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Asymptomatic Chlamydia Trachomatis Infection: The Case for Screening Students Attending Higher Education, Targeted by the Lifetime Number of Sexual Partners

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Keywords Chlamydia; Students; Prevalence; Risk factors; Targeted screening; Targeting predictors

Abbreviations CI: Confidence Interval; DNA: Deoxyribonucleic Acid; NAAT: Nucleic Acid Amplification Tests; PR: Prevalence Ratio; POR: Prevalence Odds Ratio; STI: Sexually Transmitted Infection; CTI: Chlamydia Trachomatis Infection; yo: Years Old; AIC: Akaide Information Criterion

Abstract

Background: Higher education students belong to the group of young sexually active persons, which is at high risk for Chlamydia Trachomatis Infection (CTI), a Sexually Transmitted Infection (STI) with worldwide increasing notifications. Recommendations for potential cost-effective screening programs are hindered by the lack of recent student population based data.

Objectives: To assess the current prevalence of CTI among asymptomatic students attending higher education through an opportunistic screening, and to identify factors strongly associated with CTI.

Methods: This cross-sectional study was conducted at a French student health center between October 2015 and March 2016. CTI testing, using nucleic acid amplification tests on first-void urine samples was proposed to all students attending the medical center except for STI-related consultation. Voluntary students were surveyed through an anonymous self-administered questionnaire about their sexual health history, sexual behavior and level of deprivation (EPICES score). Factors associated with CTI were identified using bivariate analysis and multivariate logistic regression.

Results: Among the 400 eligible students who accepted to be screened, 384 had interpretable laboratory results and were included in analysis. Overall prevalence of CTI was 6.3% [95%CI=4.1-9.3] (24 CTI positive students). Lifetime number of sexual partners (>2), and high deprivation score (EPICES ≥ 48.5) were identified as independent significant risk factors to be CTI carrier, with respective adjusted prevalence odds ratio (POR) of 12.9 [95%CI=2.6-234] and 6.8 [95%CI=2.3-18.9]. In this sample, using the lifetime number of sexual partners as a dichotomous screening factor (>2 or not) detected most of CTI cases (96%) and would have avoided 37% of students to be screened.

Conclusions: CTI prevalence is above previously described prevalence's in France, consistent with reports showing a continuous increase in notified CTI. Cost-effective threshold may be reached, thus supporting a screening among asymptomatic students attending higher education in France regardless of gender and year of study. Targeted screening based on one element of the sexual activity pattern ("more than 2 lifetime sexual partners") can identify most of the cases and be even more cost-effective. However, to be a relevant strategy, opportunistic screening must have an extended acceptance rate.

Brief Summary

A study of students attending higher education in France found that prevalence of chlamydial infection is higher than previously described and strong predictors suitable to patient interview were identified.

Background

Chlamydia Trachomatis Infection (CTI) is the most commonly reported bacterial Sexually Transmitted Infections (STI) in Europe [1]. In 2015, 394 163 cases (overall notification rate: 173 per 100 000 persons) were reported in 27 EU/EEA Member States [2]. Incidence is higher among young people between 15 and 24 years old (yo), particularly in countries with implemented CTI screening or testing programs. In France, the number of CTI notifications has increased by 10% between 2013 and 2015 [3]. According to 2015 data, the majority of French patients diagnosed with CTI are women (64%) and the most affected age classes are 15-24 yo among women and 20-29 yo among men. CTIs are often asymptomatic, around 77% of the cases according to a screening study among young adults [4]. However, they can progress and lead to serious and costly sequelae for women, such as tubal factor infertility, chronic pelvic pain, acute and chronic pelvic inflammatory disease, and ectopic pregnancy [5]. As asymptomatic infections are likely to be unrecognized and

untreated, the infection may provide a reservoir for transmission to others: regular partners and/or new partners. French data on CTI prevalence are more limited than its incidence. A first national survey (NatChla) conducted in 2006 estimated a prevalence of 3.2% and 2.5%, respectively, in women and men between 18 and 29 yo [6]. A more recent study revealed a higher prevalence of 7.9% in a specific young population, pregnant women aged < 25 yo [7].

Early screening of patients and their partners, followed by a rapid treatment, is crucial to interrupt STIs transmission such as CTI. Non-invasive Nucleic Acid Amplification Based Tests (NAAT) used on urinary samples are more effective at detecting asymptomatic CTIs than other conventional tests like ELISA tests [8], and make more feasible to screen both men and women. According to a systematic review, the threshold population prevalence of CTI over which screening is cost effective varies from 3.1 to 10.0 % [9]. Moreover, this review showed that screening would be cost saving at prevalence as low as 1.1 % if targeting asymptomatic women under 30 yo and using NAAT. Historically, screening programs have focused on screening women because consequences of CTI are more damaging to women than to men. However, recent population-based surveys have shown similar CTI prevalence's between men and women, which tip the scales in favor of equalizing screening criteria between genders to decrease transmission rates [10].

Higher education students belong to the age group with highest CTI risk. Disparity in STI risk such as CTI can be explained by differences in known behavioral and lifestyle factors such as lifetime number of sexual partners, use of condom, personal and partner's history of STI(s), as well as sociodemographic characteristics [11-13].

Within the same age group (19-22 yo), a study comparing student and non-student young adults found no difference in risky patterns of sexual behavior [14], while another study found that students engaged in more risky patterns (higher proportion of sexual activity and of multiple partners, lower level of condom use) [15]. In 2001, a prevalence study in German asymptomatic students showed that 4.8% of female and 2.2% of male had CTI, a higher prevalence than in Spanish students in parallel to differences in risky patterns [12]. In France, recent prevalence studies in unselected, asymptomatic higher education female and male students are lacking to our knowledge. In 2006, a French epidemiological report (Bulletin Epidémiologique Hebdomadaire) concluded that female students called for preventive medical consultation are low risk population (CTI prevalence ranging between 1 and 3%) [16].

However, as observed in many developed countries, CTI notifications have consistently increased since 2006 in France, with a 4 to 5-fold increase between 2005 and 2015 data [3], that could be the consequence of the progression of the disease and/or progress in medical diagnosis and epidemiological surveillance.

These data support the need to examine the current CTI prevalence among students. Therefore, the purpose of this cross-sectional study was to describe the prevalence of CTI through a widespread opportunistic testing of asymptomatic female and male higher education students, to examine health and lifestyle factors associated with the presence of CTI and that could help in the implementation of a cost effective targeted screening strategy.

Methods

Screened study population

The target population was male and female students attending higher education in France (namely the education level following the completion of secondary education school). The source population was students presenting for medical or prevention consultation at the Service de Santé Universitaire (SSU). This is the only public health service for students at the University Clermont-Auvergne and associates (France) which has a student population of approximately 35 000 students (full and part time). Each year, approximately 9 000 of the 35 000 students who can have access to this health service are effective visitors. Eligible subjects were all male and female student presenting the medical center for medical consultation or prevention visit between October 2015 and February 2016. Exclusion criterions were: STI- related consultation, recent antibiotherapy (during the last 15 days), never having had intercourse, not understanding French language, not being affiliated to the French social security system. The study didn't target any age, any level of education or any nationality. For data collection, participants gave their written informed consent. Procedures were designed to use individual anonymous codes in order to protect students' privacy.

Laboratory procedures

For each included student, a small volume of first-void urine was collected at the SSU without antiseptic periurethral cleaning (sodium hypochlorite solutions may inhibit PCR detection). Samples were held at 4°C until transported (within 24 hours of collection), and sent to a laboratory diagnostic facility (Laboratoire MAYMAT, Clermont-Ferrand, France). Detection of C trachomatis DNA in urine samples was performed using a NAAT based on real-time Polymerase Chain Reaction (PCR) assay (BD Max GC real-time PCR assay run on BD Max system, which provides automated DNA extraction and real-time PCR). Routine procedure was carried out by the laboratory. Results were either positive, negative or uninterpretable.

Questionnaire

All included subjects were asked to fill an anonymous self-administered questionnaire on sexual health and sexual habits around the sample collection moment. The questionnaire collected demographic information (age, sex, year and location of completion of secondary education school), the age of the first sexual intercourse, the lifetime number of sexual partners, the number of sexual partners in the past 12 months, the personal and partner's history of STI(s), the systematic use of condom, the actual use of birth control methods (oral contraception, intrauterine device, condoms, other methods, no contraceptive use), the date of the last gynecologic medical consultation (for women only) and EPICES deprivation score (Evaluation of Precarity and Inequalities in Health Examination Centers), which is a validated scale to assess individual deprivation [17]. EPICES score's scale varies from 0 to 100, from the least to the most deprived situation. The value of 30.17 was previously identified as a threshold to deprivation, but a tighter ranking by quintiles (from the 1st quintile the least deprived to 5th quintile the most deprived) was considered when examining EPICES to CTI. Because of a too small number of students in quintile 1 and quintile 2 for statistical power, these two quintiles were merged.

Data analysis

The main outcome measure was CTI prevalence. The secondary outcome measure was the risk factor(s) for CTI positivity. CTI prevalences were described with their 95% confidence intervals (95%CI) according to the listed covariates for all included students and separately for women and men.

We carried out a two-stage analysis of the potential risk factors. 1) In bivariate analyses, unadjusted prevalence ratios (unadjusted PR) were generated to describe associations between CTI prevalence (dependent variable) and a covariate (independent variable), and compared by Fisher's exact test and Fisher-Freeman- Halton test for contingency tables larger than 2x2. A P value <.05 was considered statistically significant. 2) In multivariate analysis, adjusted prevalence odds-ratio (adjusted POR) were estimated by stepwise logistic regression modelling and testing including variables highlighted in bivariate analyses with P values ≤ 0.20. Predictive variables were selected through backward elimination. Farrar-Glauber test was used to detect collinearity between explanatory variables. In the model, we chose to keep non-collinear variables leading to the lowest Akaide Information Criterion (AIC). Finally, we assessed the sensitivity, the specificity, the positive predictive value and the negative predictive value of explanatory variables selected after logistic regression. The sensitivity, defined as the probability of the risk factor to be present among infected student, represents the proportion of CTI detected by screening using this risk factor. The specificity, defined as the probability of the risk factor to be absent among uninfected students, represents the proportion of uninfected students who would avoid screening if based on that risk factor. The positive predictive value was defined as the probability that subjects with positive risk factor truly have CTI. The negative predictive value was defined as the probability that subjects with negative risk factor truly don't have CTI. CTI laboratory test and questionnaire data were imported, through an EPIDATA 3.1 mask, onto a secure. CSV database protecting the anonymity. Statistical analyses were carried out using R software 3.4.3 through R Studio interface 1.1.383.

Results

Screened population characteristics

Of approximately 3000 students visiting the health service during the 4 months of effective investigation (excluding one month of school vacation/closure of theservice), around 13.3% (N=400) of the eligible ones agreed to participate to the study. 16 NAAT were uninterruptable, and involved students were excluded from the study. Overall, 384 subjects (98 men and 286 women) were included, forming the final sample. Table 1 presents the tested population characteristics with lifestyle and sexual health behaviors. The male:female ratio of the study sample (5:15) was significantly lower than the ratio of the source population (17:23) (chi-square goodness of fit test P <.0001). All higher education age groups were represented: half of the subjects were between 16 to 20 yo included, and the other half over 20 yo (median age: 20.5 yo; range: 16-32 yo). 43% of the tested students had their first intercourse before (strictly) 17 yo (median 17.0 yo). The median number of lifetime sexual partners was 6.8 and the median number of sexual partners in the past 12 months was 2.0. 29% of tested students reported systematic condom use, and 77.6% reported using at least one method of birth control. Most of them (79.4%) did not have a STI history and most of declared previous STIs were fungal infection (N=55) and CTI (N=17). Sexual partners STI history showed a similar distribution. Most of female students (73%) declared a recent (< 1 year) gynecologic medical visit. 26.8% of tested students were deprived (EPICES ≥ 30.17).

CTI prevalence

24 participants had positive first-void urine CTI NAAT. Overall, CTI prevalence was 6.3% (24/384) [95% CI = 4.1-9.3], 6.0% (17/282) [95%CI = 3.7-9.7] in female students and 6.9% (7/102) [95%CI=3.0-14.1] in male students. Age groups prevalence's were all above 3%, ranging between 4.1 and 8.1%. According to the gender, highest rate occurred in 19-20 yo (included) age group for female students and in >23 yo (included) age group for male students.

Factors associated with CTI

Results of bivariate and multivariate analyses (final logistic regression) are shown in Table 2.Unadjusted analyses Table 2 presents assessed candidate risk factors bivariately associated with CTI in either women or men when tested individually; associations are expressed as unadjusted prevalence ratios, 95%CIs and P value. Bivariate analysis showed a significant association between CTI and: a lifetime number of sexual partners > 2 (PR = 11.4 [95%CI = 1.6; 83.4]), a number of sexual partners of the last 12 months ≥ 2 (PR = 4.4 [95%CI = 1.5; 12.7]) and the 5th quintile of EPICES scale (PR = 7.5 [95%CI = 2.6; 22.3]). Gender was not a significant risk factor, consistent with similar found prevalences (Table 1). Other factors not significantly associated with CTI were age groups, first intercourse age, prior STI(s) diagnosis, partner's history of STI(s), birth control, systematic use of condom (and last gynecologic consultation for female students).

Adjusted analyses during the backward stepwise regression procedure, we found that the number of sexual partners of the last 12 months was collinear with the lifetime sexual partner's number. Keeping in the model the lifetime sexual partners number and rejecting the number sexual partners of the last 12 months led to a lowest AIC than the opposite (153.4 vs 154.3). Results from final logistic regression showed that the independent predictors of CTI among students were a lifetime sexual partners number > 2 (POR = 12.9 [95%CI = 2.6; 234]), and a EPICES score in the 5th quintile (POR = 6.8 [95%CI = 2.3; 18.9]).

Detective ability of targeting risk factors the sensibilities, specificities, positive and negative predictive values of selected variables for CTI detection are shown in Table 3. Screening students solely on the basis of whether they had strictly more, or less, than 2 lifetime sexual partners would have required 63.0% of the visiting students to be screened to detect 95.8% of the CTI. Adding in combination (with an "inclusive or operator") the EPICES variable didn't increase the number of detected CTI. If dichotomous EPICES variable (5th quintile or not) was used to decide screening, in combination or not with lifetime partners number (with an "and operator"), this would result in a major fall in the number of students to be screened (around 5 to 8%), but also adversely in detected CTI (approximately 35%).

Table 1 : Prevalence of CTI by selected health and lifestyle variables assessed in the self-administered survey.

	Overall			Women			Men		
	Tested N = 384 N	CTI positive N = 24 N	CTI prevalence 6.3 (4.1-9.3) % (95% CI)	Tested N = 282 N	CTI positive N = 17 N	CTI prevalence 6.0 (3.7-9.7) % (95% CI)	Tested N = 102 N	CTI positive N = 7 N	CTI prevalence 6.9 (3.0-14) % (95% CI)
Age									
16-19 yo	121	5	4.1 (1.5-9.9)	96	4	4.2 (1.3-10.9)	25	1	4 (0.2-22.3)
20-22 yo	177	12	6.8 (3.7-11.8)	130	10	7.7 (4.0-14.1)	47	2	4.3 (0.7-15.7)
≥23 yo	86	7	8.1 (3.6-16.6)	56	3	5.36 (1.4-15.8)	30	4	13.3 (4.4-31.6)
First intercourse age									
<17 yo	157	14	8.9 (5.1-14.8)	119	10	8.4 (4.3-15.3)	38	4	10.5 (3.4-25.7)
≥17 yo	207	10	4.8 (2.5-10.0)	148	7	4.7 (3.5-12.4)	59	3	5.1 (1.3-15.1)
Last 12 months number of sexual partners									
<2	175	4	2.3 (0.7-6.1)	139	4	2.9 (0.93-7.7)	36	0	0 (0-12.0)
≥2	198	20	10.1 (6.4-15.4)	136	13	9.6 (5.4-16.1)	62	7	11.3 (5.0-22.5)
Lifetime number of sexual partners									
1 or 2	120	1	0.8 (0.04-5.2)	92	1	1.1 (0.06-6.8)	28	0	0 (0-15.0)
>2	242	23	9.5 (6.2-14.1)	173	16	9.2 (5.5-14.8)	69	7	10.1 (4.5-20.4)
Prior STI(s) diagnosis									
Yes	73	4	5.5 (1.7-13.8)	67	3	4.5 (1.2-13.4)	6	1	16.7 (0.88-64)
Yes, CTI	17	0	0 (0-23)	13	0	0 (0-28)	4	0	0 (0-60.4)
No	301	20	6.6 (4.2-10.2)	209	14	6.7 (3.9-11.2)	92	6	6.5 (2.7-14.2)
Partner's history of STI(s)									
Yes	35	4	11.4 (3.7-27.7)	22	2	9.1 (1.6-30.6)	13	2	15.4 (2.7-4.6)
No	327	20	6.1 (3.9-9.4)	247	15	6.1 (3.6-10.0)	80	5	6.3 (2.3-14.6)
Birth control									
Yes	298	19	6.4 (4.0-9.9)	235	14	6.0 (3.4-10.0)	63	5	7.9 (3.0-18.3)
No	86	5	5.8 (2.2-13.7)	47	3	6.4 (1.7-18.6)	39	2	5.1 (8.9-18.6)
Systematic use of condom									
Yes	106	5	4.7 (1.7-11.2)	80	4	5.0 (1.6-13.0)	26	1	3.8 (0.2-22)
No	259	19	7.3 (4.6-11.4)	189	13	6.9 (3.9-11.7)	70	6	8.6 (3.5-18.4)
Last gynecologic consultation									
<1 year	153	9	5.9 (2.9-11.2)	153	9	5.9 (2.9-11.2)	n/a	n/a	n/a
≥1 year	57	3	5.3 (1.4-15.5)	57	3	5.3 (1.4-15.5)	n/a	n/a	n/a
EPICES score									
Q1-Q2 (0-16.6)	162	5	3.1 (1.1-7.4)	119	2	1.7 (0.3-6.5)	43	3	7.0 (1.8-20.1)
Q3 (16.6-30.2)	95	8	8.4 (4.0-16.4)	71	6	2.8 (0.4-18.0)	24	2	8.3 (1.5-28.5)
Q4 (30.2-48.5)	64	3	4.7 (1.2-14.0)	49	3	6.1 (1.6-17.9)	15	0	0 (0-25.3)
Q5 (>48.5)	30	7	23.3 (10.6-42.7)	22	5	22.7 (8.7-45.8)	6	2	33.3 (6.0-76)

NOTE. n/a : not applicable.

Table 2 : Unadjusted Prevalence Ratios (PR) and adjusted Prevalence Odds Ratios (POR) for variables associated with CTI.

	Bivariate analysis		Multivariate analysis (reduced model)	
Risk factor	**Unadjusted PR (95% CI)**	**p**	**Adjusted POR (95% CI)**	**p**
Sexe (vs female)				
Male	1.1 (0.3-2.6)	0.81		
Age (versus “16-19 yo”)				
20-22 yo	1.6 (0.6-4.5)	0.45		
≥23 yo	2.0 (0.6-6.0)	0.24		
First intercourse age (versus “<17 yo”)				
≥17 yo	1.9 (0.8-4.0)	0.14		
Partners number last 12 months (versus “<2”)				
≥2	4.4 (1.5-12.7)	0.0024		
Lifetime partners number (vs “1 or 2”)				
>2	11.4 (1.6-83.4)	0.0011	12.9 (2.6–234.0)	0.014
Prior STI diagnosis (vs yes)				
No	1.2 (0.4-3.4)	1		
Partner’s history of STI(s)				
Yes	1.9 (0.7-5.1)	0.27		
Birth control				
Yes	1.1 (0.4-2.9)	1		
Systematic use of condom				
No	1.6 (0.6-4.1)	0.49		
Last gynecologic consultation				
<1 year	1.1 (0.3-3.9)	1		
EPICES score (vs Q1-Q2 (0-16.6))				
Q3 (16.6-30.2)	2.7 (0.9-8.1)	0.077		
Q4 (30.2-48.5)	1.5 (0.4-6.2)	0.069		
Q5 (≥48.5)	7.6 (2.6-22.3)	0.0005	6.8 (2.3-18.9)	0.0003

Table 3 : Reduced model performance using any variable alone or in combination for CTI targeted screening among urinary NAAT positive students.

Variable	Sensitivity (% 95%CI)	Specificity (%95%CI)	Positive predictive value	Negative predictive value	No of students tested	No of infections identified	Proportion screened (%)
0 variables (all students)	n/a	n/a	n/a	n/a	384	24	n/a
Lifetime partners number (>2)	95.80%	35.20%	9.50%	99.20%	242	23	63.00%
EPICES Q5	29.20%	93.00%	23.30%	95.00%	30	7	7.81%
Lifetime partners number (>2) **OR[a] EPICES Q5**	95.80%	36.10%	9.10%	99.20%	253	23	65.90%
Lifetime partners number (>2) **AND EPICES Q5**	29.20%	96.50%	36.80%	95.10%	19	7	4.95%

Note : [a]inclusive OR operator; n/a : not applicable.

Discussion

Prevalence of CTI and justification for screening

Lack of reliable information on CTI prevalence among unselected students makes prevention and treatment strategies difficult. This study of a nationally representative sample of French higher education students shows that CTI is common, affecting 6.3% of supposedly asymptomatic female and male students. Contradictory results have been published on CTI prevalence among students, in relation to the 3% prevalence threshold for cost effective screening. Observed CTI prevalence in this study is higher than the last 2006 French data regarding students showing 1-3% prevalence. Our observed prevalence is consistent to recent studies in other developed countries that carried out opportunistic screening among students, with prevalence from 2.7% to 9.7% [18-25]. Two of the most recent were European, showing a CTI prevalence of 4.9% in Croatia [26] and 4.2% in Norway [27]. Contrary to the Croatian study that tested only first-year university students and showed higher CTI prevalence in female students, no significant CTI prevalence difference between genders was identified in our study. It can be explained by the observation that male students CTI prevalence increased along with their age (more than half of the cases affecting male students ≥ 23 yo), a tendency which was not observed for female students. Therefore, first-year students could have a different prevalence distribution between genders that is not found when testing all-year students. Our results support that CTI screening programs should be initiated among students regardless of gender, and regardless of year of study. The identification of young people with asymptomatic CTI is crucial for decreasing the risk of CTI transmission and acquisition. A first example of a substantial decline in CTI associated with screening has recently been published in US public high schools [28] and must be confirmed in higher education structures.

Risk factors

A second objective of this study was to identify risk factors which can be useful to target screening, and so, to reduce the number of students that should be tested. We identified 2 risk factors that are independently associated with CTI: a lifetime number of sexual partners > 2 and a deprivation score EPICES ≥ 48.5 (5th quintile). Having at least 2 sexual partners in the last 12 months was also associated with CTI but was highly collinear with the lifetime number of sexual partners. It could be explained by the fact that students have a relatively recent sexual life, probably leading to quite similar lifetime and last 12 months numbers of sexual partners. Logistic regression modelling rejected the number sexual partners of the last 12 months, and this is also relevant to practical context. Indeed, patient's calculation of the number of sexual partners may be more subjective and complex (for instance, in terms of dates) for the last 12 months than for the lifetime period, leading to a higher risk of recall bias.

Besides, it may be surprising that known protective factors like systematic use of condom are not associated with CTI risk. However, it can be unraveled by a reporting bias already demonstrated in teens and young adults whose self-reported systematic condom use is discordant with an objective biological measure [29]. Inaccurate report, socially desirable answer or incorrect use is several explanations for the observed discordance.

At the end, we identified a simple criterion (having strictly more than 2 lifetime sexual partners) that may allow detecting 96% of students with CTI and may avoid screening 37% of students in comparison with an untargeted mass screening in our sample. CTI prevalence among this category of students is 9.5%, well beyond the estimated cost-effective threshold for screening. Even if we didn't proceed to multivariate analysis according to gender, lifetime sexual partners number does not appear to be a sex-dependent targeting factor, as it was found in 94% of female students CTI cases and 100% of male students CTI cases. Mass screening for CTI could be prohibitively expensive in routine in terms of human and fiscal resources, supporting a targeted strategy. In this strategy, it may be relevant not to screen students with 0, 1 or 2 lifetime sexual partners. We want to stress that these associated risk factors are not necessarily causative factors, but they are meant to be simple targeting factors for that particular population, easy to get by physicians during preventive or medical visit because suitable to patient interview.

Limitations

Our study has several limitations. A small number of unique individuals were included in this study (N=384) because of a low acceptance rate (13.3%). As CTI cases number is low (N=24), the study sample might have been too small to reach statistical significance for some variables when assessing their association to CTI.

The small sample size hindered also to proceed to a logistic regression modeling according to gender, because of a too small number of events among male students (N=7). However, we described similar prevalence's between genders according to listed covariates except for age-groups. It is therefore unlikely that statistical analysis of risk factors would have led to meaningful different results between genders.

A tendency to overestimate CTI prevalence has been shown when screening individuals seeking medical advice [30], which was in part the case in our sampling (some students visiting the SSU for medical advice whereas some others for a recommended preventive visit). Also, the SSU is recognized as a family planning center, where CTI prevalence is recognized to be higher, around 6-11% in France [16], and where generalized screening was recommended as of 2002 for women < 25 yo. On the other side, the exclusion of students for STI-related consultation (who could be more susceptible to accept a test) could lead to underestimate CTI prevalence. In consequence, though the acceptance rate is low and that requested unselected population could still imply selection bias, it is not sure how it could have biased the results of CTI prevalence.

Another limitation is due to a necessarily restricted choice of questionnaire items. Some characteristics were not asked, such as how recent was the last partner, the existence of a new partner in the last 12 months or if the last sexual partner was casual, factors which have been already associated to CTI in the general population in France [6]. Among young people, these variables may be strongly correlated to the identified predictive risk factors such as the lifetime number of sexual partners. However, we can't know if they would improve the specificity of the predictive model while retaining the same sensibility (thus reducing the number of students to be screening and improving the cost-effectiveness).

Conclusion

In conclusion, found CTI prevalence (6.3%) in unselected students is higher than expected from previous French studies and at a level where screening is expected to be cost effective according to previous evaluations. Opportunistic screening for CTI in student health centers is likely to bring benefits to students, their partners and at the end, to the general population, especially given that students are certainly more captive to be prompted for CTI testing in their dedicated health centers than the general population. Sexual life habits such as having more than 2 lifetime sexual partners and, to a lesser extent, high deprivation situation, can be used as criteria to decrease the number of students who should be tested while detecting most of CTI. Such a targeted screening can avoid a mass screening and decrease both human and fiscal resources. It would be interesting to experiment if implementing such a screening in student health centers would lead to a substantial decline in CTI in this population. However, to be a relevant strategy, such an opportunistic screening must have a better acceptance rate which could be achieved by health communication and education among students.

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