



# **Prevalence of Sexually Transmitted *Chlamydia trachomatis* and *Neisseria gonorrhoeae* Infections in an Asymptomatic Population in Dakar, Senegal**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors BN and AS conducted the research and prepared the manuscript. Authors Abdou Diop, TAD, CM and PD participated in the collection of samples. Authors Assane Dieng and AS revised and reviewed the study and approved the research. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Introduction:** Sexually transmitted infections (STIs) represent a major public health problem. *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections are often asymptomatic, thus leading to a high risk of transmission in subjects with risky behaviors. The objective of this study was to determine the prevalence of these 2 pathogens in an asymptomatic population.

**Methodology:** A retrospective, cross-sectional, descriptive study was conducted in the medical biology laboratory of the Pasteur Institute of Dakar over a period of 23 months in asymptomatic patients who were seen as part of a travel check-up. A first-draft urine sample was collected and tested for *C. trachomatis* and *N. gonorrhoeae* by molecular biology techniques. Data entry and statistical analysis were performed by Excel 2010 and SPSS 2.0 respectively.

**Results:** A total of 5012 patients were included and the overall prevalence of STIs related to these 2 pathogens was 3.8% (194/5012).

The prevalences of *C. trachomatis* and *N. gonorrhoeae* were 2.7% (137/5012) and 1.0% (55/5012), respectively. The age group most affected was [20-29 years] with 58.4% (80/137; p=0.0001) for *C.*

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*trachomatis* and 45.5% (25/55;  $p=0.471$ ) for *N. gonorrhoeae*. Co-infection with these two germs was observed in 0.3% (18;  $p=0.001$ ) of patients.

**Conclusion:** STIs with *C. trachomatis* and/or *N. gonorrhoeae* can be asymptomatic and continue the chain of transmission. Thus, for a better prevention of STIs due to these pathogens, it is important to screen, educate and sensitize the populations considered at risk.

**Keywords:** Asymptomatic carriage; *C. trachomatis*; *N. gonorrhoeae*; PCR.

## 1. INTRODUCTION

Sexually transmitted infections (STIs) of bacterial origin are mainly caused by *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) [1].

These pathologies represent a major cause of infertility, long-term disability with serious medical and psychological consequences for millions of individuals [2,3].

Indeed, WHO reports that every year 357 million people worldwide, or more than one million per day, contract an STI (chlamydia, gonorrhoea, syphilis, trichomoniasis), 40% of which are in Africa [4].

The global burden of disease and mortality associated with these pathogens jeopardizes the quality of life of populations, their sexual and reproductive health, and the health of newborns and children [5,6].

Asymptomatic carriage of germs responsible for STIs such as *Treponema pallidum*, *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, *Trichomonas vaginalis* contributes to their dissemination and to the occurrence of late and irreversible complications such as tubal infertility, salpingitis, pelvic inflammatory disease or the occurrence of ectopic pregnancy [7].

At the same time, the transmission of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections is closely linked to that of HIV and viral hepatitis B [8,9]. The stakes are therefore higher in view of the heavy burden that HIV and viral hepatitis represent for health systems worldwide.

Thus, recommendations for screening of these pathogens in asymptomatic subjects have been issued in several countries [10].

In Senegal, data on these STIs are very limited and there is no strategy for screening and prevention of these pathogens.

It is in this context that we conducted this study to determine the prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* in an asymptomatic population.

## 2. METHODOLOGY

We conducted a retrospective descriptive cross-sectional study at the Medical Biology Laboratory (LBM) of the Pasteur Institute of Dakar covering data from a 23-month period between January 2017 and November 2018.

The study population consisted of subjects who came to the laboratory for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* testing as part of a travel visa application and who had no symptoms.

A first-draft urine sample was taken for each patient included in the study. The samples were stored at  $-20^{\circ}\text{C}$ .

Bacterial DNA was extracted from the urine with the Real Line *Chlamydia trachomatis* /*Neisseria gonorrhoeae* Kit (Str-format) using the Amplix 12 automated nucleic acid extractor according to the supplier's recommendations. A volume of 20  $\mu\text{L}$  of internal control was added to the volume of 200  $\mu\text{L}$  of the mixture (urine buffer-pellet) and the whole was submitted to the automated extraction protocol.

Detection by amplification of bacterial DNA was performed using the Exicycler 96 Real-Time Quantitative Thermal Bloc universal molecular diagnostic system.

A volume of 10  $\mu\text{L}$  of DNA extract was added to 50  $\mu\text{L}$  of master mix.

The thermal cycler was programmed using a five-step protocol:

- 2 minutes incubation at  $37^{\circ}\text{C}$  for Uracile-DNA glycosylase (UAG) activation,
- 10 minutes at  $95^{\circ}\text{C}$  for polymerase activation and for 45 cycles.

- 5 Seconds at 95°C for the separation of the two DNA strands
- 40 seconds at 60°C for primer hybridization
- 20 seconds at 72°C for DNA strand elongation.

Data (age, sex, PCR results) were entered into Excel 2010 and analyzed by SPSS 20.0. The Chi-2 test was used to analyze the contingency tables with a statistically significant difference retained if  $p < 0.05$ .

### 3. RESULTS

A total of 5012 subjects were included; women represented 52.3% or a sex ratio of 1.1. The median age of the patients was 29 years.

The age group [20-29 years] was the most representative (35.9%) followed by [30-39 years] and [10-19 years] with 23.3% and 13.6% respectively.

The overall prevalence of *C. trachomatis* and *N. gonorrhoeae* infections was 3.8% (n=192 cases).

*C. trachomatis* was detected in 2.7% of the population (n=137) and the age groups [20-29 years], [30-39 years] and [10-19 years] were the most affected with respectively 4.4% (80/1802), 2.7% (32/1170) and 1.6% (11/683) (Table 1).

A significant difference was noted between *C. trachomatis* infection and age group ( $p=0.0001$ ).

*C. trachomatis* was found in 3.5% (85/2391) of men and 2.0% (52/2621) of women with a statistically significant difference ( $p=0.001$ ).

*N. gonorrhoeae* was found in 1.1% of patients (n=55). The age group [20-29 years] was the most affected followed by the age group [30-39 years] with respectively 1.4% (26/1801), 1.1% (14/1170) with no significant difference between age and presence of *N. gonorrhoeae* ( $p=0.471$ ).

The presence of *N. gonorrhoeae* was 1.2% (29/2391) in men and 1.1% (26/2621) in women.

*C. trachomatis* / *N. gonorrhoeae* co-infection was found in 0.3% (18/5012) of patients with a significant difference ( $p=0.0001$ ) (Table 2). The majority of patients with co-infection (61.1%; 11/18) were in the age group [20-29 years].

### 4. DISCUSSION

This study was conducted on an asymptomatic population in order to test for *C. trachomatis* and

*N. gonorrhoeae* in the urine of the first jet by molecular biology technique (RT PCR) in the context of a travel assessment.

Other similar studies have used this same sample to investigate *C. trachomatis* and *N. gonorrhoeae* infections, particularly in Nigeria among men who have sex with men (MSM) and transgender people [11].

Indeed, urine from the first jet offers the advantage of a good sensitivity for the molecular diagnosis of these two pathogens and constitutes an alternative in the absence of discharge and especially in children. Urine is preferable to traumatic urethral sampling in men. However, in women, vaginal swabbing is more sensitive than first pass urine for the diagnosis of chlamydia [12].

We performed a real-time duplex PCR for *C. trachomatis* (intracellular germ not cultivable on conventional culture media) and *N. gonorrhoeae* (fragile germ cultivable on selective media containing Vancomycin, Colistin and Nystatin). This same technique was used in the 2007 multicenter study by Silvia and colleagues in women from 4 continents [13].

In fact, the nucleic acid amplification technique (NAAT), in this case PCR, represents the reference test for the diagnosis of STIs such as chlamydia and gonorrhoea, both in symptomatic and asymptomatic forms [14].

In France, the French National Authority for Health (HAS) recommends diagnosis by molecular biology on self-sampling, urine of the first jet in men and self-sampling of the vagina in women [15].

In most high-income countries, NAATs are the standard of diagnostic care for NG and CT due to their wide availability and high sensitivity and specificity [14,16]. However, many other countries do not have tests available or rely on tests with lower sensitivities and specificities.

Cultures for NG and CT have estimated sensitivities of 41% and 21%, respectively, and depend on the level of laboratory infrastructure [16,17].

The main limitation of PCR is the fact that there is no possibility to perform the antibiogram of *N. gonorrhoeae* from the molecular technique.

Thus, with the emergence of antibiotic resistance, it would be interesting to associate the culture of

this bacterium in patients whose molecular biology result is positive for *N. gonorrhoeae* in order to carry out an antibiogram to best guide management.

The overall prevalence of *C. trachomatis* and *N. gonorrhoeae* STIs in the asymptomatic population was 3.8%.

In a study published in 2018 involving women in sub-Saharan Africa, a prevalence of 6.1% was observed [18].

In 2012, a global estimate of STI incidence showed a higher frequency in South America and Asia [19].

Thus, there are variations in the prevalence of STIs depending on the type of population studied and the geographical area [20].

In fact, risk-taking during sexual relations, which is very frequent during travel, non-optimal condom use and lack of knowledge of the modes of transmission of STIs are important factors contributing to the maintenance of the epidemiological chain [21].

Among the causes of STIs, *C. trachomatis* was the most frequent with a prevalence of 2.7% and predominantly male with 3.5% (85/2391).

This predominance of *C. trachomatis* has been previously observed in sub-Saharan Africa and generally in the world [18,20].

In Nigeria, high prevalences of 17.0% and 18.3% were reported in Abuja and Lagos, respectively, between 2013 and 2016 in MSM and transgender populations [22].

Globally, a meta-analysis reports a prevalence among subjects between 15-49 years of age of 4.2% in women and 2.7% in men with regional variations of 1.8-7.6% in women and 1.3-5.2% in men, respectively [23].

Men were more affected. This result is contradictory to those observed in the world where women are generally the most affected by these STIs because of their greater sensitivity to infection due to their genital tract [24].

This contradiction observed could be explained by the low diagnostic sensitivity of urine of the first jet in women where vaginal swabbing constitutes the best sample [20].

Concerning the age groups most affected by STIs, those of [20-29 years] and [30-39 years] were the most representative. Indeed, these age groups constitute a sexually active fringe with a high risk of contracting an STI.

A similar result was reported in France by the NatChla survey with a higher frequency of STIs in the sexually active population aged 18-29 years [25].

Thus, sexually active age groups constitute an important risk factor for the occurrence of *C. trachomatis* infection and a statistically significant difference was found in our study.

For *N. gonorrhoeae*, the prevalence in our study was low (1.0%) with a slight male predominance and a higher age range [20-29 years].

Similar results have been observed in countries with a high socioeconomic level, notably the United States and the United Kingdom [26].

However, contradictory results with high prevalences have been observed in Nigeria and Ethiopia in populations at risk [11].

*N. gonorrhoeae* infection was not very common in women (1.0%). Conflicting results were observed in Sub Saharan Africa in 2018 with a higher prevalence (2.2%) [18].

This low prevalence in women could be explained by the type of sample taken (1st stream urine sample) which is less sensitive in the diagnosis of STIs in women [20].

A *C. trachomatis/N. gonorrhoeae* co-infection was observed in 0.3% of cases (18/5012) with a statistically significant difference, the majority of which were in the age group [20-29 years].

A multivariate analysis conducted in Nigeria in 2016, had shown that the increased risk of *C.trachomatis / N.gonorrhoeae* co-infection was associated with younger age, multiple partners and homosexuality [11].

Thus, it is important to look for co-infection of these two bacterial pathogens in case one of the germs is found in a patient. And in the context of STI control, it is recommended that the diagnosis be extended to include screening for HIV, syphilis and other STIs in any person with a documented *C. trachomatis* and/or *N. gonorrhoeae* infection [27].

**Table 1. Sociodemographic characteristics of the patients (n=5012)**

Socio demographics characteristics	<i>C. trachomatis</i>			<i>N. gonorrhoeae</i>		
	Absolute value (N=5012)	Percentage (%)	p-value	Absolute value (N=5012)	Percentage (%)	p-value
<b>Age groups (years)</b>	0-9	1/75	(1.3)	0/75	(0)	p=0,471
	10-19	11/683	(1.6)	6/683	(0.9)	
	20-29	80/1802	(4.4)	26/1802	(1.4)	
	30-39	32/1170	(2.7)	14/1170	(1.2)	
	40-49	7/404	(1.7)	4/404	(1.0)	
	50-59	4/331	(1.2)	4/331	(1.2)	
	60-69	2/359	(0.5)	1/359	(0.3)	
	70-79	0/170	(0)	0/170	(0)	
80-89	0/19	(0)	0/19	(0)		
<b>Gender</b>	Male	85/2391	(3.5)	29/2391	(1.2)	p=0,453
	Female	52/2621	(2.0)	26/2621	(1.0)	

**Table 2. *C. trachomatis* / *N. gonorrhoeae* co-infection**

Germs	NG Negative (N, %)	NG Positive (N, %)	Total (N, %)	p-value
CT Negative (N, %)	4838 (96,6)	37 (0,7)	4875 (97,3)	0,0001
CT Positive (N, %)	119 (2,4)	18 (0,3)	137 (2,7)	
<b>Total</b>	<b>4957 (99,0)</b>	<b>55 (1,0)</b>	<b>5012 (100)</b>	

## 5. CONCLUSION

The prevalence of *C. trachomatis* and/or *N. gonorrhoeae* STIs was relatively high in this asymptomatic population. These infections were more prevalent among young people, with a male predominance. Thus, for a better prevention of these STIs, systematic screening strategies should be applied in addition to education of youth on sexual and reproductive health.

## DATA AVAILABILITY

The data used to support the findings of this study are included in the manuscript and are available from the corresponding author upon reasonable request.

## CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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