ORIGINAL ARTICLE
Infectious Diseases, Microbiology & Parasitology

JKMS

https://doi.org/10.3346/jkms.2017.32.11.1771 • J Korean Med Sci 2017; 32: 1771-1778

Prevalence of and Risk Factors for Sexually Transmitted Infections among Korean Adolescents under Probation

Jin Ju Park,[1] Yu Bin Seo,[1] Sookyung Jeong,[2] and Jacob Lee[1]

[1]Division of Infectious Diseases, Department of Internal Medicine, Hallym University Kangnam Sacred Heart Hospital, Hallym University College of Medicine, Seoul, Korea; [2]Department of Nursing, Ansan University, Ansan, Korea

Received: 23 May 2017
Accepted: 21 July 2017

Address for Correspondence:
Jacob Lee, MD, PhD
Division of Infectious Disease, Department of Internal Medicine, Hallym University Kangnam Sacred Heart Hospital, Hallym University College of Medicine, 1 Singil-ro, Yeongdeungpo-gu, Seoul 07441, Korea
E-mail: litjacob@chol.com

Funding: This work was supported by the Research Program funded by the Korea Centers for Disease Control & Prevention (grant number: 2014-E31001-00).

There is limited research on sexually transmitted infections (STIs) among adolescents in Korea. The objective of this study was to explore the prevalence of and risk factors for STIs among Korean adolescents under probation. A cross-sectional analysis was conducted in one juvenile-delinquent center and five probation offices in Korea to determine the prevalence of STIs caused by the following pathogens: *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, *Trichomonas vaginalis*, herpes simplex virus (HSV), human immunodeficiency virus (HIV), *Treponema pallidum*, *Mycoplasma hominis*, *Mycoplasma genitalium*, *Ureaplasma urealyticum*, and *Ureaplasma parvum*. Of the 237 (208 male and 29 female) participating adolescents, 152 (64.1%) had a history of coitus. Overall, 133 (56.1%) subjects tested positive for at least one microorganism in their genitourinary tract. The most prevalent pathogen was *U. urealyticum* (24.7%, n = 65), followed by *U. parvum* (24.1%, n = 57), *M. hominis* (17.3%, n = 41), *C. trachomatis* (13.9%, n = 33), *N. gonorrhoeae* (1.7%, n = 4), *T. vaginalis* (0.8%, n = 2), and HSV (0.8%, n = 2). The prevalence of syphilis was 0.8% (n = 2). There were no reported cases of HIV infection. Fifty-four participants (35.5%) were positive with more than two pathogens. We did not find any significant difference between STIs and socioeconomic factors, behavioral factors or sexual practices. In conclusion, the prevalence of STIs among adolescents under probation was high. Systematic screening programs, more practical sexual education, and adequate provision of treatment are essential for the prevention and management of STIs among adolescents, especially those under probation.

Keywords: Adolescent; *Chlamydia trachomatis*; *Mycoplasma*; *Neisseria gonorrhoeae*

INTRODUCTION

It is estimated that, worldwide, half a billion new controllable sexually transmitted infections (STIs) such as syphilis, chlamydia, and gonorrhoea occur annually, with the highest rates observed among young persons aged 20–24 years, followed by those aged 15–19 years (1,2). Adolescents are potentially at greater risk of STIs as they tend to have multiple sex partners and engage in unprotected intercourse using condoms inconsistently because of delayed or inadequate sex education (3,4). STIs can lead to serious health problems including ectopic pregnancy, pelvic inflammatory disease, infertility, congenital infection, and cervical carcinoma (1,5). Most infected adolescents do not seek treatment due to financial and time constraints (1,6). Thus, adolescents are more vulnerable to the complications of STIs; this can affect public health.

Adolescents who attend correctional facilities tend to engage in risky sexual behaviours and do not readily engage with medical services (7-9). The United States' Centers for Disease Control and Prevention (CDC) estimated that the prevalence of chlamydial infection was 15.7% among female adolescents and 7.4% among male adolescents in juvenile correctional facilities in 2011 (10), markedly higher than the prevalence of 1.8% in the general population of adolescents reported in 2014 (11); adolescents in correctional facilities are at a higher risk of STIs. Currently, there is one reported prevalence survey of STIs targeting adolescents under probation in correction facilities in Korea. That survey, conducted by Lee et al. (12) in 2004, reported that the prevalence of *Chlamydia trachomatis* among adolescents attending youth shelters was 12.6%. Thus, the prevalence among adolescents at higher risk in Korea was similar to that reported in the United States. However, there is no screening system for and no recent prevalence data on STIs in Korea.

As most STIs may be asymptomatic, it is important to screen for and prevent them (6). Prevalence surveys are essential for the establishment of screening and preventive strategies. Therefore, we examined the prevalence of STIs involving the following causative pathogens: *C. trachomatis*, *Neisseria gonorrhoeae*, herpes simplex virus (HSV), *Treponema pallidum*, human immunodeficiency virus (HIV), and *Trichomonas vaginalis* among Korean adolescents under probation. Some studies have suggested that mycoplasma and ureaplasma can contribute to gen-

pISSN 1011-8934
eISSN 1598-6357

itourinary infection and infertility (13-18). However, studies have only investigated the prevalence of *Mycoplasma genitalium* in adolescents (19,20). Therefore, we investigated the prevalence of *Mycoplasma hominis, M. genitalium, Ureaplasma parvum*, and *Ureaplasma urealyticum*. This study also examined current sexual behaviours, circumstances, and socioeconomic factors related to STIs.

MATERIALS AND METHODS

Study design and participants

We conducted a prospective, cross-sectional study among adolescents aged ≤ 19 years who were under probation in two cities in Korea. One juvenile-delinquent centre protecting male adolescents and five probation offices participated. The study took place from April to November 2014.

Data collection

An anonymous, self-administered, structured questionnaire prepared in Korean was used to collect data on the socioeconomic status of participants (age, residence type, economic status, and weekly allowance), behavioural factors (smoking, alcohol use, hallucinogen use, and runaway experience), sexual practices (age of sexual debut, condom use, number of sex partners over the preceding 3 months, and date of most recent sexual intercourse), and history of STIs. Weekly allowance was converted into United States dollar (USD) at the exchange rate of May 2, 2017. To evaluate sexual knowledge, 45 questions were included in the questionnaire regarding safe sex and STIs. The questionnaire about sexual knowledge was administered in combination with a previously published sexually transmitted disease knowledge questionnaire (STD-KQ) and a Korean sex knowledge questionnaire developed for adults (21). The STD-KQ was translated into Korean and the questionnaire was distributed to all subjects. Correct answers were scored as 1 and "do not know" or incorrect answers were scored as 0. The total score was calculated by adding the scores for all questions.

Urine specimens (50 mL of the first void) were collected in sterile screw-cap plastic bottles, and serum samples (10 mL) were obtained. A code number linked the urine and serum specimens to the questionnaire. All results were reported to participants. All participants who received positive results requested treatment.

Laboratory tests and methods

The urine specimens were analysed to detect the presence of *C. trachomatis, N. gonorrhoeae, T. vaginalis, M. hominis, M. genitalium, U. urealyticum*, and *U. parvum* by nucleic acid amplification tests using multiplex real-time polymerase chain reaction (PCR) (Anyplex™ II; Seegene, Seoul, Korea). Multiplex real-time PCR showed sensitivity as 100% for *C. trachomatis, N. gonorrhoeae, T. vaginalis, M. genitalium*, and *M. hominis* and 97.8% for *U. urealyticum*. Specificity of that was as follows: 100% for *C. trachomatis* and *M. genitalium*, 99.9% for *T. vaginalis*, 99.3% for *M. hominis* and *U. urealyticum* and 99.2% for *N. gonorrhoeae* (22). PCR was performed using a real-time PCR instrument (CFX96 Real-time PCR System; Bio-Rad, Hercules, CA, USA) according to the manufacturer's instructions, as follows: 1) primary denaturation at 95°C for 15 minutes; 2) 50 cycles of denaturation at 95°C for 30 seconds, annealing at 60°C for 1 minutes and extension at 72°C for 30 seconds; and 3) final cooling down at 55°C for 30 seconds. The results were analysed using Seegene software, which interpreted results as positive or negative. Positive results were confirmed by single PCR using the Seeplex STD kit (Seegene).

The 10 mL serum samples were used for rapid plasma reagin (RPR) testing for syphilis, HSV-1 and HSV-2 immunoglobulin (Ig) G, and HIV antigen/antibody combination testing. Samples were tested by the Department of Laboratory Medicine in Hallym University Kangnam Sacred Heart Hospital. Syphilis was diagnosed based on RPR performed by latex suspension (Hitachi, Tokyo, Japan). Mediace RPR ≥ 1.0 RU was considered positive. HIV antibodies were detected by the chemiluminescent micro-particle immunoassay (Abbott Architect i2000SR; Abbott Laboratories, Chicago, IL, USA) and positive results were confirmed by western blot. HSV IgG was tested by chemiluminescent immunoassay (DiaSorin Inc., Stillwater, MN, USA) entrusted to Green Cross Laboratories, Korea.

Statistical analysis

The prevalence of STIs was calculated using positive rates, computed as the total number of positive tests divided by the total number of subjects tested. The association between STI positivity and risk factors was assessed using χ^2 tests. If the expected frequency was < 5% for ≥ 20% of categories, Fisher's exact test was performed. Risk factors were examined in sex-experienced subjects. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Variables with a P value < 0.3 were included in a multivariate logistic regression model. In the model, a P value of < 0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS software, version 20 (IBM SPSS Inc., Armonk, NY, USA).

Ethics statement

Written informed consent was obtained from all subjects prior to enrolment. The study was approved by the Institutional Review Board (IRB) of Hallym University Kangnam Sacred Heart Hospital in Korea (IRB number: 2014-03-36).

RESULTS

A total of 237 adolescents (208 male and 29 female adolescents)

 https://doi.org/10.3346/jkms.2017.32.11.1771

were enrolled. The mean age of participants was 16.1 ± 1.5 years (range, 12–19 years) (Table 1). Overall, 223 (94.1%) participants lived with their parents and eight (3.4%) lived in a day-care center. Most participants (32.1%, n = 76) received a weekly allowance of 10,000–30,000 won (8.8–26.5 USD); followed by those receiving > 50,000 won (44.2 USD) (26.2%, n = 62) and < 10,000 won (8.8 USD) (22.8%, n = 54). Overall, 186 (78.5%) adolescents reported having drunk alcohol, 211 (89.0%) had experienced smoking, and 104 (43.9%) had dropped out of school. Twenty participants (8.4%) had used hallucinogens and 27 (11.4%) had experienced running away from home. Despite the fact that almost 60% (n = 142) of participants had received sex education, the average sexual knowledge score was 11.0 ± 7.7 points on a 45-point scale. A total of 152 (64.1%) participants had a history of coitus. Of these, 103 had had sexual intercourse within the preceding 6 months, representing 67.8% of sex-experienced subjects (Table 2). Most adolescents (55.3%, n = 84) reported an age of sexual debut between 15 and 16 years. The majority (75.7%, n = 115) of participants had had a single sex partner over the preceding 3 months, although 24.3% (n = 37) had had multiple sex partners. Only 27.6% (n = 42) always used a condom during sexual intercourse; 16.4% (n = 25) never used a condom. There was no homosexual. Twenty-six (17.1%) participants gave a history of having had a STI.

In total, 133 (56.1%) participants had at least one of the microorganisms tested for detected in their genitourinary tracts

Table 1. Baseline characteristics of enrolled adolescents (n = 237)

Characteristics	Value
Sex	
Male	208 (87.8)
Female	29 (12.2)
Age, yr	16.1 ± 1.5
Age category, yr	
12	3 (1.3)
13	11 (4.6)
14	24 (10.1)
15	36 (15.2)
16	59 (24.9)
17	59 (24.9)
18	36 (15.2)
19	9 (3.8)
Residence type	
With parents	223 (94.1)
With relatives	2 (0.8)
Boarding house/live apart from family	3 (1.3)
Day-care center	8 (3.4)
Other	1 (0.4)
Weekly allowance, won (USD)	
< 10,000 (8.8)	54 (22.8)
10,000–30,000 (8.8–26.5)	76 (32.1)
30,001–50,000 (26.5–44.2)	45 (19.0)
> 50,000 (44.2)	62 (26.2)
Alcohol	186 (78.5)
Smoking	211 (89.0)
Dropped out of school	104 (43.9)
Runaway	27 (11.4)
Hallucinogen use	20 (8.4)
Sex education received	142 (59.9)
Sexual knowledge score*, points	11.0 ± 7.7
Coitus history	152 (64.1)

Values are presented as number (%) or mean ± SD.
SD = standard deviation, USD = United States dollar.
*On a 45-point scale.

Table 2. Sexual practices in sex-experienced adolescents (n = 152)

Variables	Value
History of recent coitus	
Within 1 mon	35 (23.0)
1–2 mon ago	30 (19.7)
3–6 mon ago	38 (25.0)
> 6 mon ago	49 (32.2)
Age at sexual debut, yr	
< 13	9 (17.3)
14	25 (16.4)
15	42 (27.6)
16	42 (27.6)
17	23 (15.1)
18	11 (7.2)
No. of sexual partners over the past 3 mon	
1	115 (75.7)
2–5	32 (21.1)
6–10	2 (1.3)
> 11	3 (2.0)
Condom use	
Always	42 (27.6)
Sometimes	85 (56.0)
Never	25 (16.4)
Homosexual	0 (0)
STI history	26 (17.1)

Values are presented as number (%).
STI = sexually transmitted infection.

Table 3. Distribution of microorganism detection according to sex experience

Variables	Positive test result		
	Total (n = 237)	Sex-experienced (n = 152)	Sex-inexperienced (n = 85)
Chlamydia trachomatis	33 (13.9)	33 (21.7)	0 (0)
Neisseria gonorrhoeae	4 (1.7)	4 (2.6)	0 (0)
Trichomonas vaginalis	2 (0.8)	2 (1.3)	0 (0)
HSV	1 (0.4)	1 (0.7)	0 (0)
Treponema pallidum	2 (0.8)	2 (1.3)	0 (0)
HIV	0 (0)	0 (0)	0 (0)
Ureaplasma urealyticum	65 (24.7)	53 (34.9)	12 (14.1)
Ureaplasma parvum	57 (24.1)	50 (32.9)	7 (8.2)
Mycoplasma hominis	41 (17.3)	37 (24.3)	4 (4.7)
Single pathogen	79 (33.3)	60 (39.5)	15 (17.6)
Two pathogens	35 (22.9)	35 (22.9)	4 (4.7)
Three pathogens	14 (9.2)	14 (9.2)	-
Four pathogens	5 (3.3)	5 (3.3)	-
Total	133 (56.1)	114 (75.0)	19 (22.4)

Values are presented as number (%).
HSV = herpes simplex virus, HIV = human immunodeficiency virus.

(Table 3). The most prevalent STI pathogen was *U. urealyticum* (24.7%, n = 65), followed by *U. parvum* (24.1%, n = 57), *M. hominis* (17.3%, n = 41), and *C. trachomatis* (13.9%, n = 33). There were four cases (1.7%) of *N. gonorrhoeae* but no reported cases of HIV. The prevalence of *T. vaginalis* and HSV was 0.8% (n = 2) and 0.4% (n = 1), respectively. Two participants (0.8%) tested positive for *Treponema pallium*. At least one pathogen was detected in the 114 (75.0%) participants who were sex-experienced. *U. urealyticum* was found in 53 (34.9%) of these participants' specimens, followed by *U. parvum* (32.9%, n = 50) and *M. hominis* (24.3%, n = 37). The total number of participants who had more than two pathogens was 54 (35.5%). Among these participants, 35 (22.9%) and 14 (9.2%) tested positive for two different pathogens and three pathogens simultaneously. Five participants (3.3%) had four different pathogens. Table 4 showed the distribution of microorganism positive with multiple pathogens. Among the sex-inexperienced participants, 19 tested positive for at least one pathogen: 12 (14.1%) were positive for *U. urealyticum*, seven (8.2%) for *U. parvum*, and four (4.7%) for *M. hominis*. There were no cases of *C. trachomatis*, *N. gonorrhoeae*, *T. vaginalis*, HIV, HSV, syphilis, and *M. genitalium* among sex-inexperienced subjects. Four participants (4.7%) were positive with two pathogens simultaneously. Three (3.5%) were positive with *M. hominis* and *U. urealyticum* and one (1.2%) was *U. parvum* and *U. urealyticum*.

Table 4. Distribution of microorganism in positivity with multiple pathogens in sex-experienced adolescents (n = 54)

Variables	Value
Two pathogens	35 (64.8)
CT & UP	10 (18.5)
MH & UU	10 (18.5)
MH & UP	7 (13.0)
CT & UU	3 (5.6)
CT & MH	1 (1.9)
CT & MG	1 (1.9)
TP & UU	1 (1.9)
TP & UP	1 (1.9)
UP & UU	1 (1.9)
Three pathogens	14 (25.9)
CT + UP + UU	3 (5.6)
CT + MH + UU	3 (5.6)
MG + MH + UU	2 (3.7)
MH + UP +UU	2 (3.7)
HSV + MH + UU	1 (1.9)
CT + MH + UP	1 (1.9)
CT + MH + NG	1 (1.9)
MG + MH + UP	1 (1.9)
Four pathogens	5 (9.3)
CT + MG + MH + UU	2 (3.7)
CT + MG + UP + UU	1 (1.9)
CT + TV + UP + UU	1 (1.9)
MG + MH + TV + UP	1 (1.9)

Values are presented as number (%).
CT = *Chlamydia trachomatis*, UP = *Ureaplasma parvum*, MH = *Mycoplasma hominis*, UU = *Ureaplasma parvum*, MG = *Mycoplasma genitalium*, TP = *Treponema pallidum*, HSV = herpes simplex virus, NG = *Neisseria gonorrhoeae*.

Factors associated with STIs in sex-experienced adolescents are shown in Table 5. In the univariate analysis, only STI history differed significantly between those with a STI relative to those without (OR, 4.5; 95% CI, 1.02–20.30; $P = 0.032$). We did not find any statistically significant differences in the variables relating to sexual practices, such as age of sexual debut, number of sexual partners in the preceding 3 months, and condom use dur-

Table 5. Associations between variables and STIs in sex-experienced adolescents

Variables	Positive (n = 114)	Negative (n = 38)	Univariate analysis		Multivariate analysis	
			OR (95% CI)*	*P* value	aOR (95% CI)†	*P* value
Residing with family	109 (95.6)	35 (92.1)	0.5 (0.122–2.354)	0.413	-	-
Weekly allowance < 50,000 won (44.2 USD)	81 (71.1)	25 (65.8)	1.3 (0.583–2.793)	0.541	-	-
Runaway	11 (9.6)	4 (10.5)	0.9 (0.271–3.039)	1.000	-	-
Alcohol use	97 (85.1)	32 (84.2)	1.1 (0.389–2.946)	0.896	-	-
Smoking	105 (92.1)	35 (92.1)	1.0 (0.256–3.902)	1.000	-	-
Hallucinogen use	11 (9.6)	2 (5.3)	1.9 (0.407–9.090)	0.519	-	-
Dropped out of school	52 (45.6)	22 (57.9)	1.6 (0.781–3.443)	0.190	0.5 (0.230–1.089)	0.081
Sex knowledge score < 12 points	52 (45.6)	19 (50.0)	1.2 (0.572–2.486)	0.639	-	-
Aged < 16 yr at sexual debut	53 (46.5)	23 (60.5)	0.6 (0.268–1.196)	0.134	2.06 (0.945–4.491)	0.069
Sexual intercourse in past 6 mon	79 (69.3)	24 (63.2)	1.3 (0.610–2.844)	0.483	-	-
≥ 2 sex partners in the past 3 mon	26 (22.8)	11 (28.9)	0.7 (0.317–1.657)	0.445	-	-
Condom use						
Always	29 (25.4)	13 (34.2)	-	Ref	-	-
Sometimes	65 (57.0)	20 (52.6)	1.5 (0.639–3.321)	0.371	-	-
Never	20 (17.5)	5 (13.2)	1.8 (0.552–5.825)	0.331	-	-
Sex education received	75 (65.8)	28 (73.7)	1.5 (0.642–3.303)	0.367	-	-
STI history	23 (20.2)	2 (5.3)	4.5 (1.020–20.299)	0.032	1.225 (1.216–25.721)	0.741

Values are presented as number (%).
CI = confidence interval, STI = sexually transmitted infection, OR = odds ratio, aOR = adjusted odds ratio, USD = United States dollar, Ref = reference category.
*Chi-square tests and Fisher's exact test. †Logistic regression model adjusted for dropped out of school, aged < 16 years at sexual debut and STI history.

https://doi.org/10.3346/jkms.2017.32.11.1771

Table 6. Associations between variables and multiple infection in STI positive adolescents (n = 114)

Variables	Single pathogen (n = 60)	Multiple pathogens (n = 54)	Univariate analysis	
			OR (95% CI)*	*P* value
Residing with family	56 (93.3)	53 (98.1)	0.3 (0.029–2.440)	0.367
Weekly allowance < 50,000 won (44.2 USD)	41 (68.3)	40 (74.1)	1.3 (0.585–2.995)	0.500
Runaway	6 (10.0)	5 (9.3)	0.9 (0.264–3.200)	1.000
Alcohol use	52 (86.7)	45 (83.3)	0.8 (0.274–2.160)	0.618
Smoking	55 (91.7)	50 (92.6)	1.1 (0.289–4.469)	1.000
Hallucinogen use	5 (8.3)	6 (11.1)	1.4 (0.395–4.791)	0.616
Dropped out of school	27 (45.0)	25 (46.3)	1.1 (0.504–2.204)	0.890
Sex knowledge score < 12 points	25 (41.7)	27 (50.0)	1.4 (0.668–2.935)	0.372
Aged < 16 yr at sexual debut	28 (46.7)	25 (46.3)	1.0 (0.471–2.059)	0.968
Sexual intercourse in past 6 mon	40 (66.7)	39 (72.2)	1.3 (0.583–2.898)	0.521
≥ 2 sex partners in the past 3 mon	13 (21.7)	13 (24.1)	1.1 (0.478–2.751)	0.760
Condom use				
Always	15 (25.0)	12 (22.2)	-	Ref
Sometimes	36 (55.4)	29 (53.7)	1.0 (0.408–2.484)	0.988
Never	9 (15.0)	13 (24.1)	1.8 (0.578–5.643)	0.308
Sex education received	22 (36.7)	17 (31.5)	0.8 (0.364–1.728)	0.560
STI history	9 (15.0)	14 (25.9)	2.0 (0.779–5.048)	0.147

Values are presented as number (%).
CI = confidence interval, STI = sexually transmitted infection, OR = odds ratio, USD = United States dollar, Ref = reference category.
*Chi-square tests and Fisher's exact test.

ing sexual intercourse. Previous sex education experience and sex knowledge scores were not significantly associated with the presence of an STI. No significant difference was found according to other socioeconomic and behavioural factors such as residence type, runaway history, smoking, alcohol use, hallucinogen use, and history of having dropped out of school. On multivariate analysis, we found no significant independent variable associated with the presence of microorganisms causing STIs. We also evaluated factors in participants that tested positive according to multiple pathogens and single pathogen (Table 6). In the univariate analysis, we did not find any statistically significant differences in the variables relating to sexual practices, other socioeconomic and behavioural factors.

DISCUSSION

Currently, the only available data on the prevalence of STIs among adolescents under probation in Korea comes from a single prevalence survey conducted in 2004 among homeless adolescents attending a shelter (12). That study reported that 54.9% of adolescents had engaged in sexual intercourse and that 36.5% were younger than 16 years old at sexual debut. In our study, 152 (64.1%) participants had experienced sexual intercourse, and half of them had experienced their first sexual intercourse aged younger than 16 years. Sexual intercourse experience was comparable to the 2004 study of homeless adolescents, but the proportion of adolescents reporting an earlier sexual debut was higher in the present study. A Korean study involving general middle and high school students revealed that approximately 4.2% adolescents had experienced sexual intercourse from 2007 to 2013 (23). Compared with the general population, a greater proportion of adolescents under probation had engaged in sex.

In the 2004 study, the prevalence of *C. trachomatis* and *N. gonorrhoeae* was 12.6% and 15.4%, respectively (12). Based on a self-administered questionnaire, experience of any previous STI was 7.4% among boys and 7.5% among girls attending general middle or high school during 2007 to 2013 (23). In the present study, the prevalence of *C. trachomatis* and *N. gonorrhoeae* was 13.9% and 1.7%, respectively. Compared with the 2004 study on adolescents attending a shelter, the prevalence of *C. trachomatis* in the present study was similar while the prevalence of *N. gonorrhoeae* was lower. The prevalence of STIs in adolescents under probation is considerably higher than in the general population.

In the United States, the CDC estimated that the prevalence of *C. trachomatis* among female and male adolescents in juvenile correctional facilities was 15.7% and 7.4%, respectively, in 2011 (10), and the prevalence of *N. gonorrhoeae* was 1.2% and 4.4% among male and female adolescents, respectively. The prevalence of *C. trachomatis* and *N. gonorrhoeae* in our study was similar to that reported in the United States. The CDC recommends the screening of all sexually active women younger than 25 years for *C. trachomatis* and *N. gonorrhoeae*. Despite the high prevalence of STIs among adolescents under probation, there is no screening system for STIs targeting adolescents under probation in Korea. Although up to 80% of women and 50% of men infected with *C. trachomatis* are asymptomatic or have few symptoms, these infections can result in long-term sequelae, such as infertility and cervical cancer (1,24). Diagnosis by means of a screening process is essential. Considering

the high prevalence of STIs among adolescents under probation, it is advisable to screen such adolescents for STIs when they are admitted to correctional facilities.

Some studies have suggested that mycoplasma and ureaplasma can contribute to the development of genitourinary infection and infertility (13-15,18). Despite studies on potential STI causative pathogens, there are no established guidelines on when to use diagnostic tools and when to treat mycoplasma and ureaplasma. Furthermore, few prevalence surveys of mycoplasma and ureaplasma have been conducted among adolescents and no prevalence studies of adolescents under probation have been performed to date. To our knowledge, this is the first study researching the prevalence of STIs, including infection with mycoplasma and ureaplasma, in adolescents under probation. In this study, the prevalence of *M. hominis*, *M. genitalium*, *U. urealyticum*, and *U. parvum* was 17.3%, 4.2%, 27.4%, and 24.1%, respectively. There is no comparable study targeting the general adolescent population in Korea. However, according to a study involving female adolescents aged 14–21 years in the United States, the prevalence of *M. genitalium* was 22.4% (19). A Korean study involving asymptomatic adults attending a clinic for a checkup found that the prevalence of *M. genitalium* was 1.0% and the prevalence of *U. urealyticum* was 11.8% (25). In a comparable study targeting asymptomatic Korean adults, the prevalence of *M. hominis*, *M. genitalium*, and *U. urealyticum* was 11.6%, 0.3%, and 22.1%, respectively (26). Compared with studies conducted abroad, the prevalence of *M. genitalium* among Korean adolescents under probation was lower; however, compared to asymptomatic adults in Korea, the prevalence was higher. Interestingly, 22.4% of adolescents who had not experienced sexual intercourse also tested positive for mycoplasma and ureaplasma. It is possible that adolescents under probation tend to hide their sexual intercourse experience due to Korean culture which considers sexuality among adolescents as taboo. It is also possible that mycoplasma and ureaplasma, considered causative pathogens for STIs, can colonize the genital tract at birth (following passage through the maternal vaginal tract). Therefore, it is difficult to decide when to consider the organisms as true pathogens and, thus, to decide when or whether to commence treatment. We must be cautious of treating all adolescents who test positive for mycoplasma or ureaplasma. It may be appropriate to use a diagnostic tool to detect mycoplasma or ureaplasma and to commence treatment if there is no clinical improvement following treatment for common pathogens. However, further studies investigating the timing of investigating and treating these pathogens are needed.

We found no association between the variables investigated in this study and STI positivity. The distribution of variables considered to be risk factors for STIs, such as residence type, weekly allowance, having run away from home, alcohol use, smoking, and having dropped out of school (27,28), were similar in both groups. As we compared risk factors within a population of adolescents under probation, who by definition engage in higher-risk habits and live in riskier circumstances than the average adolescent, we could not identify any meaningful risk factors in this study. The sexual knowledge score was not significantly different. Furthermore, the sexual knowledge score was very low, despite > 60% of adolescents having received sex education. According to the middle school education regulations, it is mandatory to provide at least 15 hours of sex education per year. However, in practice, this class is substituted for personal study time. Also, it is doubtful that adolescents under probation are focused on education. Providing sex education in correctional facilities may be an effective strategy, but it is important to improve the content of sex education programmes. Surprisingly, > 20% of the adolescents who reported that they always used condoms during sexual intercourse tested positive for at least one examined STI pathogen. Although adolescents under probation reported that they knew how to use condoms correctly, our results suggest that their knowledge was inadequate. A more practical approach is warranted, including information on the use of contraceptive devices, methods to prevent STIs, and the symptoms of STIs.

There is also gap between theoretical knowledge and the practical application thereof. In Korea, it is difficult for adolescents to obtain contraceptives such as condoms. According to the Korean Youth Protection Act, there is no restriction on purchasing condoms and it is possible to buy them at convenience stores or pharmacies. However, in practice, many adolescents cannot purchase condoms because of sales refusal and the surrounding attention received. Contraceptives should be accessible to adolescents in environments such as schools or public health centres. In addition, it is difficult for adolescents to make use of medical institutions specializing in STIs for cultural reasons. Despite recognizing the symptoms of an STI, adolescents are likely to miss the appropriate timing for treatment. There is a need to establish medical services that are free for adolescents and that are able to provide accurate information and treatment for STIs. Because the prevention and treatment of STIs in adolescents is crucial, it is important to understand adolescent sexuality and behaviour and to publicize activities to raise awareness of STIs.

Our study has some limitations. First, we included only 29 (12.2%) female adolescents. However, according to the 2014 Crime Prevention Policy Bureau statistics, of the 140,572 adolescents under probation, 124,385 (88.5%) were male and 16,187 (11.5%) were female (29). This male-to-female ratio coincides with the ratio in our study. Second, sexual intercourse experience might be underestimated because most adolescents avoid making their experience known due to social attention. Third, we could not collect data about the reason for entering the probation office. It might act as a risk factor according to some crime

 https://doi.org/10.3346/jkms.2017.32.11.1771

types such as sex crime but it was not investigated. Finally, we included probation offices and juvenile delinquent centres in only two metropolitan areas in Korea. Hence, our findings cannot reflect the general Korean regional characteristics. Thus, further surveys that include all regional Korean adolescents under probation should be performed.

In conclusion, the prevalence of STIs among adolescents under probation is high, and adolescents are currently exposed to more STI risks than they were in the past. More systematic screening policies, use of more practical sex education, and the provision of appropriate treatment for STIs are essential for the prevention and management of STIs in adolescents, particularly among those at risk. Furthermore, increased societal focus on adolescents is important.

DISCLOSURE

The authors have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTION

Conceptualization: Park JJ, Seo YB, Jeong S, Lee J. Data curation: Lee J. Formal analysis:Jeong S. Investigation: Seo YB, Jeong S. Writing - original draft: Park JJ. Writing - review & editing: Seo YB.

ORCID

Jin Ju Park https://orcid.org/0000-0002-5224-0837
Yu Bin Seo https://orcid.org/0000-0001-5183-1996
Sookyung Jeong https://orcid.org/0000-0001-7119-3039
Jacob Lee https://orcid.org/0000-0002-7041-065X

REFERENCES

1. Dehne KL, Riedner G. Sexually Transmitted Infections among Adolescents: the Need for Adequate Health Services. Geneva, World Health Organization, 2005.
2. World Health Organization. Report on Global Sexually Transmitted Infection Surveillance 2013. Geneva, World Health Organization, 2014.
3. Chinsembu KC. Sexually transmitted infections in adolescents. *Open Infect Dis J* 2009; 3: 107-17.
4. Carmine L, Castillo M, Fisher M. Testing and treatment for sexually transmitted infections in adolescents--what's new? *J Pediatr Adolesc Gynecol* 2014; 27: 50-60.
5. Wallin KL, Wiklund F, Luostarinen T, Angström T, Anttila T, Bergman F, Hallmans G, Ikäheimo I, Koskela P, Lehtinen M, et al. A population-based prospective study of *Chlamydia trachomatis* infection and cervical carcinoma. *Int J Cancer* 2002; 101: 371-4.
6. Choi JH, Jeung IC, Pak YG, Park DC. Prevalence and risk factors of *Chlamydia trachomatis* and *Neisseria gonorrhea* among Korean women. *Korean J Obstet Gynecol* 2007; 50: 1739-46.
7. Farley TA, Hadler JL, Gunn RA. The syphilis epidemic in Connecticut: relationship to drug use and prostitution. *Sex Transm Dis* 1990; 17: 163-8.
8. Cates W Jr, Wasserheit JN. Genital chlamydial infections: epidemiology and reproductive sequelae. *Am J Obstet Gynecol* 1991; 164: 1771-81.
9. Harwell TS, Trino R, Rudy B, Yorkman S, Gollub EL. Sexual activity, substance use, and HIV/STD knowledge among detained male adolescents with multiple versus first admissions. *Sex Transm Dis* 1999; 26: 265-71.
10. Centers for Disease Control and Prevention (US). 2011 Sexually transmitted diseases surveillance [Internet]. Available at http://www.cdc.gov/std/stats11/corrections.htm [accessed on 25 September 2016].
11. Centers for Disease Control and Prevention (US). 2014 Sexually transmitted diseases surveillance. Available at http://www.cdc.gov/std/stats14/adol.htm [accessed on 25 September 2016].
12. Lee SJ, Cho YH, Kim CS, Shim BS, Cho IR, Chung JI, Lee JG, Kim ME. Screening for chlamydia and gonorrhea by strand displacement amplification in homeless adolescents attending youth shelters in Korea. *J Korean Med Sci* 2004; 19: 495-500.
13. Friberg J, Gnarpe H. Mycoplasmas in semen from fertile and infertile men. *Andrologia* 1974; 6: 45-52.
14. O'leary WM. Ureaplasmas and human disease. *Crit Rev Microbiol* 1990; 17: 161-8.
15. Keck C, Gerber-Schäfer C, Clad A, Wilhelm C, Breckwoldt M. Seminal tract infections: impact on male fertility and treatment options. *Hum Reprod Update* 1998; 4: 891-903.
16. Deguchi T, Yoshida T, Miyazawa T, Yasuda M, Tamaki M, Ishiko H, Maeda S. Association of *Ureaplasma urealyticum* (biovar 2) with nongonococcal urethritis. *Sex Transm Dis* 2004; 31: 192-5.
17. Anagrius C, Loré B, Jensen JS. *Mycoplasma genitalium*: prevalence, clinical significance, and transmission. *Sex Transm Infect* 2005; 81: 458-62.
18. Waites KB, Katz B, Schelonka RL. Mycoplasmas and ureaplasmas as neonatal pathogens. *Clin Microbiol Rev* 2005; 18: 757-89.
19. Huppert JS, Mortensen JE, Reed JL, Kahn JA, Rich KD, Hobbs MM. *Mycoplasma genitalium* detected by transcription-mediated amplification is associated with *Chlamydia trachomatis* in adolescent women. *Sex Transm Dis* 2008; 35: 250-4.
20. Shipitsyna E, Krasnoselskikh T, Zolotoverkhaya E, Savicheva A, Krotin P, Domeika M, Unemo M. Sexual behaviours, knowledge and attitudes regarding safe sex, and prevalence of non-viral sexually transmitted infections among attendees of youth clinics in St. Petersburg, Russia. *J Eur Acad Dermatol Venereol* 2013; 27: e75-84.
21. Jaworski BC, Carey MP. Development and psychometric evaluation of a self-administered questionnaire to measure knowledge of sexually transmitted diseases. *AIDS Behav* 2007; 11: 557-74.
22. Choe HS, Lee DS, Lee SJ, Hong SH, Park DC, Lee MK, Kim TH, Cho YH. Performance of Anyplex™ II multiplex real-time PCR for the diagnosis of seven sexually transmitted infections: comparison with currently available methods. *Int J Infect Dis* 2013; 17: e1134-40.
23. Lee SY, Lee HJ, Kim TK, Lee SG, Park EC. Sexually transmitted infections and first sexual intercourse age in adolescents: the nationwide retrospective cross-sectional study. *J Sex Med* 2015; 12: 2313-23.
24. Stamm WE. *Chlamydia trachomatis* infections: progress and problems. *J Infect Dis* 1999; 179 Suppl 2: S380-3.
25. Choi JY, Cho IC, Lee GI, Min SK. Prevalence and associated factors for four sexually transmissible microorganisms in middle-aged men receiving general prostate health checkups: a polymerase chain reaction-based study in Korea. *Korean J Urol* 2013; 54: 53-8.

26. Kim SJ, Lee DS, Lee SJ. The prevalence and clinical significance of urethritis and cervicitis in asymptomatic people by use of multiplex polymerase chain reaction. *Korean J Urol* 2011; 52: 703-8.
27. Castillo Mezzich A, Tarter RE, Giancola PR, Lu S, Kirisci L, Parks S. Substance use and risky sexual behavior in female adolescents. *Drug Alcohol Depend* 1997; 44: 157-66.
28. Slater C, Robinson AJ. Sexual health in adolescents. *Clin Dermatol* 2014; 32: 189-95.
29. Ministry of Justice (KR). 2014 Crime Prevention Policy Bureau statistics in Korean [Internet]. Available at http://www.cppb.go.kr/ [accessed on 30 September 2016].

https://doi.org/10.3346/jkms.2017.32.11.1771