



## Seroprevalence of Syphilis Infection in Individuals at Cape Coast Metropolis, Ghana

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### Authors' contributions

This work was carried out in collaboration with all the authors. Author SVN designed the study and wrote the manuscript. Author NBAF carried out the study, searched and analyzed the data. All authors read and approved the final manuscript.

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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 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 palladium* haemagglutination (TPHA) test. Questionnaires, reflecting the participant's sociodemographic data were also administered. The

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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.

**Keywords:** *Syphilis; seroprevalence; infection; Treponema palladium; participants.*

## 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 every 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. Thus, it will be encouraging to determine the general prevalence rates of the disease through screening in the major cities of countries in Africa where it can easily spread. The spread of human immunodeficiency virus (HIV) infection, due to unsafe sexual practices especially among gay homosexuals, increased promiscuity, prostitution and decreasing use of condoms, [10] has however increased infection rate of syphilis among people in 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]. Also prevalence of 7.9% and 4.5% were noted in the general population at Accra [12] and Kumasi [13] respectively. 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 more incidence of unprotected sex, especially among unmarried young adults. The above mentioned situations predisposes majority of them 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. The aim of this study is therefore to determine the prevalence rate of syphilis infection in the general population at Cape Coast Metropolis and to describe the factors associated with this infection.

## 2. MATERIALS AND METHODS

### 2.1 Area of Study

This study was conducted in the Cape Coast Metropolis with an approximate population of 169,894, according to the 2010 population and housing census [16], and 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.

## 2.2 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 sexually active 110 females and 90 males and within 15-55 years of age. They were randomly selected irrespective of where they might have come from in the Cape Coast metropolis.

## 2.3 Ethical Concern

The protocol of the study was reviewed and approved by the University of Cape Coast Ethical Review Committees. The study was explained to each participant (translating to local Ghanaian language where necessary) to determine their interest and willingness for their participation. Every individual signed a consent form to confirm their willingness to participate in the study. The participants were not forced or coerced to participate and had the freedom to withdraw from the study.

## 2.4 Blood Sample Collection

Five millilitres of blood sample was collected from each participant through venipuncture at the Central Regional Hospital laboratory by qualified laboratory technicians from September 2012 to April 2013.

Two hundred microlitres of blood samples were added to labelled ethylenediaminetetraacetic acid (EDTA) test tubes to prevent coagulation. The blood samples were centrifuged, the plasma collected and frozen at  $-15^{\circ}\text{C}$ . Also 1 microlitre of blood samples was added into a test tube to obtain sera that was used for *Treponema pallidum* haemagglutination (TPHA) test confirmation.

## 2.5 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 data may influence their susceptibility to syphilis infection as direct and indirect predisposing factors.

## 2.6 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 pallidum* 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 read at ten (10) minutes and recorded.

For TPHA test, briefly, the plasma was inactivated by heating at  $56^{\circ}\text{C}$  for 30 minutes and diluted to 1 in 20. Samples were allowed to absorb for 30 minutes at room temperature. After which 25 ul aliquots were transferred to U-type microtitre plates and 75 ul test cells (antigen coated) were then added for a final dilution of 1 in 80 and the Plates examined after 4 hrs incubation at  $25^{\circ}\text{C}$ . 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.

## 2.7 Statistical Analysis

The results were analysed using SPSS (SPSS Inc., Chicago, IL, USA) 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 for differences between categorical variables. 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 estimated prevalence of syphilis infection was 8.5% (17 out of 200) (Table 1). Out of which 6 (6.7%) were males and 11 (10.0%) were females. There were no significant differences between male and female participants generally

(p=0.343) and also those who were reactive to syphilis antigens (p= 0.152). Seventy-five (37.5%) of the participants were 'single' but sexually active with 12 (6.0%) positive for syphilis infection. Married participants were 125 (62.5%), and 5 (2.5%) were positive for syphilis infection. The married subjects were significantly higher than the unmarried individuals (p=0.007) but a few of them were similarly reactive to syphilis antigens (p=0.432).

Those with age group of 21-30 years were many with 56 (28.0%) out of the 200 participants. They had the highest reactivity to syphilis antigens: 10 (5.0%) and were significantly many than those with age groups of 31-40 years (p=0.014), 11-20 years (p=0.010) and 51-60 years (p=0.010). 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%) who were significantly lesser compared to 21-30 years (p=0.016) and 31-40 years (p=0.017); 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.

About 90% of the participants have had at least primary education (Table 2). Seventy-nine

(39.5%) of them had tertiary education and only 2 (1.0%) were positive for syphilis infection. For those with secondary education: 37 (18.5%), 3 (1.5%) were infected with syphilis bacteria. However 8 (4.0%) of syphilis infected subjects were among 65 (32.5%) who had only primary education. Four (2.0%) were among 19 (9.5%) who were not having any formal education and were infected with syphilis bacteria. 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 the bacteria compared to tertiary level participants (p=0.012).

From Table 3, the percentage of lifetime monogamy was 40 (20.0%) with 3(1.5%) positive for syphilis infection. The remaining 80.0% being polygamous had 14 (7.0%) positive for syphilis infection. They included 10 (5.0%), with 2 sexual partners and 4 (2.0%), with 3 sexual partners. 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).

Also 86 (43.0%) of the participants had heard about the disease and only 1 (0.5%) was positive for syphilis infection (Table 4). Those who had no knowledge about the disease were 114 (57.0%)

**Table 1. Syphilis infection, gender, marital status and age groups distribution of the study participants**

	Syphilis test		Total no. participants (%)	P-value
	Positive (%)	Negative (%)		
<b>Sex</b>				
Male	6 (3.0) <sup>a</sup>	84(42.0)	90(45.0) <sup>b</sup>	a=0.0142
Female	11(5.5) <sup>a</sup>	99(49.5)	110(55.0) <sup>b</sup>	b=0.303
<b>Marital status</b>				
'Single'	12(6.0) <sup>c</sup>	63(31.5)	75(37.5) <sup>d</sup>	c=0.432
Married	5 (2.5) <sup>c</sup>	120(60.0)	125(62.5) <sup>d</sup>	d=0.007
<b>Age group (yrs)</b>				
11-20	1(0.5) <sup>e</sup>	28(14.0)	29(14.5)	e=0.010
21-30	10(5.0) <sup>e,f,g</sup>	46(23.0)	56(28.0) <sup>h</sup>	f=0.010
31-40	2(1.0) <sup>g</sup>	51(25.5)	53(26.5) <sup>i</sup>	g=0.014
41-50	3(1.5)	44(22.0)	47(23.5)	h=0.016
51-60	1(0.5) <sup>f</sup>	14(7.0)	15(7.5) <sup>h,i</sup>	i=0.17

**Table 2. Syphilis infection and educational levels of the participants**

	Education (%)			
	Primary	Secondary	Tertiary	No formal education
Syphilis positive	8 (4.0) <sup>a</sup>	3 (1.5)	2 (1.0) <sup>a</sup>	4 (2.0)
Syphilis negative	57 (28.5)	34 (17.0)	77 (38.5)	15( 7.5)
Total no. participants	65 (32.5) <sup>b</sup>	37 (18.5)	79 (39.5) <sup>b</sup>	19 (9.5)

a: p=0.012, b:p=0.633

**Table 3. Syphilis infection and lifetime sexual partners of the participants**

Syphilis test	Number of life time sexual partners (%)		
	1	2	3
Syphilis positive	3 (1.5) <sup>a</sup>	10 (5.0) <sup>a</sup>	4 (2.0) <sup>a</sup>
Syphilis negative	37 (18.5)	117 (58.5)	29 (14.5)
Total no. participants	40 (20) <sup>b</sup>	127 (63.5) <sup>b</sup>	33 (16.5) <sup>b</sup>

a:  $p > 0.05$ , b:  $p > 0.05$

and 16 (8.0%) of them were positive for syphilis infection. Those who were infected but had not heard about the disease were significantly many than those who had knowledge about the infection ( $p=0.004$ ). Thus, they might have been having unprotected sex with their infected partners leading to transmission of the bacteria pathogens.

**Table 4. Syphilis infection among participants with or without knowledge of Syphilis infection**

Syphilis test	Knowledge of participant about syphilis (%)	
	Yes	No
Syphilis positive	1 (0.5) <sup>a</sup>	16 (8.0) <sup>a</sup>
Syphilis negative	66 (33.0)	98 (49.0)
Total no. Participants	67 (33.5)	114 (57.0)

a:  $p=0.004$

The main occupation of the participants was teaching, trading and farming (Table 5). A few were health workers and students but a good number were unemployed. There were 52 (26.0%) teachers with only 1 (0.5%) positive case. Out of the 27 (13.5%) farmers, 3 (1.5%) were positive for syphilis infection. Health workers were 16 (8.0%) with no syphilis infection. Students were 21 (10.5%) with only 1 (0.5%) positive case. Traders on the other hand, were 32 (16.0%) with 4 (2.0%) positives cases. The unemployed participants were 43 (21.5%) and had the highest positive cases with 5 (2.5%) participants. There were others, 9 (4.5%) whose occupation were not known and had 3 (1.5%) positive cases. These people were significantly lesser group ( $p=0.009$ ) but with 3 (1.5%) being reactive to syphilis antigens as against 1 (0.5%) 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 to the spread of the disease that may be observed in the men as a result of early clinical manifestations.

Although syphilis infection have been reported in older men [22-24], this study has shown that younger age group were significantly infected. This may be due to their increase 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 suggesting having knowledge about the disease may contribute a lot in protecting against the risk of contracting the infection [29]. However, it must be noted that 19 (9.5%) of those with prior

**Table 5. Syphilis infection and the occupations of the participants**

Syphilis test	Occupation (%)						
	T	F	HW	S	Tr	O	U
Syphilis positive	1(0.5)	3(1.5)	0 (0.0)	1(0.5)	4(2.0)	3(1.5)	5(2.5)
Syphilis negative	51(25.5)	24(12.0)	16(8.0)	20(10.0)	28(14.0)	6(3.0)	38(19.0)
Total No. participants	52(26.0) <sup>a</sup>	27(13.5)	16(8.0)	21(10.5)	32(16.0)	9(4.5) <sup>a</sup>	43(21.5)

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

knowledge about syphilis infection had never 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. Other reason was the fact that they did not feel ill.

Marriage requires some level of commitment to one sexual partner. This somehow protects people 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' (6.0%) 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 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 occupation 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. Also only one student had the syphilis infection. The remaining 12

syphilis infected participants were distributed among the unemployed (5), farmers (3) and traders (4). 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 both direct and indirect factors that contribute to the rate of syphilis infection. The disease may primarily be reduced by education and making knowledge and information available to all. Besides, epidemiological investigations to assess the prevalence of syphilis infection in relation to other sexually transmitted infections including HIV should be encouraged in Ghana. This will enable the generation of data and formulation of policies by Ghana Health Service for effective control of the disease.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Singh AE, Romanowski B. Syphilis: Review with emphasis on clinical, epidemiologic and some biologic features. *Clin Microbiol Rev.* 1999;12:187-209.
2. WHO: The Global Elimination of congenital Syphilis: Rationale and strategy for action. Geneva; World Health Organisation; 2007.
3. WHO: Global Prevalence and Incidence of selected Available Sexually Transmitted Infections: Syphilis, Geneva: WHO Geneva; 2001.
4. Batina A, Kabemba S, Malengela R. [Infectious markers among blood donors in Democratic Republic of Congo (DRC)]. *Rev Med Brux.* 2007;28:145-149.
5. Bisseye C, Sanou M, Nagalo BM, Kiba A, Compaore TR, Tao I, Simpore J. Epidemiology of syphilis in regional blood transfusion centres in Burkina Faso, West Africa. *Pan Afr Med J.* 2013;16:69.

6. Ojo DA, Oyentunji AO. Sero-prevalence of syphilis among pregnant women in Osogbo in Southwest Nigeria. *ASSET series B*. 2007;6:61-65.
7. Braunstein SL, Ingabire CM, Kestelyn E, Uwizera AU, Mwamarangwe L, Ntirushwa J, Nash D, Veldhuijzen NJ, Nel A, Vyankandondera J, van de Wijgert JH. High human immunodeficiency virus incidence in a cohort of Rwandan female sex workers. *Sex Transm Dis*. 2011;38:385-394.
8. Tessema B, Yismaw G, Kassu A, Amsalu A, Mulu A, Emmrich F, Sack U. Seroprevalence of HIV, HBV, HCV and syphilis infections among blood donors at Gondar University Teaching Hospital, Northwest Ethiopia: Declining trends over a period of five years. *BMC Infect Dis* 2010;10:111.
9. Gloyd S, Chai S, Mercer MA. Antenatal syphilis in sub-Saharan Africa: Missed opportunities for mortality reduction. *Health Policy Plan*. 2001;16:29-34.
10. Newell J, Senkoro K, Moshia F, Grosskurth H, Nicoll A, Barongo L, Borgdorff M, Klokke A, Changalucha J, Killewo J, et al. A population-based study of syphilis and sexually transmitted disease syndromes in north-western Tanzania. 2. Risk factors and health seeking behaviour. *Genitourin Med*. 1993;69:421-426.
11. Adjei AA, Armah HB, Gbagbo F, Ampofo WK, Quaye IK, Hesse IF, Mensah G. Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus and syphilis among prison inmates and officers at Nsawam and Accra. Ghana. *J Med Microbiol*. 2006;55:593-597.
12. Adjei AA, Kudzi W, Armah H, Adiku T, Amoah AG, Ansah J. Prevalence of antibodies to syphilis among blood donors in Accra, Ghana. *Jpn J Infect Dis*. 2003;56:165-167.
13. Owusu-Ofori AK, Parry CM, Bates I. Transfusion-transmitted syphilis in teaching hospital, Ghana. *Emerg Infect Dis*. 2011;17:2080-2082.
14. Awuku Y. Central Region tops syphilis cases in Ghana; 2011. Available: [www.ghananewsagency.org/26/8/2011](http://www.ghananewsagency.org/26/8/2011)
15. GAC; 2014. Available: <http://www.ghanaweb.com/GhanaHomePage/health/artikel.php17/11/2014>
16. GSS: Ghana Statistical Service. Geo Hive Ghana Population Statistics; 2010. Available: <http://www.geohive-ghanapopulationstatistics.html> (Accessed 2012, November 18, 2010).
17. Young H, Henrichsen C. Treponema pallidum haemagglutination test as a screening procedure for the diagnosis of syphilis. *Brit J Vener Dis*. 1974;50:341-346.
18. Wiwanitkit V. A cost-utility analysis of Treponema pallidum haemagglutination (TPHA) testing for syphilis screening of blood donors: Is the TPHA test useful for syphilis screening in a blood centre? *Blood Transfus*. 2009;7:65-66.
19. Gao L, Zhang L, Jin Q. Meta-analysis: Prevalence of HIV infection and syphilis among MSM in China. *Sex Transm Infect* 2009;85:354-358.
20. Maruti S, Hwang LY, Ross M, Leonard L, Raffel J, Hollins L. The epidemiology of early syphilis in Houston, Texas, 1994-1995. *Sex Transm Dis*. 1997;24:475-480.
21. Gupte S, Daly C, Agarwal V, Gaikwad SB, George B. Introduction of rapid tests for large-scale syphilis screening among female, male and transgender sex workers in Mumbai, India. *Sex Transm Dis*. 2011;38:499-502.
22. Tan HH, Chan RK, Goh CL. Sexually transmitted diseases in the older population in Singapore. *Ann Acad Med Singapore*. 2002;31:493-496.
23. Bodley-Tickell AT, Olowokure B, Bhaduri S, White DJ, Ward D, Ross JD, Smith G, Duggal HV, Goold P. Trends in sexually transmitted infections (other than HIV) in older people: Analysis of data from an enhanced surveillance system. *Sex Transm Infect*. 2008;84:312-317.
24. Colon-Lopez V, Ortiz AP, Banerjee G, Gertz AM, Garcia H. HIV and syphilis infection among men attending a [corrected] sexually transmitted infection clinic in Puerto Rico. *P R Health Sci J*. 2013;32:8-13.
25. Li X, Fang X, Lin D, Mao R, Wang J, Cottrell L, Harris C, Stanton B. HIV/STD risk behaviors and perceptions among rural-to-urban migrants in China. *AIDS Educ Prev*. 2004;16:538-556.
26. van Griensven F, Thanprasertsuk S, Jommaroeng R, Mansergh G, Naorat S, Jenkins RA, Ungchusak K, Phanuphak P, Tappero JW. Evidence of a previously undocumented epidemic of HIV infection among men who have sex with men in

- Bangkok, Thailand. AIDS. 2005;19:521-526.
27. Adimora AA, Schoenbach VJ, Martinson FE, Coyne-Beasley T, Doherty I, Stancil TR, Fullilove RE. Heterosexually transmitted HIV infection among African Americans in North Carolina. J Acquir Immune Defic Syndr. 2006;41:616-623.
  28. Cai R, Tan JG, Chen L, Richardus JH, de Vlas SJ. Prevalence and risk factors of syphilis infection among female sex workers in Shenzhen, China: An observational study (2009-2012). Trop Med Int Health. 2013;18:1531-1538.
  29. Makwe E, adenyuma MO. Awareness of Sexually Transmitted Infections (STIs) including HIV/AIDS among undergraduate students of University of Abuja, Nigeria. British Journal of Applied Science & Technology. 2014;4:705-717.
  30. Li Y, Detels R, Lin P, Fu X, Deng Z, Liu Y, Huang G, Li J, Tan Y. Difference in risk behaviors and STD prevalence between street-based and establishment-based FSWs in Guangdong Province, China. AIDS Behav. 2012;16:943-951.
  31. Tucker JD, Chen XS, Peeling RW. Syphilis and social upheaval in China. N Engl J Med. 2010;362:1658-1661.
  32. Kourbatova EV, Akovbyan VA, Chesson HW, Lytkina IN, Dmitriev GA, Tikhonova LI, Koubanova AA, Petukhova, II, Latypova MF, Aboymova OA, et al. Assessment of the routine, occupation-based gonorrhea and syphilis screening program in Moscow, Russia: An analysis of sexually transmitted infection prevalence and cost-effectiveness. Sex Transm Dis. 2008;35:453-460.
  33. Das A, Li J, Zhong F, Ouyang L, Mahapatra T, Tang W, Fu G, Zhao J, Detels R. Factors associated with HIV and syphilis co-infection among men who have sex with men in seven Chinese cities. Int J STD Aids. 2015;26:145-155.

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