disease in the district revealed that at least five cases are reported monthly for treatment at the Buruli ulcer-dressing centre at Pakro. Using the provisional 2000 Population census total population of one hundred and twenty thousand, five hundred (120500), the incidence rate as of March 2000, was 1.1 per 1000 for the entire district. However, the rate differs from one area to another. It was 4.4 per 1000 for the highly endemic area and 0.03 per 1000 in the low endemic area.

The sex ratio of victims was sixty-one (61) males to sixty-eight (68) females. Most cases were children or teenagers. In all, a little over seventy-two percent
(72.1%) or 93 cases were less than twenty years old. Out of this, 58.1% (75 cases) were below fifteen years. The distribution shows a rapid decrease with age in prevalence. In adults, women had a higher incidence than men. The same is true for the children and teenagers aged below twenty. The preceding information is illustrated in the Table 3.3.

Table 3.3: Age and gender distribution of reported Buruli ulcer cases in the district between August 1998 and March 2000

<table>
<thead>
<tr>
<th>Age group</th>
<th>Males (Number)</th>
<th>%</th>
<th>Females (Number)</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>2</td>
<td>3.3</td>
<td>11</td>
<td>16.2</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>0-5.</td>
<td>9</td>
<td>15</td>
<td>13</td>
<td>19.1</td>
<td>22</td>
<td>17.1</td>
</tr>
<tr>
<td>10-14.</td>
<td>9</td>
<td>31.7</td>
<td>21</td>
<td>30.9</td>
<td>40</td>
<td>31</td>
</tr>
<tr>
<td>15-19.</td>
<td>14</td>
<td>23.3</td>
<td>3</td>
<td>4.4</td>
<td>17</td>
<td>13.2</td>
</tr>
<tr>
<td>20-24</td>
<td>4</td>
<td>6.7</td>
<td>5</td>
<td>7.4</td>
<td>9</td>
<td>6.9</td>
</tr>
<tr>
<td>25-29</td>
<td>2</td>
<td>3.3</td>
<td>2</td>
<td>2.9</td>
<td>4</td>
<td>3.1</td>
</tr>
<tr>
<td>30-34</td>
<td>1</td>
<td>1.7</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>35-39</td>
<td>1</td>
<td>1.7</td>
<td>2</td>
<td>2.9</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>40-44</td>
<td>2</td>
<td>3.3</td>
<td>1</td>
<td>1.5</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>45-49</td>
<td>2</td>
<td>3.3</td>
<td>1</td>
<td>1.5</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>50-54</td>
<td>2</td>
<td>3.3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>55-59</td>
<td>1</td>
<td>1.7</td>
<td>3</td>
<td>4.4</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>60+</td>
<td>2</td>
<td>3.3</td>
<td>6</td>
<td>8.8</td>
<td>8</td>
<td>6.2</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>100</td>
<td>68</td>
<td>100</td>
<td>129</td>
<td>100</td>
</tr>
</tbody>
</table>


There is the possibility that some people may be suffering from the disease but may not have reported for diagnosis at any of the health facilities in the district. Such cases are not reflected in Table 3.3. The problem of under-reporting or under-diagnosis makes it very difficult to ascertain the exact magnitude of the scourge. The problem of under-reporting or late reporting has persisted in the communities due to the wrong public perception of the disease and its appropriate treatment. General awareness of the disease is low. This is because before the disease was first
diagnosed, thirteen percent (13%) representing 26 of the public (heads of households) had heard of it while eighty-seven percent had not.

The chronic nature of ulcers associated with low rates of success of treatment has made people to believe that supernatural forces are responsible for the cause of the disease. Table 3.4 represents the public perception of the disease.

**Table 3.4: Respondents' perception on the cause of the Buruli ulcer**

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No idea</td>
<td>95</td>
<td>38.3</td>
</tr>
<tr>
<td>Bacteria</td>
<td>18</td>
<td>7.3</td>
</tr>
<tr>
<td>From water</td>
<td>26</td>
<td>10.5</td>
</tr>
<tr>
<td>Witchcraft</td>
<td>66</td>
<td>26.7</td>
</tr>
<tr>
<td>Poor hygiene</td>
<td>19</td>
<td>7.7</td>
</tr>
<tr>
<td>Curse from gods</td>
<td>23</td>
<td>9.3</td>
</tr>
<tr>
<td>Total</td>
<td>247</td>
<td>100</td>
</tr>
</tbody>
</table>

**Source: Fieldwork, May 2000**

The information as represented in the table above involves both the afflicted and household heads. From Table 3.4, a little over twenty-six percent attributed the cause to witchcraft while a little over nine percent assigned the cause to a spell cast by gods. In all, thirty-six percent attributed the cause to supernatural forces. Thirty-eight per cent could not assign any possible cause of the disease. The responses given in the table indicate low level of awareness of the disease among the public and this will undoubtedly influence their health care seeking behaviour. As a result of these perceptions cases continue to receive attention from traditional healers, thinking that those healers can provide effective cure to their affliction. The wrong public perceptions on the cause of the disease reveal the shallow depth of knowledge of the disease among the public and this will continue to deter people from seeking health care from the appropriate source. Not until the erroneous impression among the public on the disease is corrected, incidence of the disease
will persist and spread. When this happens the exact magnitude of the disease cannot be assessed hence under-reporting will continue to occur due to the fact there will not be adequate data on the disease.

3.3 Risk factors and transmission dynamics

A risk factor is a characteristic which, if present and active, clearly increases the probability of a particular disease in a group of persons who have the factor, compared to an otherwise similar group of persons who do not have (Jekel et. al., 1996; Farmer et. al., 1996). Some risk factors are associated with several diseases, and some diseases are associated with several risk factors. Epidemiological studies can measure the relative contribution of each factor to the occurrence of diseases, and the corresponding potential reduction in disease from the elimination of each risk factor (Beaglehole et. al., 1993).

A number of risk factors are associated with the Buruli ulcer. Some of these are skin contamination and any penetrating injury. This is because mycobacterium ulcerans (the causative organism) cannot by itself penetrate the skin (Sciencenews, 1999). The abiotic environment in the form of stagnant waters, slow moving waters, certain water insects on the roots of aquatic plants (Barker, 1972; WHO, 2000) serve as a habitat for the causative organism. Certain insects may also help the bacteria get under a person's skin due to the fact that certain water bugs living on plant roots in endemic areas of Benin and Ghana have tested positive for mycobacterium ulcerans (Lancet, 1999). However, this ought to be treated with caution for such a discovery could be accidental. Furthermore, mycobacterium ulcerans is believed to
occur in soil or on vegetation, thereby infecting the skin through pricks or other
penetrating injuries (Meyers et. al., 1974).

It was discovered in the study that penetrating injuries caused by pricking by
vegetation, striking the foot against objects, cutlass wounds, that of water vessels,
stagnant water bodies and restricted access to health facilities as well as the public
perception on the disease were the main risk factors that are associated with the
disease in the Akwapim South District. Contact with water cannot be left out of the list
of possible risk factors in the Akwapim South District. This is because there is great
water-contact through swimming and farming along watercourses and in swampy
lands.

There are several important factors in the transmission of Mycobacterium
ulcerans infection in the Akwapim South District. Fishing in water bodies that are
either stagnant or flowing which eventually might predispose one to infection. This is
because fishes caught might be contaminated with the causative organism but
cannot be seen with the naked eye. Thus pricking by the fin of a fish or any other
penetrating injury may lead to infection. Farming along water bodies or on swampy
lands expose people to infection by the mycobacterium ulcerans. This is because
such areas harbour the causative organism. According to Meyers et.al., (1974), it is
believed mycobacterium ulcerans resides in soils. Therefore if any penetrating injury
occurs on a contaminated skin infection may result.
3.4 Geographical pattern of Buruli ulcer in the district

Geographical epidemiology is the description of spatial patterns of disease incidence (prevalence) and mortality (English, 1996). It is a descriptive epidemiology, which is more generally concerned with describing the occurrence of disease with respect to demographic characteristics, places, and time. Geographical studies have provided important clues to the aetiology of diseases. For instance, the geographical distribution of mortality from malignant melanoma led Lancaster (1956) to conclude that, its major cause was excessive sunlight. Palm (1890) suspected that lack of sunshine was the major cause of rickets. His suspicion was confirmed having obtained data on the geographical variation in the prevalence of rickets in various countries.

Maps provide the most succinct summary of descriptive geographical phenomena since they display the spatial distribution of the characteristics of interest. On a map, the geographical distribution of disease is readily visible. For instance, the production of cancer maps for many countries (Boyle et. al., 1989) testifies to the appeal of this approach. Maps in the Chinese atlas of cancer show substantial regional variation in mortality for many sites (English, 1996).

Statistical tables, while able to present more data than maps, cannot easily convey these spatial patterns and so are less comprehensible or accessible means of representing geographical data. Minute patterns may be missed in tables since they cannot take spatial relationships between populations into account.

Although maps have the ability to portray spatial patterns of phenomena, they have limitations. Sutherland (1962) pointed out the principal deficiency of the
geographical base-map in respect of Scotland. He showed that on the normal map correct weighting could not be given to the large urban populations, which occupy small areas, whilst small populations sparsely distributed over large areas could appear to be over-represented. The inherent deficiencies can be traced to the potential problems in the interpretation of geographical data. In other words, it is easy to forget that the instant visual impression of regions of high and low risk and of spatial patterns of disease frequency is based upon descriptive data which are subject to the problems of geographical interpretation. Furthermore, Barker (1981) noted that: ‘maps of disease compel speculation about aetiology, but only rarely has such speculation by itself led directly to the discovery of causes’. This means that disease maps can give clues to areas of occurrence of diseases. However, they (maps) cannot provide interpretation to the exhibited patterns unless they are probed into. Nevertheless, base-maps could relate disease rates to the local populations at risk as well as to geographical position and might prove to be a useful epidemiological tool (Brew, 1996).

For the purpose of this study, the administrative map of the Akwapim South District is the base-map upon which the prevalence of Buruli ulcer is plotted for the study and it is shown in Figure 2.1. The geographical distribution (prevalence) of the disease is established via district medical reports. Vigneron (1989) used a similar approach in the geographical studies of cancer in French Polynesia. In this study, only eight hundred and twenty-two (822) registered cancer cases could be used on a geographical basis. This is because places of residence for ninety-nine patients were missing. In a related development hospital registry data on cancer incidence in many
developing countries (Parkin, 1988) have given valuable insight into high and low incidence areas in parts of the world where no population-based data exist. This approach is relevant and can therefore be extended to establish the geographical distribution of Buruli ulcer cases in the Akwapim South District. The disease shows clustering in one particular sub-district, Pakro while it is sporadic in the other sub-districts but one. The spatial pattern of the disease is shown in Figure 3.1.

Of the total number of Buruli ulcer cases in the entire district, 81% can be found in the high endemic area (High number of cases). This corresponds to the Pakro-Dego sub-districts, which cover the north-western corner of the district. The disease is prevalent in twenty-six villages. The worst affected village is Tabankro. Others are Buokrom and Asaasiansa. In this area, infection is reported in all the settlements.
FIG. 3.1 DISTRIBUTION OF BURULI ULCER CASES REPORTED BETWEEN AUGUST 1998 AND MARCH 2000 IN THE AKWAPIM SOUTH DISTRICT BY RESIDENCE.
The prevalence rate for the area is 4.14 per 1000. Retrospectively, linguistic evidence dates the incidence of the disease back to the early 1970s. The queenmother of Tabankro later during an interview confirmed this fact. Verbal responses from the public on the prevalence of the disease showed that it is common.

The second level (low endemic) area is characterized by sporadic prevalence. It encompasses three sub-districts namely Nsawam, Pokrom and Panpanso. Cases are few in numbers and scattered over the entire areas. This level thus represents the characteristic geographic pattern of scattered foci. It has a prevalence rate of 0.03 per 1000 per two years. Verbal response from elders and the public was that it (Buruli ulcer) is not common there but in high endemic area, Pakro-Dego sub-district.

The third level is the non-endemic zone that has no evidence of the disease prevalence. The sub-district concerned is Aburi and the verbal responses on the prevalence of the disease showed that it is not known here, but common in the Pakro area.

3.5 Observed demographic patterns of Buruli ulcer patients

3.5.1 Sex

The gender distribution of Buruli ulcer patients residing in the Akwapim South District surveyed for the effects of the disease is shown in Figure 3.2. Apart from the non-endemic area where Buruli ulcer prevalence was zero, fifty-one percent of the patients in the high endemic area were females while forty-nine percent were males. There was not much difference in terms of prevalence of the disease between the
two sexes. On the other hand, fifty-eight percent and forty-two percent of the patient respondents were females and males respectively in the low endemic area. Unlike the high endemic area where there was a slight female predominance over males, the opposite was the case in the low endemic area.

**Figure 3.2: Sex Distribution of Buruli Ulcer Patients in the Two Endemic Areas**

![Sex Distribution Diagram]

**Source: Fieldwork, May 2000**

In all, prevalence was higher in females than males. This conforms to the overall picture in the district, which shows that forty-seven percent and fifty-three percent of reported cases in the district involved males and females respectively. Female predominance could be attributed to the domestic division of labour (behavioural roles) such as fetching firewood and other domestic chores, which exposes them to greater risk of infection through injuries in the discharge of their duties.
3.5.2 Age

The study revealed a high prevalence of the disease in children or teenagers aged below twenty. Figure 3.3 shows the age distribution of the observed Buruli ulcer patients.

Figure 3.3 Age Distribution of the Observed Patients in both Endemic Areas

![Age Distribution Chart]

Source: Fieldwork, May 2000

From Figure 3.3, seventy-seven per cent (77%) of the observed patients in the high endemic area were aged below twenty (20) while the remaining twenty-three percent (23%) were over twenty (20) years. This shows a progressive fall in prevalence with age. This is in line with the overall prevalence of seventy-two per cent (72.1%) in the entire district. Although this group constitutes the dependent group, their plight has serious socio-economic effects on the children themselves and
their parents. This is because they cannot help their families in economic ventures but their families will have to expend on their medical bills.

On the other hand, fifty percent (50%) of the patients were aged below twenty (20) years in the low endemic area while the remaining fifty percent (50%) were over twenty (20) years. The infection rate therefore balances between the two groups. This distribution therefore shows a balanced infection rate between the independent (productive) and the dependants age groups. Unlike the high endemic area where prevalence was high among the unproductive group, the opposite was the case in the low endemic area.

On the whole, seventy percent of the patients were below twenty (20) years. The foregoing discussion points to the fact that the disease predominantly affects young people. It is possible to suggest that young people are more susceptible to infection than their older counterparts. The high prevalence of the disease in children could be explained by the fact that they (children) over-expose their bodies particularly the limbs to penetrating injuries and rough play. The habit of not wearing clothes exposes them to hazards such as injury by any possible means, which will inevitably become a route for mycobacterium ulcerans the causative organism to enter the body. Furthermore, they have a higher conscious or unconscious trauma rate and less tough skin than adults do. Lastly, children were found not to be observing proper hygiene. It is therefore not surprising that infection was very common among children. In sum, since children or teenagers are most vulnerable to infection the impact of the disease may be greater on them than in adults.
3.5.3 Occupation

Figure 3.4 illustrates the various occupations as were declared by the patients.

As can be seen from Figure 3.4, seventy-seven percent of the patients in the high endemic area were pupils, fourteen percent, six percent and three percent (3%), were engaged in farming, trading and masonry respectively. On the other hand, in the low endemic area fifty per cent (50%) were pupils, thirty-three percent (33%) were farmers while seventeen percent (17%) were traders. No cases were observed in the non-endemic area. The occupational distribution as shown in Figure 3.4 indicates that the disease can impact severely on the socio-economic lives of its
victims. It will adversely affect the education of the children owing to the fact that many of them would have to stop schooling or absent themselves from school sessions in order to seek treatment. Thus, their output both in school and home will be adversely affected.

3.5.4 Religious background of the patients

The following declarations were made with respect to religion. From Figure 3.5, thirty-six percent of the patients from both areas claimed to be Christians, four percent were Muslims (Islam), fifteen percent were Pagans and forty-five percent (45%) did not belong to any religious denomination.

![Figure 3.5 Religious Background of the Observed Patients by Residence](source: Fieldwork, May 2000)

Religion as discussed earlier influences public perception of health and disease. This is because depending on one's religious affiliation, one can give a different interpret to the cause of the disease. Whilst Christians for instance, do not
believe that the devil is responsible for the plight of the people with respect to the
affliction, others believe otherwise. It (religion) no doubt influences attitudes towards
the disease and the appropriate therapeutic practices. Religion therefore has the
potential for determining the type of medical system to consult for healing.

3.5.5 Marital status

In all, sixty-eight percent of the sampled patients were not married, thirteen
percent (13%) were married with divorcees accounting for nine percent (9%), and ten
percent (10%) had separated. The dominance of not married stems from the fact that
a substantial part of that group was children. It can be concluded therefore that the
children are unable to take good care of themselves.

3.5.6 Educational status

The relevance of the educational status of the patients reveals the impact of
the disease on those who were still in school. It can also influence decision on when
to patronize a health facility for medical attention. Figure 3.6 illustrates the
educational status of the observed patients.

The overall profile on education of the observed patients as revealed by Figure
3.6 shows that fifteen percent had never been to school, another fifteen percent had
completed different levels while seventy percent were still in school and were in
different levels. The highest level attained was the Junior Secondary. By this
statistics, it can be inferred that a greater proportion of the pupils had their education
in jeopardy. The disease will adversely affect their performance. In addition, the statistics reveal low educational status of the respondents. This development has serious implications for the use of health care and public perception of the disease.

3.5.7 Ethnicity

Figure 3.7 below shows the ethnic background of patients for the two endemic areas.

On the whole, seventeen percent of the patients were Gas, twenty-eight percent were Ewes, and forty percent were Akans (Akwapim). Eleven percent and four percent were Krobos and Dagartis respectively. However, differences exist in the composition of the population with respect to each of the two endemic areas.
In the high endemic area comprising the Pakro-Dego sub-district, seventeen percent of the patients were Gas, twenty-six percent were found to be Ewes and Akans accounted for thirty-seven percent. The rest were Krobos fourteen percent, and six percent were Dagartis. These statistics point to the fact that the population is fairly composed even though the area is for the Akwapims.

On the other hand, in the low endemic area constituted by the Panpanso, Pokrom and Nsawam sub-districts, seventeen percent of the patients declared themselves to be Gas, thirty-three percent were Ewes and fifty percent were Akans mainly Akwapims. The picture here contrasts sharply from the high endemic area. Over here, there is dominance by Akans. The distribution as outlined in Figure 3.7 shows the extent of migration or the composition of the population. Although the area belongs to the Akwapims, the other ethnic groups together outnumbered the
indigenes. Furthermore, the distribution indicates that Buruli ulcer affects people with diverse ethnic origin. This attests to the fact that the disease does not discriminate in affliction. The ethnic composition as discussed necessitated probing the history of travel of the patients in order to rule out the chance element in explaining the spatial pattern of the disease.

3.5.8 Travel history of patients

Before infection two percent of the patients had not lived within any of the endemic areas during the last four years, while ninety-eight percent had lived in both endemic areas. Figure 3.8 shows the travel history of the observed patients.

From Figure 3.8, three percent of the patients got infected outside the high endemic area. Nine percent declared to have lived in their locality (the high endemic area) for a year before infection and thirty-one percent declared to have stayed around for two years. Twenty percent of them had stayed there for three years, fourteen percent mentioned four years and twenty-three percent of them declared more than five years.

In the low endemic area, none of the patients declared to have lived outside the locality. According to the statistics for the low endemic area, forty-two percent lived there for only one year before infection. Those who had lived there for two years accounted for seventeen percent, another seventeen percent indicated four years while those who had stayed around for over five years accounted for twenty-five percent.
Figure 3.8: Travel History of the Observed Patients by Residence

Source: Fieldwork May, 2000

On the whole, only two percent lived outside the district before infection while the remaining ninety-eight percent had lived around for between one and more than five years. The 2% involved a woman who was a native of Buokrom in the high endemic area but had lived elsewhere till she got infected. She had only come to Buokrom, to seek medical treatment from a fetish priestess, who unfortunately passed away in the course of attending to her (the patient). The ninety-eight percent (98%) who had lived continuously in both endemic areas points to the fact that they got the infection there. The periods indicated were long enough for the causative
organism to cause the disease. Consequently, element of chance cannot be said to be influencing the pattern of the spatial spread.

The magnitude of the disease, its associated risk factors, the geographical distribution and the socio-economic dimensions of the observed patients have been discussed in this chapter.

3.6 Conclusion

Determining the exact magnitude of the disease requires accurate data on the incidence of the disease. Owing to the fact that some people continuously avoid medical treatment, it will be very difficult to know the exact magnitude of the disease in the district. This is because such unreported cases are not reflected in the records of the health administrators. This undoubtedly makes assessing the exact magnitude at any given time a very difficult task.

The next chapter focuses on the factors that could possibly explain the spatial patterns of the disease in the district.
CHAPTER FOUR

4.0 Factors Underlying Observed Spatial Patterns

4.1 Introduction

The previous chapter discussed the magnitude of the problem as well as some factors that militate against the ascertainment of the magnitude of Buruli ulcer in the study area. It again, touched on the geographical distribution of the disease and the socio-economic dimensions of the subjects. An attempt is made in this chapter to examine the underlying factors of the spatial spread of the disease.

4.2 Buruli ulcer and the natural environment

Independent studies by Snow (1854), Palm (1890), and Lancaster (1956), into the geographical distribution of diseases and mortality showed a link between spatial disease patterns and the natural environment. These studies confirm that the natural habitat influences the spatial variation of disease. The findings made by these people are relevant to this study. The physical factors that favour the survival of the causative organism prevail in the Akwapim South District, therefore physical environment can be said to have influence on the spatial distribution of the disease.

One striking characteristic of the spatial patterns of the disease in the district is the significance of natural drainage and altitude in the geography of the disease. Buruli ulcer has been found to be associated with riverine rural areas in Ghana and elsewhere (Mensah-Quainoo, 1997; van der Werf et. al., 1989 and Barker, 1972). Similar findings were made in this study.
There was a high prevalence of the disease in the settlements along river Densu and its tributary, Ponponso. This area corresponds to the high endemic area. Some of the affected settlements are Asaasiansa, Pakro, Tabankro and Asikabew. These settlements are situated very close to water bodies. The high concentration of the disease in the basin of the Densu and its tributary, Ponponso suggests initial disease foci which later spread to other areas.

Beside the drainage factor, much of the topography in the high endemic area is below 150 metres (500 feet) above sea level. The low-lying nature of the terrain facilitates the growth and development of swamps along these watercourses particularly river Densu. Consequently, the water bodies overflow their banks during the rainy season. The often-resultant stagnant pool of water provides a conducive habitat for the causative organism. Oral evidence in the high endemic area indicates that there has been environmental change in the form of deforestation due to agriculture and exploitation of lumber. This also contributes to flooding.

There was a progressive fall in incidence of the disease in the low endemic area. Unlike the high endemic area, settlements such as Pokrom, Ahodwo and Obodan all in the low endemic zone are situated farther away from the basin of rivers Densu and Ponponso. In addition to the natural drainage, the zone is relatively higher in elevation than the high endemic area. Thus, there is an improvement in drainage quality. Again, most of the streams that serve this zone are ephemeral in nature. Consequently, waterlogged conditions are rare or absent.

Lastly, the non-endemic area occurs on the Akwapim ridge. The height of the area is higher than both the high and low endemic areas. Thus, there are no well-
developed water bodies to create waterlogged conditions for the causative organism to survive. Some of the settlements on the ridge are Aburi, Ahwerase, and Obosomase.

From the discussion, poor drainage in the form of waterlogged conditions has been found to be associated with spatial variation in the prevalence of the disease in the district. It has in its small way helped in shaping the geography of the disease. In sum, it can be said that most of the Buruli ulcer cases in the district were located at low and on gentle slopes and occurs along watercourses.

Apart from the natural environment, the spatial patterns of the disease in the district cannot be understood without comprehending the secondary factors namely socio-economic and cultural factors. These artificial factors also help to interpret a health hazard. Probing into the differential living conditions rather than the 'natural' foci of disease (Shannon and Spurlock, 1976), can also bring out differences in the spatial spread of the disease. It may include socio-economic and cultural factors (Iyun, 1983). Prominent among the secondary factors is accessibility to health care facilities in the district, and lifestyles that predispose the inhabitants to health hazards.

The inclusion of secondary factors is a way of avoiding the temptation to search for a single determinant of spatial morbidity patterns in the district. All sorts of possible influences may have accounted for the observed patterns, some of which can be measured, others can only be inferred.
4.3 Utilization of health care services in relation to Buruli ulcer

4.3.1 Utilization and distance

A society's access to a health facility can determine its morbidity level. It was observed that restricted access to modern health facilities contributed to the incidence of the disease.

Physical distance was observed to have influence on the use of health facilities in the Buruli ulcer endemic settlements in the district. This has grave repercussions on the incidence of the disease. The study revealed the extent of the impact of physical distance on the use of health facilities in the high and low endemic areas. It was discovered that poor geographic access to health facilities had disadvantaged patients in the high endemic area. This is due to poor transportation system compounded by bad road network. Third class roads network the entire area most of which are rendered impassable during the rainy season. Besides the bad road network, some settlements such as Asaasiansa, Adjinase-Zongo all in the high endemic area are without road network. Consequently, inhabitants from distant areas in the high endemic areas really find it difficult to reach health facilities for consultation. Because vehicles hardly ply on these bad roads long distances are covered on foot. They are therefore compelled to live with whatever ailment they have irrespective of its degree of seriousness until their condition worsens. Based on this deterrent factor of physical distance, it is likely that treatment was not sought early hence the high incidence of the disease in the high endemic area. It is not surprising that there was a very high prevalence at Pakro, Asaasiansa, Asikabew, Buokrom and Tabankro all in the high endemic area.
Poor transportation system has combined with the skewed distribution of health facilities in the district to put accessibility of health care beyond the reach of the populace in rural areas in the district. The over-concentration (60%) of these facilities in the urban areas poses grave consequences for health related matters particularly in the deprived rural areas. The distance decay factor, which also has socio-economic dimensions thus, becomes a well-recognized spatial phenomenon in the high endemic area.

From the foregoing discussion, it can be said that the high incidence of the disease in the high endemic area could be due to poor transportation system compounded by poor road network and skewed distribution of health facilities. Baseline studies conducted in the district in 1995 revealed that about 60% of the villages do not have access to health facilities. The situation in the high endemic area therefore makes it difficult for the communities to seek health care from both within and outside their locality.

Unlike the high endemic area, which is characterized by restricted access to health care due to poor transportation system and lack of health facilities, there was a sharp contrast in the low and the non-endemic areas. Although there are not enough health facilities in these areas, there is an improved transport system, which facilitates movement from one place to another. The improved transport system is made possible by the fact that all classes of road network serve both (low and non-endemic) areas. Some of the settlements are Ahodwo, Pokrom, Nsawam and Aburi. With settlements such as Nsawam, Aburi and Pokrom being health centres inhabitants do not hesitate to seek medical care. In addition, improved transportation
system, which is made possible by regular movement of vehicles, facilitates movement of people to reach health facilities located in the sub-district capitals like Pokrom, and Aburi as well as the district hospital at Nsawam. With this development, it is likely that Buruli ulcer cases received early medical attention hence low and non-incidence in both areas respectively hence the lower prevalence rate.

In sum, it can be said that poor geographic access to health facilities due to poor transportation system has greatly contributed to the high prevalence of Buruli ulcer in the high endemic area. In the low and non-endemic areas improved transportation system has overcome the problem of physical distance hence high level of utilization of health facilities. The result is a low prevalence of the disease.

Poor geographic access to health facilities in the endemic areas has paved the way for diverse treatment options irrespective of the degree of seriousness of one's sickness. This perhaps could be due to a matter of convenience.

Table 4.1: Utilization of health care facilities by level of endemicity.

<table>
<thead>
<tr>
<th>Source of treatment</th>
<th>High endemic area</th>
<th>Low endemic area</th>
<th>Non-endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
</tr>
<tr>
<td>Self-medication</td>
<td>7</td>
<td>24</td>
<td>6</td>
<td>37</td>
</tr>
<tr>
<td>Orthodox medicine only</td>
<td>13</td>
<td>20</td>
<td>10</td>
<td>43</td>
</tr>
<tr>
<td>Traditional medicine only</td>
<td>24</td>
<td>14</td>
<td>5</td>
<td>43</td>
</tr>
<tr>
<td>Both (traditional and orthodox)</td>
<td>56</td>
<td>17</td>
<td>4</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>75</td>
<td>25</td>
<td>200</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000
The information in Table 4.1 was analysed based on the sample size from each of the endemic areas. As can be seen from the table, fifty-six percent of the household heads in the high endemic area relied heavily on both traditional and the orthodox medicine. Twenty-four percent depended on traditional medicine only, another thirteen percent mentioned the orthodox medicine as their only means of treatment whilst seven percent mentioned self-medication. On the other hand in the low endemic area, twenty-three percent declared that they combine both traditional and orthodox medicine, a significant proportion (thirty-two percent) relied on self-medication, twenty-seven percent cited reliance on the orthodox medicine only while nineteen percent mentioned traditional medicine. In the non-endemic area sixteen percent of the respondents utilized both traditional and orthodox medicine, twenty-four percent relied on self-medication, forty percent mentioned the orthodox medicine and twenty percent declared to be relying on traditional medicine only.

The general picture of the treatment options open to the populace due to poor geographic access to health facilities showed that thirty-eight and a half percent used both medical systems (orthodox and traditional medicines). Eighteen and a half percent depended on self-medication and twenty-one and a half apiece opted for only orthodox and traditional medicine respectively.

From the responses given, the traditional and the orthodox medical systems play a complementary role in the health care of the populace. In other words, the two medical systems supplement each other as a matter of convenience. However, there was a strong preference for the traditional medical system. The complementary role played by these two medical systems is very significant in the high endemic area.
probably due to restricted access to modern health care facilities. Apart from the orthodox medicine, which can properly diagnose the onset of Buruli ulcer, the others are incapable of achieving that since their mode of diagnosis is purely speculative. By over relying on unorthodox medical system, which lacks precision in diagnosing the disease, it is possible that those sources of treatment from which household heads sought treatment for their children could not detect the disease. Consequently, the corresponding high prevalence in the high endemic area compared to lower prevalence in the low endemic area and none for the non-endemic area. In other words, low patronage of modern health care in the high endemic area is tantamount to initial self-denial of health services delivered by trained eyes in diagnosing the disease. Hence seeking assistance late. That is at the time when the situation of the victim might have already been worsened. The opposite was the case in the low and non-endemic areas since high patronage of modern health care might have exposed the disease at its initial stages of development for treatment hence low prevalence. High patronage of orthodox medicine could therefore account for the low prevalence of Buruli ulcer in the low endemic area owing to the fact that it might have been detected at the onset. For it is possible that early detection and treatment would reduce the grave consequences the disease has on its victims.

Comparatively, there was improved geographic access to health facilities at Okobeyeye, Aburi, Pokrom and Sakyirom all in the low and non-endemic areas hence a strong preference for orthodox medicine as reflected in the responses given.
Table 4.2: Respondents' preference for either orthodox or traditional medicine by household.

<table>
<thead>
<tr>
<th>Source of treatment</th>
<th>Highly endemic area</th>
<th>Low endemic area</th>
<th>Non-Endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>Traditional medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional medicine</td>
<td>41</td>
<td>41</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Orthodox medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthodox medicine</td>
<td>15</td>
<td>15</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not applicable</td>
<td>44</td>
<td>44</td>
<td>58</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

Of the fifty-six percent respondents who combined traditional and orthodox medicine in the high endemic area, only 15% opted for orthodox medicine. This fraction however, rarely used the orthodox medicine for the following reasons: no health facility 13%, 46% indicated long distance travel to reach a health facility, and 41% said they cannot afford it. Furthermore, respondents from the low and non-endemic areas accounted for 6% and 16% respectively for orthodox medicine. Like their counterparts in the high endemic villages, patronage was low due to user fees charged at health centres. Comparatively, patronage was quite higher in the low endemic zone than the high endemic zone. This presupposes that those who frequent modern health facility stood the chance of benefiting from the early detection of the disease for themselves and their dependants. Thus, cases detected early were likely to have received early treatment hence low prevalence in these areas than the high endemic zone.
A story by a Buruli ulcer patient underscores the problem of physical access to health facilities and the kind of initial treatment sought due to poor transportation system. The patient, a twelve-year-old boy at Tabankro in the high endemic area disclosed that owing to the poor transportation system in the area, he at times found it difficult to go for treatment at the health centre at Pakro. Therefore, his family initially relied on traditional medicine as a means of overcoming the physical barrier. Owing to the poor transportation system, he used to be carried on the back of his father in order to be able to reach Pakro for treatment. Later, he had to go to Pakro on foot anytime that he was to receive medical care. Consequently there were times he could not show up at the health centre simply because the ulcer became so painful, that he could not walk.

4.3.2 Ability to pay for health care

It was observed that income was a factor that greatly influenced the use of health facilities in the study area. This compels people to postpone seeking early treatment or resort to alternative medical sources for treatment, which sometimes fail them. In this study, seventy percent (70%) of the Buruli ulcer patients were children aged below twenty and for that matter depended on their parents and guardians for health care. The remaining thirty percent (30%) were adult patients. The inability to pay for modern health care, according to the children, compelled their parents to delay seeking early medical care and resorted to traditional medicine. This therefore caused the delay in seeking medical assistance among the patients. Table 4.3 shows the period patients waited until they sought treatment at a health facility.
Table 4.3: Responses on the time gap between infection and first visit to a health facility

<table>
<thead>
<tr>
<th>Period (months)</th>
<th>High endemic area</th>
<th>Low endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>1-3.</td>
<td>3</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>4-6.</td>
<td>11</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>7-12.</td>
<td>15</td>
<td>43</td>
<td>1</td>
</tr>
<tr>
<td>Do not remember</td>
<td>6</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

From Table 4.3, nine percent of the patients in the high endemic area received medical care between one and three months after infection. Thirty-one percent waited for between four and six months, forty-three percent had to wait for between seven and twelve months while seventeen percent did not remember when they had it.

In the low endemic area, forty-two percent of the patients waited for between one and three months before medical personnel were consulted. Twenty-five percent did report after four to six months of affliction, eight percent did so between seven and twelve months after affliction while twenty-five percent could not remember the time lapse between onset of the disease and the time of seeking medical care at a health facility.

On the whole, seventeen percent waited for between one and three months after affliction, thirty percent said between four and six months, thirty-four percent mentioned between seven and twelve months whilst nineteen percent could not
indicate when they did so. The indication here is that treatment was being sought elsewhere thinking that the ulcers were ordinary sores, which could easily be treated with warm water. The time lapse between the onset of the disease and when modern medical care was sought suggests that treatment was not sought early enough in order to check the disease from advancing among the patients. Postponing seeking medical care in this way could be seen to have compounded the plight of the afflicted particularly those in the high endemic zone.

Only nine percent of the patients in the high endemic area sought medical care during the first three months of infection compared to forty-two percent in the low endemic area. Again, the high prevalence of the disease in the high endemic area lies in the fact that the majority (74%) of the patients in the most endemic area sought medical care late. Behind the delay was their inability to pay their medical bills particularly the young patients whose health needs were determined by their parents.

The underlying factor of their financial woes was that their main source of income, agriculture was and continues to be saddled with marketing problems.

4.3.3 Educational status and the utilization of health care facilities

Education revealed its influence on the use of health care facilities, the public perception on the cause of disease and the appropriate treatment options. Generally, the low educational level of the respondents was observed to be associated with low utilization of health care facilities. It was also associated with erroneous impression with respect to the cause of the disease. The level of utilization of health care facilities will determine the degree of contact with trained health personnel whose
services could moderate the incidence of the disease. Public perception that the disease is incurable by orthodox medicine to a large extent determined the type of medical system that was consulted when the disease started. Therefore, if people do not patronise such health care facilities, they deny themselves of scientific diagnosis thereby compounding their health problems.

Low patronage of health care services was found to have compounded the incidence of Buruli ulcer in the endemic areas in the district, particularly in the Pakro-Dego area, which corresponds to the high endemic area. Table 4.4 illustrates the educational profile of the household heads.

**Table 4.4: Educational status of household heads**

<table>
<thead>
<tr>
<th>Response</th>
<th>High endemic area</th>
<th>Low endemic area</th>
<th>Non-endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>No education</td>
<td>19</td>
<td>19</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Primary/ Middle</td>
<td>64</td>
<td>64</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>J.S.S</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>O'Level</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Post-secondary</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A'Level</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tertiary</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

The table above was analyzed in terms of the sample size per unit area. From the table, nineteen percent of the respondents in the high endemic area had no formal education, sixty-four percent had Primary and the defunct Middle school certificate background, and five percent had completed Junior Secondary. Six percent and one percent declared to have completed the General Certificate of
Education Ordinary and Advanced levels respectively. While four percent had completed Post-secondary and were practicing as teachers and only one percent (1%) had completed the University.

For the low endemic area, twenty percent (20%) had no formal education. The majority (61%) had Primary and Middle school background and five percent had completed the Junior Secondary (Basic Education Certificate Examination). Another twelve percent and two percent had completed Ordinary level and Post-secondary respectively. Lastly, respondents in the non-endemic area seem to have a better educational background as outlined as follows. When compared to the high and low endemic areas, it has a low rate for those with no formal education. It was thirteen percent for those with no formal education and twenty-four percent for those with Primary and Middle school background. Twelve percent had completed Junior Secondary, sixteen percent and twelve percent were General Certificate of Education at the Ordinary level and Advanced level holders respectively. Twelve percent apiece declared to have completed various Tertiary institutions and Post-secondary.

These responses indicate low educational background of the respondents in both the high and low endemic areas and a high literacy rate in the non-endemic area. However, this does not change the overall low level of education unfolded in this study. This has some implications on the use of health facilities by themselves and their awards.

Consequently, such a weak educational background impacted negatively on the use of health care facilities as put forward by Grossmann (1975). This therefore caused the disease to persist and grew in some areas especially in the high endemic area.
area. For people with such educational background many a time are ignorant about health problems. This state of affairs is a deviation from the fact that the better educated are more aware of health problems. Table 4.5 reflects the responses given with regards to the use of health care facilities and their educational background (see the table below).

The educational background of the household heads as discussed have influenced the use of health services on either themselves or their dependents who were afflicted by the Buruli ulcer. Because the minors' demand for health care is decided by their parents or guardians.

Table 4.5: Utilization of health services by education per household heads.

<table>
<thead>
<tr>
<th>Educational level</th>
<th>Rarely Frequency</th>
<th>%</th>
<th>Very often Frequency</th>
<th>%</th>
<th>Total Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education</td>
<td>35</td>
<td>25</td>
<td>4</td>
<td>21</td>
<td>39</td>
<td>19.5</td>
</tr>
<tr>
<td>Primary/Middle</td>
<td>93</td>
<td>68</td>
<td>4</td>
<td>21</td>
<td>97</td>
<td>48.5</td>
</tr>
<tr>
<td>J.S.S.</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Ordinary level</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>10.5</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Post-secondary</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>26</td>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td>Advanced level</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>10.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Tertiary</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>10.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Not applicable</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>43</td>
<td>21.5</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>100</td>
<td>19</td>
<td>100</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

As can be seen from Table 4.5 above, sixty-nine percent (138 persons) of the household heads rarely used health care services whilst thirty-one percent (19 heads of households) used it regularly. Among those who rarely used health facilities, twenty-five percent had no education, sixty-eight per cent had Primary or Middle education, and those with Basic education certificate background accounted for four percent. The rest (Ordinary level and Post-secondary) constituted 3%.
Among the 31% (19 persons) household heads that patronised the formal medical care very often, 21% had no education and another 21% either ended at the Primary level or were the defunct Middle School leavers. The rest, from GCE Ordinary to tertiary levels constituted fifty-eight percent. These statistics shown in Table 4.5 indicates that the level of utilization of health care services is very low among respondents with little education (notably those with no education, Primary, Middle and the Basic education level). The educational status of guardians influence decisions on the use of medical facilities for dependants when ill. It is clear that the household heads with little education outnumbered the better educated. The reverse is the case among those with relatively higher education, and this in a way confirms Grossman (1975) assertion on the relationship between education and the use of health services.

It is not surprising that the high endemic area has a high prevalence due to low usage of health care services. This is because the bulk of those with little or no education came from the high endemic area, which until the discovery of the disease had not benefited from any health education with respect to the disease. Although the level of education is low in the low endemic area, the health education on the disease has made a positive impact on the villagers. It could be that they became enlightened on the disease or health workers who were going round the villages identified cases for treatment.

Besides educational status accounting for the low utilization of health care services, it also influences their perceptions on the cause of the disease and consequently, the source of treatment to consult.
The public has different perceptions about the causes of the disease. The root of these perceptions could be attributed to the cultural background of the populace. This has influenced their choice of medical system when struck by the disease. These perceptions according to the study have a link with the educational background of the populace as well as the patients. Table 4.6 illustrates the perceptions of both the heads of households and the patients.

<table>
<thead>
<tr>
<th>Level of education/ cause of the disease</th>
<th>No idea</th>
<th>Bacteria</th>
<th>Contaminated water</th>
<th>Witchcraft</th>
<th>Poor hygiene</th>
<th>Curse by gods</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>27</td>
<td>-</td>
<td>8</td>
<td>10</td>
<td>1</td>
<td>6</td>
<td>52</td>
<td>21</td>
</tr>
<tr>
<td>Primary/Middle</td>
<td>68</td>
<td>13</td>
<td>47</td>
<td>7</td>
<td>11</td>
<td>146</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>J.S.S.</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td>Ordinary level</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Post-secondary</td>
<td>-</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Advanced level</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>21</td>
<td>21</td>
<td>27</td>
<td>59</td>
<td>20</td>
<td>247</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May, 2000

Table 4.6 shows the causes of the disease according to the educational status of the respondents. Out of the twenty-one percent who had no formal education, fifty-two percent could not tell the cause of the disease. Fifteen percent attributed its cause to contaminated water. This sounds quite plausible since they might have got to know it through the health education embarked upon soon after the disease attracted attention in the district. The rest of the distribution is as follows: nineteen percent, represented by ten respondents perceived it (Buruli ulcer) to be the work of
witches. This could be due to its low success rate of treatment. Two percent and twelve percent respectively attributed it to poor hygiene and a spell cast by gods. Given these responses, it can be said that only a handful of respondents with no education at all, were able to give plausible explanation to the cause of the disease. Respondents with Primary and Middle school educational background together constituted fifty-nine (146 persons). Forty-six percent had no idea about the cause, four percent attributed it to bacteria; eleven percent pointed to contaminated water while twenty-eight percent assigned the cause to a spell cast on them by gods. It can be inferred from these responses that their level of education on the disease is low. Other responses given were poor hygiene (8%) and curse from gods (7%). Judging from the responses given there was not much variation between those without formal education and those with little education with respect to the cause of the disease.

The perception of those with higher educational background is plausible to explain the cause of the disease. This contrasts sharply from their counterparts with little or no education. Those constituting this group (higher educational background) had educational levels from the General Certificate of Education Ordinary and Advanced through Post-secondary to the Tertiary. There is no doubt that the better educated have a more accurate idea about the causes of the disease. They can therefore protect themselves against infection by observing good hygiene unlike some of those with low education ones who think otherwise.

When put in geographic context, the responses illustrated in Table 4.7 show spatial trends and could be used to account for spatial patterns of the disease in the
Akwapim South District. Table 4.7 below illustrates the responses for each endemic area.

### Table 4.7: Cause of the disease by zone

<table>
<thead>
<tr>
<th>Reason</th>
<th>High endemic area</th>
<th>Low endemic area</th>
<th>Non-endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>No idea</td>
<td>50</td>
<td>37</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>Bacteria</td>
<td>12</td>
<td>10</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Contaminated water</td>
<td>15</td>
<td>11.1</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Witchcraft</td>
<td>37</td>
<td>27</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Poor hygiene</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Curse</td>
<td>11</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>100</td>
<td>87</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

Perception about the disease in no doubt determines the type of medical system to consult. This in the end may worsen the plight of the afflicted, if the source of treatment fails. From Table 4.7, seventy-two percent of the respondents in the high endemic area could not provide plausible cause of the disease compared to twenty-eight percent (28%) who could do so. The former group are likely to associate the chronic nature of ulcers to unscientific causes thereby seeing orthodox medicine as ineffective. Given the fact that the disease had prevailed in some communities such as Tabankro for over two decades but has not benefited from any education regarding the disease, prevalence overthere was high.

Although respondents in the low endemic area who assigned unscientific causes to the disease was quite high (65%), the prevalence rate was low. This could be attributed to the moderating effect of the vigorous public education that was embarked upon soon after the disease became medically known in the area. It is
likely the awareness created compelled people to seek medical attention at the least symptoms of the disease. However, the high level of ignorance displayed suggests that not everybody did benefit. The few, who did might have advised their folks to report any traces of the disease at the nearest health facility or health post. It was a different scenario altogether in the non-endemic area. Here knowledge about the cause of the disease, shown in Table 4.7, was very high. This is represented by the responses given. Sixty-four percent (64%) of the respondents were very much aware of the clues to the cause of the disease. With this high degree of awareness there is no way that, they would allow themselves to be taken unawares by the disease hence low prevalence in the low endemic area.

4.4 Lifestyles and Buruli ulcer

According to Meade et al., (1988), humans create many habitat conditions that could be hazardous. Implicitly implied by this assertion is that a habitat may become a health hazard to the society concerned. Besides creating habitat conditions to suit disease agents, one’s behaviour exposes one to hazards and protects them from others. Newly created habitats and exposure to hazards could be extended to include disease pathways associated with all sorts of insanitary conditions. Certain human behaviours as was observed are a predisposition to infection in the study area.

4.4.1 Sources of drinking water and scarcity of water and poor hygiene

Majority of the Buruli ulcer endemic communities in the district depends on unprotected surface water sources such as streams and ponds. Underground water
(wells) and boreholes are another source of drinking water. It is only at Nsawam and on the Akwapim ridge where pipeborne water is available. However, supply is not regular on the ridge. Table 4.8 illustrates the sources of drinking water as indicated by the Buruli ulcer patients in the two endemic areas.

Table 4.8: Responses on the source of drinking water indicated by the Buruli ulcer patients.

<table>
<thead>
<tr>
<th>Source of drinking water</th>
<th>High endemic area</th>
<th>Low endemic area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>%</td>
<td>frequency</td>
</tr>
<tr>
<td>Borehole</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Well</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Pond</td>
<td>15</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>Stream/ Rivers</td>
<td>19</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Fieldwork, May 2000

A majority (47%) of the patients depended on streams while thirty-six percent mentioned ponds as their sources of drinking water. Another six percent and eleven percent depended on boreholes and wells respectively, which by all standards are well protected. This information represents the entire patients' population.

According to Table 4.8, fifty-four percent of the patient respondents in the high endemic area depended on streams and rivers for drinking water, forty-three percent depended on ponds while three percent mentioned boreholes. It is clear from these responses that the high endemic area lacks potable water. Consequently, they experience water shortages during dry seasons. This has serious implications for hygienic practices and on the incidence and the prevalence of the disease.

On the other hand, twenty-five percent of the patients in the low endemic area relied on streams, seventeen percent depended on ponds, forty-one percent depended on wells whilst seventeen percent mentioned borehole. The distribution as
shown in the table indicates that the sources of drinking water are fairly balanced in the low endemic area. Thus when one source fails them, they can rely on the other.

In communities such as Tabankro, Adesa, Asaasiansa, Buokrom and Adjimase-Zongo all in the high endemic zone, the river Densu is their main source of drinking water. At Pakro, also in the high endemic area, the source of water is from boreholes and surface water. The situation is quite different in the low and non-endemic areas, which comprise such settlements as Okobeyeye, Nsawam, Pokrom, and Ahodwo. Here, the inhabitants draw water mainly from wells, boreholes and particularly at Nsawam, it is piped and surface water. The outcome of the dependence on these water sources is that the high endemic area that depends heavily on surface water and ponds, at times experience acute water shortage during flooding of the water bodies and dry season. Inhabitants therefore have no alternative than to depend on ponds, some of which look muddy and are likely to be contaminated. Infection could therefore occur when such untreated waters are used for bathing.

Unhygienic practices are often associated with water scarcity. Children in particular hardly bath in order to keep their bodies clean and healthy. In an interview with an opinion leader at Buokrom, in the high endemic area it was mentioned that children in the community feel reluctant to have their bath before they go to school or after the day’s work. Not even persistent call from their parents or guardians to do so would be heeded to. Oral evidence also indicated that there is frequent outbreak of skin diseases during periods of water scarcity, and it is common among children. These remarks were made after explaining some of the underlying factors for the
cause of the disease to him. It is no wonder that more children in the high endemic area are afflicted compared to the low endemic area, where high prevalence in adults could be attributed to the economic activity they are involved in.

Poor environmental sanitation was observed to be another underlying factor in the spatial variation of the disease. The dispersed nature of settlements in the high endemic area compounds the sanitation situation there. For instance, at Tabankro and Asaasiansa all in the high endemic area, the inhabitants dispose of household waste in their surroundings. This practise no doubt creates room for disease causing organisms of which the mycobacterium ulcerans is one. The scenario was different in the low and non-endemic areas, which are more urban and more accessible than the high endemic area. Sanitary inspectors therefore, find it difficult to reach settlements in the high endemic area to carry out inspection because most of the settlements apart from Pakro, are farming communities where the buildings are widely apart, and separated by thick bushes. In this way, filthy habitats are created for disease causing organism to thrive.

4.4.2 Human-water contact activities that predispose population to infection

Many human activities facilitate human-water contact in the endemic villages in the river Densu basin. Swimming is a very common activity practised by both young and old particularly in the high endemic area. However, this scenario changes farther away from the river Densu basin. A fact admitted to by both household heads and the afflicted. With the known risk factor of abrasion on a contaminated skin, one can easily get infected with the causative organism. In this survey, 44.7% of the
patient respondents from the endemic villages indicated swimming as a common and easiest way of having their bath as against 55.3% who mentioned the use of a water vessel. It is through water contact that the causative organism can penetrate the skin. The fraction of patient respondents, who could remember a trauma at the site of lesion, forty-seven percent (47.3%) indicated injury while swimming, fourteen percent mentioned an injury knock at the site of the lesion but could not tell the cause and thirty-eight percent cited a prick by a thorn. The situation is different in the low and non-endemic areas, where such water bodies do not abound to permit swimming. About forty-six percent of the patient respondents indicated surface water (streams and river) as their main source of water supply, thirty-six percent cited ponds, a little over six percent (6.4%) cited borehole and the rest mentioned wells. Availability of surface water (rivers, streams and ponds) therefore enhances swimming. The essence of the discussion is that it explains the nature of human-water contact in the study area.

In addition to swimming, farming on swampy lands is also a very common activity in the endemic areas particularly in the high endemic area. By associating Buruli ulcer with swamps suggests that the agent thrives very well in such places. Farming on such lands increases human contact with the causative organism leading to infection. This fact was admitted to by forty-six percent (46%) of the respondents who were farmers, and for that matter relied on such water bodies to water their crops.
High water contact activities thus suggests a high prevalence at Tabankro, Asaasiansa, Buokrom and Pakro all in the high endemic area and vice versa in the low and non-endemic areas.

4.4.3 The role of health workers

The geographical distribution of the disease in the district can also be understood by acknowledging the activities of health workers. The initial or the suspected case of the disease was spotted by the then District Chief Executive in the district, who was attending a funeral at Tabankro, in the high endemic area. He then drew the attention of the authorities of the District Health Management Team that came and confirmed the cases. The discovery by the District Chief Executive portrayed the inefficiency of general disease surveillance in the district at the time. Had the exercise been effective, incidence of the disease would have been detected long ago for early treatment. This further suggests that the depth of knowledge among health workers was low. It is possible that they had spotted cases of the disease but mistook it for an ordinary sore or chronic ulcer due to diabetes, as some people believe. The way by which the incidence of the disease came to the attention of the district health authorities suggests low awareness and the lack of capacity for detection. Given the favourable environmental conditions for the causative organism to survive, the disease persisted and spread in the high endemic area. This perhaps accounts for the high prevalence of the disease in the high endemic area prior to its diagnosis.
Ever since the detection of the disease, the District Health authorities have not relented in their efforts at checking the further spread of the disease to other parts of the district. Vigorous health education was embarked upon in order to raise awareness in the communities of the disease and its symptoms. Volunteers from the communities were trained in order to be able to identify the onset of the disease for onward reporting to the district health authorities for action to be taken. It therefore follows that increase in knowledge about the disease in other parts of the district helped in keeping incidence and prevalence low. This is because with knowledge about the symptoms of the disease any sign of its occurrence would be reported immediately for medical assistance. This perhaps accounted for the low endemic and non-reporting cases of the disease in both areas. With the knowledge acquired, they would not hesitate to report any traces of the disease for cure.

It can be concluded from this discussion that the physical environment is a very important factor underlying the spatial variation of the disease. However, secondary factors such as the socio-economic, and cultural are also equally important. Laying emphasis alone on natural factors (environmental factors) such as climate, biotic and biological conditions that suggest “disease region” cannot give a clearer picture of the geography of Buruli ulcer in the district. This is because Buruli ulcer as a disease has socio-cultural dimensions, which need to be understood in order to come out with plausible explanation for its spatial spread. This could help to arrive at preventive measures to reduce its harsh effects.
4.5 Conclusion

It can be said from the discussion that the spatial variations of the disease correspond to the pattern of the quality of the natural environment as well as human behaviour. That is the environment influences the geography of the disease. There was a high incidence of cases in the poorly drained and swampy lands in low-lying areas. In areas of low prevalence drainage is better and occurred on gentle slopes while in the non-endemic area, highland (the Akwapim ridge) and better drainage characterized it. This confirms the proposition that the quality of the natural environment influences the spatial patterns of the disease.

Secondly, the socio-economic status of household heads coupled with the skewed distribution of health facilities have restricted access to these health facilities in the endemic areas. The socio-economic background greatly influenced the health needs of children in the households. In addition, certain bad habits predispose the population to infection. In sum, these factors confirm the propositions that guide the study.
CHAPTER FIVE

5.0 Consequences Of Buruli Ulcer Infection and Strategies to Check its Spread

5.1 Introduction

Buruli ulcer is an infection that has significant immediate and long-term socio-economic effects on the people it afflicts. It has direct and indirect effects. It directly affects sufferers and impacts indirectly on their relatives, who provide medical care and attention while receiving treatment, if the patient is hospitalised. This chapter attempts to examine the effects of the disease on the patients, their relatives and health resources. In addition, it discusses the strategies adopted by the health personnel to check the spread of the disease. It therefore addresses the research objective of assessing the impact of the disease on the sufferers.

5.2 Effect on the human body (Physical effect)

Lesions can occur on any part of the body especially on parts, which are most of the time exposed to injuries. One could hypothesise on aetiological possibilities based on the distribution of the lesions. Among the children or teenagers aged below twenty (20), the disease occurred on all parts of the body. Ulcers were mostly singles and were more prevalent on the trunk and the lower limbs. On the other hand lesions were common on both upper and lower limbs in adults.

The distribution of the ulcers on the body suggests that differential exposure to the causative organism probably account for the difference in the location of lesions according to age. Differential exposure of the body to the causative organism through
injuries to the body implies that infection can occur on different parts of body that are more prone to injury.

The physical effects thus come from the lesions on the human body. This is seen in the pain that is associated with the disease as well as the physical damage it can cause to the victims. In this study, twenty percent (20%) of the patients were found to have been disfigured in the limbs particularly in the lower limbs. This took the form of contracture of muscles in the body. A majority of these patients were children currently in school. It is likely that these affected children would drop out of school in view of the fact that they travel long distances to attend school. In addition to the physical defects that some of the patients had suffered, the pain from the ulcers was described as terrible. It is very difficult to sleep when one is in pain neither can one concentrate effectively on any activity. This undoubtedly could disturb sleeping. Insufficient hours of sleep would certainly affect the general health situation of the patients owing to the fact that sleep is a form of therapy.

Besides the physical effects the disease has on its victims, the patient suffers other consequences as unfolded in the remaining sections.

5.3 The stigma attached to Buruli ulcer

Besides the physical effects that are associated with the disease is the stigma attached to patients by society due to the unusual nature of the ulcers. This causes psychological stress in the patients, as they most often feel embarrassed. The subjects for this study did attest to this fact. Owing to the low success rate of treatment of the disease, thirty-three percent (33%) of them said members in their
respective communities described them to be agents of the devil. All sorts of stories were told about their plight. It was believed that the ulcers served as dining tables for the wizards. This perhaps originates from the wrong notion that the disease is caused by some supernatural forces. This again underscores the need to intensify public education. The younger patients intimated that their playmates did tease them both in school and at home. According to them their playing mates did not want them (the patients) to come closer to them simply because of the bad odour from their ulcers. The adults were also not left out. Their difficulty lay in their inability to go to places where their colleagues met and played the games of draught and “oware”, a local game. This is because participants when winning a game compose songs to tease their opponents. The words of which can be centred on any theme such as Buruli ulcer. Thus, patients who cannot resist being teased under such conditions did not want to go to such places.

The psychological torture associated with the disease was further manifested at Asaasiansa, a settlement in the high endemic area. A patient was unwilling to grant a request for an interview. He preferred keeping his plight to his folks than to a stranger. He shifted his earlier position following persistent persuasion from a member of the community who was attending a bi-weekly meeting to discuss the welfare of members and their community. His earlier stand could be attributed to the fact that he might have overcome the initial mental trauma suffered. Thus there was no need to expose himself again to a fresh mental torture to someone whom he did not know. The attitude of a patient towards a teacher in class was another testimony that confirms the mental torture patients go through. A schoolteacher residing at
Pakro but teaching at Otukwadwo confirmed this assertion with a story. According to him, he once posed a question to a Buruli ulcer infected schoolgirl in his class in order to test her understanding on a topic being discussed in class. While he was staring at her in anticipation of an answer to the question, the girl got annoyed that the teacher was staring at her due to her condition. Eventually, she did not answer the question. These two narratives reveal the extent of mental trauma patients undergo.

5.4 Effect on marriage

The disease can dwindle one’s marriage prospects in the event of any physical disfigurement. Although none of the subjects in the study could tell the exact impact of the disease on their marriage, a different scenario emerged. It involves how a disagreement ensued between a young man on one hand and his wife and mother-in-law on the other over the type of treatment to seek for their child. He got to know, on returning home from a journey that one of his children had been struck by Buruli ulcer. Instead of seeking medical care at the Pakro health post, his mother-in-law together with his wife had rather sent the sick child to a fetish priest for treatment. Their reason was that the kind of ulcer the child was suffering from was not an ordinary type due to its chronic nature. He did not like the action the in-law and the wife had taken. He intimated that getting the materials or the objects for the healing process for the priest to perform the necessary rites for healing was more expensive than what would have cost them at the health centre. None of his persuasions to seek medical care from credible source could yield positive results.
Because of the misunderstanding that ensued, his wife out of anger left with the sick child to join her mother in another village outside the Akwapim South District. Consequently, he had threatened not to follow the wife. Thus he was staying alone at the time this study was being conducted. It was later on communicated to him that the child had been deformed in the left lower limb. If the strained relationship should continue, there is no doubt that the marriage would not survive.

It can be concluded that though the young man did not suffer from the disease, the incidence of the disease indirectly had caused a strained marital relationship. This shows the extent to which the incidence of the disease can throw families apart.

5.5 Effects on socio-economic activities

The disease apart from its physical and psychological effects has socio-economic dimensions as well. This is because the physical effects of the disease on the victim will in no doubt disturb the social and the economic lives of the victims as well as the health resources that are used for treatment. The preceding section therefore examines the socio-economic effects of the disease on the patients.

5.5.1 Effect on education

Advanced ulcers require prolonged period of treatment and hospitalisation, where necessary. In this study, seventy percent (70%) of the patients were currently in school with active ulcers. The prolonged treatment period had disturbed their
education in so many ways. The educational status of the respondents had already been shown in Figure 3.6.

With reference to Figure 3.6, seventy percent (70%) of the patients were currently in school and were seeking treatment. This scenario could seriously jeopardise their education since treatment requires a long period of time.

From Figure 5.1, thirty-three percent (33%) of the respondents of school-going age repeated in class for a year. This could be attributed to the prolonged treatment they underwent. This therefore cost them dearly since they could not write terminal exams that provide a basis for assessing their promotion to the next class. The majority (67%) intimated that attendance at school was not regular.

Figure 5.1: Effects of the disease on the Education of the Observed Patients

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Repeated</th>
<th>Irregular Attendance</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td></td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

Source: Fieldwork May, 2000
This could be attributed to prolonged treatment along side schooling. Some of the patients indicated that there were at times that their ulcers became painful that they could not afford walking to school let alone to concentrate on what is being taught there. It was terrible for patients at Asaasiansa and Adesa where there are no schools. Consequently, children from there always walk to nearby villages to attend school. Therefore when a patient is in pain there is no way that the said child can make it to school.

Lastly, four and a half percent of the deformed patients declared that they might discontinue with their formal education owing to the physical defect they have suffered. None of them was able to tell the last time he or she was in school. It might be that they had stopped but did not want to disclose it.

The preceding discussion points out that the performance of these children is certainly not the best, a fact made known by them. Regular school attendance to a large extent guarantees a good performance. However, the disease keep them out of school for long periods of time will no doubt adversely affect their output in school. In short, the disease has had a negative impact on these school children.

5.5.2 Effects on economic activities

The destructive nature of the disease and the associated prolonged treatment period it requires have adversely affected the economic lives of the people. Patients have to suspend whatever economic activity they might be engaged in so as to seek medical care from whichever medical system they deemed appropriate. The situation as highlighted is not different from what was obtained from the study. Respondents in
the productive age group declared that they have been affected in several ways. Although the sample size was small, it reveals the extent of the impact of the disease on those it affects.

The occupational distribution of the patients has already been shown in Figure 3.4. The proportion of the patients in employment constituted thirty percent of the total population (the observed patients). On the whole, nineteen percent were farmers. Nine percent were traders while two percent were bricklayers or masons. Given the physical effects the disease suffered, their income earning ability was severely affected. They could not work and this undoubtedly impacted negatively on themselves and their dependants. Having been rendered incapable of earning income as a result of the disease, they were thus denied the opportunity of enjoying

![Figure 5.2 Economic Effects of Buruli Ulcer Infection](chart.png)

CPSF = Cannot Pay School Fees, CAMC = Cannot Afford Medical Care, CPFN = Cannot Provide Family Needs, LAEI = Lost Ability to Earn Income, NA = Non Application

**Source:** Fieldwork, May 2000
some services to the disadvantage of the households they headed as shown in Figure 5.2.

From Figure 5.2, twenty-one percent declared that they could not pay their wards’ school fees. The affected children were thus being denied their rights to education. Forty-three percent also intimated that they could not afford paying for health services for themselves and their families. It is therefore not surprising that the patients of school going age disclosed that their parents could not send them early enough for medical treatment hence allowing the disease to advance. Another twenty-one percent intimated that they could not provide basic family needs such as clothing and nutritious food for their households. No clothing on implies children walking bare-chested whilst no nutritious food for family members may cause malnourishment especially in children, and consequently prone to infection via a weakened immune system. Lastly, fourteen percent pointed out that they had been physically disabled and consequently, they had lost the ability to earn income. In sum, the disease has rendered them unemployed.

The adverse effects on their economic lives would certainly have grave consequences on their families particularly the young ones. The welfare of their dependants may suffer in this regard. Instead of being breadwinners, these unfortunate people are rather going to depend on their family members for survival.

It can therefore be concluded from the discussion that although the disease affected the patients directly, the setback they suffered to their income earning potential indirectly affected members of their household.
5.5.3 Impact on health resources

Treating Buruli ulcer patients at no cost to the patient has put an enormous pressure on the limited health resources in the district. The 1998 Yamoussoukro Declaration on Buruli ulcer mandates governments of the affected countries to provide free medication for sufferers. This will make cost recovery very difficult for health facilities owing to the fact that sometimes the much-needed medical supplies do not arrive on time to serve the purpose for which they are needed.

Notwithstanding his inability to provide data on the average cost of treating a patient, the District Director of Health Services intimated that cost of treatment has stretched the scarce health resources at their disposal. Consequently, his outfit is unable to run vital health programmes. This stems from the fact that patients do not pay for medical treatment thereby compelling them to divert resources for other programmes to furnish the dressing centre at Pakro with dressing materials. Cost recovery therefore becomes impossible.

The strain on the scarce medical resources is made worse by the uncooperative attitude of beneficiaries to contribute in order to sustain the Buruli ulcer-dressing centre at Pakro. The beneficiaries (the patients) are not comfortable with the laudable idea of voluntary contribution to sustain centre. It was disclosed by the health personnel at the Buruli ulcer dressing centre that anytime they ran out of dressing materials and patients were asked to supplement their efforts they refused or would temporarily discontinue treatment until the situation improves. Since the district health authorities want to keep the incidence rate low, they have no option
than to provide the needed dressing materials for the patients to continue enjoying free medical treatment.

5.6 Strategies to check the spread of the disease

Efforts are being made by the district health authority to alleviate the Buruli ulcer scourge in the Akwapim South District. In this direction, so much has been done aimed at reducing its spread since the incidence of the disease caught attention.

Presently, there is a Buruli ulcer Surveillance Team in the district whose duties include disease identification for early treatment. Established two and half years ago, the team has helped in training community volunteers whose main task is to identify the disease at the nodular stage of development, and to advise potential sufferers to go to any health centre excision to be performed on them. Attacking the disease at the nodular stage of its development saves the patient from the harsh conditions, associated with the disease. It is also cost saving to the advantage of the health authorities.

The surveillance team also analyses and collates reports on the disease in order to establish at first hand areas where the problem is most serious. This facilitates rapid action to check its further spread.

In addition to the trained community volunteers identifying nodules, public education is ongoing in order to increase awareness among the public on the various stages of development of the disease. This is done to enhance the public's ability to identify the disease early for prompt medical attention. A dressing centre has been established at Pakro (the heart of the problem), to treat ulcers. The location of the
settlement is strategic because it is there that the bulk of the cases (81%) have been reported from. Furthermore, two medical doctors have been trained in surgical removal of nodules. These pieces of evidence show that the District Health Authority has not relented in its efforts at alleviating the scourge of the Buruli ulcer in the Akwapim South District.

Programme of activities that have been embarked upon by the health authority are beset with problems. The District Director of Health Services enumerated inadequate dressing centres considering the growing incidence of the disease as a major problem they face. There is only one dressing centre thus, patients have to travel long distances on foot to reach it due to poor transportation system. Other problems narrated were inadequate resources to acquire dressing and surgical supplies for excision. Therefore, for the programme to be successful these problems ought to be ameliorated.

5.7 Conclusion

From the discussion in this chapter, incidence of the disease has adverse effects on the various socio-economic groups. The disease has directly affected the lives of the patients and indirectly the dependants of patients in the economically active group. The discussion shows the extent of the socio-economic impact the disease has on the population in the study area. This fulfils the research objective of ascertaining the effects of the disease on sufferers in the study area. The chapter also examined the activities of the district health authorities so as to keep incidence
as low as possible. This fulfils another research objective of ascertaining the efforts made by the health authorities to check the spread of the disease.
CHAPTER SIX

6.0 Summary, Conclusion and Recommendations

6.1 Summary

The thesis has attempted to account for the incidence and prevalence of Buruli ulcer in the Akwapim South District. The following observations based on the research objectives and the propositions were made.

The disease was more prevalent in all the administrative sub-districts but one, the Aburi sub-district located on the Akwapim ridge. However, it clustered near swampy lands along the river Densu and its tributary Ponponso in the high endemic area as pertains in the study. Apart from the poor drainage, the topography in much of the area is low, below 75 metres (250 feet) above sea level. The natural environment has influenced the spatial distribution of the disease. The most endemic villages were in the Pakro-Dego sub-district. Incidence decreases farther away from the river Densu basin where drainage is better and marked by gentle sloping. The area concerned is characterised by sporadic cases of the disease. The most endemic areas were remote and difficult to reach rural areas. This observation therefore confirms the proposition that the natural environment influences the spatial spread of the disease in the district.

It was further observed that incidence was highest in children and teenagers aged below twenty (20) years. They accounted for seventy percent (70%) of the subjects for the study. Prevalence therefore decreased with age. This compares favourably with the overall high prevalence in children and teenagers. On the other hand, incidence was higher in females than males in both endemic areas. This, like
the age also conforms to the general sex pattern for the entire district. The high incidence of the disease among children there could be attributed to the fact that they do not on their own determine when to seek medication from appropriate sources. This fact supports the proposition that the socio-economic background of parents influence their level of utilization of health care for themselves and their dependents particularly the young ones. Thus their educational and income levels influence the decision on when and where to seek medical care.

Unlike some studies that observed seasonal variation in incidence between dry and wet season (Barker, 1972), no such phenomenon was observed. This is because apart from the cumulative cases that were recorded in the middle of 1998, the subsequent monthly medical records on the disease showed a uniform pattern. It would therefore be incorrect to conclude that what was recorded in 1998 was only for wet period.

The study also revealed that lesions occurred singly and on any part of the body. However, it was very common on the trunks of the children. Although this part of the body is supposed to be always clothed the children most of the time were seen not to be covering that part of their bodies. In adults, lesions occurred on the limbs, but largely on the lower limbs.

Another fact worth mentioning is the lack of potable water in the endemic communities. Their main sources of water were surface water (rivers and streams), underground water (wells and boreholes) and ponds. Frequent breakdown of boreholes and drying up of surface water during the dry season result in water scarcity in these villages. The villages are therefore compelled to fetch water from
ponds, which by their very appearance suggests contamination. Communities such as Asaasiansa, Buokrom and Adjinase-Zongo that depend greatly on streams and rivers hardly have good drinking water during the rainy season owing to the fact these water bodies get flooded. There was direct contact with the water bodies through swimming, wading in surface water in order to fetch some for domestic purposes and for watering of crops along watercourses. Poor sanitation supports the proposition that it is a predisposition of the populace to infection.

Low literacy level, inability to pay for health care and poor geographic access were found to have restricted the use of health facilities among the heads of households and their subordinates. This had serious implications for children who could not decide on their own as to when to use a health facility. Consequently, the traditional and orthodox medicines play a complementary role in the health care needs of the people. However, the traditional medicine was the most preferred in areas disadvantaged by poor geographic access to health facilities.

Risk factors associated with the disease related to the natural environment. Others were injuries sustained through kicking the foot against objects and water contact through bathing without treating water.

6.2 Conclusion

The environment plays a crucial role in the spatial patterns of the disease in the district. The geographical distribution of the disease followed the quality and the pattern of the physical environment. The spatial distribution thus suggests a link of the prevalence of the disease and the quality of the natural environment. Similar
observations were made in the Nile basin in Uganda (Barker, 1972) and along the river Densu in the Ga District of the Greater Accra Region of Ghana (Mensah-Quainoo, 1998).

Poverty is another environmental factor that determines financial and geographical access to health services. Restricted access to medical care was a major problem in the endemic villages in the district. This is attributed to difficult geographic access because of poor transportation system, no health facilities, and inability to pay for health care. The result is low utilization of such facilities where expert advice would have been given on health problems. In addition, bad habits such as poor hygiene predispose the populace to infection by mycobacterium ulcerans.

With increasing number of cases, high treatment cost and serious complications, a vaccine to immunize individuals against the disease is yet to be designed. The best and effective means of controlling the disease from advancing, is early detection and treatment at the nodular stage of development. Urgent attention should therefore be given to the disease in terms of control and research efforts aimed at early detection and treatment.

6.3 Recommendations

Buruli ulcer is emerging as a serious public health problem all over the world particularly in the humid tropics and the sub-tropics. Presently, the treatment choice is surgical but adequate surgical facilities are not available in most endemic areas particularly where dressing centres have been established. Because of limited
access to health care and other socio-economic and cultural factors, most patients report late at health centres for medical attention. Consequently, complications often occur associated with high treatment costs. This is because some cases of Buruli ulcer require a prolonged hospitalisation. Treatment therefore becomes burdensome to both patients and their relatives. With increasing number of cases therefore, the burden prolonged treatment brings deepens. With no vaccine against, early detection and treatment for Buruli ulcer is crucial and could thus, be cheaper. However, this would require an effective control programme, expanded health education good surveillance system, and increased access to health services.

Both patients and non-patients still hold on to the claim that the disease is caused by supernatural forces. The root cause of this misconception stems from the low rate of success of treatment hence hospital treatment is irrelevant or even dangerous. This is an indication of sheer ignorance. The situation is not different from what prevails in the Akwapim South District. Preventive measures should look beyond environmental and biological factors to include people’s lifestyles and other co-factors as contributory factors of illness in much the same way as Buruli ulcer. The study therefore strongly suggests a more comprehensive Buruli ulcer surveillance system in the Akwapim South District.

The fact that not all incidence of Buruli ulcer has been reported in the district makes it difficult to measure the exact magnitude of the disease for effective planning. It is therefore necessary to have a surveillance system in place, which will undertake an ongoing, systematic collection, analysis and timely dissemination of public health data for planning purposes. Such a surveillance mechanism would help
identify areas where the disease is, who it affects and to decide on how preventive measures should be directed. When this is accomplished, it would be possible to measure the exact magnitude of the burden associated with the disease for effective planning in order to minimise future incidence.

For a successful surveillance strategy, the superstitious beliefs some people have about the cause of the disease can deter them from seeking medical care at the formal health sector. This misconception stems from the fact that the disease cannot be effectively treated by western medicine. Consequently, treatment continues to be sought outside the formal medical sector. This undoubtedly may derail any surveillance effort due to the fact there is no collaboration between the medical systems. Thus, vital statistics needed for a surveillance system might be lost. It is when these factors are thoroughly dealt with that such a programme will be successful. Vigorous and sustained health education should be embarked upon so as to remove any ingrained cultural belief, which is a potential threat to a successful Buruli ulcer Surveillance.

It is further recommended that health workers must be given adequate training in order to be able to accurately recognise the onset of the disease for prompt action to be taken. With increased awareness among health workers, the incidence of the disease can be reduced. Because they can make accurate diagnosis that would possibly stop the disease from advancing. Apart from the training given to such health personnel, they must be motivated in order to stay and work in the rural areas where the disease is very common.
Since health workers are not available in every village coupled with the fact that many people have limited access to health facilities, volunteers must be recruited from these villages to be trained on how to recognise the disease for onward reporting to trained health workers for confirmation. These volunteers will in no doubt play the role of health workers in areas that lack the services of such personnel.

Furthermore, any ulcer found among the populace must be treated with seriousness. They must be washed to ward off any suspecting organism, which is capable of causing the disease. It would be appropriate in this regard to report such cases to the health centres for prompt action to be taken.

The disease-causing organism it is believed thrives in water bodies. Since these organisms cannot be seen with the naked eyes, it is recommended that water must be treated using chemicals or simply by boiling it before bathing. Comparatively, the latter is cheaper than the former. Treating water before bathing can kill the causative organism if any, thereby making the water safe for use. In case of any puncture on the skin, there will be no organism to enter the body.

Health care facilities must be strengthened, and made both geographically and economically accessible, in order to provide treatment for all patients identified to be having the disease. If the remotest areas are opened up by way of improved transportation system more people in these remote villages will be able to visit health facilities for treatment. Besides improving the spatial accessibility, regular screening should be undertaken on rotational basis by the health workers in the district. Chiefs and opinion leaders must co-operate with the health personnel in this regard.
The district administration must be seen as an active partner in this crusade. Part of the share of the District Assembly common fund must be channelled into improving the socio-economic well being of the populace. In this regard, the poverty alleviation programme must be vigorously pursued in the district. A successful poverty alleviation programme would improve the well-being of the populace. By that they can enjoy vital life enhancing services including health care. This will therefore improve their health status. This will save people including the afflicted who cannot make it on foot to the nearest health facility for treatment.

Owing to the poor system of transport in the remote areas of the district, more dressing centres must be established. Since the only one at Pakro offers free medical service, people travel from far away places to enjoy the facility. These facilities should as much as possible have simple surgical units that can perform incision without referring cases to the district hospital where such facilities are available. Further, dressing materials must always be made available to the Buruli ulcer-dressing centre to provide uninterrupted service to the patients. In addition, more health personnel should be trained in the treatment of the disease.

Education has the ability to remove public misconception on a subject. Certain cultural beliefs have been found to be hindering villagers in Buruli ulcer endemic areas from seeking medical care outside their locality. The removal of these cultural beliefs could be a fundamental key to the success of any Buruli ulcer surveillance strategy. Based on this, people through education would understand that the disease is curable by western medicine when detected early. Education can uproot the superstitious beliefs people have about the disease due to its chronic nature. It will
enable them to know that the disease can be cured by orthodox medicine and it is not dangerous or irrelevant as some people share that view. Besides, the populace can be educated on the need to utilise a health facility where expert advice can be given on the disease.

Though public education has gone on, it seems it has not gone down well with the people as reflected in the response on the knowledge (57%) about the symptoms of the disease. Therefore, public education should be intensified in order to equip the people with skills in the accurate identification of the disease at the nodular stage for prompt treatment. This can take the form of colour posters displayed at popular points in the villages and video shows in the evenings interspersed with questions and answers session. This will go a long way to minimise the reliance on friends and local traditional healers for information about the disease and appropriate form of treatment.

It is further suggested that who receive medical care patients must supplement the efforts of the health personnel by contributing towards the provision of dressing materials at the dressing centre. Services are supposed to be free of charge, courtesy the 1998 Yamoussoukro Declaration on Buruli ulcer. However, where the co-operation of patients are needed, it must be done in such a way that it does not discourage the patients from coming to the Buruli ulcer dressing-centre.

The water supply system for the communities ought to be improved upon in order to provide safe water for the communities. Frequent breakdown of boreholes should be accompanied by regular maintenance in order to ensure safe water for the populace. The district assembly, the government, non-governmental organisations
and individuals must assist communities without boreholes to acquire such facilities. This to a large extent will provide potable water throughout the year.

People must also try as much as possible to wear clothes to cover parts of their bodies, which are most of the time, exposed to injuries so as to reduce likely points of entry for the organism into the skin. Parents must check the habit of children by not wearing clothes at home and in the bush, since they will be exposing themselves to the risk of sustaining preventable injuries.

People must observe good hygienic practices. This can ward off the agent for the disease from striking. Indiscriminate waste disposal in the surroundings particularly in the villages must be stopped. Sanitary inspectors should go round the communities to inspect the surroundings of households in the various communities. Anyone found to have gone contrary to the practice of good hygiene should quickly be sanctioned as it was some decades ago.

It is envisaged that if these recommendations would be followed incidence of the disease would be reduced.
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Appendix A

QUESTIONNAIRE FOR HOUSEHOLD HEADS

Section A: Personal information

1a. Age: .................................................................

2a. Name of village: ........................................... 3a. Subdistrict: .................

4a. District: ..............................................................

5a. Sex: (Tick) (i) Male [ ] (ii) Female [ ]

6a. Marital status
   (i) Married[ ] (ii) Divorced[ ]
   (iii) Single[ ] (iv) Separated[ ]
   (v) Others, specify ............

7a. What is your educational background?
   (i) None [ ] (ii) Primary [ ]
   (iii) Middle[ ] (iv) J.S.S.[ ]
   (v) Secondary[ ] (v) Others, specify .................

8a. Which religious denomination do you belong?
   (i) Christianity [ ] (ii) Muslim [ ]
   (iii) Pagan[ ] (v) Non denomination [ ]

9a. What is your ethnic group?
   (i.) Ga[ ] (ii) Ewe[ ]
   (iii) Akan (iv) Krobo[ ]
   (v) Dagarti[ ]; (vi) Others ............

10a. How long have you lived here? ........................................

Section B: Utilisation of health care services

1b. Which of these medical systems do you utilize?
   (i) Orthodox medicine[ ];
   (ii) Traditional medicine[ ]
   (iii) Do not rely on any of these sources[ ]
   (iv) Self-medication [ ];
   (v) Both traditional and orthodox medicine[ ]
2b. If both medical systems are utilized, which one do you prefer most?
   (i) Traditional medicine[ ] (ii) Orthodox medicine[ ]

3b. Give reasons for your choice of answer in Question 2b
   i. ........................................................................................................

4b. If traditional medicine is preferred to orthodox medicine, which of these practitioners do you seek treatment?
   (i) Faith healers[ ]
   (ii) Herbalists[ ]
   (iii) TBAs[ ]
   (iv) Fetishpriests/ Priestesses;
   (v) Others, specify...........

5b. Give reasons for your choice of answer in question 4b
   i. ........................................................................................................

6b. How often do you seek medical care?
   (i) Every month[ ]
   (ii) Once in every three months[ ]
   (iii) Once in a year[ ]
   (iv) Twice in a year[ ]
   (v) Thrice in a year[ ]
   (vi) Very often[ ]
   (vii) Daily[ ]
   (viii) Rarely[ ]

7b. If rarely, give reasons
   (i) No health facility[ ]
   (ii) No money to pay for the service[ ];
   (iii) Have to walk over a considerable distance from home[ ]

Section C: Economic Activities

1c. What is your occupation? .................................................................

2c. What factors negatively affect your income earning?
   (i) Ill-health[ ]
   (ii) Damage to produce[ ]
   (iii) Marketing problem[ ]
   (iv) None of these[ ]

3c. How does unreliable income affect your consumption of services?
   (i) Cannot pay for health services[ ]
   (ii) No entertainment[ ]
   (iii) Cannot pay children's school fees[ ]
   (iv) Cannot afford basic family needs[ ];
   (v) Not affected[ ]
Section D: Behavioural roles (Division of labour in the family)

1d. How has domestic duties been shared among the family members?
   (i) Boys fetch water and weed the surroundings[ ]
   (ii) Girls help their parent in selling to generate family income[ ]
   (iii) Females fetch firewood[ ]
   (iv) Males work on the family farm[ ]
   (v) Both males and females work on the family farm[ ]
   (vi) Such division does not exist[ ]
   (vii) Cooking is done by the females[ ]

2d. Would you say such activities involve dangers (injuries)?
   (i) Yes [ ]   (ii) No [ ]

3d. If yes to the question above, which of these injuries do they sustain?
   (i) Pricking by thorns [ ]
   (ii) Cutlass wounds [ ]
   (iii) Puncture on skin by stone(s) [ ]
   (iv) Piercing by pointing instruments[ ]

4d. With regards to the dangers involved, which group is the most vulnerable?
   (i) Children[ ];   (ii) Women[ ];   (iii) Men[ ]

Section E: Source of water supply

1e. Which source do you draw water?
   (i) River/stream[ ]   (ii) Pond [ ]
   (iii) Borehole [ ]   (iv) Well [ ]

2e. How do you draw water from the source?
   (i) Wade in stream due to shallow river/stream mouth[ ]
   (ii) Steps on rocks in river[ ]

3e. Which route leads to the water source?
   (i) Footpath through the bush[ ];
   (ii) Road[ ]
   (iii) No clear -cut route[ ]

4e. What are some of the dangers encountered on the way to the site?
   (i) Snake bite[ ]   (ii) Cut due to striking of toes against stones[ ]
   (iii) Thorn prick[ ]   (v) Cut caused by water vessel[ ]
   (vi) Others, specify...
5e. How do you treat water before bathing?
(i) Boil it [ ];
(ii) Filter it [ ];
(iii) Chlorinating [ ];
(v) Do not treat it [ ]

6e. Why do you treat water before bathing?
(i) To kill germs in order to avoid skin infection [ ]
(ii) With no clear motive because others do it [ ]
(iii) No treatment because I swim in stream/ rivers [ ]

7e. What is responsible for water shortage in this community?
(i) Water bodies dry up during the dry season [ ]
(ii) Frequent break down of boreholes [ ]
(iii) Do not experience water shortage [ ]

8e. How many times do you bath in a day?
(i) Once [ ]
(ii) Twice [ ]
(iii) Thrice [ ]
(iv) None [ ]

9e. Which is the commonest form of bathing to both children and adults?

Section F: Perceptions and attitudes

1f. Have you ever heard of the disease, buruli ulcer before?
(i) Yes [ ]
(ii) No [ ]

2f. Where did you first hear of it?
(i) In the news bulletin [ ]
(ii) Read from the dailies [ ]
(iii) From a friend [ ]
(iv) Have not heard of it [ ]
(v) Other sources, specify ...........................................

3f. If you have heard of it, how long ago?
(i) 1-3 months ago [ ]
(ii) 4-6 months ago [ ]
(iii) 7-12 months ago [ ]
(iv) Over one year [ ]
(v) Others, specify ...........................................

4f. What do you think underlies the cause of the disease?
(i) It is a curse from gods [ ];
(ii) Its cause is due to natural factors [ ];
(iii) Poor hygiene [ ]
(iv) Witchcraft [ ]
5f. If the family has experienced the disease, which medical system did you utilise?
   (i.) Western medicine[ ]
   (ii) Traditional medicine[ ]
   (iii) Did not seek medical care[ ]
   (iv) Self-medication[ ]

6f. How many cases have you had so far?
   (i) Once[ ]; (ii) Two cases[ ]; (iii) Three cases[ ]; (iv) Over four cases[ ]

7f. If yes, would say medical treatment was sought early?
   (i) Yes [ ]  (ii) No [ ]

8f. Give reasons if no medical treatment was sought?
   .................................................................

9f. What are your beliefs about the Buruli ulcer? ........................................

Section G: Access to facilities

1g. How would you rate road transport in this area?
   (i.) Excellent[ ]
   (ii) Very good[ ]
   (iii) Good[ ]
   (iv) Average[ ]
   (v) Very poor[ ]

2g. How does bad transport network affect you? ........................................
Appendix B

FIELD QUESTIONNAIRE FOR PRESENT BURULI ULCER PATIENTS

Section: A: Personal information

1a. Name of village..................................................................................................................

2a. Subdistrict.........................................................................................................................

3a. District............................................................................................................................... 

4a. Gender: (i) Male [ ] (ii) Female [ ]

5a. Age (state): .....................................................................................................................

6a. What is your ethnic origin: ............................................................................................... 

7a. Religion:
   (i) Christianity [ ] (ii) Muslim [ ]
   (iv) Pagan [ ] (v) Non denomination............................................................... 

8a. Marital status:
   (i) Single [ ] (ii) Married [ ]
   (iii) Divorced [ ] (iv) Others, specify ............................................................... 

9a. Level of education:
   (i) None[ ] (ii) Primary [ ]
   (iii) J.S.S./ Middle[ ] (iv) Secondary [ ]
   (v) Others............................

10a. If ever schooled, did you complete? (i) Yes[ ] (ii) No [ ]

11a. If you did not, why?
   (i) Did not have interest in schooling[ ]
   (ii) Due to financial difficulties [ ]
   (iii) Due to disease (Buruli ulcer)[ ]
   (iv) Others, specify .............................

(Students should answer questions 11 to 14)

12a. If you are still in school, is your attendance regular?
   (i) Yes [ ] (ii) No [ ]
13a. If No, why?
(i.) Because of the Buruli ulcer[ ];
(ii) No one to pay school fees [ ]
(iii) Others, specify..........................

14a. Has irregular attendance affected your performance?
(i.) Yes[ ]
(ii) No[ ]

15a. If Yes to question 13a above, in what way?
(i.) Very good[ ]
(ii) Good[ ]
(iii) Average[ ]
(iv) Poor[ ]

16a. If poor, give reason(s) for that poor performance..........................

Section B: Economic activities

1b. What is your main occupation?...........................................................

2b. How did or has the disease interfered in pursuing your activities?
.................................................................................................................

Section C: Community specific question

1c. Source of drinking water: (i)
(i) Pipebome [ ]
(ii) Borehole [ ]
(iii) Well [ ]
(iv) Stream/river [ ]
(v) Pond [ ]

2c. How do you draw water from the source?
(i) Wade in stream due to shallow river/stream mouth[ ]
(ii) Steps on rocks in river[ ]

3c. Which route leads to the water source?
(i) Footpath through the bush[ ]
(ii) Road[ ]
(iii) No clear -cut route[ ]

4c. What are some of the dangers encountered on the way to the site?
(i) Snake bite [ ]
(ii) Cut due to striking of toes against stones [ ]
(iii) Thom prick [ ]
(v) Cut caused by water vessel [ ]
(vi) Others, specify....................
Section D: Individual specific questions

1d. What is the duration of the illness before you sought medical care?

2d. If you reported late what was the cause?
   (i.) No money to pay for health care[
   (ii.) No health facility[
   (iii) Others (state)...........................................

3d. Which is the commonest form of bathing to both children and adults?
   (i.) Swimming [ ]
   (ii.) Fetch water into bucket[ ]
   (iii.) Others...........

4d. Did you have a trauma at the site of lesion?
   (i) Yes[ ]    (ii) No[ ]

5d. If yes, what was the cause of the trauma?
   (i) Cannot remember [ ]
   (ii) Pricking by thorn[ ]
   (iii) Puncture through injection [ ]
   (iv) Others,

6d. How long have you lived here?..............................................

7d. Where did you get infected?..............................................

8d. What are your views about the cause of Buruli ulcer?

9d. Which form of medical treatment did you seek?
   (i) Orthodox medicine[ ]    (ii) Traditional medicine[ ]

10d. Why did you seek treatment from the source as indicated in question 8d?

11d. Do you often sustain penetrating injuries?
   (i) Yes[ ]    (ii) No[ ]

12d. Mention any two forms of injury you sustain.
   i..................................................ii..................................
APPENDIX C

QUESTIONNAIRE FOR HEALTH WORKERS

1. Name of institution
2. Subdistrict
3. Sex: (i.) Male[ ] Female[ ]
4. Profession/Status
5. Do you have a Disease Surveillance Team in the district? (i.) Yes[ ] (ii) No[ ]
6. If yes to question (5) above, how long has it been in existence?
7. Could you define its scope of operation?
8. What has it been doing since its inception?
9. When was the first case of the Buruli ulcer reported at your health facility?
10. Would you say it was detected early? (i.) Yes[ ] (ii) No[ ]
11. If No, to the preceding question could you explain why?
12. Do you often record cases of the disease? (i) Yes[ ] (ii) No[ ]
13. If Yes, to the preceding question, how often?
14. Do patients pay for the cost of treatment? (i) Yes [ ] (ii) No[ ]
15. Ever since it was reported what has your outfit been doing to alleviate the situation?
16. If you have a programme in place, how effective is it?
17. Do you encounter problems in the discharge of your activities? (i)Yes[ ] (ii) No[ ]