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Prevalence and risk factors of *Chlamydia trachomatis* genital infection among military personnel of the Armed Forces of Serbia: a cross-sectional study

Prevalencija i faktori rizika od genitalne infekcije koju uzrokuje *Chlamydia trachomatis* među pripadnicima Vojske Srbije: studija preseka

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Abstract

Background/Aim. *Chlamydia trachomatis* infection (CTI) is an increasing public health problem worldwide and is the most frequent sexually transmitted infection. Studies conducted in many armed forces worldwide showed that CTI is common within military population and generate significant healthcare costs. The aim of this study was to estimate the prevalence of CTI among members of the Serbian Armed Forces (SAF) and to determine risk factors for this infection. **Methods.** The study was designed as a cross-sectional survey and consisted of completing a questionnaire and chlamydial testing. The questionnaire was divided into two question groups: one was about demographic/service related characteristics and the other was about behavioral patterns/habits. *Chlamydia trachomatis* real time polymerase chain reaction (Real-TM PCR) was used for detection of pathogen genome specific sequence in the male urethral swabs and in the female endocervical swabs. All data collected were used to compare military personnel with and without CTI. Risk factors independently associated with CTI were identified by the stepwise multivariate logistic regression analysis (MLRA) of variables selected by the univariate logistic regression analysis (ULRA), with a limit for entering and removing variables from the model at 0.05. **Results.** The overall prevalence of CTI was 55 of 356 respondents (15.4%; 95% CI 0.5–2.7%). The ULRA identified that CTI was significantly associated with several characteristics: number of sexual partners during previous year ($p = 0.008$), knowledge about symptoms of CTI ($p = 0.035$), tattooing ($p = 0.035$) and married or in stable relationship ($p = 0.022$). The MLRA revealed that number of different sexual partners during last year was independent risk factor of CTI ($p = 0.026$; OR : 0.344; 95% CI: 0.13–0.88). **Conclusion.** CTI is significant problem in male and female military personnel in the SAF. The number of different sexual partners during previous year was independently associated with CTI. These finding indicates that screening for CTI should be undertaken in the SAF, to reduce rates of CTI in the SAF and to prevent morbidity due to this infection.

Key words:
chlamydia trachomatis; reproductive tract infections; military personnel; risk factors; prevalence; serbia.

Apstrakt

Uvod/Cilj. Infekcija sa *Chlamydia trachomatis* (ICT) je rastući javno zdravstveni problem širom sveta i predstavlja najučestaliju polno prenosivu infekciju. Istraživanja u mnogim vojskama su pokazala da je ova infekcija česta i među pripadnicima vojne populacije i da čini značajan udeo u troškovima njihovog lečenja. Cilj ove studije je bio da istraži učestalost ICT među pripadnicima Vojske Srbije (VS), kao i da definiše faktore rizika od ICT. **Metode.** Studija je koncipirana kao studija pre-

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seka. Ispitanici su popunjavali epidemiološki upitnik i bili su testirani na prisustvo ICT. Upitnik je bio podeljen na dve grupe pitanja: o demografskim podacima i podacima u vezi sa vojnom službom, kao i pitanja o ponašanju i navikama ispitanika. Za dokazivanje ICT u uretralnom brisu muškaraca, odnosno endocervikalnom brisu žena korišćen je *real-time polymerase chain reaction* (Real-TM PCR). Svi prikupljeni podaci su korišćeni za poređenje ispitanika sa i bez ICT. Faktori rizika nezavisno povezani sa ICT su identifikovani multivarijantnom logističkom regresionom analizom (MLRA) varijabli identifikovanih u univarijantnoj logističkoj regresionoj analizi (ULRA) (korišćene varijable sa $p \leq 0,05$). **Rezultati.** Ukupna prevalencija ICT u ispitivanoj populaciji je iznosila 55 od 356 ispitanika (15,4%; 95% CI 0,5–2,7%). ULRA je pokazala da su sa ovom infekcijom statistički značajno povezani: broj različitih seksualnih partnera u prethodnih godinu dana ($p = 0,008$), znanje o simptomima ICT ($p = 0,35$), tetoviranje ($p = 0,035$) i brak ili stabilna veza ($p = 0,022$). MLRA je otkrila da je broj različitih seksualnih partnera u prethodnih godinu dana nezavisni factor rizika od ICT ($p = 0,026$; OR: 0,344; 95% CI: 0,13–0,88). **Zaključak.** ICT je značajan zdravstveni problem za pripadnike VS oba pola. Broj različitih seksualnih partnera tokom prethodnih godinu dana je nezavisno povezan sa ovom infekcijom. Rezultati studije ukazuju na opravdanost uvođenja periodičnog skrininga na ICT kod svih pripadnika VS, što bi dovelo do smanjivanja učestalosti ove infekcije, kao i preveniranja njenih komplikacija.

Ključne reči:
chlamydia trachomatis; polni organi, infekcije; kadar, vojni; faktori rizika; prevalenca; srbija.

Introduction

Chlamydia trachomatis infection (CTI) is an increasing public health problem worldwide and the most frequent sexually transmitted infection (STI) [1, 2]. According to the data of the World Health Organization (WHO), there are about 131 million new infections yearly [1]. CTI is common both in men and women and with the highest rates among 20–24 years olds, followed by 15–19 years olds [2, 3].

The main mode of transmission of CTI is through sexual contact, including vaginal, anal and oral sex. In addition, CTI can be transmitted from mother to child during pregnancy and childbirth [2].

CTI can be detected in urogenital system, but a site of infection could also be the eye, pharynx and rectum [4].

Urogenital infection in both sexes most commonly presents with urethritis, characterized by dysuria and urethral discharge. Left untreated, it can lead to serious complications such as cervicitis, chronic pain, ectopic pregnancy and infertility in women as well as epididymitis, prostatitis and proctitis in men [5, 6].

In typical cases, adult chlamydial eye infection manifests as follicular conjunctivitis, characterized by mucopurulent discharge, redness and foreign body sensation. About 80% of these patients have concurrent urogenital infections [7]. Neonatal conjunctivitis develops in 20%–50% of babies born to mothers with chlamydial cervical infection and can lead to focal corneal neovascularisation, scarring, pannus formation, and chronic conjunctivitis [8].

Pharyngeal CTI can cause pharyngitis and lymphadenitis [9]. Rectal CTI can cause rectal pain, bleeding and discharge as well as proctitis [4]. Pharyngeal and rectal infections are most common among women and men who have sex with men [4].

CTI is curable with effective single-dose regimens of antibiotics [1]. However, a major concern with CTI is that most patients are asymptomatic. Some studies estimated that only about 10% of men and 5%–30% of women with laboratory-confirmed CTI develop symptoms [10, 11]. Moreover, in absence of symptoms the majority of extragenital infections are undiagnosed, untreated, and, as a result, remain important reservoir for further CTI transmission [4].

The Center for Disease Control and Prevention (CDC) recommends annual screening for CTI in all sexually active women younger than 25 years. Women older than 25 years as well as all sexually active men, should be screened if they are at a risk (current STI, new or multiple sex partners, inconsistent condom use, drug use, commercial sex work, and/or high community prevalence of STIs, etc.) [5].

Studies conducted in the Armed Forces of Poland [12], Estonia [13], Brazil [14], Israel [15], Slovenia [16] and the United States of America [17], shown that CTI is common within military population. High rates of CTI among military population generate significant healthcare costs in the armies [18].

Until now, there has been no study about prevalence and risk factors (RF) for CTI among members of the Serbian Armed Forces (SAF). The aim of this study was to estimate the prevalence of among members of the the SAF and to determine RF for this infection.

Methods

Study design

The study was designed as a cross-sectional survey and performed during January–June 2016. Participation in the study was voluntary and all participants gave written consent. The study consisted of completing the questionnaire and chlamydial testing. The Research Ethics Board of the Military Medical Academy (MMA) Belgrade, Serbia approved the research protocol.

Study population

The study was undertaken in eight barracks across Serbia: Sombor, Belgrade, Niš, Valjevo, Vranje, Pančevo, Zaječar and Požarevac. Approximately, 1,500 soldiers who were present in the barracks were given an educational briefing about CTI and after that they were invited to enroll in

the study. A total of 356 members of the SAF volunteered to participate in the study. Exclusion criteria were subjects that had been taking antibiotics within six weeks prior to chlamydial testing, urinating two hours before sample collection and currently diagnosed with CTI.

Data collection

The participants completed a self-administered questionnaire. The questionnaire was divided into two parts. The first part consisted of demographic and service related characteristics: gender, age, marital status, military rank, service/branch, years of service in the army and participation in peacekeeping missions. The second part of questionnaire asked questions about behavioral patterns and habits: age at first sexual intercourse, number of sexual partners during last year, lifetime number of sexual partners, multiple sexual partners (more than one sexual partners at the same period of time), sexual intercourse at first meeting, sexual workers as sexual partners, frequency of condom use, habits related to alcohol consumption, smoking, tattooing, knowledge about symptoms of CTI and regularity of gynecological examinations for the female participants. All data collected were used to compare military personnel with and without CTI.

Laboratory procedures and treatment

Chlamydia trachomatis real-time polymerase chain reaction (Real-TM PCR) kit (Sacace Biotechnologies) was used for detection of pathogen genome specific sequence in the male urethral swabs as well as in the female endocervical swabs. This test is based on the real-time hybridization-fluorescence detection (exquisitely sensitive and highly specific). CTI positive military personnel were given antibiotics and were retesting for 6 weeks after the therapy. Also, they were advised that all their sexual partners should be treated from CTI.

Statistical analysis

Data analyses were performed with the SPSS, version 18. The prevalence was defined as a number of the CTI positive participants per 100 tested. To test the statistical significance of the difference, the χ^2-test was used. The odds ratio (OR) and its respective 95% confidence interval (CI) for each variable were calculated. The RF independently associated with CTI were identified by the stepwise multivariate logistic regression analysis (MLRA) of the selected variables by the univariate logistic regression analysis (ULRA), with a limit for entering and removing variables from the model at 0.05.

Results

Demographic and service related information

A total of 356 respondents participated in the study, with 306 (85.9%) male participants and 50 (14.1%) females. Overall, the study population median age was 30.9 years (range 19–59 years). Majority of the study participants, [230 (64.6%)] were married or in long-term, stable relationships while others were single. The participants had different ranks and most often they were contract soldiers [117 (32.9%)], or officers [79 (22.2%)]. More than a half of the respondents [187 (52.5%)] had 5 or fewer years in service, while 118 (33.1%) were in the military service more than 10 years. The distribution of their service/branches were as follows: 199 (55.9%) of them were in the Army, 137 (38.5%) in Logistics, 73 (20.5%) and 20 (5.6%) in the Air Force. Only 12 (3.4%) respondents participated in the peacekeeping operations.

Prevalence of the CTI

The overall prevalence of CTI was 55 of 356 resodents (15.4%; 95% CI 0.5-2.7%). *Chlamydia trachomatis* specific genome sequence was detected in the 7 of 50 endocervical swabs (14%) and in 48 (15.7%) of 306 urethral swabs.

Risk factors

The ULRA identified that CTI was significantly associated with several characteristics: number of sexual partners during previous year ($p = 0.008$), knowledge about symptoms of CTI ($p = 0.035$), tattooing ($p = 0.035$) and being married or in stable relationship ($p = 0.022$).

Other demographic and service related characteristics (Table 1) as well as behavioral patterns and habits (Table 2) were not significantly associated with CTI.

After entering the significant variables into the MLRA, a number of different sexual partners during last year significantly interact with other selected parameters and was an independent RF of CTI (Table 3).

A characteristic that was examined only for female participants in the study, was regularity of the gynecological examinations. Among 43 CTI negative female participants 42 (97.7%) had regular gynecological examinations, at least once per year, while 1 (2.3%) CTI negative female participant had the gynecological examination only occasionally. Among 7 CTI positive female participants, 4 (57.1%) had the regular gynecological examinations and 3 (42.9%) had them occasionally ($p = 0.007$; OR: 0.032; 95%CI: 0.003–0.381).

Discussion

We found a prevalence rate of CTI of 15.4% among the members of the SAF. This CTI prevalence is higher than previously reported in the most of other studies conducted within the military population, noting the prevalence ranging from 2.5%–9.5% [13, 15, 19, 20]. Our results were similar to a large survey among female military recruits conducted in the United States of America in 1997. This survey showed that the CTI prevalence was 10% –15% of recruits from New Jersey, North Carolina, Kentucky, Texas, Oklahoma and Arkansas and more than 15% of recruits from South Carolina, Georgia, Alabama, Louisiana and Mississippi [21].

Table 1

Demographic and service related characteristics associated with *chlamidia trachomatis* infections (CTI)

Characteristics	CTI negative n = 301 n (%)	CTI positive n = 55 n (%)	*p*	OR	95% CI	
					lower	upper
Sex						
male	258 (85.7)	48 (87.3)	0.760	1.143	0.485	2.690
female	43 (14.3)	7 (12.7)				
Age, (years)						
≤ 20	13 (4.3)	2 (3.6)	0.429	0.821	0.146	4.606
21–30	141 (46.8)	32 (58.2)	0.822	1.210	0.467	3.138
31–40	115 (38.3)	15 (27.3)	0.694	0.696	0.250	1.938
≥ 41	32 (10.6)	6 (10.9)	0.488			
Stable relationship	202 (67.1)	28 (50.9)	0.022	0.508	0.284	0.908
Rank						
officer	66 (21.9)	13 (23.6)	0.571	1.379	0.454	4.183
NCOs	58 (19.4)	5 (9.1)	0.449	0.603	0.163	2.233
contract soldier	95 (31.6)	22 (40.0)	0.365	1.621	0.570	4.612
civilian serviceman	20 (6.7)	2 (3.6)	0.686	0.700	0.124	3.946
conscript soldier	47 (15.6)	8 (14.6)	0.243	2.074	0.609	7.060
cadets	35 (11.6)	5 (9.1)				
Service/branch						
army	167 (55.5)	32 (58.2)	0.853	1.058	0.581	1.927
air Force	18 (6.0)	2 (3.6)	0.533	0.614	0.132	2.843
logistics	116 (38.5)	21 (38.2)				
Years in service						
≤ 5	159 (52.8)	28 (50.9)	0.581	1.209	0.616	2.373
6–10	39 (13.0)	12 (21.8)	0.082	2.113	0.909	4.913
≥ 11	103 (34.2)	15 (27.3)				
Peacekeeping missions	9 (3.0)	3 (5.5)	0.359	1.872	0.490	7.145

OR – odds ratio; CI – confidence interval.

Table 2

Sexual behavior patterns and habits associated with *chlamidia trachomatis* infections (CTI)

Sexual behaviour	CT negative (n = 301) n (%)	CT positive (n = 55) n (%)	*p*	OR	95% CI	
					lower	upper
Age at first sexual intercourse (years)						
≤ 15	32 (10.6)	11 (20.4)	0.102	1.765	0.732	4.256
16–18	192 (63.8)	28 (51.8)	0.206	0.749	0.379	1.479
≥ 19	78 (25.6)	15 (27.8)	0.404			
No of sexual partners during last year						
≤ 1	181 (59.8)	25 (46.3)	0.008	0.250	0.104	0.602
2–5	103 (34.3)	19 (35.2)	0.002	0.332	0.133	0.829
≥ 6	18 (5.9)	10 (18.5)	0.018			
No of lifetime sexual partners						
≤ 1	18 (5.6)	3 (5.6)	0.350	0.667	0.176	2.528
2–10	165 (54.8)	27 (50.0)	0.551	0.618	0.320	1.196
11–20	51 (16.9)	6 (11.1)	0.153	0.444	0.444	1.199
≥ 21	68 (22.7)	18 (33.3)	0.109			
Multiple sexual partners	156 (51.8)	27 (50.0)	0.709	0.896	0.504	1.593
Sexual intercourse at first meeting	135 (44.8)	29 (52.7)	0.282	1.372	0.771	2.440
Sexual workers as sexual partner	23 (7.6)	6 (10.9)	0.418	1.480	0.573	3.821
Condom use			0.626			
regularly	64 (21.3)	10 (18.2)	0.399	0.699	0.304	1.606
occasionally	152 (50.5)	26 (47.3)	0.419	0.765	0.400	1.463
never	85 (28.2)	19 (34.5)				
Alcohol consumption	269 (86.0)	50 (90.9)	0.331	1.622	0.611	4.301
Smoking	111 (36.8)	16 (29.1)	0.269	0.702	0.375	1.315
Tattooing	38 (12.6)	13 (23.6)	0.035	2.142	1.054	4.353
Knowledge about symptoms of CTI						
yes	22 (7.3)	9 (16.4)	0.035	3.273	1.085	9.871
no	223 (74.1)	39 (70.9)	0.442	1.399	0.594	3.294
don't know	56 (18.6)	7 (12.7)				

OR – odds ratio; CI – confidence interval.

Table 3

Multivariant logistic regression

Number of sexual partners during last year	Wald	*p*	OR	95% CI	
				lower	upper
≤ 1	4.928	0.026	0.344	0.134	0.883
2–5	5.232	0.022	0.335	0.131	0.855
≥ 6	1.796	0.180	0.447		

OR – odds ratio; CI – confidence interval.

Our study shows that the prevalence among female participants was 14% and among male was 15.7%. Although the data from the WHO [1] and CDC [5] as well as from some studies the military populations [17, 22–24] indicate that CTI is more common among females, our investigation showed different results. One possibility could be due to the fact that only 14% of our study population were females. Also, the prevalence of CTI among males is underestimated since there was no regular screening on CTI among males worldwide. With the increased availability of the urine testing, men are increasingly being tested for CTI in the last several years [20]. During 2010–2014, the CTI in men increased for 22%, compared with 6% increase in women during this period [6].

The studies conducted in the military populations showed considerable variations in determining the RF for CTI. For example, a study conducted among female military recruits in the US Army [21] showed that the young age was associated with CTI both in the ULRA and MLRA. Similar results are also found in a number of other studies [17, 18, 22]. In our study, the age was not significant RF, but still had the highest CTI prevalence in the population younger than 30 years.

The ULRA identified that CTI was significantly associated with several characteristics of our respondents: number of sexual partners during the previous year, knowledge about symptoms of CTI, tattooing, being married or in a stable relationship.

The respondents who were married, or in a stable relationship, had significantly lower risk for CTI than those who were single ($p = 0.022$, OR: 0.508, 95% CI: 0.284–0.908). Similar results were found in the studies conducted among military populations by Jordan et al. [17] and Barnett and Brundage [25]. Respondents who were in a stable relationship had same sexual partner for a long period of time and were not at risk of acquiring CTI. This explanation is even more reasonable when we know that other significant RF associated with CTI was number of different sexual partners during last year (Table 2). A protective factor for acquiring CTI was lower number of sexual partners. Compared with those who had more than five sexual partners during last year, those with one sexual partner had OR: 0.250; 95% CI: 0.104-0.602.

The MLRA for independently significant RF also showed that number of different sexual partners during the previous year was still stable and significantly interacted with other selected parameters.

A significant connection also existed between CTI and tattooing (12.6% *vs* 23.6%; $p = 0.035$; OR: 2.142; 95% CI: 1.054–4.353). Since tattooing is associated with the transmission of CTI, a possible explanation may be a result of behavior. Tattooing is allowed for members of the SAF, but it is not common. Therefore, we can assume that among military population in Serbia, the tattooed people have tendency to express other forms of risky behavior. A possible reason for this correlation between CTI and tattooing could be that reporting tattoo is culturally acceptable, but could indicate a more riskier form of behavior.

Those who had knowledge about CTI symptoms were significantly more frequent in the group of respondents with CTI (16.4% *vs* 7.3%; $p = 0.035$, OR: 3.273, 95% CI: 1.085–9.871). We did not find any studies conducted in the military populations that examine the connection between knowledge about CTI symptoms and the risk of acquiring it, but there are several studies that show that health education is important in the prevention of HIV/AIDS as well as other STIs [26–28].

Finally, the women who regularly had the gynecological exams were in a lower risk for CTI than the women who did those exams occasionally (97.7% *vs* 57.1%; $p = 0.007$; OR: 0.032; 95% CI 0.003–0.381). Based on these data, it seems that the regular gynecological exams are protective factors against acquiring CTI. Of course, that is not case, and probable explanation is that women who regularly visit their gynecologist have more chance that CTI will be recognized and diagnosed, or less chance to accidentally find out their CTI status.

Some studies show that failures to use condoms were significantly associated with CTI [14, 24]. In our study, as well as in a study among the Male College Reserve Officer Training Corp Cadets [19], irregular condom use was not a significant RF for CTI. This data could not be interpreted alone (for those who have only one sexual partner, the irregular condom use is not a RF for any STIs) and they still could indicate that self-reported sexual-risk histories are not always valid.

When compared to different services/branches in the SAF, the highest CTI prevalence was found in the Army (16.1%) and the lowest among members of the Air Force (10%). This is in accordance with the study conducted among the U.S. Active Duty Service members in period 2000–2008 [17].

Peacekeeping operations did not significantly increase a risk for CTI among members of the SAF. Similar results were published in the study conducted among the U.S. military personnel deployed to Iraq and Afghanistan. The rates of CTI in this population were the same or lower than age- and year-matched U.S. rates reported by the CDC [23].

The aim of our research was to determine the CTI prevalence and RF in male and female military personnel of different ages, ranks, services/branches and years of active ser-

vice. Also, our study had a wide geographic sampling (eight barracks across Serbia). Because of that, the results of our study could be used as a recommendation for preventive measures and screening for the whole SAF.

Our study had two limitations. First, we did not collect samples for diagnosing extragenital CTIs. Another limitation was that we choose urogenital and endocervical swabs as samples for urogenital CTI detection (high sensitivity and high specificity). It is possible that some of our volunteers actually had some symptoms and because of that volunteered for painful swab collection. First limitation could lead to underestimation and other limitation could lead to overestimation of the CTI prevalence among the military population in the SAF. Consequently, more research on CTI in the the SAF military population is required.

Conclusion

CTI is significant problem in male and female military personnel in the SAF. The number of different sexual partners during the previous year was independently associated with CTI. These finding indicates that screening for CTI should be undertaken in the SAF. A screening program should be developed for all military personnel at the entry to the SAF as well as for the periodic rescreening. Such screening program has the potential to reduce rates of CTI in the SAF and to prevent morbidity due to this infection. In addition, the military should increase the prevention programming and knowledge about SII`s that encourages STI screening.

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