

Risk factors associated with increasing prevalence of gonorrhea and the antimicrobial susceptibility profiles of *Neisseria gonorrhoeae* among adolescents: A decade-long, hospital-based study from India

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Abstract

Background: Gonorrhea is a significant cause of morbidity among sexually active population. Young adults and adolescents have a high risk of contracting sexually transmitted infections (STIs) due to behavioral, biological, and cultural factors fuelling the epidemic among them. The Centers for Disease Control recommends annual STI screening for sexually active individuals under twenty-five and those at higher risk. The present study aims at determining the risk factors linked to the rising prevalence of gonorrhea among Indian adolescents and antimicrobial susceptibility profiles of *Neisseria gonorrhoeae*. **Materials and Methods:** Clinical samples from adolescents attending the STI clinics were collected over 10 years. The isolates were confirmed as *N. gonorrhoeae* and antimicrobial susceptibility tests were performed to various drugs using the minimum inhibitory concentration strip method. **Results:** A total of 7308 genital discharge specimens were collected from STI clinic attendees, of which 417 samples were positive for gonorrhea (25 among male adolescents). Seventy six percent of positive adolescents had multiple sex partners, with only 4% using condoms. Nearly 20% practiced exchange of drugs for sex. Antimicrobial susceptibility rates were 96% sensitive for azithromycin, cefixime, and ceftriaxone. Gentamicin and spectinomycin reported 100% sensitivity rates. High resistance rates were reported to penicillin, ciprofloxacin, and tetracycline at 80%, 88%, and 68%, respectively. **Conclusion:** Regular screening for STIs helps understand the trends and transmission of gonorrhea, which helps initiate appropriate control measures. The resistance to recommended treatment regimens such as azithromycin and cefixime seems to be escalating gradually, probably due to irrational use of antibiotics for non-STI cases and empirical treatment, which needs close monitoring.

Key words: Adolescents – sexually transmitted infections, antimicrobial resistance, risk factors

Introduction

Gonorrhea, a sexually transmitted infection (STI) caused by *Neisseria gonorrhoeae*, is one of the major causes of morbidity among sexually active population. Globally, gonococcal infections are now a significant threat because *N. gonorrhoeae* can expeditiously develop resistance to multiple classes of antibiotics. The Centers for Disease Control (CDC) classified it as a “superbug” in 2012, since the issue with drug-resistant gonococcus has surged to a level that it might become untreatable in future.^[1] *N. gonorrhoeae* acts as a significant cofactor in HIV-1 infection.^[2] Adolescents and young adults are

disproportionately affected. Young adults and adolescents have a high risk of contracting STIs. This is brought on by the same behavioral, biological, and cultural factors fuelling the STI and HIV epidemic among teenagers. Chlamydia is the most prevalent bacterial STI, with gonorrhea coming in second. According to estimates from the World Health Organization, 106 million cases of gonorrhea in adults are reported each year globally, and many more go unreported.^[3] According to a study

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conducted in Italy, gonorrhea affected a sizable percentage of adolescents (12–18 years) and young adults (18–24 years) (10.4%). Two-thirds of the 12 million new STIs in the United States, in 1995, occurred in people under 25 years of age.^[4] In a developing country like India, STIs increase the financial burden and raise several other public health issues.^[5] According to an ICMR report, 30 million STIs and reproductive tract infections are estimated to be reported annually in the nation.^[6] The potential risk factors influencing adolescent STI cases include inconsistent condom use, a lack of sexual health knowledge, multiple sex partners, and drug abuse.^[5] Furthermore, society's stigma, ignorance, and fear make it worse for them to access basic health facilities such as screening, counseling, and treatment.^[7] Teenagers also face difficulties getting care due to stigma, financial constraints, and a lack of transportation.^[8]

The majority of girls who develop vaginitis do so during their adolescent years, and it is frequently accompanied by gonococcal cervicitis and mucopurulent vaginal discharge. According to reports, 50% of women have no symptoms. However, males may experience a mucopurulent discharge, dysuria, and urethral pruritus following a 2–7-day incubation period. Gonorrhea rarely presents as a disseminated gonococcal infection in adolescents.^[9] Several studies have identified the causes of the high STI incidence among adolescents. One of the leading causes is the lack of screening of adolescents. All sexually active females under 25 should undergo routine gonorrhea screening, as advised by CDC, United States Preventive Services Task Force, and American Academy of Pediatrics.^[10] Treatment regimen in India consists of cefixime 400 mg orally plus azithromycin 1 g orally as single doses. Limited data are available regarding gonorrhea-affected adolescents in India. The past 10 years have seen a significant increase in the incidence of child and adolescent sexual abuse as a serious social issue. To fully manage these patients, social and psychological support must be offered. The confidentiality of patients who are children or adolescents must be respected and upheld by health-care professionals. They must be educated and have access to STI care that is more kid-friendly. The present study was undertaken to determine the prevalence of gonorrhea among adolescents (10–19 years) and study the risk factors linked to the rising prevalence of this infection, among Indian adolescents and the antimicrobial susceptibility profiles of *N. gonorrhoeae* in this age group.

Materials and Methods

A hospital-based, retrospective study was conducted after seeking due approval from the institutional ethics committee. The gonococci isolated from specimens received in the STI clinics, between January 2013 and December 2022, were revived from lyophilized stocks and their antimicrobial susceptibility testing was performed using minimum inhibitory concentration strips, on gonococcal agar base media, using various antibiotics, including cefixime, ceftriaxone, penicillin, tetracycline, ciprofloxacin, azithromycin, gentamicin, and spectinomycin. The details of the isolates were documented and preserved.

Initial isolation of gonococci was by plating patient's specimen onto selective media such as modified Thayer Martin agar (Vancomycin, Colistin, Nystatin, Trimethoprim) and chocolate agar and then incubating the plates at 35°C in 5% CO₂, for 18–24 h. Plates were examined for growth and colony characteristics, and a Gram smear performed,

to look for Gram-negative kidney-shaped diplococci. Final identification was made on the basis of biochemical tests including, positive superoxol and oxidase tests, followed by a rapid carbohydrate utilization test, showing a color change only for glucose. The long-term storage of isolates was by lyophilization.

The demographic profiles of STI clinic attendees were available from the records maintained in the department. The records were maintained both manually in registers and/or in the form of excel sheets in the desktops.

Results

A total of 7308 genital discharge specimens were collected from STI clinic attendees over the 10-year period. Of these, 417 were positive for gonorrhea by culture (5.7%). Of the 417 gonorrhea positive cases, only 25 were adolescents (6%). All adolescent cases were male between 15 and 19 years of age, with no positive adolescent females. Of the 7308 STI clinic attendees over 10 years, only 156 were adolescents (2.13%), giving a prevalence of gonorrhea among adolescents as 16.02% (25 out of 156). Details of sexual history revealed that 76% of the positive cases had multiple sex partners.^[1–3] Only 4% of adolescents admitted using condoms regularly, and almost 24% never used condoms, while others reported inconsistent use of condoms. Of the 25 adolescent males positive for gonococcus, 23 gave a history of having sex with the same gender person (92%). The exchange of drugs for sex was practiced by 20% of adolescents. A large proportion (around 80%) was indulging in smoking and alcohol consumption. Figure 1 shows the antimicrobial susceptibility patterns of the gonococcal isolates among adolescent patients.

Statistical analysis of the data collected was performed by simple statistical methods, including percentages and prevalence.

Discussion

The gonorrhea-positive cases in this study were disproportionate, with all cases reported being young men, between 15 and 19 years of age, and no positivity among females. In a study reported from Kerala, the female-to-male ratio was one to three.^[11] Here again, the number of males was more than females. While the exact reason for this is not known, it is possible that, given

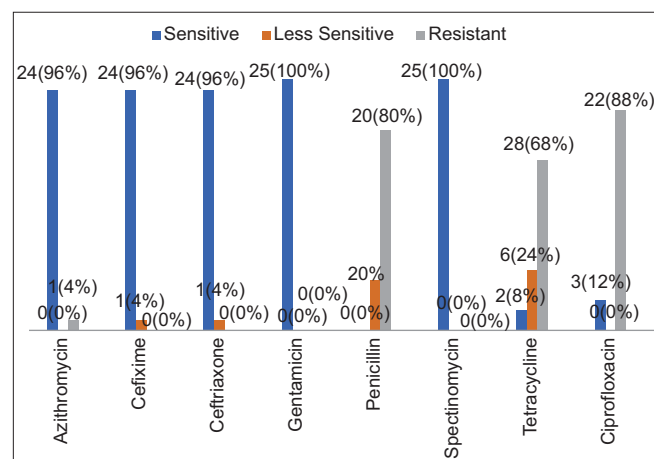


Figure 1: Antimicrobial susceptibility patterns of *Neisseria gonorrhoeae* isolates among adolescents n (%)

the societal norms in India, females in the adolescent age group have less freedom to seek health-care facilities on their own, especially in matters pertaining to sexual health.

It is tempting to feel positive about the low incidence of gonorrhea in the adolescent age group (6%), vis a vis the total population. However, this may not reflect the true situation, because it is possible that adolescents are hesitant to approach a health-care facility for their sexual problems, and usually, their first point of contact may be with private practitioners and quacks and peer groups. Our results were in synchronization with a study conducted in US, by Kahn *et al.* who reported prevalence of adolescents affected with gonorrhea to be 6.4%.^[12] However, a study by Webster *et al.* reported a higher percentage of gonococcal positivity among adolescents (24%–30%).^[13] Hence, it is important to keep these figures low, by instituting preventive measures, such as awareness programs, condom promotion, education in prevention, and screening of sexually active adolescents practicing high-risk behavior.

Resistance to penicillin was considerably high, at 80%, in the present study, many isolates being penicillinase-producing *N. Gonorrhoeae* positive, while tetracycline resistance was 68%. It must be noted here that, although 80% were resistant to penicillin, it does not translate as 20% being sensitive, because these 20% of isolates were in the less sensitive category and hence not useful in treating gonorrhea.

A study on gonococcus isolates from India, Pakistan, and Bhutan, by Sethi *et al.*,^[14] from 2007 to 2011, reported 68% resistance to penicillin with 52% isolates producing β -lactamase. The resistance to tetracycline reported in the same study was 55%. Approximately 88% of isolates were seen to be resistant to ciprofloxacin in the present study, which was less than the figures reported by Sethi *et al.*,^[14] i.e., 94% resistance to ciprofloxacin.

The gradually increasing resistance to the drugs used in the recommended national treatment regimen (National AIDS Control Organization) viz., azithromycin, cefixime/ceftriaxone, is a cause of great concern. In the current study, 4% of isolates were resistant to azithromycin and 4% were less susceptible to third-generation cephalosporins. The probable cause of this is the irrational use of antibiotics for non-STI cases and empirical treatment of other diseases. Appropriate control measures and a strong antimicrobial stewardship are required to limit the spread of antibiotic resistant strains and control the emergence of multi drug resistant and extensively drug resistant strains. It is heartening to note that there is no resistance as yet, to spectinomycin and gentamicin. These results were in concurrence with another study, which had 100% sensitivity to ceftriaxone, cefixime, and spectinomycin; however, a higher resistance was noted to azithromycin (7.7%).^[14]

The findings of this study revealed that almost 76% of adolescents had multiple sex partners (up to 4 partners). Our estimates were higher than a study conducted in Italy, by Matteelli *et al.*, which reported 56.9% patients having multiple sex partners.^[15] Another underlying risk factor [Figure 2] is inconsistent condom use, which poses a major risk for STI transmission. In the current findings, only 4% of adolescents admitted using condoms regularly, and 24% never used condoms; however, as per a study by Matteelli *et al.*, 27.5% of adolescents reported regular condom use during the 6 months before the survey.^[15] The nonavailability of condoms at the time of sexual

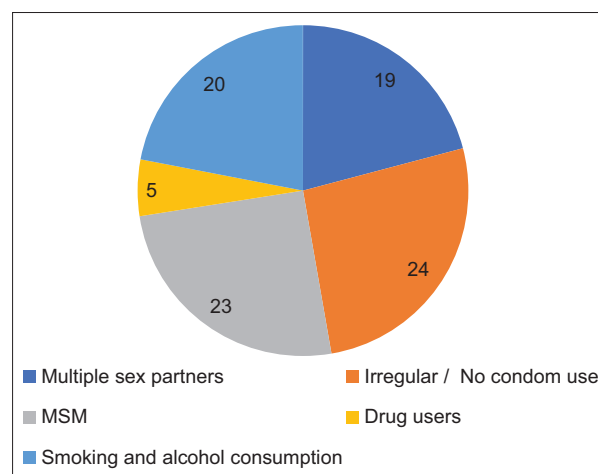


Figure 2: Risk factors associated with *Neisseria gonorrhoeae* infection among adolescents (n). MSM = Men having Sex with Men

intercourse or poor awareness about STIs might be the reason for choosing other contraceptive methods over condom. Exchange of sex for drugs, lack of knowledge, and awareness regarding sexual health contribute considerably to STIs among adolescents. Among these 25 adolescent males, 23 had histories of having sex with the same gender. The exchange of drugs for sex was admitted by around 20% of adolescents in this study, corroborated by another study which reported 18.5% of adolescents involved in drug usage. However, a large proportion (around 80%) were into smoking and alcohol consumption which was in agreement with a study conducted in Singapore with 78.5% and 71.3% adolescents indulging in smoking and alcohol consumption, respectively.^[16] Smoking and alcohol consumption are indirect behavioral risk factors that render the adolescents prone to risky behavior, as these activities are generally practiced in peer groups and affect the decision making ability, along with increasing the susceptibility to STIs.^[16]

Conclusion

Regular screening helps in understanding the trends and transmission modes and rates of gonorrhea, which can be addressed by appropriate control measures. There is an urgent need to take note of the underlying risk factors responsible for gonorrhea among adolescents, which has been attempted by this study. Society stigma, fear, and illiteracy often pose barriers for adolescents to approach health-care facilities; thus, counseling and generating awareness among adolescents about STIs is a crucial step toward controlling the spread of gonorrhea.

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Conflicts of interest

There are no conflicts of interest.

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