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Systematic review

# A systematic review of the prevalence of selected sexually transmitted infections in young people in Latin America

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**ABSTRACT**

**Objective.** To estimate the burden of *Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (NG), *Treponema pallidum* (TP), and human papillomavirus (HPV) infections among people aged 10 to 25 in Latin America and the Caribbean.

**Methods.** The MEDLINE, EMBASE, and LILACS databases were searched, as well as documents from regional organizations or national health Institutions. Population-based studies that reported prevalence or incidence of CT, NG, TP, and HPV detected through confirmatory tests in adolescents and young people were included. Two reviewers independently selected studies and extracted data. The quality of studies was assessed using the Newcastle–Ottawa Scale. Pooled estimators were calculated in cases where heterogeneity was <70%; when not feasible, prevalence ranges were reported.

**Results.** Out of a total of 3 583 references, 15 prevalence studies complied with the inclusion criteria. Due to substantial heterogeneity (>70%), it was not possible to pool frequency estimators. Among the general population, the prevalence of CT infection ranged between 2.1% and 30.1% (9 studies, 5 670 participants); for NG, prevalence ranged between 0% and 2.9% (8 studies, 5 855 participants); for TP, prevalence varied between 0% and 0.7% (3 studies, 11 208 participants), and for HPV infection, prevalence ranged between 25.1% and 55.6% (8 studies, 3 831 participants).

**Conclusions.** Reliable, population-based data on sexually transmitted infections (STIs) in adolescents and youth in Latin America and the Caribbean are limited. Additional studies are needed to better understand the burden of STIs in this population. However, given the substantial prevalence of STIs detected, countries need public health policies for prevention, early diagnosis, and treatment of STIs in young people.

**Keywords** Adolescent; sexually transmitted diseases; systematic review; prevalence; *Chlamydia trachomatis; Neisseria gonorrhoeae; Treponema pallidum;* papillomavirus infections; Latin America.

Sexually transmitted infections (STIs) are an important global public health problem. According to World Health Organization estimates, more than 1 million STIs are acquired daily worldwide. In 2016, the global estimated burden of STIs included a total of 124 million prevalent cases of *Chlamydia trachomatis* (CT), 30 million cases of *Neisseria gonorrhoeae* (NG), and 19.9 million cases of syphilis (*Treponema pallidum* – TP) (1). In the Region of the Americas, for the year 2012, there were an estimated 18.8 million cases of CT, 1.9 million cases of gonorrhea, and 1 million cases of syphilis (2). STIs are important causes

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of morbidity and mortality due to their contribution to complications such as pelvic inflammatory disease (3), infertility, ectopic pregnancy, miscarriage, and fetal and infant death (4, 5). Studies have demonstrated a strong association between HIV infection and ulcerative and non-ulcerative STIs (6).

While reliable data are limited, indications are that young people carry a substantial proportion of the STI burden. It is estimated that close to half of STIs are acquired by young people aged 10–24 years in the United States of America (7) and that one in four adolescents is infected with *Chlamydia* or human papillomavirus (HPV) (8). Behavioral aspects related to the initiation of sexual activity, the number of sexual partners, sexual relations with casual partners, and inconsistent condom use are among the risk factors of this population, in addition to the use of psychoactive substances (9, 10). In Latin America and the Caribbean (LAC), an estimated 11% of males and females engage in sexual intercourse before the age of 15 (11). Subgroups identified as having a higher frequency of STIs are sex workers, men who have sex with men, persons living with HIV, and people in correctional facilities (12).

There are a limited number of systematic reviews that estimate the burden of STIs globally or in specific regions like sub-Saharan Africa or LAC, and information concerning STIs in adolescents and youth is scarce, both globally and in LAC (1, 2, 13–15). Limited understanding of the burden of STIs in young people, stigma, and the systemic barriers young people face to access quality health services, contribute to an inadequate response for the prevention, early diagnosis, and treatment of STIs in this population group. Information on the incidence and prevalence of STIs among young people is highly relevant to better understand the magnitude of the problem and to guide national policies for prevention and control specifically targeting this age group. Thus, the objective of this systematic review is to estimate the burden of CT, NG, TP, and HPV infections in people aged 10 to 25 years in the LAC region.

## MATERIALS AND METHODS

A systematic literature review was undertaken based on the protocol published in PROSPERO under the code CRD42020155877.

### Eligibility criteria of studies

We searched population-based observational studies or data from mandatory STI reporting systems to measure the incidence or prevalence of one of the following STIs: CT, NG, TP, or HPV. We excluded studies that did not report frequency of CT, NG, TP, and HPV separately for each condition, those that did not report the frequency of the respective STI in populations between 10 and 25 years of age, and studies that did not indicate explicitly the denominator (population at risk) from which the reported relative frequencies of CT, NG, TP, and HPV infection were obtained. Population-based studies were defined as those with a random sampling of clusters (e.g., schools or primary care centers) or participants. The age group criterion was that of a population between 10 and 25 years from LAC countries. The outcome considered for analysis was the incidence or prevalence of CT, NG, syphilis, or HPV, diagnosed by a gold-standard test for each condition. For CT and NG diagnosis, this referred to culture or amplification of nucleic acids; for HPV infection, DNA detection; and for syphilis, both treponemal and nontreponemal tests had to be positive (independently of titer) or positive darkfield for TP.

### Search of studies

A systematic search was conducted in MEDLINE (Ovid), EMBASE (embase.com), and LILACS (iAHx interface – BIREME) using keywords related with "adolescents," "sexually transmitted infections," and "prevalence or incidence." The search strategies were designed by the Cochrane Sexually Transmitted Infections Group (supplementary material available upon request). Complementary searches were done in the following search engines and websites: Joanna Briggs Institute Library, Google, webpages of the ministries of health of the LAC countries, OpenGrey Repository, Pan American Health Organization, World Health Organization, and UNICEF. Duplicate records were removed using EndNote (Clarivate). The last search was undertaken in February 2021.

### Selection of studies and data extraction and management

Eligible studies were selected independently by two researchers based on title and abstract. Subsequently, two researchers independently verified the eligibility criteria and extracted the information in the available full texts. In case of discrepancies, researchers met to resolve disagreements. Information was collected in an Excel spreadsheet designed for the purpose. Information regarding each study was collected: design, setting, population, age group, sampling, type of STI assessed, case definition, laboratory method of detection, confirmation used in the diagnosis of infection, type of frequency estimator used, and frequency estimated by type of infection.

### Risk of bias assessment of the included studies

All studies were assessed independently by two researchers applying the Newcastle–Ottawa Scale adapted for cross-sectional studies (16, 17). This tool evaluates selection bias, performance bias, bias caused by inadequate control of confounding, and selective reporting bias.

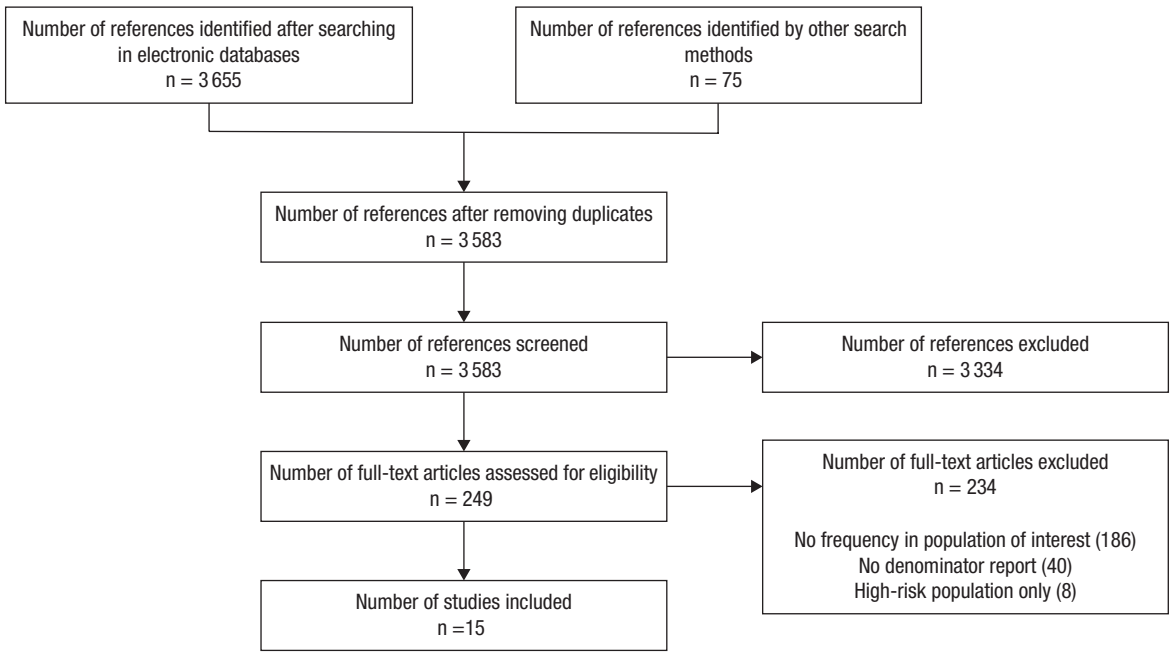
### Measurement of the effect of the interventions and unit of analysis

To establish the frequency estimators, we reported the percentages of prevalence defined by the included studies. The unit of analysis was individuals.

### Data analysis

To determine the possibility of generating pooled frequency estimators, the following steps were undertaken: (a) ascertainment of compliance with criteria for the development of meta-analysis of proportions (18) – three studies per infection were established as the minimum required to consider performing a quantitative analysis; (b) assessment of heterogeneity, undertaken qualitatively by evaluating possible sources of heterogeneity related to the condition and the population (type of infection, type of population, special populations, and

**FIGURE 1. PRISMA flow diagram for selection of studies**




***Source:*** Prepared by the authors.

coinfection with HIV) and epidemiological aspects such as the design and type of estimator reported. The quantitative assessment of heterogeneity was done by estimating the $I^2$ statistic (19), obtained by direct method, and the double arcsine square root transformation was compared to get the best adjustment (20); frequency pooled estimators were calculated by type of STI when the $I^2$ value was lower than 70% through a random-effects model. In cases where this was not possible, prevalence ranges were reported.

## Summary of changes to the protocol (PROSPERO: CRD42020155877)

The age groups were changed from 10–19 and 20–24 to 10–20 and 21–25 according to the findings of the included studies. Studies that were focused on high-risk populations for HIV/STI or based on diverse populations were excluded. Disagreements were resolved during the selection of studies and data extraction not by a third evaluator but by consensus. The unit of analysis included only individuals, as episodic prevalence was not found. Adjustments were made to the risk-of-bias assessment tool based on studies with a descriptive objective (measurement of prevalence). Studies were not excluded due to missing data. Sensitivity analysis was not performed due to the quality of the studies.

# RESULTS

## Search results

In total, 3 655 references were retrieved. After removing the duplicates and confirming compliance with eligibility criteria, 15 studies met the inclusion criteria; all were prevalence studies conducted among the general population (21–34) and one study estimated the prevalence for both the general population and sex workers (35) (Figure 1); no population-based incidence studies were found. Seven studies were conducted in Brazil (22–24, 28, 30–32), two in Colombia (29, 33), and one in each of the following countries: Argentina, Costa Rica, Guatemala, Mexico, and Panama (21, 26, 27, 34, 35). Additionally, one study was conducted in two countries simultaneously: Argentina and Colombia (25).

## Characteristics of the included studies

Regarding gender, 12 studies were reported among women, and three were conducted exclusively in pregnant or postpartum women (24, 30, 32). One study included pregnant and non-pregnant patients; however, because it did not specify whether random sampling was used in pregnant women, only the non-pregnant women group was included in the analysis (25). Three studies reported male and female populations (29, 33, 34). All 15 studies registered approval by an ethics committee. Two studies did not declare the sources of funding (21, 32). Table 1 presents the characteristics of the included studies. Information about detailed search strategies and the list of excluded studies are available from the authors upon request.

## Risk of bias

**Selection bias.** Thirteen studies used a random sampling design (21–23, 25–34), and two applied recruitment strategies that ensured that the entire population of interest was included (24, 35). Eight studies reported sufficient information to justify

**TABLE 1. Characteristics of population and confirmatory studies used in the included studies**

| First author and year, country, and design | Population | STIs included and confirmatory test methods |
|---|---|---|
| Clarke 2012 (21), Costa Rica, Cohort | Random sample of 20% of Guanacaste census. Women of 18 years or older were included. Researchers made a random sample stratified by age to assess *C. trachomatis* prevalence. | • *C. trachomatis*: PCR<br>• HPV: HPV DNA detection |
| de Lima 2014 (22), Brazil, Cross sectional | Sexually active, non-pregnant women aged 15 to 24 years monitored by a domestic family health program in three cities. | • *C. trachomatis* and *N. gonorrhoeae*: PCR (nucleic acid amplification)<br>• *T. pallidum* screening test: VDRL; confirmatory tests: FTA-ABS<br>• HPV: HPV DNA detection |
| Figueiredo 2013 (23), Brazil, Cross sectional | Female adolescents aged 15 to 19 years, who were not pregnant or postpartum, had not used oral or vaginal antimicrobial drugs in the previous 15 days, and had not engaged in sexual intercourse in the previous 48 hours. | • *C. trachomatis* and *N. gonorrhoeae*: PCR<br>• HPV: confirmatory test: PCR |
| Figueiró-Filho 2007 (24), Brazil, Cross sectional | All pregnant women aged 11 to 49 years who received prenatal care triage through serology. | • *T. pallidum* screening test: VDRL; confirmatory test: FTA-ABS Laboratory samples were obtained in filter paper. |
| Franceschi 2007 (25), Colombia–Argentina, Cross sectional | Random sample, age-stratified of sexually active, non-pregnant women aged 15 to 65 years. Their recruitment sources varied between countries and included census, mandatory family planning clinic list, among others. Each city recruited a sample of 100 women in each age group. | • *C. trachomatis* and *N. gonorrhoeae*: nucleic acid amplification |
| Gabster 2016 (34), Panama, Cross sectional | 592 participants, aged 14 to 18 years, enrolled in public high schools in the District of Panama, who agreed to participate. | • *C. trachomatis* and *N. gonorrhoeae*: real-time PCR |
| Hernández-Girón 2005 (26), Mexico, Cross sectional | The study comprised two populations; population 2 (non-pregnant women) was included in the present review, as population 1 (pregnant women) was not randomly selected.<br>A random sample of 1 060 non-pregnant women aged 15 to 85 years who received cervical cancer screening at the Instituto Mexicano del Seguro Social (IMSS) in Cuernavaca, Mexico. | • HPV: HPV DNA detection |
| Matos 2003 (27), Argentina, Cross sectional | Non-pregnant women aged ≥15 years, without previous hysterectomy or conization.<br>The population was recruited from a national census subsample. | • HPV: PCR |
| Miranda 2004 (28), Brazil, Cross sectional | Young women aged 15 to 19 years residing in Vitória, Brazil. | • *C. trachomatis* and *N. gonorrhoeae*: ligase chain reaction |
| Paredes 2015 (29), Colombia, Cross sectional | Sexually active adolescents aged 14 to 19 years enrolled in secondary and high schools located in Sabana Centro province, Colombia. | • *C. trachomatis* and *N. gonorrhoeae*: real-time PCR |
| Pinto 2011 (30), Brazil, Cross sectional | Parturient women attending Brazilian public hospitals.<br>The maternity units were selected through random sample stratified by region. | • *C. trachomatis*: nucleic acid amplification |
| Santos 2016 (31), Brazil, Not specified | A random sample of 515 sexually active women attending public or private cytology and colposcopy services. | • HPV: PCR |
| Silveira 2017 (32), Brazil, Cross sectional | Pregnant women aged 15 to 29 years admitted during labor in all maternity wards in Pelotas, Brazil. The study excluded women who had reported the use of antibiotics in the previous month to the recruitment. | • *C. trachomatis*: PCR |
| Tamayo 2011 (33), Colombia, Cross sectional | Sexually active students inscribed in secondary and high schools (9th and 11th Grade). | • *C. trachomatis*: immunochromatography (rapid test, data not included in the present review)<br>• *N. gonorrhoeae*: Thayer–Martin culture<br>• *T. pallidum* screening test: RPR; confirmatory test: FTA-ABS<br>• HPV: PCR |
| Vallés 2009 (35), Guatemala, Cross sectional | All: Non-pregnant women aged 18 to 49 years without contraindication for pap smear examination.<br>Group 1 – sex worker population: sex workers who had been visited as part of a local program to prevent STIs.<br>Group 2 – general population: women who attended selected health centers regardless of the reason for the visit. | • HPV: PCR |

***Notes:*** DNA, deoxyribonucleic acid; FTA-ABS, fluorescent treponemal antibody absorption test; HPV, human papillomavirus; PCR, polymerase chain reaction; STIs, sexually transmitted infections; RPR, rapid plasma reagin; VDRL, Venereal Disease Research Laboratory.
***Source:*** Prepared by the authors based on published data.

the sample size (22, 24, 29, 30, 32–35). Two studies provided adequate justification for the percentage of non-responders and established comparability of the study population with the non-included population (28, 35).

**Measurement bias.** All included studies reported that confirmatory tests were processed in reference centers, thus all studies were classified as independent measurements of the outcome of interest.

**TABLE 2. Summary of risk of bias assessment (Newcastle–Ottawa Scale adapted for cross-sectional studies)**

| | | Author, year, and country | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Clarke 2012 Costa Rica | de Lima 2014 Brazil | Figueiredo 2013 Brazil | Figueiró-Filho 2007 Brazil | Francheschi 2007 Colombia–Argentina | Gabster 2016 Panama | Hernandez-Girón 2005 Mexico | Matos 2003 Argentina | Miranda 2004 Brazil | Paredes 2015 Colombia | Pinto 2011 Brazil | Santos 2016 Brazil | Silveira 2017 Brazil | Tamayo 2011 Colombia | Vallés 2009 Guatemala |
| Selection | Representativeness of the sample | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| | Sample size | | * | | * | | * | | | | * | * | | * | * | * |
| | Non-responder rate | | | | | | | | | * | | | | | | * |
| Comparability | Comparability between groups | | * | * | | * | | | * | * | * | * | | | * | |
| Outcome measurement | Assessment of the outcome | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| | Statistical test | | * | * | | * | * | | | * | * | * | | * | | * |
| Total score/8 | | 3 | 6 | 5 | 4 | 5 | 5 | 3 | 4 | 6 | 6 | 6 | 3 | 5 | 5 | 6 |

***Note:*** * The study fulfilled the assessed criteria; * * The study measured the outcome through independent blind assessment or by record linkage.
***Source:*** Prepared by the authors based on published data.

**Control of confounding and selective reporting biases.** Eight studies reported having adjusted their infection frequencies for confounding factors (22, 23, 25, 27–30, 33). When evaluating adequate reporting of the estimators, nine studies reported the prevalence and corresponding confidence intervals (22, 23, 25, 28–30, 32, 34, 35) (Table 2).

## Description of the results of the population-based studies: frequency of STIs in the study population

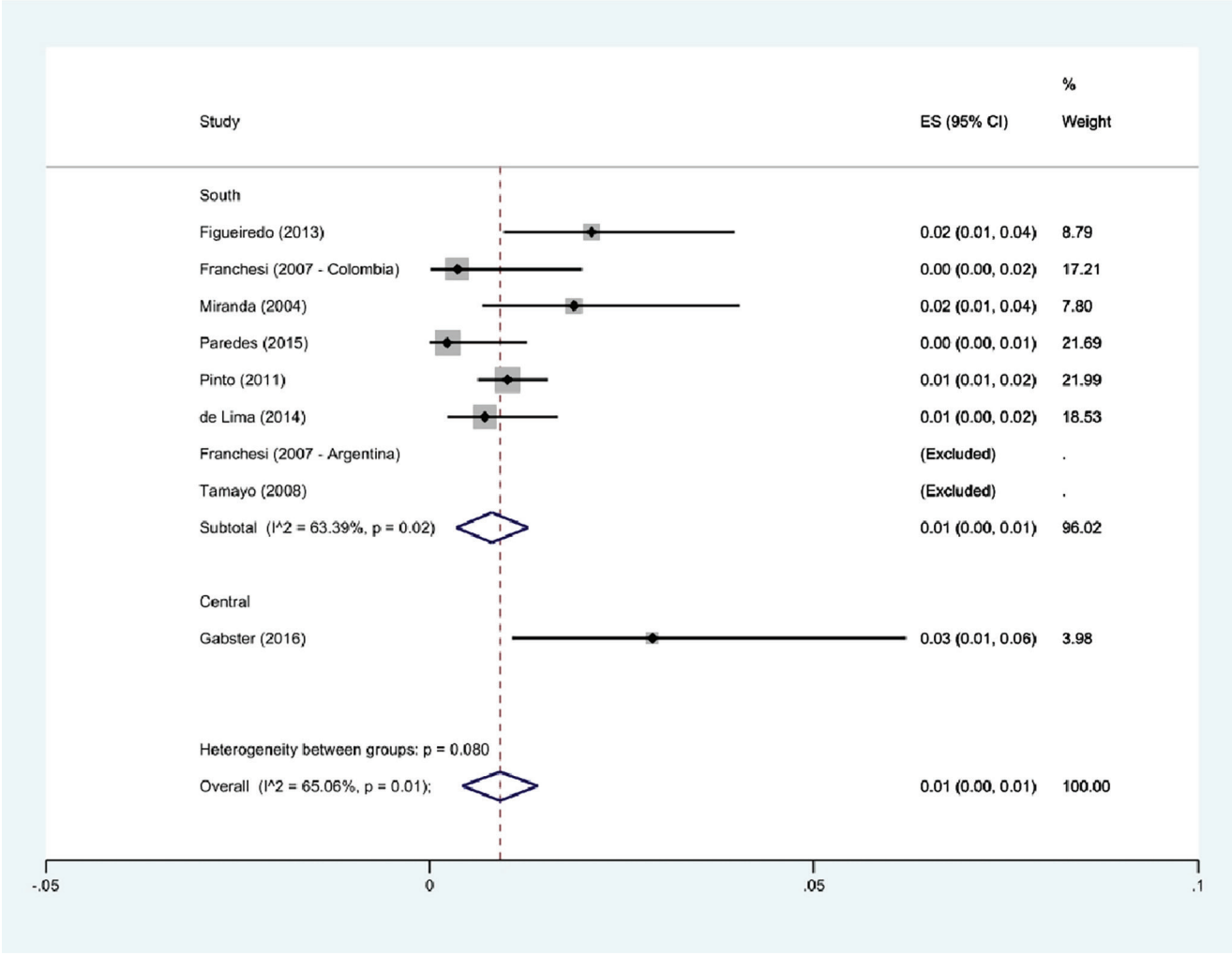
***C. trachomatis.*** Nine studies evaluated CT prevalence. All used polymerase chain reaction (PCR) as the confirmatory diagnostic test. All subgroup analyses showed a significant heterogeneity (range, both sexes, 2.1% to 21.4%; $I^2$ 96.4%) (Table 3). Nine studies evaluated CT prevalence among women (5 004 participants; quality range of the included studies 3/8 to 6/8; $I^2$ 93.4%) (21–23, 25, 28–30, 32, 34). The prevalence range of CT infection among non-pregnant women was between 3.2% and 30.1% (21–23, 25, 28, 29, 34) (7 studies; 2 567 participants; $I^2$ 98.24%) and among pregnant women between 9.8% and 14.2% (2 studies; 2 437 participants) (30, 32). Two studies reported the frequency of CT infection among men under 20 years of age (prevalence range from 1.1% to 6.1%; 666 participants) (29, 34).

By age group, the prevalence range of CT in women <20 years old was from 3.2% to 30.9% (6 studies; 2 281 participants) (23, 28–30, 32, 34) and in women between 20 and 25 years old it ranged from 7.4% to 14.2% (2 studies; 1 551 participants) (30, 32). Table 3 reports the results by age group, sex, and region.

***N. gonorrhoeae.*** Eight studies evaluated the prevalence of NG (22, 23, 25, 28–30, 33, 34), of which six used PCR as the confirmatory test (22, 23, 25, 29, 30, 34), one used ligase chain reaction test, and another used Thayer–Martin culture as confirmatory test (28, 33). We found eight studies reporting the prevalence of NG in women (4 845 participants; quality range of studies 5/8 to 6/8; $I^2$ 65.1%) (22, 23, 25, 28–30, 33, 34), a pooled frequency of 1% (95% CI [0, 1]; $I^2$ 65.1%) (Figure 2), and a prevalence range of 0% to 2.9%. The two studies that evaluated NG prevalence in men under 20 years old reported a 0% prevalence (666 participants) (29, 34) (Figure 3). One study that included pregnant women reported a prevalence of NG of 1% (2 071 participants) (30). The evaluation of prevalence by age group found five studies (1 652 participants) that reported a pooled frequency of NG infection in women under 20 years of 2% (95% CI [0, 3]; $I^2$ 78.6%; range from 0% to 2.9%) (Table 3). The studies did not provide information to be able to establish the prevalence of infection in the population aged 21 to 25 years.

**Syphilis.** The prevalence range of syphilis infection in women was reported in three studies (11 208 participants; quality range was between 4/8 and 6/8; $I^2$ 85.14%) (22, 24, 33), which used the FTA-ABS treponemal test as screening and confirmatory test, one study used VDRL (22), another RPR (33), and another ELISA (24). The prevalence varies between 0% and 0.7% (Figure 3), with the frequency of 0.7% corresponding to the prevalence of infection in pregnant women (24). No information was found on prevalence in men separately. Regarding the distribution of prevalence by age group, the three studies provided information on prevalence of infection in the population aged <20 years, and the range was between 0% and 0.7% (3 studies; 10 858 participants; $I^2$ 85.8%), but only one study reported the frequency of infection in the population 21 to 25 years, which was 0.3% (1 study; 350 participants) (22).

**FIGURE 2. Prevalence meta-analysis of *N. gonorrhoeae* infection among female adolescents by region (frequencies estimated from published data)**




***Note:*** ES, Estimated prevalence; South, South America; Central, Central America.
***Source:*** Prepared by the authors based on published data.

**Human papillomavirus.** Eight studies on HPV infection were identified in women (3 831 subjects; quality range 3/8 to 6/8; $I^2$ 94.6%) (21–23, 26, 27, 31, 33, 35), and all of them used PCR for detection. The prevalence of HPV infection among women ranged between 25.1% and 55.6% (27, 31). Three studies reported infection frequencies in women from the general population between 10 and 20 years (643 women), finding a prevalence between 27.9% and 42.9% (33, 35). One study reported an infection prevalence of 35.6% among women in the general population aged 21–25 (35); four studies did not provide information that allowed including data in subgroups by age (21, 26, 27, 31).

## DISCUSSION

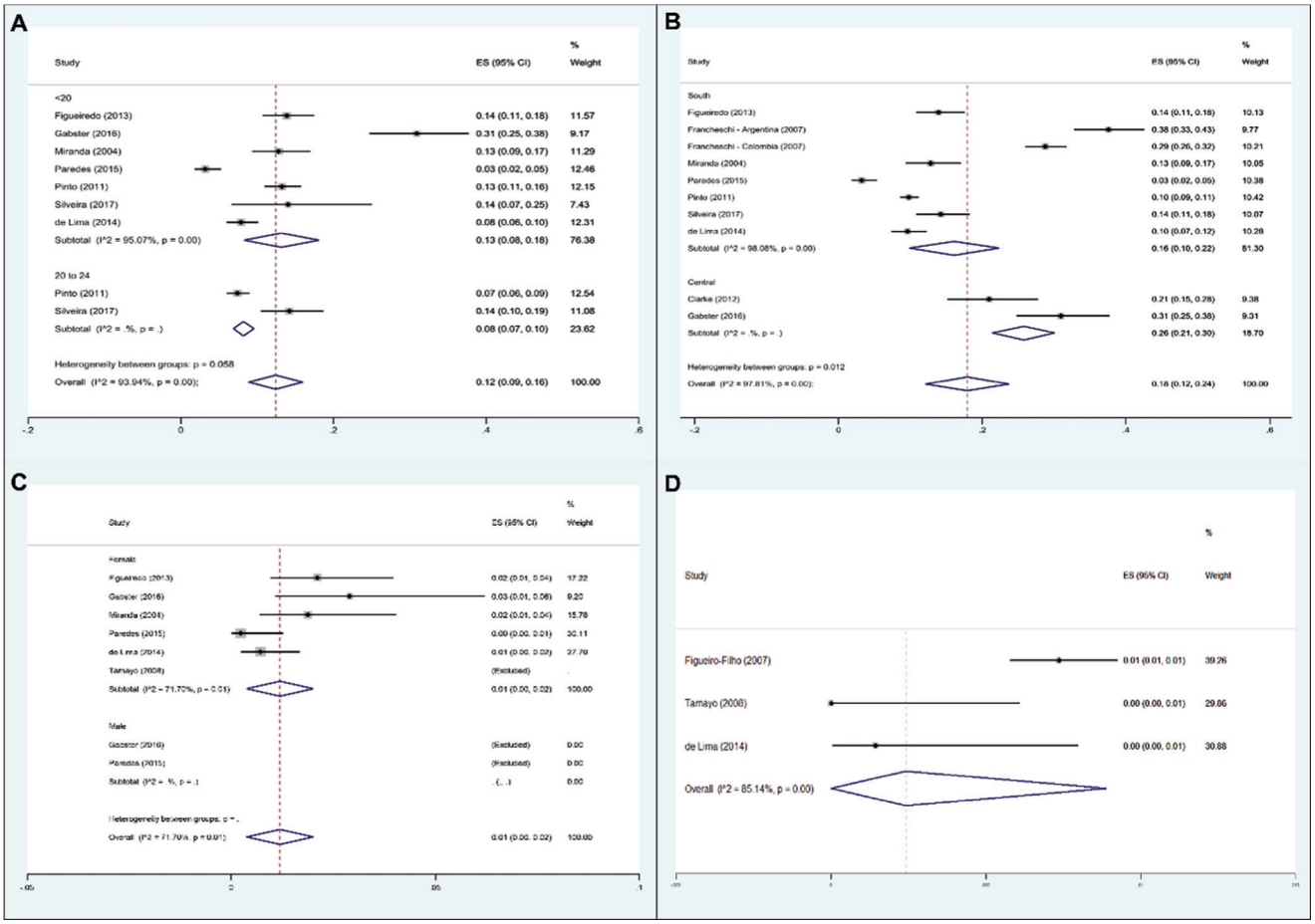
### Summary of findings

A total of 15 eligible population-based studies published as of February 2021 in Spanish, Portuguese, and English that reported prevalence of CT, NG, TP, or HPV infections in populations aged 10 to 25 years in LAC were identified. We found substantial heterogeneity between results, which did not allow us to pool the prevalence estimators by sex, age group, or country. In adolescent and young women, CT infection ranged from 2.1% to 30.1%, NG varied from 0% to 2.9%, syphilis from 0% to 0.7%, and HPV from 25.1% to 55.6%.

### Completeness and applicability

The study searches included the main databases of medical literature in LAC, with emphasis on the Latin American and Caribbean Health Sciences Literature (LILACS) electronic library, as well as reports from the epidemiological surveillance of communicable infections units of the ministries of health of the countries of the region. Consequently, it is unlikely that we have missed population-based studies that include the target population of this systematic review. Regarding applicability, the samples were obtained from population-based random

**FIGURE 3. Heterogeneity assessment of prevalence by age, sex, and region for selected STIs (frequencies estimated with published data)**




***Notes:*** ES, Estimated prevalence.
**A.** Heterogeneity analysis for *C. trachomatis* infection among female adolescents by age (<20, 20–24 years).
**B.** Heterogeneity analysis for *C. trachomatis* infection among female adolescents by region (Central America, South America).
**C.** Heterogeneity analysis for *N. gonorrhoeae* infection among adolescents by sex.
**D.** Heterogeneity analysis for *T. pallidum* infection.
***Source:*** Prepared by the authors based on published data.

**TABLE 3. Summary of findings, STI prevalence by type of infection, age group, sex, and region**

| | Subgroup | *C. trachomatis* | *N. gonorrhoeae* | *T. pallidum* | Human papillomavirus |
|---|---|---|---|---|---|
| Age group | <20 years-old | 3.2% to 30.9%[a] ($I^2$ 95.07%) | Pooled 2% (95% CI [0, 3]; $I^2$ 78.6%)[a] Range: 0% to 2.9%[a] | 0% to 0.7%[a] ($I^2$ 85.14%)[b] | 27.9% to 42.9%[a] |
| | 21–25 years old | 7.4% to 14.2%[a] ($I^2$ n/a)[b] | -- | 0.3%[a,d] | 35.6%[a,d] |
| Sex | Female | 3.2% to 30.9% ($I^2$ 93.4%) | Pooled: 1% (95% CI [0, 1]; $I^2$ 65.1%) Range: 0% to 2.9% | 0.2% to 0.7% | 25.2% to 55.6% |
| | Male | 1.1% to 6.1%[c] ($I^2$ n/a)[b] | 0%[c] | -- | -- |
| Region | Central America | 21.0% to 30.1%[a] ($I^2$ n/a)[b] | 1.8%[d] | -- | 37.6% to 55.6% |
| | South America | 3.2% to 14.2% ($I^2$ 90.45%)[b] | 0% to 2.1% | 0% to 0.7% ($I^2$ 85.14%)[b] | 25.1% to 47.1% |
| Other features | Pregnant women | 9.8% to 14.2% | 1%[d] | 0.7%[d] | -- |
| | Non-pregnant women | 3.2% to 30.1% | -- | -- | -- |

***Notes:*** [a] Only females included; [b] Heterogeneity not applicable (fewer than 3 studies); [c] Only males under 20 years were included; [d] Single study.
***Source:*** Prepared by the authors based on published data.

sampling; however, data could be inferred more to the young people aged 15–24 (considering the scarcity of specific information for adolescent people aged from 10 to 15).

## Risk of bias of this systematic review

We followed the criteria for selection of studies according to the protocol; those were clear and non-ambiguous. Additionally, risk of bias in selection is considered low because searches were conducted in the main databases in Spanish, Portuguese, and English, the most frequently spoken languages in LAC. Regarding study appraisal, we used the Newcastle–Ottawa Scale modified for prevalence studies. We were not able to report data on STI incidence in young people because there were no studies that complied with the selection criteria.

## Comparison with similar studies

Regarding the prevalence of CT, our results are similar to the CT prevalence of 11.3% (95% CI [7.3, 17.1]) among pregnant women of all ages reported by Davey and that reported by Korenromp, 9.5% (95% CI [4.4, 15.4]), by means of modeling (Spectrum STI), which was also carried out on the general population (15, 36). Results reported by Redmond et al. in Spain ranged from 0.2% to 8%, the lowest in sexually experienced persons aged 15 to 44 years, followed by 21 to 23 years old in Denmark and 18 to 25 years old in the United Kingdom (37). On the other hand, Lewis et al. reported a prevalence of 5.02% (95% CI [3.14, 6.91]) in women under age 25 using primary care services and a prevalence of 3.93% (95% CI [2.71, 5.13]) in men under age 30 in Australia (38). The same author reported a prevalence of 3.4% (95% CI [1.80, 5.90]) for pregnant women under 25 years of age, which is slightly below our results (38).

As for NG, our results are similar to those reported by Hengel et al. in a systematic review that evaluated the scope of screening programs for CT and NG in young population (15–29 years old) (39). This review reported a prevalence range between 0% and 1.2% – figures similar to ours. Moreover, Davey et al. reported a prevalence among pregnant women of 1.2% (95% CI [0.1, 2.1]) (36). These results are lower than those published by Chico et al. in pregnant women from sub-Saharan Africa, where they found a cluster prevalence of 3.7% (95% CI [2.8, 4.6]) (40); however, they did not describe the age range of the participating women or the diagnostic methods used.

Concerning syphilis, our results are similar to those reported by Korenromp et al., who reported a global prevalence of syphilis with an interquartile range of 0.16% to 1.62% (41). The epidemiological bulletin of Chile reported a "rate" of 21 per 100 000 in the 15–19 age group and a rate of 55 per 100 000 in the 20–25 age group (42); these are reported cases, but it is unknown whether they are new cases or new and old cases (latent syphilis). In Costa Rica, the 2015 epidemiological bulletin reported a rate of 2.7 per 100 000 live births in the 10–14 age group, 31.6 per 100 000 live births in the 15–19 age group, and 74.6 per 100 000 live births in the 20–25 age group, which are cases reported by year (43). These data do not indicate whether they are new or old, and are data found in this study. Additionally, most epidemiological bulletins focus on the prevalence of gestational syphilis and do not differentiate by age group.

Finally, with respect to HPV prevalence, our data are similar to those reported by Brunni et al. for LAC, which are between 15% and 35% in a systematic review on HPV infection in women (44). However, this study does not provide data by age group. In Mexico, Smith et al. reported a prevalence of 14% in men under 24 years of age, but most studies are conducted on special populations (45).

## Quality of evidence

We consider that the body of evidence included in this review is qualified as low due to limitations from the moderate risk of bias and substantial heterogeneity in the informed prevalence. Based on this appraisal, new studies should be undertaken to confirm these results.

## Limitations and strengths of the review

The strength of this review is the selection of studies that guaranteed an adequate representation of the population of interest and the use of gold-standard diagnostic tests to confirm cases, in addition to the use of a scale to assess the methodological quality of the studies. The main limitation was a high heterogeneity in the results of the studies, which limited the generation of pooled estimators. Also, due to the absence of frequencies in at least 10 studies, it was not possible to perform an objective analysis of publication bias through funnel plots.

## Conclusion

Reliable, population-based data on STIs in adolescents and youth in LAC are limited. Additional studies are needed to better understand the burden of STIs in this age group, especially in males and females from 10 to 14 years of age. However, given the substantial prevalence of STIs found in this review, countries need to formulate and implement national public health policies for prevention, early diagnosis, and treatment of young people, considering the early sexual initiation of adolescents in this setting.

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## Revisión sistemática de la prevalencia de determinadas infecciones de transmisión sexual en la población joven en América Latina

**RESUMEN**

**Objetivo.** Calcular la carga de infecciones por *Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (NG), *Treponema pallidum* (PT) y el virus del papiloma humano (VPH) en personas de edades comprendidas entre los 10 y los 25 años en América Latina y el Caribe.

**Métodos.** Se realizaron búsquedas en las bases de datos MEDLINE, EMBASE y LILACS, así como en documentos de organizaciones regionales o instituciones nacionales de salud. Se incluyeron estudios poblacionales que notificaron la prevalencia o la incidencia de CT, NG, TP y VPH, detectados mediante pruebas confirmatorias en adolescentes y jóvenes. Dos revisores seleccionaron de forma independiente los estudios y extrajeron los datos. La calidad de los estudios se evaluó mediante la escala de Newcastle-Ottawa. Se hicieron estimaciones combinadas en los casos en que la heterogeneidad era <70 %; cuando no era posible, se presentaron los rangos de prevalencia.

**Resultados.** De un total de 3 583 referencias, 15 estudios de prevalencia cumplieron los criterios de inclusión. Debido a una significativa heterogeneidad (>70%), no fue posible agrupar las estimaciones de frecuencia. En la población general, la prevalencia de infección por CT fluctuó entre 2,1 % y 30,1 % (9 estudios y 5 670 participantes); en el caso de NG, la prevalencia fluctuó entre 0 % y 2,9 % (8 estudios y 5 855 participantes); en el caso de PT, la prevalencia varió entre 0 % y 0,7 % (3 estudios y 11 208 participantes) y en el caso de infección por VPH, la prevalencia fluctuó entre 25,1 % y 55,6 % (8 estudios y 3 831 participantes).

**Conclusiones.** Los datos poblacionales fiables sobre las infecciones de transmisión sexual (ITS) en adolescentes y jóvenes en América Latina y el Caribe son limitados. Es necesario hacer estudios adicionales para comprender mejor la carga de las ITS en este grupo poblacional. Sin embargo, dada la significativa prevalencia de ITS detectada, los países requieren políticas de salud pública para la prevención, el diagnóstico temprano y el tratamiento de las ITS en la población joven.

**Palabras clave** Adolescente; enfermedades de transmisión sexual; revisión sistemática; prevalencia; *Chlamydia trachomatis; Neisseria gonorrhoeae; Treponema pallidum;* infecciones por papillomavirus; América Latina.

# Revisão sistemática da prevalência de determinadas infecções sexualmente transmissíveis em jovens na América Latina

**RESUMO**

**Objetivo.** Estimar a carga de infecção por *Chlamydia trachomatis* (CT), *Neisseria gonorrhoeae* (NG), *Treponema pallidum* (TP) e papilomavírus humano (HPV) na população entre 10 e 25 anos de idade na América Latina e no Caribe.

**Métodos.** Foi realizada uma pesquisa nas bases de dados MEDLINE, EMBASE e LILACS, assim como da documentação de entidades regionais ou nacionais que atuam na área da saúde. Foram incluídos na revisão estudos populacionais que registraram a incidência ou a prevalência de infecção por CT, NG, TP e HPV, verificada por meio de exames confirmatórios realizados em adolescentes e jovens. Dois revisores trabalharam de modo independente na seleção dos estudos e extração dos dados. A qualidade dos estudos foi avaliada utilizando a Escala de Newcastle-Ottawa. Foi feito o cálculo dos estimadores combinados quando a heterogeneidade era <70% e apresentada a variação da prevalência nos outros casos quando essa estimativa não foi possível.

**Resultados.** Das 3 583 referências levantadas, 15 eram estudos de prevalência que satisfizeram os critérios de inclusão. Devido à heterogeneidade considerável entre os estudos (>70%), não foi possível combinar os estimadores de frequência. Na população geral, a prevalência de infecção por CT variou entre 2,1% e 30,1% (9 estudos, 5 670 participantes); a de NG, entre 0 e 2,9% (8 estudos, 5 855 participantes); a de TP, entre 0 e 0,7% (3 estudos, 11 208 participantes); e a de infecção por HPV, entre 25,1% e 55,6% (8 estudos, 3 831 participantes).

**Conclusões.** Faltam dados populacionais confiáveis relativos a infecções sexualmente transmissíveis (ISTs) em adolescentes e jovens na América Latina e no Caribe. Outros estudos devem ser realizados para um entendimento melhor da carga dessas infecções na população. Diante da elevada prevalência verificada, os países precisam dispor de políticas de saúde pública para prevenção, diagnóstico precoce e tratamento de ISTs na população jovem.'

**Palavras-chave** Adolescente; doenças sexualmente transmissíveis; revisão sistemática; prevalência; *Chlamydia trachomatis; Neisseria gonorrhoeae; Treponema pallidum;* infecções por papillomavirus; América Latina.