


The Prevalence of Sexually Transmitted Infections and Sociosexual Behaviors in the South Korean Military Before and During the COVID-19 Pandemic

Tae Hoon Oh, MD*,†; Jong Hyun Baeck, MD*; Seung Ryeol Lee, MD, PhD*; Dong Soo Park, MD, PhD*; Young Dong Yu, MD *

ABSTRACT

Introduction:

This study evaluated the epidemiological factors of sexually transmitted infections (STIs) among South Korean troops including the prevalence, therapeutic methods, and sexual risk behaviors.

Material and Methods:

The medical records of the STIs diagnosed troops at the Armed Forces Capital Hospital (AFCH) for 36 months (between January 2018 and December 2020) were retrospectively reviewed. The data collection for the study began after obtaining research approvals from the institutional ethics committee of AFCH. The patients were classified into two subgroups, pre-coronavirus disease 2019 (COVID-19) and COVID-19 groups. The clinical parameters of the patients including STI-related symptoms and underlying diseases were analyzed. The sociosexual conduct of the two study groups was evaluated and compared by using a survey questionnaire.

Results:

Overall, 138 STI patients with mean age of 21.2 years were included (pre-COVID-19: 106 patients/COVID-19: 32 patients). 32.6% of the patients received college education before the military service. Regarding previous history of STIs, 24 patients (17.4%) had previous experience of STIs, which occurred before participation in the current study. Initial urine analysis results showed that 95 (68.8%) and 79 patients (57.2%) showed pyuria and bacteriuria, respectively. *Neisseria gonorrhoeae* (29.7%) was the most commonly identified pathogen. Each pathogen was treated with the therapies recommended by the current treatment guidelines, and no patient showed any recurrence of the disease during follow-up. Both pre-COVID-19 (91.5%) and COVID-19 (93.8%) groups showed high rates of binge drinking during off-duty. The pre-COVID-19 group had a greater number of patients (21.7%) having multiple sex partners (during the past 12 months) than the COVID-19 group (15.6%). The COVID-19 group had 18.8% of the troops involved in sexual activity even after the onset of STI-related clinical symptoms, whereas the rate was significantly higher than 2.8% of the pre-COVID-19 group ($P = .001$). The COVID-19 groups showed a significantly higher number of patients (four patients, 12.5%) experiencing suicidal ideation than the pre-COVID-19 group (two patients, 1.9%) ($P = .010$). Both groups showed <40% of condom use rates at the last sexual intercourse.

Conclusion:

The soldiers with STIs showed high rates of binge alcohol consumption, while the rates of engaging in safe sex by using condoms are markedly low. Although the COVID-19 group was under influence of social distancing and military base lockdown, the soldiers' sociosexual conduct was not significantly different in the pre-COVID-19 group. The importance of education on alcohol misuse and safe sexual relationships should be taken more seriously within the military.

INTRODUCTION

Throughout the long-standing history, sexually transmitted infections (STIs) have been one of the potential and persistent problems of the military around the world. Even some historical literature provide the evidence of gonorrhea outbreak

among the Roman soldiers who fought for Julius Caesar.¹ Moreover, STIs generally used to be found in mostly male troops or their civilian sexual partners, but it affects both male and female troops with similar incidences in nowadays.² The STIs in the military cause significant deterioration of potential military power and substantial healthcare costs.³ There are several etiological factors or characteristics contributing relatively high prevalence of STIs in military such as young and sexually active, physically fit, lower socioeconomic status and continuous exposure to circumstantial risks with hegemonic forms of masculinities.⁴ Although several studies evaluated the sexual behavior and STI risk factors in the military, most of the studies were performed for the U.S. military personnel, and these studies often accompanied limitations regarding the spectrum of cohort evaluation

*Department of Urology, College of Medicine, CHA University, Bundang CHA Hospital, Seongnam, Korea

†Department of Urology, Armed Forces Medical Command, Armed Forces Capital Hospital, Seongnam, Korea

The authors have no conflicts of interest with any institutions or products. No financial support was received by any author.

doi:<https://doi.org/10.1093/milmed/usab479>

© The Association of Military Surgeons of the United States 2021. All rights reserved. For permissions, please e-mail: journals.permissions@oup.com.

period.⁵ Few researchers assessed STI rates and sexual behaviors in the military during the lockdown. Since the pandemic outbreak of coronavirus disease 2019 (COVID-19), the life patterns of people all over the world have changed beyond recognition. The medical resources of the military have been actively used to assist civilian medical hospitals, which were out of their capacities.⁶ In many countries, both military and civilian societies have been placed under some sort of lockdown orders in an effort to prevent or minimize COVID-19 spread by achieving intensive social distancing.^{6,7} For example, nationwide lockdown (between March 17, 2020 and May 11, 2020) resulted in 81% reduction of the average COVID-19 reproductive number in France, which was from 3.18 [before lockdown, 95% confidence interval (CI), 3.09-3.24] to 0.68 [after lockdown, 95% CI, 0.66-0.69].⁷ Many countries including South Korea reached the effects of protective measures to the military by initiating base lockdowns and temporary prohibition on travel for troops.⁸ The absence of prior knowledge regarding COVID-19 limited the predictions for social restriction effects on the military health and behavioral aspects. Furthermore, the impact of the restrictions on risk factors of STIs among military personnel is generally unknown. To our knowledge, few studies analyzed the epidemiological factors of STIs among the South Korean troops even before the COVID-19 pandemic.

This study evaluated the epidemiological factors of STIs among South Korean troops, including the prevalence, therapeutic methods, and sociosexual behaviors before and during COVID-19, to find out the influence of pandemic on the military health system. Furthermore, the study also tried to take a novel approach to gender-related education systems within the South Korean military, which might lead to gaining better insights into the areas that potentially need intervention.

METHODS

Study Design and Cohort

The medical records of the South Korean troops who visited the Armed Forces Capital Hospital (AFCH) and clinically diagnosed as STIs between January 2018 and December 2020 (total 36 months) were retrospectively reviewed. Among the troops diagnosed with STIs at AFCH, only active duty soldiers undertaking legally obligated national duty of defense were included in the study. The data collection for the study began after obtaining research approvals from the institutional ethics committee of AFCH. All study subjects completed the written informed consent regarding permission to use their clinical records and sociosexual behavior questionnaire results. Data collection and clinical procedures performed for the study strictly followed relevant guidelines and regulations. All cohorts had at least 6 months of follow-up. The clinical parameters of the patients included in the study were urine analysis results, STI-related clinical symptoms, underlying diseases, and previous history of STIs.

The patients were classified into two subgroups regarding the time of STI diagnosis, which were pre-COVID-19 and COVID-19. The time period of “pre-COVID-19” was defined as January 2018 to December 2019 as the first lockdown order from the South Korean ministry of defense to regulate COVID-19 spread in the military was activated in January 2020.

Specimen Collection and Pathogen Analysis

Urine samples were obtained from all study patients by collecting midstream voiding urine. From the subjects showing urethral discharge, urethral swab samples were collected by removing secretions around urethral meatus with a sterile cotton swab. For the urine and urethral discharge samples collected, a multiplex real-time PCR assay was used to detect the presence of 12 different STI pathogens including *Treponema pallidum* (TP), *Neisseria gonorrhoeae* (NG), *Chlamydia trachomatis* (CT), *Trichomonas vaginalis* (TV), *Mycoplasma hominis* (MH), *Mycoplasma genitalium* (MG), *Gardnerella vaginalis* (GV), Herpes simplex virus (HSV)-1 and -2, *Candida albicans* (CA), *Ureaplasma urealyticum* (UU), and *Ureaplasma parvum* (UP). All study cohorts also underwent serologic tests for syphilis and HIV infection by performing rapid protein reagin (RPR) test and the 4th-generation enzyme immunoassays, respectively. The patients who were found to be reactive by RPR tests underwent additional confirmatory tests with fluorescent treponemal antigen-absorption test. The patients with genital warts had the lesions removed by surgical excision, and the specimen was subjected to real-time-PCR human papilloma virus testing and conventional pathological analysis.

Antibiotic Susceptibility Testing

The patients who were tested positive for NG, MG, UU, or UP underwent routine antimicrobial susceptibility testing as those pathogens often encounter resistance to the antibiotics suggested from the treatment guidelines.⁹ For the other STI pathogens, clinical therapies recommended by the recent treatment guidelines were performed without antibiotic susceptibility testing. To define the antibiotic sensitivity of NG, the Clinical Laboratory Standards Institute disc diffusion method was performed for the following antibiotics: azithromycin, spectinomycin, doxycycline, ofloxacin, ciprofloxacin, and ceftriaxone. By measuring the annular radius of the inhibition zones for each antibiotic, the results were interpreted and categorized as sensitive, intermediate, and resistant. For MG, UU, and UP, a commercially available liquid culture medium-based *Mycoplasma* species antimicrobial susceptibility testing kit was used, whereas antibiotic resistance was defined by interpreting the color alteration of media. The antimicrobials used for susceptibility testing were as follows: ciprofloxacin, ofloxacin, tetracycline, doxycycline, azithromycin, clarithromycin, josamycin, pristinamycin, and erythromycin.

Sexual and Social Behavior Evaluation

Among the patients visiting the urology clinic of AFCH, the patients with STI-related symptoms have been asked to complete the sociosexual conduct questionnaire since year 2017 for the purpose of sexual risk management in the military. The survey was voluntary and anonymous as the soldiers taking the survey were not required to write their names and military serial numbers. All of the troops included in this study also voluntarily completed a sociosexual survey questionnaire during their visit to the clinic. The survey was anonymous as the soldiers were not required to write their personal information, which can identify them, such as name and military serial number. The questionnaire consisted of multiple-choice questions encompassing in total seven domains, assessing (a) education level, (b) marital status, (c) number of years in the military service, rank and service branch, (d) military service–or individual life-related psychological distress, (e) alcohol consumption pattern, (f) sexual activity–related potential risks including previous STI history, and (g) patterns of sexual activities including homosexual or group sex activity. The survey results were collected and retrospectively analyzed to evaluate sociosexual conduct of the troops.

Statistical Analysis

Mean and proportions were applied for presentation of categorical parameters. Mann–Whitney tests and Student t-tests were performed to evaluate the clinical and behavioral differences between two study groups. As the study subjects showed significant differences in basic characteristics, propensity score matching was performed to adjust the collected data. The propensity scores were evaluated by undertaking non-parsimonious and multivariate logistic regression analyses regarding basic characteristics including age, service branch, military rank, time in the military service, education level, and previous medical history of STIs. After statistical adjustments, 26 patients of the pre-COVID-19 group were successfully matched to 26 patients of the COVID-19 group by using the nearest neighbor matching method with 95% power and a two-sided probability of .05. All statistical evaluations were performed by using the SPSS package version 24.0 (SPSS Inc., Chicago, IL, USA), and *P*-values <.05 were considered statistically significant.

RESULTS

Patient Characteristics

The baseline demographics of the study cohort are presented in Table I. Overall, 138 STI patients with mean age of 21.2 years were included in the study. Among the patients, 106 patients (76.8%) and 32 patients (23.2%) were categorized as pre-COVID-19 and COVID-19 groups, respectively. Due to the national legislation of South Korea drafting only young males for compulsory military service (18-22 months), no female subject was involved in the study. The majority of the subjects belonged to Army (109 patients, 78.9%) as more

TABLE I. Baseline Characteristics of Soldiers Diagnosed with STIs (*n* = 138)

Parameters	Values
Age (years), mean ± SD	21.2 ± 0.9
Gender, <i>n</i> (%)	
Male	138 (100.0)
Female	0 (0.0)
Military rank, <i>n</i> (%)	
Private first class	16 (11.6)
Private	33 (23.9)
Corporal	62 (37.7)
Sergeant	37 (26.8)
Service branch	
Army	109 (78.9)
Navy	2 (1.5)
Air Force	27 (19.6)
Period in the military service (months), mean (range)	15.7 (4.0-17.3)
Education level, <i>n</i> (%)	
High school graduate	93 (67.4)
College education (time-off for military service)	45 (32.6)
Marital status	
Single, never married	138 (100.0)
Married	0 (0.0)
Divorced	0 (0.0)
Abnormal urine analysis results, <i>n</i> (%)	
Pyuria	95 (68.8)
Microscopic hematuria	31 (22.5)
Bacteriuria	79 (57.2)
Previous history of STIs	24 (17.4)
Underlying disease	
Congenital urogenital anomaly	0 (0.0)
Hypertension	0 (0.0)
Diabetes mellitus	0 (0.0)

STIs; sexually transmitted infections.

than half of the South Korean Armed Forces consist of Army troops. Regarding the service time and military ranks of the study subjects, the mean duration of service was 15.7 months (range 4-17.3 months), whereas corporal was the most common rank of the patients (62 patients, 37.7%). Only 32.6% of the cohort (45 patients) received college education before joining the military. No study subject was ever married before and during the military service, and all of the study patients did not have any underlying disease such as hypertension, diabetes mellitus, or congenital urogenital anomaly. However, 24 patients (17.4%) had previous experience of STIs, which occurred before participation in the current study. According to the initial urine analysis results, 95 (68.8%) and 79 patients (57.2%) showed pyuria and bacteriuria, respectively.

Types of STIs and Treatments

The types of diagnosed STI pathogens, related clinical symptoms, and therapies are shown in Table II. NG and TP were the two most commonly identified STI pathogens with infections of 41 patients (29.7%) and 29 patients (21.0%), respectively. There was no patient diagnosed with UP, HIV, CA, and pubic lice. Among the cohorts, the prevalence rate for each

TABLE II. STIs and Related Clinical Symptoms ($n = 138$)

STI type	Treatment period	Patients		Treatment methods
		<i>n</i>	%	
Neisseria gonorrhoeae	Overall	41	29.7	Intravenous ceftriaxone 1 g, once + oral azithromycin 1 g, once
	Pre-COVID-19	31/41	75.6	
	COVID-19	10/41	24.4	
Treponema pallidum	Overall	29	21.0	Intramuscular benzathine penicillin G 2.4 million IU, once
	Pre-COVID-19	21/29	72.4	
	COVID-19	8/29	27.6	
Trichomonas vaginalis	Overall	17	12.3	Oral metronidazole 2 g, once
	Pre-COVID-19	10/17	58.8	
	COVID-19	7/17	41.1	
Chlamydia trachomatis	Overall	15	10.9	Oral azithromycin 1 g, once
	Pre-COVID-19	11/15	73.3	
	COVID-19	4/15	26.7	
HPV (condyloma)	Overall	15	10.9	Mass excision and CO ₂ LASER ablation
	Pre-COVID-19	10/15	66.7	
	COVID-19	5/15	33.3	
Ureaplasma urealyticum	Overall	10	7.2	Oral doxycycline 100 mg, 2 times/day, for 7 days
	Pre-COVID-19	7/10	70.0	
	COVID-19	3/10	30.0	
HSV (type 1 and 2)	Overall	6	4.3	Oral famciclovir 250 mg, 3 times/day, for 7 days + 5% acyclovir ointment, 5 times/day, for 7 days
	Pre-COVID-19	4/6	66.7	
	COVID-19	2/6	33.3	
Mycoplasma genitalium	Overall	5	3.6	Oral doxycycline 100 mg, 2 times/day, for 7 days
	Pre-COVID-19	4/5	80.0	
	COVID-19	1/5	20.0	
Ureaplasma parvum	Overall	0	0.0	N/A
HIV	Overall	0	0.0	N/A
Candida albicans	Overall	0	0.0	N/A
Scabies (pubic lice)	Overall	0	0.0	N/A
Clinical symptoms				
Urethral discharge		68	49.2	
Genital wartz		15	10.9	
Rash or other skin lesions in genitalia		33	23.9	
Pain in genitalia		73	52.9	N/A
Pruritis in genitalia or peri-genital area		12	8.7	
Voiding urethral pain		98	71.0	
Fever and myalgia		3	2.2	

Abbreviations: HIV: human immunodeficiency virus; HPV: human papillomavirus; HSV: herpes simplex virus; STIs: sexually transmitted infections.

pathogen was similar before and during COVID-19. Regarding the treatment of STIs, each pathogen was treated with the therapies recommended by the most recent and relevant treatment guidelines,^{10,11} and no patient showed any recurrence of the disease during follow-up. Among the study patients, a total of 15 patients were diagnosed with genital warts (condyloma), and these patients underwent surgical removal of the warts followed by CO₂ LASER ablation for the purpose of bleeding control and more radical resection. Regarding STI-related clinical symptoms, voiding pain (98 patients, 71.0%), pain in genitalia (73 patients, 52.9%), and urethral discharge (68 patients, 49.2%) were the three most commonly occurred symptoms.

Antibiotics Susceptibility Analysis

Among the entire study cohorts, 41 patients, 5 patients, and 10 patients were diagnosed with NG, MG, and UU, respectively.

These patients routinely underwent antimicrobial susceptibility testing, and the test results are presented in [Table III](#). According to the antibiotic sensitivity test results, ceftriaxone was the most active antimicrobial with the lowest resistance rate (0.0%) for treating NG, whereas quinolone antibiotics (ofloxacin and ciprofloxacin) were resistant in all NG infection cases. Regarding the antibiotic susceptibility profiles of MG and UU, josamycin, pristinamycin, tetracycline, and doxycycline presented effective therapeutic outcomes with 100.0% of sensitivity rates.

Social and Sexual Behaviors

The social and sexual behaviors of the study cohorts are presented in [Table IV](#). Regarding alcohol consumption, both pre-COVID-19 (91.5%) and COVID-19 (93.8%) groups showed high rates of binge drinking during off-duty, while off-duty was defined as staying overnight outside military base

TABLE III. Antibiotic Sensitivity for STI Pathogens

Antibiotics	Pathogens, <i>n</i> (%)		
	Neisseria gonorrhoeae (<i>n</i> = 41)	Mycoplasma genitalium (<i>n</i> = 5)	Ureaplasma urealyticum (<i>n</i> = 10)
Azithromycin			
Sensitive	38 (92.7)	2 (40.0)	3 (30.0)
Intermediate	1 (2.4)	0 (0.0)	1 (10.0)
Resistant	1 (2.4)	3 (60.0)	6 (60.0)
Clarithromycin			
Sensitive	N/A	2 (40.0)	1 (10.0)
Intermediate		1 (20.0)	1 (10.0)
Resistant		2 (40.0)	8 (80.0)
Josamycin			
Sensitive	N/A	5 (100.0)	10 (100.0)
Intermediate		0 (0.0)	0 (0.0)
Resistant		0 (0.0)	0 (0.0)
Spectinomycin			
Sensitive	35 (85.3)	N/A	N/A
Intermediate	4 (9.8)		
Resistant	2 (4.9)		
Pristinamycin			
Sensitive	N/A	5 (100.0)	10 (100.0)
Intermediate		0 (0.0)	0 (0.0)
Resistant		0 (0.0)	0 (0.0)
Erythromycin			
Sensitive	N/A	2 (40.0)	0 (0.0)
Intermediate		0 (0.0)	3 (30.0)
Resistant		3 (60.0)	7 (70.0)
Tetracycline			
Sensitive	N/A	4 (80.0)	9 (90.0)
Intermediate		1 (20.0)	0 (0.0)
Resistant		0 (0.0)	1 (10.0)
Doxycycline			
Sensitive	0 (0.0)	5 (100.0)	10 (100.0)
Intermediate	0 (0.0)	0 (0.0)	0 (0.0)
Resistant	41 (100.0)	0 (0.0)	0 (0.0)
Ofloxacin			
Sensitive	0 (0.0)	1 (20.0)	2 (20.0)
Intermediate	0 (0.0)	0 (0.0)	1 (10.0)
Resistant	41 (100.0)	4 (80.0)	7 (70.0)
Ciprofloxacin			
Sensitive	0 (0.0)	0 (0.0)	2 (20.0)
Intermediate	0 (0.0)	0 (0.0)	0 (0.0)
Resistant	41 (100.0)	5 (100.0)	8 (80.0)
Ceftriaxone			
Sensitive	41 (100.0)	N/A	N/A
Intermediate	0 (0.0)		
Resistant	0 (0.0)		

Abbreviations: STIs: sexually transmitted infections; N/A: not applicable.

for more than 1 day. The pre-COVID-19 group demonstrated 96.2% of the troops using alcoholic drinks at the last sexual intercourse, which were slightly higher than 93.8% of the COVID-19 group. Regarding psychological distress, the COVID-19 groups showed a significantly higher number of patients (four patients, 12.5%) experiencing suicidal ideation due to military service- or personal life-related stress compared with the pre-COVID-19 group (two patients, 1.9%) ($P = .010$). However, statistical significance

of the differences regarding suicidal ideation between the two groups was lost after propensity matching. According to the pre-adjustment results regarding sexual risks, both study groups had no patient engaged in unwanted sexual contact or group/homosexual activity. Only 38.7% and 34.4% of the patients had condom use at the last sexual contact among the pre-COVID-19 group and COVID-19 group, respectively ($P = .661$). The pre-COVID-19 group had a greater number of patients (21.7%) having multiple sex partners (during the past 12 months) than the COVID-19 group (15.6%), but the difference was statistically insignificant ($P = .456$). Among the COVID-19 group, 18.8% of the troops involved in sexual activity even after the onset of STI-related clinical symptoms. This value was significantly higher than 2.8% of the pre-COVID-19 group ($P = .001$). Both study groups showed a majority of the patients having regular, non-spouse partners at the last sexual intercourse (pre-COVID-19: 89.6%, COVID-19: 75.0%). The COVID-19 group showed a slightly greater number of patients (25.0%) undergoing one-night-stand experience at the last sexual intercourse compared with the pre-COVID-19 group (10.4%). However, both groups had no patient involved in sexual contact with a sex worker. After propensity matching, no significant differences were observed between the two study groups in terms of sexual risks and partner type at the last sexual contact.

DISCUSSION

The current study retrospectively reviewed young South Korean soldiers who were diagnosed with STIs. Moreover, this study also researched social and sexual behavioral patterns of the troops before and during COVID-19. To our knowledge, this is the first study evaluating the prevalence of STIs and sociosexual conduct among the South Korean soldiers.

During the whole 36 months of study period, overall, 138 troops were diagnosed with STIs, and they received proper therapies suggested from the current treatment guideline of the related disease. We do not believe the number of patients included in the study represents all the cases of STIs that occurred in the South Korean military in this same time frame as some soldiers with STIs might have underwent treatments at civilian medical clinics or military hospitals other than AFCH. Thus, the prevalence of STIs within the South Korean troops could be higher than the values described in this study. Although our study results are indicating important public health issues within the military, the results should not be interpreted as implications of the gender-specific nature of STIs risks as no female military personnel was included in the study.

According to our study results, an increase in the number of military service years could be related to the risks of STIs as 64.5% of the study subjects were ranked as either corporal or sergeant. Furthermore, only 32.6% of the study subjects received college education before joining military service, which is relatively lower than the college entrance

TABLE IV. Sexual and Social Behavior Pattern (n = 138)

	Before propensity matching			After propensity matching		
	Pre-COVID-19 (n = 106)	COVID-19 (n = 32)	P-value	Pre-COVID-19 (n = 26)	COVID-19 (n = 26)	P-value
Alcohol use, n (%)						
^{a,b} Binge drinking during off-duty	97 (91.5)	30 (93.8)	.683	23 (88.5)	24 (92.3)	.641
Alcohol use at the last sexual contact	102 (96.2)	30 (93.8)	.549	25 (96.2)	24 (92.3)	.556
Sexual risks, n (%)						
Condom use at the last sex	41 (38.7)	11 (34.4)	.661	9(34.6)	10(38.5)	.775
Unwanted sexual contact (forced by others)	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
^c Multiple sex partners, past 12 months	23 (21.7)	5 (15.6)	.456	6 (23.1)	4 (15.4)	.486
Involved in sex after onset of STI-related symptoms	3 (2.8)	6 (18.8)	.001	1 (3.8)	4 (15.4)	.162
Partner type at the last sex, n (%)			.036			.163
Spouse	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Regular, non-spouse	95 (89.6)	24 (75.0)		23 (88.5)	19 (73.1)	
One-night stand, not a sex worker	11 (10.4)	8 (25.0)		3 (11.5)	7 (26.9)	
Sex worker	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Engaged in group or homosexual activity, n (%)	0 (0.0)	0 (0.0)	N/A	0 (0.0)	0 (0.0)	N/A
Psychological distress (work- or personal life-related)						
Suicide ideation	2 (1.9)	4 (12.5)	.010	2 (7.7)	4 (15.4)	.390
Suicide attempt	0 (0.0)	0 (0.0)	N/A	0 (0.0)	0 (0.0)	N/A

^aOff-duty indicates staying overnight outside military base for ≥ 1 day.

^bBinge drinking is defined by consuming more than five standard drinks (1 standard drink = 350 cc/1 can of 5% beer) during each day of off-duty time.

^cMultiple sex partner: ≥ 2 sex partners.

P-values written in bold characters indicate statistically significant numbers.

N/A: not applicable.

rates of general Korean civilian population, as more than 70% of the high school graduates go to college every year over the last decade.¹² These results are similar with previous studies evaluating STI risks in the U.S. military.¹³ Deiss et al.¹³ reviewed 92,000 cases of military personnel data stored in the U.S. Defense Medical Surveillance System, and they found an association between increasing number of years of service and escalating rates of experiencing STIs. Another sexual behavior-related study, which analyzed a total of 812 Ethiopian military personnel (808 males, four females), described that fewer years of education is related to increased STI risks such as lack of HIV risk perception.¹⁴ These recent research outcomes including our study results strongly suggest that ongoing education regarding STIs should be undertaken to the troops throughout their national military service time to minimize the rate of STIs.

The current study results presented no patient among the cohorts having recurrence after the initial treatments, which indicates no presence of significant pathogen-specific antimicrobial resistance. Routine antibiotics susceptibility tests were performed for only three types of STI pathogens, which are NG, MG, and UU, because the STI pathogens' antimicrobial susceptibility testing kits available at AFCH were directed against either *Neisseria* or *Mycoplasma* species. Moreover, the rates of resistance to the guideline suggested primary antimicrobial therapies among *Neisseria* and *Mycoplasma* species are relatively higher than the other STI pathogens, and indeed, routine antimicrobial susceptibility testing is not strongly recommended for some STI pathogens such as TP.¹⁰

There are previous studies that evaluated the antibiotic resistance profile of *Mycoplasma* or *Ureaplasma* species.^{15,16} A recent study by Song et al.¹⁶ showed that *Ureaplasma* species have significantly low levels of resistance for tetracyclines, which is similar to our current study results (0.0% resistance rates for tetracycline and doxycycline).

Although previous studies testing newer nucleoside analogs tried radial eradication of HSV infections, HSV still has very high recurrence rates in infected patients.¹⁷ The current study results presented no HSV recurrence cases after the initial treatment, but these successful therapeutic outcomes might have resulted mainly from good post-treatment general hygiene care rather than the quality of the initial therapy itself. Therefore, we suggest military hospitals should regularly educate the troops on general hygiene care. Among the cohorts, NG infection was the most commonly observed pathogen-specific diagnosis, which was consistent with the STI prevalence profile of the general Korean civilian populations.¹⁸ Our study results demonstrate the impact of NG on sexual health of young Korean soldiers and directly highlight the continuous need for STI prevention.

The current study results regarding sociosexual conduct of the troops showed that markedly high rates of binge drinking, which was over 90% of the cohorts, were observed during off-duty time. Moreover, most of them had their last sexual contact under influence of alcohol. Another noticeable result of this study is that the rates of binge drinking among the cohort did not decrease during the COVID-19 period while

social lockdown and distancing measures were implemented in the whole country. We believe these values might not be applicable to general Korean military population because the alcohol dependency rates are usually higher in the STI patients compared with general healthy population.^{19–21} A study of O'Hara and colleagues²⁰ studied 1,867 urban participants and surveys were performed regularly up to 5 times over a 15-year period. They have demonstrated that adolescent sexual risk-taking behavior was directly associated with binge drinking habits in young adulthood for white males. Moreover, Berry et al.²¹ reviewed 43 articles and demonstrated the association between alcohol intoxication and HIV sexual risk. Thus, diminishing the binge drinking rates of the soldiers might lead to subsequent reduction of STIs prevalence. The rates of condom use in our study were less than 40%, whereas previous studies from other countries also demonstrated younger military personnel with a relatively lower tendency of self-protection such as using condoms during sexual intercourse.^{22,23} Although it was a statistically insignificant difference, our study results showed slightly higher proportions of soldiers involved in sexual activity even after the onset of STI-related symptoms during the COVID-19 period compared with the pre-COVID-19 period. A recent study evaluated stress levels and patterns of 285 South Korean soldiers undertaking legal duty of national defense and presented that psychological stress levels might influence the soldiers' life adjustment in the military.²⁴ The results were similar to previous studies based on the U.S. military, which consisted of voluntary recruits.²⁵ In terms of psychological distress of the current study cohort, unadjusted data of this study presented the COVID-19 group had greater rates of suicide ideation among the troops compared with the pre-COVID-19. A feasible explanation for these results can be limited off-duty time due to military base lockdown probably caused significantly greater amount of psychological distress, which might have interfered with the ability to maintain normal sociosexual behaviors of the troops. Qualitative studies with a greater sample size are still needed to clearly define the relationship between mental distress and STI risks in the military. Nevertheless, the current study results still imply that the importance of education on alcohol misuse should be taken more seriously in the military. Although majority of the current study cohorts reported sexual engagement with regular sex partners, some soldiers committed in one-night stand whereas the rates increased during COVID-19. Several previous studies also presented the association between individual's psychological distress and sexual relationship or STI risk in the military.^{26,27} Thus, we believe structural interventions such as education on safer sex behaviors and STI reduction should be extended to all military personnel. In addition, leadership messages from military doctors and high-ranking officers encouraging consistent condom use with all sex partners should be emphasized. Frequent screening of STIs for high-risk military personnel such as the soldiers undergoing lengthy deployments or recent off-duty after long time base

lockdown/quarantine could be another practical option for the military.

There are several limitations to the current study. The retrospective nature of this study limited clinical data collection from only AFCH that consecutively produced a relatively small cohort size. Thus, the prevalence of STIs and pathogen-specific diagnoses might be underestimated or overestimated, which indicates further evaluation with a larger cohort size should be performed in the future investigations. Moreover, the social and sexual behavior-related information is susceptible to self-reporting bias. Due to the fear of punishment from the military, soldiers on active military service might be reluctant to disclose sensitive personal information including psychological distress or alcohol misuse. Nonetheless, for the purpose of minimizing the bias, the survey was conducted anonymously by using a paper-based survey questionnaire in an isolated circumstance with no surveillance. In addition, the post-adjustment data analysis showed that no significant differences were present between the two study groups, and this discrepancy between pre- and post-adjustment results was probably due to the small study sample size of post-adjustment data. A relatively large difference in pre-adjustment sample size between the two study groups might be also another contributing factor to these statistical results. Thus, further analysis with a larger sample size and longer follow-up time should be undertaken to make definite confirmation regarding the effect of COVID-19 pandemic on sociosexual conduct of the troops.

Although there are some limitations, this study still carries strengths of evaluating the prevalence of STIs and related sociosexual conducts in the South Korean troops for the first time.

CONCLUSIONS

NG was the most commonly observed STI pathogen among the South Korean troops. Increasing number of years in military service might be associated with STI risk. The reported STI cases showed no definite resistance to the current treatment guidelines for STIs. The soldiers with STIs showed high rates of binge alcohol consumption, while the rates of engaging in safe sex by protecting themselves with condoms are markedly low. Although the COVID-19 group was under the influence of social distancing and military base lockdown, the soldiers' sociosexual conduct was not significantly different than that in the pre-COVID-19 group. The long-standing lockdown period might have increased the psychological distress of the troops, with a greater number of soldiers experiencing suicidal ideation during the COVID-19 period, but further evaluations with larger cohorts are still required to make definite confirmation on this matter.

ACKNOWLEDGMENTS

The authors wish to acknowledge all participating investigators.

FUNDING

This research was neither funded nor supported by any institution or organization.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest (both financial and non-financial interests) with any institutions or products. No financial support was received by any author. The corresponding author is responsible for submitting a competing financial interest statement on behalf of all authors of the paper.

AUTHOR CONTRIBUTIONS

Tae Hoon Oh designed the study, analyzed and interpreted the clinical data, and wrote and revised the manuscript. Seung Ryeol Lee and Dong Soo Park analyzed and interpreted the clinical data. Jong Tae Hoon Oh and Hyun Baek collected the clinical data and engaged in patient follow-up. Young Dong Yu designed/supervised the project and revised the manuscript. All the listed authors have participated actively in the study. All authors read and approved the final manuscript.

REFERENCES

1. Jose PP, Vivekanandan V, Sobhanakumari K: Gonorrhoea: historical outlook. *History* 2020; 2(2): 110–4.
2. Korzeniewski K, Juszczak D, Paul P: Sexually transmitted infections in the military environment. *Int Marit Health* 2020; 71(3): 207–12.
3. Gaydos JC, McKee KT, Gaydos CA: The changing landscape of controlling sexually transmitted infections in the U.S military. *MSMR* 2013; 20(2): 2–4.
4. Duron S, Panjo H, Bohet A, et al: Prevalence and risk factors of sexually transmitted infections among French service members. *PLoS One* 2018; 13(4): e0195158.
5. Hakre S, Oyler RJ, Ferrell KA, et al: Chlamydia trachomatis infection rates among a cohort of mobile soldiers stationed at Fort Bragg, North Carolina, 2005-2010. *BMC Public Health* 2014; 14(1): 181.
6. Kalkman JP: Military crisis responses to COVID-19. *J Contingencies Crisis Manage* 2021; 29(1): 99–103.
7. Domenico LD, Pullano G, Sabbatini CE, et al: Impact of lockdown on COVID-19 epidemic in Île-de-France and possible exit strategies. *BMC Med* 2020; 18(1): 240.
8. Segal D, Rotschild J, Ankory R, et al: Measures to limit COVID-19 outbreak effects among military personnel: preliminary data. *Mil Med* 2020; 185(9-10): e1624–31.
9. Lee JY, Yang JS: Prevalence and antimicrobial susceptibility of *Mycoplasma hominis* and *Ureaplasma* species in nonpregnant female patients in South Korea indicate an increasing trend of pristinamycin-resistant isolates. *Antimicrob Agents Chemother* 2020; 64(10): e01065–20.
10. Workowski KA: Centers for disease control and prevention sexually transmitted diseases treatment guidelines. *Clin Infect Dis* 2015; 61(Suppl 8): S759–62.
11. Cyr SS, Barbee L, Workowski KA, et al: Update to CDC's treatment guidelines for gonococcal infection, 2020. *Morb Mortal Wkly Rep* 2020; 69(50): 1911–6.
12. Korean Education Statistics Service, Statistics of College Entrance Rate: published on 2 March 2021. Available at <https://kess.vedi.re.kr>; accessed July 1, 2021
13. Deiss R, Bower RJ: Edgie co: the association between sexually transmitted infections, length of service and other demographic factors in the U.S. military. *PLoS One* 2016; 11(12): e0167892.
14. Weldesenbet A, Abdosh T, Tefera T, et al: Sexual risk behavior among military personnel stationed in Eastern Ethiopia: using mixed methods approaches. *HIV Curr Res* 2018; 3(1): 2.
15. Kotrotsiou T, Exindari M, Diza E, et al: Prevalence and antimicrobial susceptibility of *Ureaplasma urealyticum* in asymptomatic women in Northern Greece. *Hippokratia* 2013; 17(4): 319–21.
16. Song T, Huang J, Liu Z, et al: Antibiotic susceptibilities and genetic variations in macrolide resistance genes of *Ureaplasma* spp. isolated in China. *New Microbiol* 2019; 42(4): 225–7.
17. Birkmann A, HZimmermann H: HSV antivirals - current and future treatment options. *Curr Opin Virol* 2016; 18(1): 9–13.
18. Korean Association of Urogenital Tract Infection and Inflammation, 2016: *Korean Guideline of Sexually Transmitted Infections*. Korea Centers for Disease Control and Prevention, 2016.
19. Boden JM, Fergusson DM, Horwood LJ: Alcohol and STI risk: evidence from a New Zealand longitudinal birth cohort. *Drug Alcohol Depend* 2011; 113(2-3): 200–6.
20. O'Hara RE, Cooper ML: Bidirectional associations between alcohol use and sexual risk-taking behavior from adolescence into young adulthood. *Arch Sex Behav* 2015; 44(4): 857–71.
21. Berry MD, Johnson MW: Does being drunk or high cause HIV sexual risk behavior? A systematic review of drug administration studies. *Arch Sex Behav Pharmacol Biochem Behav* 2018; 164: 125–38.
22. Stahlman S, Javanbakht M, Cochran S, et al: A comparison of self-reported sexual risk behaviours between US civilian and active duty military women. *Sex Health* 2015; 12(3): 272–5.
23. Harbertson J, Vera KD, Scott PT, et al: Longitudinal survey of condom use across a US Navy and Marine Corps shipboard deployment. *BMJ Open* 2019; 9(6): e028151.
24. Ha JH, Jue J, Jang YJ: The relationship between army soldiers' perceived stress and army life adjustment: focusing on the mediating effect of stress response and the moderating effect of cohesion. *Mil Med* 2020; 185(9-10): e1743–9.
25. Ja W, Olson J, Df P, et al: The role of natural support systems in the post-deployment adjustment of active duty military personnel. *Am J Community Psychol* 2015; 56(1-2): 69–78.
26. Boyd MA, Bradshaw W, Robinson M: Mental health issues of women deployed to Iraq and Afghanistan. *Arch Psychiatr Nurs* 2013; 27(1): 10–22.
27. Stahlman S, Javanbakht M, Cochran S: Self-reported sexually transmitted infections and sexual risk behaviors in the U.S. military: how sex influences risk. *Sex Transm Dis* 2014; 41(6): 359–64.