SEROPREVALENCE OF SYPHILIS INFECTION IN INDIVIDUALS AT CAPE COAST METROPOLIS, GHANA

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ABSTRACT

Background: Syphilis is a sexually transmitted infection caused by *Treponema pallidum*. The disease becomes very common among individuals with multiple sexual partners without protection.

Aim: This research was aimed at assessing the prevalence of syphilis infection in Cape Coast Metropolis and the factors associated with the transmission of the disease

Methodology: 200 participants from Cape Coast were sampled, and assessed for syphilis infection using Venereal Disease Research Laboratory syphilis test strips (a nontreponemal test) and positive samples were confirmed with *Treponema pallidium* haemagglutination (TPHA) test. Questionnaires, reflecting the participant’s sociodemographic data such as sex, age, occupation, marital status, number of lifetime sexual partners and knowledge of syphilis, were also administered to each participant. The questionnaires and test results were analysed, to assess the relationship between various risk factors and syphilis infection.

Results: The prevalence of syphilis infection in Cape Coast was found to be 8.5%, mainly associated with participants having multiple sexual partners and having unprotected and indiscriminate sex. Other factors found to be indirectly affecting the rate of infection were illiteracy, lack of knowledge and information concerning the disease.

Conclusion: The seroprevalence of syphilis infection in the Cape Coast Metropolis is an indication that the disease is endemic
1. INTRODUCTION

Syphilis, a chronic disease caused by *Treponema pallidum*, is sexually transmitted with a waxing and waning course [1]. It occurs worldwide, and the incidence varies significantly with geographic location [2]. About 12 million people have been infected worldwide since 1999, with the greater proportion of cases (over 90%) in the developing world. Similarly, there are also estimated 12 million new cases of syphilis in the world each year, a quarter of which occur in Africa [2].

In Africa, syphilis prevalence rates among blood donors ranges from 1.5% in Burkina Faso, 3.7% in Congo, 8.4% in South Africa to 17.4% in Cameroon [3-5]. There were other report of syphilis infection in pregnant women in Nigeria [6], and also in association with HIV, HBV and HCV in Rwanda [7] and Ethiopia [8]. These were made possible through screening programs implemented at ante-natal care clinics or blood donors [9], however, it falls short of a consistent source of data although most people benefited a lot as they were diagnosed before the clinical manifestation of the disease. These enable the reduction of the spread of the disease and it will be encouraging to determine the general prevalence rates through screening in the major cities of countries in Africa that the disease could easily be spread. The emergence of human immunodeficiency virus (HIV) infection has attributed partly to unsafe sexual practices especially among gay homosexuals, increased promiscuity, prostitution and decreasing use of condoms [10] and therefore increased infection rate of syphilis among the developing countries.

In Ghana, there have been cases of syphilis infection among inmates in correctional facilities and other parts of the country. A study at three prisons showed a prevalence of 11% [11], in the
general population at Korle Bu showed 7.9% [12] and 4.5% at Kumasi [13]. Such prevalence rates of syphilis infection indicate that the disease may be common within the general population. And the screening of the people especially in the major cities of the country will give a clear picture about the extent of the disease among the population. In the Cape Coast metropolis, females as young as 15 years of age may have a child of their own, indicating early initiation of sexual activity. The average inhabitant may have had about three sexual partners before death. A general interview with some inhabitants showed that, there is more incidence of unprotected sex, especially among unmarried young adults. The above mentioned situations predisposes majority of the sexually active populace of the Cape Coast Metropolis to syphilis infection and other sexually transmitted diseases. This was noted in the recent national sentinel report of the region to be having the highest syphilis infection rates of 18.4% compared to other regions [14]. Although the prevalence rate has reduced to 5.7% in the region [15], it is alarming and this study aimed at determining the prevalence rate of syphilis infection in the general population at Cape Coast Metropolis which is the capital of the Central Region. The study was also to find out the knowledge of the people on the factors associated with syphilis infection and to identify possible ways of reducing or preventing syphilis infection in metropolis.
2. MATERIALS AND METHODS

Area of study

This study was conducted in the Cape Coast Metropolis. The area has an approximate population of 169,894, according to the 2010 population and housing census [16], with male to female ratio of 48.7:51.3. There is high parity in this municipality and some females as young as fifteen years may have a child of their own, while others in their mid-thirty’s have an average of four children. This indicates high sexual activity, thus predisposing them to syphilis infection and other STIs. The main occupations of the inhabitants are trading, teaching, fishing and farming; however, a good number of them are unemployed, and only about half of the teenagers are schooling.

Study participants

For the purpose of this study, two hundred (200) consenting participants, who were inhabitants of the Cape Coast metropolis and visited the Central Regional Hospital (CRH) with patients, willingly accepted to participate in the research. These were made up of 110 females and 90 males and were within 15-55 years of age. The participants were sexually active, thus may be predisposed to syphilis infection and other STIs. They were randomly selected irrespective of where they might have come from in the Cape Coast metropolis.
Ethical concern

The protocol of the study was reviewed and approved by the University of Cape Coast Ethical Review Committees. The study was introduced and explained to each participant (translating to local Ghanaian language where necessary) to determine their interest and willingness to take part in the research project. Every individual was given a consent form to sign to confirm their willingness to participate in the study. Under no circumstance was any participant forced or coerced to participate. However, each participant had the freedom to withdraw from the study at any time.

Blood sample collection

Five millilitres of blood sample was collected from each participant through venipuncture. The collection was done at the phlebotomy section of the Central Regional Hospital laboratory by qualified laboratory technicians from September 2012 to April 2013. Two hundred microlitres of blood samples were added to ethylenediaminetetraacetic acid (EDTA) test tubes to prevent coagulation. The test tubes were labelled to conform to each participant’s special code. The blood samples were centrifuged to obtain the plasma that was collected, using a Pasteur pipette, into dry 2ml test tubes. Each dry tube had a corresponding labelling as that of the special code designated to each participant. The blood plasma samples were frozen at -15°C. Also 1 microlitre of blood samples was added into a test tube to obtain sera that was used for Treponema palladium haemagglutination (TPHA) test confirmation.
Demographic data

Questionnaires were administered to collect data on the participants’ ages, sex, marital status, number of lifetime sexual partners, knowledge about syphilis infection, and the occupation. These sociodemographic factors may influence their susceptibility to syphilis infection as direct and indirect predisposing factors.

Blood samples

For the diagnosis of syphilis in the blood plasma collected from each participant, a test was carried out using Venereal Disease Research Laboratory (VDRL) syphilis test strips with a sensitivity of 86% and 85% specificity. The positive samples were Confirmed by Treponema pallidium haemagglutination (TPHA) test with >95% sensitivity and >99% specificity as described with modification in [17, 18].

Briefly, a rapid chromatographic immunoassay which detects antibodies (IgG and IgM) to *T. pallidum* qualitatively in whole blood, serum or plasma was used. Two drops of each sample was placed on one test strip each, then followed by one drop of the buffer and the result was read at ten (10) minutes. A single coloured line at the control (C) side, indicated a negative result, whiles two coloured lines, one at the C side and the other at the test (T) side indicated a positive result. No coloured line after testing and only one line at the T side suggested an invalid result and the test repeated using a new test strip. The result for each sample was read and recorded; general percentage prevalence of syphilis infection was determined.
For TPHA test, there were lyophilized test cells (antigen coated), control cells on the kit. There were absorbing diluents to remove non-specific reactions and a positive control serum. Test cells were re-constituted and diluted 1 in 6 as recommended by the manufacturer. Positive and negative control sera were included in each batch of screening tests and the positive serum titrated whenever any quantitative tests were performed. Briefly, the plasma was inactivated by heating at 56°C for 30 minutes and diluted to 1 in 20. Samples were allowed to absorb for 30 minutes at room temperature. After which 25ul aliquots were transferred to U-type microtitre plates and 75ul test cells were then added for a final dilution of 1 in 80 and the Plates examined after 4 hrs incubation at 25°C. A final reading was made after overnight incubation. Results were recorded as follows: Negative - A smooth ring or button of cells. Positive - A diffuse carpet or a thin ring of cells with marked agglutination. Weak positive - A slightly enlarged ring of cells with peripheral agglutination.

**Statistical Analysis**

The results were analysed using SPSS version 16 as well as Graphpad Prism version 3 statistical package. Frequency distributions on positive cases were performed and non-parametric Chi-square and Fisher tests were used to test differences between categorical variables. The analysis was to determine the relationship of married and unmarried participants, and their results. Also it was determined whether one's occupation, lifetime sexual partner (s) and sex ratio had an influence on the results obtained.
3. RESULTS

The 200 study participants had a mean age of 33.82 years (standard deviation of 10.91, age ranges from 15-55 years. The mean age of those who tested positive to syphilis infection was 30.12 years, with a standard deviation of 9.98. There were 110 females with a mean age of 31.23 years and 90 males with mean age of 36.99 years.

The estimated prevalence of syphilis infection was 8.5% (17 out of 200) (Table 1). Out of which 6 (6.7%) were males and 11 (10%) were females. One hundred and eighty-three (91.5%) were not infected with syphilis and they included 84 (42%) males and 99 (49.5%) females. There were no significant differences between male and female participants generally (p=0.343) and those who were reactive to syphilis antigens (p= 0.152).

Those with age groups of 21-30 were many, 56 (28.0%) out of the 200 participant and also had the highest reactivity to syphilis, 10 (5.0%) (Table. 2). This was followed by those with age group of 41-50 years who were 47 (26.5%), and 3 (1.5%) were reactive to syphilis antigens. Age group, 31-40 years were 53 (26.5%) and 2 (1.0%) were positive to syphilis antigens. And then age group 51-60 years were 15 (7.5%); only 1 (0.5%) was positive for syphilis infection. Finally, the age group 11-20 years were 29 (14.5%) and also had 1 (0.5%) positive for syphilis infection. Participants with age group of 21-30 years and 31-40 years were many compare to those with age group of 51-60 years (p=0.016, p=0.017) respectively. However, those with syphilis infection, age group of 21-30 years were significantly many than those with age groups of 31-40 years (p=0.015), 11-20 years (p=0.010) and 51-60 years (p=0.010).
From Table 3, 75 (37%) were singles but sexually active with 12 (6%) positive and 63 (31.5%) negatives for syphilis infections. Married participants were 125 (62.5%), and 5 (2.5%) were positive with 120 (60%) negative for syphilis infections. The married subjects were significantly higher than the unmarried individuals (p==0.007) but a few of them were reactive to syphilis antigens compare to the unmarried individuals (p=0.432).

About 90% of the participants have had at least primary education (Table 4). Majority of them who had tertiary education, 79 (39.5%), only 2 (1.0%) were positive for syphilis infection. For those with secondary education: 37 (18.5%), 3 (1.5%) were infected with syphilis. However 8 (4.0%) who were positive for syphilis, were among 65 (32.5%) participants who had only primary education and 4(2.0%) were among 19 (9.5%) who were not having any formal education and were infected with syphilis. Although there were no differences in participants who had primary and tertiary education (p=0.633), a significant number of primary level educated participants were infected with syphilis compared to tertiary educated participants (p=0.012).

From Table 5, the percentage of lifetime monogamy was 40 (20%), with the remaining 80% being polygamous. Three (1.5%) of the monogamous participants tested positive for syphilis. Fourteen (7%) of the polygamous group tested positive for syphilis infection. They included 10 (5%), with 2 sexual partners and 4 (2%), with 3 sexual partners. Thirty-seven (18.5%) monogamous participants were negative for syphilis and 117 (58.5%) who were having 2 sexual partners were also negative. Twenty-nine (14.5%) of those who were having 3 sexual partners
were also negative. There were no significant differences in the number of lifetime partners generally (p>0.05) and among those who were reactive to syphilis antigens (p>0.05).

Of the 200 participants who were involved in the study, 86 (43%) had heard about the disease and only 1 (0.5%) was positive for syphilis infection (Table 6). Those who had no knowledge about syphilis infection were 114 (57%). However, 16 (8%) of them were positive for syphilis infection. Those who were infected but had not heard about syphilis infection were significantly many than those who had knowledge about syphilis infection (p=0.004). Thus, the greater number of syphilis antigen reactivity in those without knowledge of infection may indicate their unprotective sexual activity with their infected partners leading to transmission of the bacteria pathogens.

The main occupation of the participants was teaching, trading and farming (Table 7). However there were others who were health workers and students. A good number of them were unemployed. There were 52 (26%) teachers with only 1 (0.5%) positive case and 51 (25.5%) negative to syphilis. Out of the 27 (13.5%) farmers, 3 (1.5%) were positive and 24 (12%) negative. Health workers were 16 (8%) and all of them were negative. Students were 21 (10.5%) with only 1 (0.5%) positive. Traders on the other hand, were 32 (16%) with 4 (2%) positives. The unemployed participants were 43 (21.5%) and had the highest positive cases with 5 (2.5%). There were others, 9 (4.5%) whose occupation were not known and had 3 (1.5%) positive cases. These people were the smallest number and about a third of them were reactive to the syphilis antigens. Compared to teachers they were significantly lesser occupational group (p=0.009) but with 3 (1.5%) people being reactive to syphilis antigens as against 1(0.05%) in the teachers.
4. DISCUSSION

In this study, the prevalence of syphilis infection in Cape Coast Metropolis was found to be 8.5%, which is similar to the regional prevalence of 9.6% in 2011[14]. This high prevalence may be compared to that of Accra [12] and Kumasi [13]. These are cities with large population and unprotected sex among the people is likely to be common as well as having multiple sexual partners [19]. Syphilis disease has been found to be recently endemic in the Central Region of Ghana and may show regional variation based on the sexual activity of the people. Women may be less likely to show primary lesions than men because they are mostly asymptomatic, and thus may not seek medical attention on time [20, 21]. They may therefore quietly contribute in spreading the disease that may be observed in the men as a result of higher rates of diagnosis and treatment of primary infections.

Although syphilis infection have been reported in older men [22-24], this study has shown younger age group were significantly infected with syphilis. This may be due to their active sexual activity in the metropolis. There were also some of the elderly group who were infected and may possibly be engaged in multiple sexual activities among their age group or having some of the youth as their partners.

Education is also a risk factor that could play a major role in acquiring syphilis infection in a community. Knowledge and understanding of the disease may assist in behavioural changes towards the control of the disease. A significant number of the participants with primary
education were infected as compared to lesser number in the tertiary education level. These findings were also noted in other part of the world [25-27]. Other contributing factors such as knowledge of syphilis, marriage and occupation may have some effect on the rate of syphilis infection among the people and also increase one’s risk of being infected [28]. Of the 67 (33.5%) participants that had knowledge of syphilis infection only one was infected, and the remaining infected participants had no idea of syphilis. Thus, having knowledge about the disease may contribute a lot in protecting against the risk of contracting syphilis infection [29]. However it must be noted that, only 19 (9.5%) of those with prior knowledge about syphilis had ever been tested for the disease. The general reasons given by participants for not going for the test included lack of funds, inadequate knowledge and availability of information on the disease and its effects, ignorance and the fact that they did not feel ill.

Marriage requires some level of commitment to one sexual partner. This somehow protects a married person from having multiple sexual partners while married, except those in polygamous marriages and a few individuals who flout these principles. In the study there were significant number of married than the single participants and majority of the participants might have been having multiple lifetime sexual partners. However, majority of infected participants were found to be single (6%) as against 2.5% of married participants having the infection. It is likely these single subjects may have more than one sexual partner and thus help spread the disease. This is supported by the fact that syphilis infection was high in subjects with more than one sexual partner [30]. In spite of the fact that some of the married participants might have been involved in relationships outside their marriage, they may be conscious in their sexual activity with their partners to avoid infection unlike the unmarried individuals.
Also it was realised that, syphilis infection was higher among participants having certain occupations. This can be linked to the fact that certain occupations gave one a greater access to information and knowledge concerning certain health issues including syphilis infection [31, 32]; thus, these people are able to protect themselves from contracting such diseases. For example, health workers, teachers and students have better access to information regarding health issues and how to prevent infection [33]. Hence, participants who were health workers were not infected. There was also higher number of teachers compared to those doing other works but, only one as against three of those doing other jobs was infected. Only one (0.5%) student also had the syphilis infection. The remaining 15 syphilis infected participants were distributed among the unemployed (2.5%), farmers (1.5%), traders (2%) and other occupations (1.5%). These were groups of people with little or no access to information on health issues.

5. CONCLUSION

This high prevalence of syphilis infection in the Cape Coast Metropolis may be influenced by direct factors such as having multiple sexual partners, and having indiscriminate and unprotected sex. Indirectly, factors such as marital status, literacy and knowledge of the disease may also contribute to the rate of syphilis infection. Hence, the primary ways of reducing the rate of syphilis infection should be by education and making knowledge and information on the disease available to all. Also larger epidemiological investigations to assess the prevalence of syphilis infection in relation to other sexually transmitted infections including HIV in the various towns and regions of Ghana should be encouraged to generate database. This will enable the Ghana Health Services to formulate policies for effective control of the disease.
COMPETING INTERESTS

The authors have declared that no competing interests exist.
REFERENCES


Table 1: Syphilis infection and gender of the study participants

<table>
<thead>
<tr>
<th>Syphilis test</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td>6 (6.7)  (^a)</td>
<td>11 (10) (^a)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td>84 (42)</td>
<td>99 (49.5)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td>90 (45) (^b)</td>
<td>110 (55) (^b)</td>
</tr>
</tbody>
</table>

\(^a\): p=0.0142, \(^b\): p=0.303

Table 2: Syphilis infection and age groups distribution of the study participants

<table>
<thead>
<tr>
<th>Ages groups (%)</th>
<th>11-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td>1(0.5) (^a)</td>
<td>10(5.0) (^a,b,c)</td>
<td>2(1.0) (^c)</td>
<td>3(1.5)</td>
<td>1(0.5) (^b)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td>28 (14.0)</td>
<td>46(23.0)</td>
<td>51(25.5)</td>
<td>44(22.0)</td>
<td>14(7.0)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td>29(14.5)</td>
<td>56(28.0) (^d)</td>
<td>53(26.5) (^e)</td>
<td>47(26.5)</td>
<td>15(7.5) (^d,e)</td>
</tr>
</tbody>
</table>

\(^a\): p=0.010, \(^b\): p=0.010, \(^c\): p=0.014, \(^d\): p=0.016, \(^e\): p=0.17
Table 3: Syphilis infection and marital status of participants

<table>
<thead>
<tr>
<th>Syphilis test</th>
<th>Marital Status (%)</th>
<th>Single</th>
<th>Married</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td></td>
<td>12 (6.0) (^{a})</td>
<td>5 (2.5) (^{a})</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td></td>
<td>63 (31.58)</td>
<td>120 (62.5)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td></td>
<td>75 (37.5) (^{b})</td>
<td>125 (62.5) (^{b})</td>
</tr>
</tbody>
</table>

\(^{a}\): p=0.432, \(^{b}\): p=0.007

Table 4: Syphilis infection and educational levels of the participants

<table>
<thead>
<tr>
<th>Education (%)</th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>No formal Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td>8 (4.0) (^{a})</td>
<td>3 (1.5)</td>
<td>2 (1.0) (^{a})</td>
<td>4 (2.0)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td>57 (28.5)</td>
<td>34 (17.0)</td>
<td>77 (38.5)</td>
<td>15 (7.5)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td>65 (32.5) (^{b})</td>
<td>37 (18.5)</td>
<td>79 (39.5) (^{b})</td>
<td>19 (9.5)</td>
</tr>
</tbody>
</table>

\(^{a}\): p=0.012, \(^{b}\): p=0.633
Table 5: Syphilis infection and lifetime sexual partners of the participants

<table>
<thead>
<tr>
<th>Syphilis Test</th>
<th>Number of lifetime sexual partners (%)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td></td>
<td>3 (1.5)(^a)</td>
<td>10 (5.0)(^a)</td>
<td>4 (2.0)(^a)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td></td>
<td>37 (18.5)</td>
<td>117 (58.5)</td>
<td>29 (14.5)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td></td>
<td>40 (20)(^b)</td>
<td>127 (63.5)(^b)</td>
<td>33 (16.5)(^b)</td>
</tr>
</tbody>
</table>

\(a: p>0.05, b: p>0.05\)

Table 6: Syphilis infection among participants with or without knowledge of Syphilis infection

<table>
<thead>
<tr>
<th>Syphilis Test</th>
<th>Knowledge of participant about syphilis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Syphilis positive</td>
<td>1 (0.5)(^a)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td>66 (33.0)</td>
</tr>
<tr>
<td>Total No. Participants</td>
<td>67 (33.5)</td>
</tr>
</tbody>
</table>

\(a: p=0.004\)
Table 7: Syphilis infection and the occupations of the participants

<table>
<thead>
<tr>
<th>Syphilis Test</th>
<th>T</th>
<th>F</th>
<th>HW</th>
<th>S</th>
<th>Tr</th>
<th>O</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis positive</td>
<td>1(0.5)</td>
<td>3(1.5)</td>
<td>0 (0.0)</td>
<td>1(0.5)</td>
<td>4(2.0)</td>
<td>3(1.5)</td>
<td>5(2.5)</td>
</tr>
<tr>
<td>Syphilis negative</td>
<td>51(25.1)</td>
<td>24(12.0)</td>
<td>16(8.0)</td>
<td>20(10.0)</td>
<td>28(14.0)</td>
<td>6(3.0)</td>
<td>38(19.0)</td>
</tr>
</tbody>
</table>

Total No. Participants: 52(26.0)\(^a\) 27(13.5) 16(8.0) 21(10.5) 32(16.0) 9(4.5)\(^a\) 43(21.5)\(^a\)

\(T=\)Teachers, \(F=\)Farmers, \(HW=\)Health Workers, \(S=\)Students, \(Tr=\)Traders, \(O=\)others, \(U=\)unemployed, \(a:p=0.009\)