

Factors Associated with Yaws Infections in the West Akim Municipality, Ghana

Emmanuel Dzotsi¹, Nsiiri Agana², Sally-Ann Ohene³, Michael Adjabeng¹,
Abdul Aziz⁴ and John Kofi Odoom^{5*}

¹Disease Surveillance Department, Ghana Health Service, Korle-Bu, Accra, Ghana.

²National Yaws Eradication Programme, Ghana Health Service, Ghana.

³World Health Organization, Country Office, Accra, Ghana.

⁴West Akim Municipal Health Directorate, Ghana Health Service, Asamankese, Eastern Region, Ghana.

⁵Department of Virology, Noguchi Memorial Institute for Medical Research, University of Ghana, Legon, Accra, Ghana.

ABSTRACT

Objectives: Yaws, caused by the spiral-shaped bacterium (spirochete) *Treponema pallidum* subspecies *pertenue* is a contagious, non-venereal infection in humans that presents mainly in children below 15 years old and primarily affects the skin, bones and cartilage. Despite the implementation of the strategy of mass drug treatment in West Akim Municipality in the Eastern Region of Ghana in the past, there is indication of resurgence of the disease. This study seeks to determine factors associated with resurgence of infection with yaws amongst residents

Study design: It is an un-matched community-based case-control study.

Methods: A standardized questionnaire was administered to the cases and controls as they were detected in the communities by trained data collection officers. Trained Community Based Volunteers moved from house to house for active case search and examined skin lesions. Data on education, occupation, religion and risk factors for yaws were analyzed using Epi-Info version 7 and Excel statistical software packages.

Results: The mean age of the cases and controls was 9.28 and 9.1 years respectively. The cases were seventy (70) times more likely to have played with yaws cases as compared to the controls [Odds Ratio= 70; 95% CI (8.97-546.56), p-value= 0.000], likewise cases were more likely to have slept in same room with yaws cases. Sharing clothing with Yaws case was significantly associated with being a yaws case [OR= 25; 95% CI, (3.12-204.69); p-value 0.0001]. Adjusting for age, overcrowding was significantly associated with yaws infection [Adjusted OR (MH); 2.8; 95% CI; 1.3-5.95.0; p-Value; 0.014]

Conclusions: The significant association of having contact with yaws infected person and overcrowded homes with yaws requires to take measures to prevent contact with yaws infected persons in addition to early detection and treatment of yaws cases.

Keywords: Yaws resurgence; skin; overcrowding; West Akim municipality.

1. INTRODUCTION

Yaws is the most common of the endemic treponematoses and is prevalent in poor rural communities in remote tropical areas of Africa,

Asia, and the Pacific Islands [1-3]. Yaws, caused by the spiral-shaped bacterium (spirochete) *Treponema pallidum* subspecies *pertenue* is a contagious, non-venereal infection in humans that presents mainly in children below 15 years

*Corresponding author: Email: jodoom@noguchi.ug.edu.gh;

old and primarily affects the skin, bones and cartilage [4]. Most people affected by yaws reside in warm, humid tropical areas, particularly in communities with low levels of hygiene. Overcrowding, poor sanitation and inadequate water supply are contributing factors to yaws infection which is more common in the rainy season probably because of the tendency to stay indoors and keep close together for warming [5].

Transmission requires a minor skin abrasion or cut for spirochetes to enter. The usual means of transmission of Yaws is close body contact with a patient with infectious lesions [6]. Fleas may be involved in transmission from clothing and dressing that have become contaminated by fluid from sores.

The clinical features are classified in stages [7, 8]. During the primary stage, a lesion called the 'mother yaws' occurs as a papule, which develops after 2-4 weeks of incubation at the site of *Treponema* inoculation and enlarges before it ulcerates. Spontaneous resolution occurs after almost 6 months, and the initial lesion heals. The secondary stage is characterized by widespread papilloma and/or smaller skin papules or macules, the 'daughter yaws'. After a variable period, which can last several years without treatment, a late stage develops in 10% of patients and consists of skin ulceration, gumma formation and destruction of bones and cartilage. Painful palmar and plantar hyperkeratosis are also observed during this third stage.

Yaws is usually diagnosed clinically, but the diagnosis is difficult and requires serological confirmation [9]. The elimination and ultimate eradication of the infection requires strategies targeted against the factors that favour its transmission. Thus, control activities must be considered in mass treatment campaigns to eliminate the source of infection, with improved environmental and individual hygiene [10]. Long-acting Benzathine Penicillin has been the drug of choice for treatment of yaws cases and their contacts with a dosage of 1.2 million units to adults as single intra-muscular injection and 0.6 million units to children below 10 years old [11, 12]. The World Health Organization (WHO) now recommends that yaws can be treated with a single oral dose of Azithromycin, a macrolide antibiotic, where yaws is prevalent but this is yet to be scaled up leaving room for infected people,

to progress in the disease to develop ulcers and other complications [13].

Ghana is among the 12 known endemic countries for yaws. The country reported over 20,000 cases of yaws each year from 2007 to 2010. In 2012 however, 9,356 cases [14] of yaws were reported out of which 534 were from the West Akim Municipality. Yaws in Ghana has been earmarked by the government for elimination by 2017, following the WHO's global elimination target of 2017 and eradication by 2020. Despite the implementation of the strategy of mass drug treatment in the past, there is indication of resurgence of the disease in West Akim Municipality that has benefitted from three Mechanical Diagnosis and Therapy (MDT) exercises. This study aims to identify the possible factors that may be contributing to the reoccurrence and upsurge of yaws cases in the district.

2. METHODOLOGY

2.1 Study Area

The study was conducted in West Akim Municipality located in the southern part of Eastern region of Ghana during the period of September to December 2013 (Fig 1). West Akim Municipality has a population of 212,282 and made of both rural and urban communities. The rural communities form a proportion of 64% and are made up of settlements with poor access to basic utilities like water, electricity, adequate sanitation facilities and motorable roads. Only 48% of the population in the Municipality has access to portable water whiles the remaining 52% of the people depend on unsafe sources like ponds, rivers and streams. The predominant occupation in the district is subsistence agriculture, employing 52.1% of the total labour force. The reported cases of yaws in the West Akim Municipality from 2008 to 2012 are shown in Table 1.

2.2 Study Design

The study was an un-matched community-based case-control study with cases of all persons with yaws and the controls who were persons without yaws and living in the same neighbourhood as the case.



Fig. 1. Map of West Akim Municipal showing sub-municipals

Table 1. Reported cases of yaws in the West Akim Municipality, 2008-2012

Reported cases /Year	2008	2009	2010	2011	2012
0-14 years	570	72	95	84	289
15 years and above	200	27	16	40	65
Total Cases	770	97	111	124	534

2.3 Study Population and Sampling

We defined a case of yaws as "any person who lives in an endemic area and presents with one or more of the following signs: painless ulcer with scab, papilloma, palmar or plantar hyperkeratosis (thickening)" [7]. Participants of the study included all persons (all ages) living in West Akim Municipality with infectious yaws detected

during the community case search and randomly selected community controls from the same neighbourhood where the cases live. Persons not resident in West Akim Municipality and non-infectious yaws cases (hyperkeratosis, Saber tibia, Gangosa, Dactylitis, Ganglion and Goundou) were excluded from the study.

A sample size of 138 (46 cases and 92 controls) was calculated with Epi Info 7 [15] based on an alpha of 0.05, at two sided confidence level of 95%, power of 80% and assuming 20% prevalence of exposure among controls to detect a least odds ratio of 3. A standardized questionnaire was used to collect demographic, clinical and exposure history from the cases and controls. Questionnaires were administered to the cases as they are detected in the communities by trained data collection officers. Communities and neighbourhoods of the confirmed cases were visited to randomly select and interview the controls. If a case or control

was a child, the questionnaire was administered to their parents or care givers.

There was a one day training of data collection officers from the West Akim Municipality (Technical Officers and Field Technicians-Disease Control) on selection of cases and controls and administering of questionnaires. The questionnaires were pre-tested in one of the communities for appropriateness before final use.

Trained Community Based Volunteers moved from house to house in selected endemic communities in West Akim Municipality in the Eastern Region of Ghana to identify persons with skin lesions then called a team of trained Field Technicians and Disease Control Officers. The team then critically examined the lesions and used yaws case definition and picture cards to identify cases. A total of 46 cases were recruited into the study.

Controls were defined as persons of all ages without skin lesions and living in the same neighbourhood as a case. For each case, two controls were selected and interviewed on the same day as the case was interviewed. Controls were selected from the same community as the cases in the following manner; the interviewer span a pen in the middle of the case's home, counted two houses in the direction of the spun pen and identified and selected two controls from among the occupants of the house randomly. The random selection was done by the following procedure; the household occupants' names were written on separate pieces of paper which were mixed in a container. The first name picked was used as the first control. This was repeated to select the second control. If the house did not have eligible controls, the next house in the same direction was visited to select the controls. This process was followed until eligible controls were found.

2.4 Data Analysis

Data was cleaned manually and necessary correction(s) was made during collection. Data was checked for consistency and analyzed using Epi Info 7 and Excel statistical software packages. The exposure variables that were with an odds ratio at 95% confidence intervals that excluded 1 and p-value of <0.05 were considered significantly associated with yaws

infection. Stratified analysis was also performed to rule out any confounding variables.

2.5 Ethical Considerations

Participants of the study were informed about the study verbally and in writing to solicit their consent to participate in the study. Children were recruited in the study after obtaining informed consent from their parents or care-givers. Ethical clearance for the study was obtained from the Ghana Health Service Ethical Review Committee, Ghana, (ID Number GHS-ERC:05/01/13).

3. RESULTS

Of the total 138 subjects that were recruited in the case control study, 46 were Yaws cases and 92 were controls and they satisfactorily completed the structured questionnaire that was administered to them for data collection.

The mean age of the cases was 9.28 years, the median 9.0 years, mode 10.0 years, range 3 to 25 years with variance of 13.54 and standard deviation of 3.68. The controls had mean age of 9.1 years, the median 8.5 years, the mode 8 years and range of 4 to 25 years with variance of 11.3 and standard deviation 3.37. Among the cases, the most affected age group was 6-10 years; 25 (54.4%) and the least affected age group being 16-25 years; 2 (4.4%), (Fig 2). As shown in Table 2, males were most affected with 71.7% (33 cases) while females represented 28.3% (13 cases).

Among the 46 yaws cases selected, 39 (84.78%) had attended school and 7 (15.22%) of them had never been to school (Table 3). Thirty-eight (82.61%) of the cases were still in school at the primary level whilst 17.39% of them had dropped out of school. Among the controls, 85 (92.39%) had attended school and 7 (7.61%) of them had never been to school. Seventy-five (81.52%) of the controls were still in school whilst 17 (18.48%) had dropped out of school. Those in school were mostly at primary level, 83 (90.22%) with only 2 (2.17%) at JHS level. Distribution of cases by place (sub-district of residence) showed that Osenase Sub-district had the most reported cases of 12 (26.1%), Ekoso and Aboso Sub-districts had the least number of cases of 1 (2.2%) each.

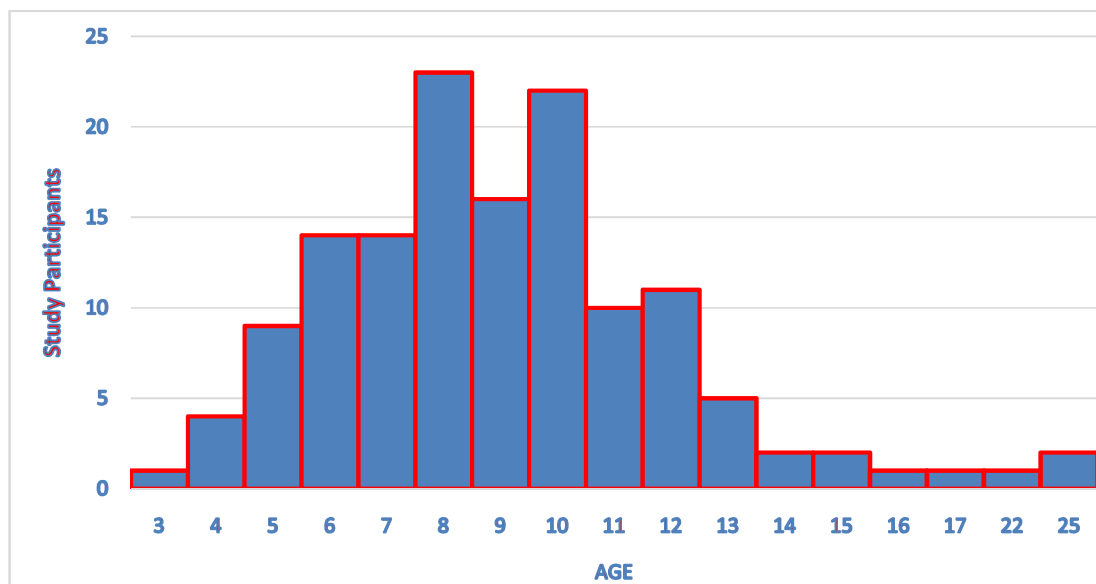


Fig. 2. Age distribution of study participants

Table 2. Age and sex distribution of yaws cases and controls; West Akim Municipality, Eastern Region, Ghana 2013

Age group	Male		Female		Total	
	Case (%)	Control (%)	Case (%)	Control (%)	Case (%)	Control (%)
Under 5	4 (12.1%)	3 (5.4%)	3 (23.1%)	4 (11.1%)	7 (15.2%)	7 (7.6%)
5-10	18 (54.6%)	37 (66.1%)	7 (53.9%)	27 (75%)	25 (54.4%)	64 (69.6%)
11-15	10 (30.3%)	14 (25%)	2 (15.4%)	4 (11.1%)	12 (26.1%)	18 (19.6%)
16-20	1 (3.0%)	0 (0.0%)	0 (0.0%)	1 (2.8%)	1 (2.2%)	1 (1.1%)
21-25	0 (0.0%)	2 (3.6%)	1 (7.7%)	0 (0.0%)	1 (2.2%)	2 (2.2%)
Total	33	56	13	36	46	92

Table 3. Demographic data of yaws cases and controls; West Akim Municipality, Eastern Region, Ghana 2013

Variable	Case N=46 (%)	Control N=92 (%)
Level of education		
None	7 (15.22%)	7 (7.61%)
Primary	38 (82.61%)	83 (90.22%)
JHS	0 (0.0%)	2 (2.17%)
SHS	0	0
Tertiary	0	0
Occupation		
None	38 (82.61%)	76 (90.48%)
Farmer	7 (15.22%)	5 (5.95%)
Trader	0	2 (2.6%)
Pupil/Student	38 (9.6%)	74 (96.1%)
Religion		
Christian	41 (89.13%)	88 (95.65%)
Moslem	1 (2.17%)	2 (2.17%)
Traditional	2 (4.35%)	0
None	2 (4.35%)	2 (2.17%)

Of the two types of yaws, macules and papillomas, which were enrolled in the study, papilloma was the most common representing 56.52% while macules recorded as 43.48%. The average number of days of having yaws was 25 days ranging from a minimum of 3 days to maximum of 90 days.

The risk factors found to be significantly ($p < 0.05$) associated with yaws infection were playing with yaws cases, sleeping in same room with yaws case, sharing clothing with a yaws case, and living in overcrowded homes which defined as the number of people living in the household was above 6 (Table 4). The average number of persons in a household with yaws cases was 7, ranging from minimum of 3 to maximum of 14 whilst the average for the controls was 3 ranging from minimum of 1 to maximum of 8. Overcrowding was significantly associated with the risk of yaws infection as shown by the fact

that households with more than 6 people were almost three times at risk of getting yaws infection as compared to households with fewer number of people [OR=2.8; CI, 1.35-5.95; p-value 0.009].

In a bivariate analysis, we found a statistically significant association between close contact with yaws infected person and developing yaws infection. People who play with yaws cases were seventy times more likely to become ill of yaws [Odds Ratio= 70; 95% CI (8.97-546.56), p-value= 0.000], likewise those sleeping in same room with yaws case and the presence of yaws cases in the same house.

Furthermore, it was found that sharing clothing with yaws case was significantly associated with being a yaws case [OR= 25; 95% CI, (3.12-204.69); p-value 0.0001]. This means that yaws cases were more likely to share clothing with other yaws cases than the community controls (Table 4). Adjusting for age, overcrowding was significantly associated with yaws infection [Adjusted OR (MH); 2.8; 95% CI; 1.3-5.95.0; p-value; 0.014]

Adjusting for sharing of clothing with Yaws cases, household overcrowding was significantly associated with yaws infection [Adjusted OR (MH); 3.6; 95% CI; 1.6-8.0; p-value; 0.003]

The study also found that education (OR=0.5; CI, 0.18-1.44; p-value 0.31), personal hygiene (OR 0.38 CI; 0.11-1.33; p-value 0.22), source of water

(OR=0.4; 95% CI, 0.04-3.41; p-value 0.66), poor sanitation (OR= 1.7 CI, 0.64-4.69; p-value 0.36) were not significantly associated with the risk of yaws infection (Table 5).

4. DISCUSSION

This study to determine factors associated with resurgence of infection with yaws amongst residents in West Akim Municipality in the Eastern Region of Ghana showed that overcrowding and contact with yaws infected person were significantly associated with yaws. It also revealed that people who played, slept in the same room, shared clothing or lived with yaws cases were more likely to contract yaws.

Please arrange serially ref [17]

The study found that children below the age group of 15 years to be most affected by yaws. The findings are consistent with the study done in Jamaica by Saunders et al., [17] that estimated incidence of yaws in the age-group 10-14 years to be about 50% among the population studied. Males in our study population were also more affected compared to females as found in the study by Kazadi and colleagues [16, 18]. It appears that males in their play have more physical contact with each other and in the process suffer more trauma which may predispose them to cuts and abrasions on the lower legs and possible transmission of yaws infection [16].

Table 4. Statistically Significant Risk Factors (Exposures) among Yaws Cases and Controls, West Akim Municipality, Eastern Region, Ghana 2013

Potential exposures	Cases N=46	Control N=92	OR	95% CI	P-value
Overcrowding	23 (50.0%)	24 (26.1%)	2.8	(1.35-5.95)	0.009
Playing with Yaws cases	20 (43%)	1 (1%)	70	(8.97-546.56)	0.0000
Sleeping in same room with Yaws case	20 (43.5%)	1 (1.1%)	25	(8.97-546.56)	0.0000
Presence of Yaws cases in a house	20 (43.5%)	1 (1.1%)	70	(8.97-546.56)	0.0000
Sharing Clothing with Yaws Case	10 (21.7%)	1 (1.1%)	25	(3.12-204.69)	0.0001

Table 5. Statistically Insignificant Risk Factors (Exposures) among Yaws Cases and Controls, West Akim Municipality, Eastern Region, Ghana 2013

Potential Exposures	Cases	Control	OR	95% CI	P-value
Education					
No Education	7 (15.2%)	7 (7.6%)	2.2	0.7-6.6	0.27
Ever Been To School	39 (84.8%)	85 (92.4%)	0.5	(0.15-1.40)	0.47
Primary Education	38 (83%)	83 (90%)	0.5	(0.18-1.44)	0.31
Bathing					

Had a bath past 24hrs	40 (87.0%)	87 (94.6%)	0.38	(0.11-1.33)	0.22
Bathed twice past 24hrs	16 (34.8%)	45 (48.9%)	0.56	(0.27-1.16)	0.16
Bathing with Soap	40 (87.0%)	86 (93.5%)	0.5	(0.14-1.53)	0.34
Source of Water					
Pipe water for cooking	1 (2.2%)	5 (5.4%)	0.4	(0.04-3.41)	0.66
Borehole	8 (17.4%)	14 (15.2%)	1.2	(0.45-3.0)	0.93
Protected well	4 (8.7%)	8 (8.7%)	1.0	(0.28-3.51)	0.73
Pipe water for cooking	1 (2%)	6 (7%)	0.3	(0.04-2.73)	0.49
Location of water source					
Home	1 (2.2%)	4 (4.4%)	0.49	(0.05-4.5)	0.87
Outside Home	36 (78.3%)	58 (63%)	2.11	(0.93-4.78)	0.11
Sanitation					
Dumping of refuse around house	40 (87%)	73 (79%)	1.7	(0.64-4.69)	0.39
Dumping of refuse away from house	6 (13%)	19 (21%)	0.58	(0.21-1.56)	0.39
KVIP toilet facility	2 (4.4%)	10 (11.0%)	0.37	(0.08-1.76)	0.33
Defecating in open	44 (95.7%)	78 (85.7%)	3.7	(0.79-17.00)	0.14

Our study did not find any significant association between persons with or without any education and the risk of developing yaws infection. While others have showed that yaws declines when standards of personal hygiene and sanitation are more rigorous [19], our study did not show an association between bathing with soap and contracting yaws infection.

Inadequate water supply (non-availability of potable water; tap water and borehole) at homes was not significantly associated with yaws infection. Poor sanitation including indiscriminate disposal of refuse at home and community, was not found to be significantly associated with yaws infection. This is in contrast to findings from a study conducted in Asseudji located in the health district of Adzopé in Côte d'Ivoire which found 81.5% of "mother yaws" households with 100% domestic animal waste and garbage stored in close proximity to the household's dwelling (49%) [20]. It is possible that the differences between our study and those mentioned above could be due to the different means by which the respective variables were measured. Our findings also suggest and agree with other studies that there are other conditions that predispose to yaws since yaws is not always present in communities where sanitary conditions are poor [17].

The significant association observed between overcrowding, playing, sharing clothing and sleeping with yaws cases suggest that close contact with yaws infected people are possible mode of the yaws transmission in the West Akim Municipality. Findings of other studies such as, crowded environments [19], social contact [21] and crowded living conditions in deep humid forest [16] were all similar to our findings.

The study findings for which contacts are major risk factor for re-emergence of yaws supports the strategy adopted by the World Health Organization (WHO) which aims to eradicate yaws by 2020 through adoption of the Morges strategy; this consists of initial mass treatment of endemic communities followed by surveys every 6 months to actively detect and treat remaining cases and their contacts [15, 22]. Our findings also support the studies by Perine *et al.* [1] that stated "all contacts of infectious cases must be treated if yaws is to be eliminated from the community". It stands to reason that once there is a pool of people with yaws infection, the risk factors for transmission could play a major role for infection of cases.

Our findings are subject to some limitations. First, sampling of cases was done by convenience method which limits the generalizability of the results to other regions. Secondly, tracing cases to respective homes were at times not possible due to poor addressing system. Thirdly, the training period was short for the diagnosis of macules/nodules in darker phototypes. Finally, the possibility of bias cannot be ruled-out.

It is evident from this study that eradication of yaws can be achieved if treatment of yaws cases goes hand in hand with tackling the risk factors associated with yaws infection. On the basis of our findings, it is anticipated that community-based strategy will be required to effectively control yaws and prevent its re-emergence. The continued existence of these risk factors of overcrowding, playing among yaws patients and non-yaws children, sharing of clothing and sleeping together means that all yaws cases and

all their contacts must be treated within the same time to prevent any re-emergence. This requires sustained effort and committed resources.

5. CONCLUSION

The significant risk factors associated with yaws infection amongst residents in West Akim Municipality in the Eastern Region of Ghana included playing, sleeping and sharing clothing with yaws cases and living in overcrowded homes. To avert the situation, measures should be in place to prevent contact with yaws infected persons and early detection and treatment of yaws cases and their contacts should be paramount.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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