Original Study

Prevalence of *Chlamydia Trachomatis*, *Neisseria Gonorrhoeae*, and *Trichomonas Vaginalis* Infection in Chilean Adolescents and Young Adults

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A B S T R A C T

Study Objective: To determine the prevalence of *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* infection in sexually active Chilean adolescents and young adults. A comparative analysis was performed between genders to identify demographic, clinical, and sexual behavior characteristics to predict the occurrence of *C trachomatis*.
Design: Analytical observational study.
Setting: Santiago, Chile.
Participants: Two hundred eighty-six sexually active volunteers aged 24 years or younger (171 female and 115 male); 82.9% (237/286) of them were classified as having high socioeconomic status.
Interventions: Confidential survey and self-collected samples (urine for men and vaginal swabs for women).
Main Outcome Measures: Prevalence, demographic characteristics, symptoms, and sexual behavior characteristics.
Results: The prevalence rate of *C trachomatis* was 8.7% (10/115) in men and 8.8% (15/171) in women ($P = .58$). *N gonorrhoeae* was detected in 1 subject, whereas no *T vaginalis* cases were detected. In multivariate analysis, having some college education was protective (odds ratio [OR], 0.28; 95% confidence interval [CI], 0.09-0.89), whereas having a higher number of sexual partners was a risk factor (OR, 1.19; 95% CI, 1.1-1.3) for *C trachomatis* infection. The latter was also predicted by postcoital bleeding (OR, 4.6; 95% CI, 1.30-16.23) in the female model.
Conclusion: C trachomatis infection rates were similar between both genders. Protective characteristics for the occurrence of this infection were having some college education, lower number of sexual partners, and if female, the absence of postcoital bleeding. This study highlights the importance of *C trachomatis* screening among the Chilean affluent population younger than 25 years. However, further studies are needed in a more diverse and representative sample to recommend universal screening in Chilean adolescents and young adults.
Key Words: Chlamydia trachomatis, *Neisseria gonorrhoeae*, *Trichomonas vaginalis*, Chile, Adolescents

Introduction

Infections by *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* represent the most common treatable sexually transmitted infections (STIs) globally. Current annual incidence estimations are 131 million for *C trachomatis* infections, 78 million for *N gonorrhoeae* infections, and 142 million for *T vaginalis* infections worldwide.[1] Up to 60% of *C trachomatis* and *N gonorrhoeae* infections occur in adolescents and young adults.[2] If left untreated, reproductive sequelae might arise, as well as further dissemination to other sexual partners and a higher risk for infection by other STIs, such as HIV.[3]

C trachomatis infection is the most frequently reported bacterial STI in sexually active adolescents with a prevalence of 5%-15%.[4] *C trachomatis* is not a notifiable disease and screening programs have not been established in the primary care facilities of public health services in Latin America. Therefore, available prevalence information is scarce and can be obtained only from isolated samples of different demographic groups.[5,6] In Chile, prevalence rates of 5.5%-7% in female adolescents, 19% in pregnant adolescents, and 5.7% in men have been reported previous studies.[7–10]

N gonorrhoeae infection, which is a notifiable disease in Latin America, is the second most reported bacterial STI and affects between 1% and 2% of sexually active adolescents.[1] In Chile, *N gonorrhoeae* prevalence has shown a decrease during 3 decades (113/100,000 in 1981 to 10/100,000 in 2015). Half of the notifications were from individuals younger than 25 years of age, and 90% occurred in men.[11] In line with this, no *N gonorrhoeae* was found in recent reports of asymptomatic Chilean women tested with nucleic acid amplification (NAAT).[7,8,12]

With the advent of the diagnosis of *T vaginalis* performed using NAAT, this infection has become one of the most prevalent STIs.[13] Predisposing factors include older age, female gender, and low socioeconomic level.[14] Studies in adolescents have shown a rate of up to 6% in high-risk groups.[15] In Chile, 2 reports of symptomatic adult women tested with NAATs showed prevalence of 3% and 6.5%, respectively.[16,17]

NAATs are the most sensitive and specific method to diagnose *C trachomatis*, *N gonorrhoeae*, and *T vaginalis*.[18,19]

The authors indicate no conflicts of interest.

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Using this technique, noninvasive samples taken by the patient detect the same amount of disease as samples taken by professionals.[20] Self-collected samples may be urine for men as well as for women or vaginal swabs in women. The latter might detect even more female infections than urine samples.[21]

The objective of this study was to determine the prevalence of *C trachomatis*, *N gonorrhoeae*, and *T vaginalis* in sexually active adolescents and adults 24 years of age or younger in Chile. We further performed a comparative analysis of *C trachomatis* prevalence between genders and built a model to identify demographic, as well as clinical and sexual behavior characteristics predicting infection.

Materials and Methods

Sample

In this analytical observational study, samples of 286 sexually active volunteers aged 24 years or younger (171 female and 115 male) were obtained. Medical professionals recruited subjects of 2 different health care institutions: the Adolescence Center of Clinica Alemana in Northeastern Santiago (n = 175) and the Consultorio Tantauco in Southern Santiago (n = 111). A video ad describing STI prevalence, risk factors, and self-collected samples was displayed in both institution's web pages to promote recruiting. After signing informed consent to participate in the study, participants were given written and verbal instructions to collect their samples in a private setting. Female participants were instructed to take their own vaginal sample by inserting a swab 5 cm into the vagina and holding it for 20 seconds. Male participants were instructed to take a sample of the first void urine. After the samples were collected, a confidential survey was applied to all participants.

Measurements

The survey instrument used was created by Schafer and colleagues.[22] It was translated to Spanish, adapted, and validated with subjects of each gender. The questionnaire contains 27 questions, including demographic characteristics (age, gender, and district of residence), educational attainment (status of high school education, completeness of college education, and/or presence of graduate degree), symptoms (presence of dysuria, discharge, postcoital bleeding, and/or pelvic pain), and sexual behavior (coitarche, number, gender and age of the last sexual partner, whether the last sexual encounter involved a romantic or casual partner, history of STIs, oral and/or anal sex, pregnancy, condom, and/or contraceptive use).

Socioeconomic status was defined according to the average income quartile of the district of residence as published in the 2015 Chilean socioeconomic survey.[23]

Samples were stored at 5°C. The processing of *C trachomatis* and *N gonorrhoeae* was performed using the APTIMA 2 (Gene Probe Inc), a US Food and Drug Administration-approved NAAT assay using a target capture system for in vitro qualitative detection and differentiation of ribosomal RNA. Processing of *T vaginalis* was performed with the NAAT kit of Cepheid GeneXpert Trichomonas Vaginalis-TV. This assay was declared substantially equivalent to the Gen-Probe APTIMA Trichomonas Vaginalis Assay (Gene Probe Inc) by the Food and Drug Administration in 2015.[24]

The research was approved by the involved institutional review boards: Comité de Ética, Facultad de Medicina Clínica Alemana Universidad del Desarrollo, and Comité de Ética, Servicio de Salud Metropolitano Sur.

Analysis

A bivariate analysis was performed to compare both genders and to determine whether there was an association between the prevalence of *C trachomatis* and demographic characteristics, symptoms, and sexual behavior. Contingency tables were used for categorical variables, and statistical significance was determined using the χ^2 or Fisher tests as needed. For continuous variables, analysis of variance was used after verifying the normal distribution. Statistically significant differences were considered from a value of *P* less than .05.

Multivariate analysis was performed, in which the dependent variable was the presence of *C trachomatis*, and the independent variables were those that were statistically significant in the second stage of the analysis. All significant associations at the 25% level (Hosmer-Lemeshow criterion) were retained to estimate a multivariate model that was later purified by a stepwise selection with a probability of retention of 0.05. Three models were created, 1 for all volunteers, 1 for female participants, and 1 for male participants. Data were analyzed using Stata 14 software (StataCorp).

Results

There were no significant differences between male and female participants in terms of sociodemographic factors. However, regarding sexual behavior, male compared with female participants, had a history of more sexual partners (3.8 vs 2.5; $P = .01$) and used condoms on a more regular basis (first sex episode 67% (77/115) vs 50.9% (87/171); $P = .01$; regular sex 65.2% (75/115) vs 47.4% (81/171); $P = .01$; last sex episode 47.8% (55/115) vs 35.1% (60/171); $P = .04$). Female participants had a higher proportion of casual sex partners (36.8% (63/171) vs 10.4% (12/115); $P = .01$), same-sex sexual activity (13.5% (23/171) vs 1.7% (2/115); $P = .01$), and higher age difference with sexual partners (difference $>$ 3 years 27.5% (47/171) vs 10.4% (12/115); $P = .01$).

The prevalence rate of *C trachomatis* was 8.7% (15/171) among male and 8.8% (19/115) among female ($P = .58$) participants. Only 1 case of *N gonorrhoeae* was detected, in a female participant in whom *C trachomatis* was also present. No sample tested positive for *T vaginalis*, in any of the subjects studied.

The bivariate analysis of demographic characteristics, symptoms, and sexual behavior with *C trachomatis* infection is shown in Table 1. The only symptom associated with infection among female participants was postcoital bleeding, 26.6% (4/15) in those with and 8.3% (13/156) in those without ($P = .01$). The only significant sexual behavior variable was the mean number of sexual partners, 4.8 in *C*

Table 1
Sociodemographic Characteristics, Genitourinary Symptoms, and Sexual Behavior According to *Chlamydia Trachomatis* Infection Status

Total	*C trachomatis* (positive)		*C trachomatis* (negative)		*P*
	n	%	n	%	
	25	8.8	261	91.2	
Demographic characteristics					
Gender					
Female	15	60	156	59.8	1
Male	10	40	105	40.2	
Median age	19.7		20.3		.29
Educational attainment					
High school	14	56	102	39.1	0.025
Some college	6	24	131	50.2	
Complete college	5	20	28	10.7	
Socioeconomic status					
Poverty < 25th percentile	20	80	213	81.6	0.52
Poverty 25-50th percentile	3	12	35	13.4	
Poverty 50-75th percentile	2	8	9	3.4	
Poverty > 75th percentile	0	0	2	.8	
Genitourinary symptoms					
Dysuria	5	20	47	18	.12
Urgency	6	24	56	21.5	.76
Polyuria	6	24	80	30.9	.24
Women					
Pelvic pain	7	46.7	68	43.8	0.96
Postcoital bleeding	4	26.7	13	8.4	0.01
Discharge	5	33.4	42	26.9	0.13
Men					
Urethral pain	2	20	8	7.6	0.11
Urethral discharge	1	10	2	1.9	0.24
Sexual behavior					
Coitarche, median age	16.3		16.9		.9
Mean sexual partners, n	4.8		2.9		.01
Previous STI	2	8	16	6.6	.68
Pregnancy ever	2	8	7	2.7	.18
Casual last partner	5	20	69	26.4	.63
Age difference of more than 3 years with last sexual partner	3	12	54	20.7	.43
Same sex sexual activity	0	0	25	9.6	.14
Never alcohol	6	24	45	17.2	.41
Never drugs	15	60	154	59	1
Oral sex	20	80	197	75.4	.76
Anal sex	8	32	72	27.5	.82

STI, sexually transmitted infection.

trachomatis positive and 2.9 in *C trachomatis* negative participants; $P = .01$).

Condom and contraceptive use and its associations with *C trachomatis* are shown in Table 2. Only 12.9% (37/286) of the respondents stated that they always used condoms, and none of these participants tested positive for *C trachomatis* ($P = .03$). However, condom use during first or last sexual intercourse and/or regular use were not associated with infection status.

Multivariate analysis showed that having some college education was protective (odds ratio [OR], 0.28; 95% confidence interval [CI], 0.09-0.89), and having a higher mean number of sexual partners was a risk factor (OR, 1.19; 95% CI, 1.1-1.3) for *C trachomatis* infection in the global model. In the female model, the presence of postcoital bleeding (OR, 4.6; 95% CI, 1.3-16.2) and a higher mean number of sexual partners (OR, 1.19; 95% CI, 1.2-2.9) were associated with the presence of *C trachomatis* infection.

Discussion

C trachomatis infection is the most frequently reported bacterial STI in sexually active adolescents. In the present study, which expands on our previous reports, we could identify predictive demographic (lower educational attainment) and clinical (having a higher number of sexual partners and postcoital bleeding) risk factors associated with this STI in a cohort of young, sexually active individuals.

The main priority of *C trachomatis* screening programs is to prevent the well known reproductive repercussions. Reported *C trachomatis* infection rates resulting from these screening policies are always higher in women.[1] However, similar to our study, when samples are analyzed for both genders, the prevalence rates are comparable.[25,26] In Chile, *C trachomatis* prevalence has not been previously reported in one congruent population including individuals of both genders and individuals 24 years old or younger. Romero et al reported a 4.72% prevalence rate among 252 men recruited in a private hospital.[9] Huneeus et al reported a 7% prevalence rate among women, 105 from high socioeconomic status and 99 from low socioeconomic status.[7] Conejero et al showed a 7.9% rate in 355 female college students recruited in a private hospital.[8] Finally, Zamboni et al reported a 5.5% positivity in 181 high socioeconomic status female volunteers.[10]

We found no correlation of socioeconomic status with the occurrence of *C trachomatis* infection. However, 82% of the sample belonged to a high socioeconomic status. It is

Table 2
Condom and Contraceptive Use According to *Chlamydia Trachomatis* Infection Status

	C trachomatis (present)		*C trachomatis* (absent)		Total		*P*
	n	%	n	%	n	%	
Condom use							
First sex	15	60	146	55.9	161	56	.83
Regular sex	13	52	139	53.3	152	53.2	1.00
Last sex	7	28	105	40.2	112	39.2	.28
Always	0	0	37	14.2	37	12.9	.03
Regular contraceptive use							
OCP	9	36	129	49	138	48.2	.21
Withdrawal	4	16	39	15	43	15	.78
Injectables	2	8	14	5.3	16	5.6	.64
Ring	1	8	14	5.3	15	5.7	1
Nothing	0	0	11	3.8	11	4.1	.61
Patch	0	0	11	3.8	11	4.1	.6
Emergency contraception	1	4	6	2.2	7	2.7	.48
Copper IUD	1	4	5	1.9	6	2.1	.43
Implant	2	8	3	1.2	5	1.8	.08
LNG IUD	2	8	0	0	2	0.7	.07

IUD, intrauterine device; LNG IUD, levonorgestrel intrauterine device; OCP, oral contraceptive pill.

important to note that systematic reviews have shown a consistent association between socioeconomic disadvantage and higher risk of *C trachomatis* infection.[27] *C trachomatis* studies performed in young adult and adolescents in Chile have not been able to reproduce this association, probably because they have only taken place in private hospitals where NAATs are available and which are not the hospitals used by the socioeconomically disadvantaged. NAATs for *C trachomatis* are not available in public health care institutions, responsible for the care of 77% of the population, because *C trachomatis* is not a notifiable disease in Chile. Therefore, our study shows a *C trachomatis* prevalence that justifies a screening program for high socioeconomic status Chileans younger than 25 years of age.

The occurrence of only 1 case of *N gonorrhoeae* in our study is consistent with results of a previous series of asymptomatic subjects done in private hospitals and also with the low prevalence rate in our country.[7,8] Similar results have been reported in the United States and United Kingdom among high socioeconomic status individuals.[28,29]

The absence of *T vaginalis* in our series was an unexpected result that can most likely be explained by the demographic characteristics of our cohort that comprised young individuals of a higher socioeconomic environment, as opposed to the risk factors described for this infection, especially older age and lower socioeconomic status.

Educational attainment has been widely described as a risk factor for STIs in adolescents.[30–33] Young individuals with higher schooling usually have higher aspirations in their lives, which might affect the perception of potential costs related to risky sexual behaviors. A stronger education might provide young individuals with more tools to prevent STIs.

Although most *C trachomatis* infections are asymptomatic, one of the classic symptoms described in symptomatic women is postcoital bleeding, caused by cervicitis due to these bacteria.[2] However, it is important to note that in sexually active women, intermenstrual bleeding is a frequent reason for consultation and is often attributed generically to changes in the bleeding pattern secondary to contraceptive use. Therefore, it is important for providers to be aware of this symptom and consider the performing of *C trachomatis* screening each time it is present.

The number of sexual partners is a well known predictor not only for *C trachomatis* infections but also for all STIs.[34] We confirmed the importance of this STI predictor among Chilean adolescents and young adults as reported in a previous Chilean study.[10] These findings empower national sexual education programs, whose interventions are aimed at reducing the number of sexual partners to prevent STIs.

We acknowledge the limitations inherent to our report. Because most of the participants belonged to a high socioeconomic status, our results are not generalizable to the entire population younger than 25 years of age in our country. We could not show differences on the basis of the sociodemographic profile. This might be because: (1) the low socioeconomic status sample was smaller, thus less representative of this demographic group; and (2) self-selection bias of a higher risk, high socioeconomic status volunteer participants, recruited through advertising, might yield a sample population worried about having an STI. Misclassification of socioeconomic status might have occurred because status was determined according to income of the area of residence and not according to individual assessment. Finally, it is important to note that educational attainment might be related to age in subjects still in school, who made up 17% of the sample (data not shown).

Understanding the tools provided by education to prevent STIs deserves further investigation. The association of postcoital bleeding with *C trachomatis* infection in women might be very useful for clinicians who deal with this mostly asymptomatic disease. Reducing the number of sexual partners and using condoms on a more regular basis could further protect against this STI. Our results raise the importance of screening the affluent Chilean sexually active population younger than 25 years of age, and extending this research to other socioeconomic groups. Further studies are needed of a more diverse and representative Chilean sample to recommend universal C *trachomatis* screening for Chilean adolescents.

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References

1. Workowski KA, Bolan GA, Centers for Disease Control and Prevention: Sexually transmitted diseases treatment guidelines, 2015 Sexually transmitted diseases treatment guidelines, 2015. MMWR Recomm Rep 2015; 64:1. [erratum in 2015; 64:924].
2. Emans SJ, Laufer MR: Goldstein's Pediatric and Adolescent Gynecology. Philadelphia, Lippincott Williams & Wilkins, 2012
3. Fleming DT, Wasserheit JN: From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sex Transm Infect 1999; 75:3
4. Gottlieb SL, Xu F, Brunham RC: Screening and treating chlamydia trachomatis genital infection to prevent pelvic inflammatory disease: interpretation of findings from randomized controlled trials. Sex Transm Dis 2013; 40:97
5. Martínez MA, Ovalle A, Camponovo R, et al: Chlamydia trachomatis genovars causing urogenital infections in Santiago, Chile. Infect Dis (Lond) 2015; 47:156
6. Silva R, León D, Viscarra T, et al: Frequency of Chlamydia trachomatis infection in a group of women from Region of Araucanía, Chile. [in Spanish]. Rev Chilena Infectol 2013; 30:611.
7. Huneeus A, Pumarino MG, Schilling A, et al: Rates of Chlamydia trachomatis and Neisseria gonorrhoeae in Chilean adolescents. [in Spanish]. Rev Med Chil 2009; 137:1569.
8. Conejero C, Cannoni G, Merino PM, et al: Screening of Neisseria gonorrhoeae and Chlamydia trachomatis using techniques of self collected vaginal sample in young women. [in Spanish]. Rev Chilena Infectol 2013; 30:489.
9. Romero J, Prado V, Gaete V, et al: Chlamydia trachomatis infection in asymptomatic Chilean men and with urethritis. Usefulness of first catch urine samples. [in Spanish]. Rev Med Chil 1997; 125:1165.
10. Zamboni M, Ralph C, García P, et al: The current prevalence of Chlamydia trachomatis infection among teenagers and young asymptomatic Chilean women justifies the periodic surveillance. [in Spanish]. Rev Chilena Infectol 2016; 33:619.
11. Díaz J: Syphilis and gonorrhea surveillance. [in Spanish]. Rev Chilena Infectol 2013; 30:303.
12. Ovalle A, Martínez MA, de la Fuente F, et al: Prevalence of sexually transmitted infections in pregnant women attending a public hospital in Chile. [in Spanish]. Rev Chilena Infectol 2012; 29:517.
13. Muzny CA, Blackburn RJ, Sinsky RJ, et al: Added benefit of nucleic acid amplification testing for the diagnosis of Trichomonas vaginalis among men and women attending a sexually transmitted diseases clinic. Clin Infect Dis 2014; 59:834
14. Hathorn E, Ng A, Page M, et al: A service evaluation of the Gen-Probe APTIMA nucleic acid amplification test for Trichomonas vaginalis: should it change whom we screen for infection? Sex Transm Infect 2015; 91:81
15. Hollman D, Coupey SM, Fox AS, et al: Screening for Trichomonas vaginalis in high-risk adolescent females with a new transcription-mediated nucleic acid amplification test (NAAT): associations with ethnicity, symptoms, and prior and current STIs. J Pediatr Adolesc Gynecol 2010; 23:312
16. Villaseca R, Ovalle A, Amaya F, et al: Vaginal infections in a family health clinic in the metropolitan region, Chile. [in Spanish]. Rev Chilena Infectol 2015; 32:30.
17. Alarcón G, Barraza G, Vera A, et al: Usefulness of conventional polymerase chain reaction for the detection of Mycoplama hominis, Ureaplasma spp and Trichomonas vaginales in female outpatient's genital samples. [in Spanish]. Rev Chilena Infectol 2016; 33:26.
18. Boyadzhyan B, Yashina T, Yatabe JH, et al: Comparison of the APTIMA CT and GC assays with the APTIMA combo 2 assay, the Abbott LCx assay, and direct fluorescent-antibody and culture assays for detection of Chlamydia trachomatis and Neisseria gonorrhoeae. J Clin Microbiol 2004; 42:3089
19. Nye MB, Schwebke JR, Body BA: Comparison of APTIMA Trichomonas vaginalis transcription-mediated amplification to wet mount microscopy, culture, and polymerase chain reaction for diagnosis of trichomoniasis in men and women. Am J Obstet Gynecol 2009; 200:188.e1
20. Falk L, Coble BI, Mjörnberg PA, et al: Sampling for Chlamydia trachomatis infection - a comparison of vaginal, first-catch urine, combined vaginal and first-catch urine and endocervical sampling. Int J STD AIDS 2010; 21:283
21. Schachter J, Chernesky MA, Willis DE, et al: Vaginal swabs are the specimens of choice when screening for Chlamydia trachomatis and Neisseria gonorrhoeae: results from a multicenter evaluation of the APTIMA assays for both infections. Sex Transm Dis 2005; 32:725
22. Tebb KP, Wibbelsman C, Neuhaus JM, et al: Screening for asymptomatic Chlamydia infections among sexually active adolescent girls during pediatric urgent care. Arch Pediatr Adolesc Med 2009; 163:559
23. Encuesta de Caracterización Socioeconómica Nacional 2015: Ministerio de Desarrollo Social. Gobierno de Chile. Available at: http://observatorio.ministeriodesarrollosocial.gob.cl/casen-multidimensional/casen/docs/CASEN_2015_Amplaindo_la_mirada_sobre_la_pobreza_desigualdad.pdf. Accessed September 2, 2017.
24. FDA: US Food and Drug Administration: 510(k) Premarket notification. Available at:. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm?ID=K151565. Accessed September 2, 2017.
25. Somayaji R, Naugler C, Guo M, et al: Examining Chlamydia trachomatis and Neisseria gonorrhoeae rates between 2010 and 2015: a population-based observational study. Int J STD AIDS 2017; 28:822
26. Dielissen PW, Teunissen DA, Lagro-Janssen AL: Chlamydia prevalence in the general population: is there a sex difference? a systematic review. BMC Infect Dis 2013; 13:534
27. Crichton J, Hickman M, Campbell R, et al: Socioeconomic factors and other sources of variation in the prevalence of genital chlamydia infections: a systematic review and meta-analysis. BMC Public Health 2015; 15:729
28. Krieger N, Waterman PD, Chen JT, et al: Monitoring socioeconomic inequalities in sexually transmitted infections, tuberculosis, and violence: geocoding and choice of area-based socioeconomic measures—the public health disparities geocoding project (US). Public Health Rep 2003; 118:240
29. Cook PA, Evans-Jones J, Mallinson H, et al: Comparison of patients diagnosed with gonorrhoea through community screening with those self-presenting to the genitourinary medicine clinic. BMJ Open 2014; 4:e004862
30. Bradley BJ, Greene AC: Do health and education agencies in the United States share responsibility for academic achievement and health? A review of 25 years of evidence about the relationship of adolescents' academic achievement and health behaviors. J Adolesc Health 2013; 52:523
31. Zuilkowski SS, Jukes MC: The impact of education on sexual behavior in sub-Saharan Africa: a review of the evidence. AIDS Care 2012; 24:562
32. Painter JE, Wingood GM, DiClemente RJ, et al: College graduation reduces vulnerability to STIs/HIV among African-American young adult women. Womens Health Issues 2012; 22:e303
33. Annang L, Walsemann KM, Maitra D, et al: Does education matter? Examining racial differences in the association between education and STI diagnosis among black and white young adult females in the U.S. Public Health Rep 2010; 125:110
34. van den Broek IV, Hoebe CJ, van Bergen JE, et al: Evaluation design of a systematic, selective, internet-based, Chlamydia screening implementation in the Netherlands, 2008-2010: implications of first results for the analysis. BMC Infect Dis 2010; 10:89