Trends of Gonorrhea and Chlamydial Infection during 1985–1996 among Active-Duty Soldiers at a United States Army Installation

Arlene C. Seña,[1] William C. Miller,[1,2] Irving F. Hoffman,[1] Hrishikesh Chakraborty,[1] Myron S. Cohen,[1] Pamela Jenkins,[3] and Kelly T. McKee, Jr.[4]

From the [1]Division of Infectious Diseases and [2]Department of Epidemiology, University of North Carolina, Chapel Hill; [3]Henry M. Jackson Foundation, and [4]Preventive Medicine Services, Womack Army Medical Center, Fort Bragg, North Carolina

High rates of sexually transmitted diseases (STDs) have been reported in military populations. However, it remains uncertain whether the incidence of STDs is higher among military personnel than in the civilian population. The annual incidence of gonorrhea and chlamydia from 1985 through 1996 at Fort Bragg, North Carolina, was determined by use of a clinic database and demographic information for the entire installation. A direct standardization for age, sex, and race/ethnicity was performed, and the adjusted annual rates among active duty soldiers were compared with rates among men and women in North Carolina and the United States. Results showed that the adjusted incidence of gonorrhea and chlamydia among Fort Bragg soldiers remained higher overall than comparable state and national rates during the period of analyses. The 1996 adjusted chlamydia rates for male and female active duty soldiers were 3-fold to 6-fold higher than rates for males and females in North Carolina and in the United States as a whole. STDs continue to lead to significant morbidity in this representative military population.

Sexually transmitted diseases (STDs) have historically been problematic in the military setting. During World War I, STDs were documented as a significant cause of lost duty time among United States forces [1, 2]. High rates of STDs among military recruits and active duty personnel were recognized during World War II, prompting the creation of the Venereal Disease Control Branch of the US Public Health Service [3]. As late as the 1970s, during the Vietnam War, venereal disease was listed as the number one diagnosis in the Army's monthly morbidity reports [1]. More recently, high rates of STDs have been documented among military recruits [4] and various military populations [5–8] in the absence of armed conflict. However, it remains uncertain whether the incidence of STDs among persons in the military during peacetime is higher than in the civilian population.

Military personnel may acquire STDs during deployment in foreign countries. The introduction of antibiotic-resistant strains of *Neisseria gonorrhoeae* after overseas deployment was first recognized in the 1960s [9]. Multiple sexual contacts with sex workers and inconsistent use of condoms have been reported as high-risk behaviors for STD acquisition during deployment [10]. Previous studies among military personnel suggest that young, nonwhite, unmarried soldiers are at greatest risk for acquiring STDs [11] and HIV infection [12, 13].

The development of HIV/STD prevention strategies for military personnel requires an understanding of the epidemiology of STDs in this population. In order to elucidate the scope of STD-related morbidity in the military, we determined STD trends among a population of active-duty soldiers. Although STD rates among military personnel have been recently reported, no previous studies have provided a comparison of rates between military and civilian populations over time. We examined the annual incidence of gonorrhea and chlamydia from 1985 through 1996 at Fort Bragg, North Carolina, 1 of the US Army's largest fixed facilities, and compared the STD rates among this military population with state and national trends during the same time period.

Methods

Study population. Fort Bragg, located adjacent to Fayetteville, North Carolina, in the southeast section of the state, is home to

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Reprints or correspondence: Dr. Arlene C. Seña, Division of Infectious Diseases, CB #7030, 547 Burnett-Womack Building, University of North Carolina, Chapel Hill, NC 27599 (idrod@med.unc.edu).

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~40,000 active-duty soldiers dispensed in rapidly deployable conventional, airborne, and special operations units. With the exception of transient fluctuations at the outset of the Gulf War in 1990, the number and demography of active-duty soldiers have remained relatively constant over the past 15 years, constituting a dynamic population at steady state. The demographic distribution of active-duty personnel for the installation is shown in table 1.

The study population was composed of male and female active-duty soldiers who presented to the Epidemiology and Disease Control (EDC) Clinic of Womack Army Medical Center at Fort Bragg from 1985 through 1996. The EDC Clinic is the principal provider of STD services at Fort Bragg. The clinic averages 4800 visits per year by patients with new STD-related concerns. Approximately 70% of STD-related visits are by active-duty personnel; the other visits are by spouses, other dependents, and retirees.

Data collection. The EDC Clinic at Fort Bragg maintains a database on all persons seen for STD-related complaints from October 1984 to the present. Information from a standardized clinic form, obtained routinely from all persons presenting with a new STD-related problem, is computer-coded and entered into this centralized database. The tabulated information includes a unique identification code, demographic data, reason for visit, condom and contraceptive use, presenting symptoms, physical examination findings, suspected diagnosis, and treatment. Any subsequent laboratory results, corrections to diagnoses made at the initial visit, additional treatment, and follow-up visits are added as necessary to the computerized record.

Outcome measures. A diagnosis of gonorrhea was defined in this study by the presence of gram-negative intracellular diplococci on a gram stain, growth of *N. gonorrhoeae* on Thayer-Martin culture medium, or both. Chlamydial infection was defined by a positive test for *Chlamydia trachomatis* by EIA (Syva Microtrak, San Jose, CA).

Essentially all male and female patients who presented to the EDC Clinic for a new visit (see definition below) from 1985 through 1996 were screened for *N. gonorrhoeae* by culture. Gram stains of urethral swabs were performed routinely for men. Routine screening for *C. trachomatis* among patients presenting for a new visit was not fully implemented in the clinic until 1991. Therefore, we identified visits associated with a diagnosis of gonorrhea from 1985 through 1996 and visits associated with a diagnosis of chlamydia from 1991 through 1996. Visits associated with a chlamydia diagnosis were analyzed for the latter period only, since most patients with chlamydia were probably included under the diagnosis of nongonococcal urethritis before 1991.

Data analysis. We extracted all new visits by active-duty soldiers from the EDC Clinic database for the 12-year period 1985–1996. A new visit was defined as an initial visit by a new patient or a subsequent visit by a patient with a problem distinct from that at the previous clinic encounter: thus >1 visit per year might be included for a given study patient.

Incidence rates of gonorrhea were estimated for each year from 1985 through 1996. Rates for chlamydia were determined for 1991–1996. We estimated the annual incidence rate as the number of cases detected in the clinic during a given year, divided by the active-duty population of Fort Bragg for the same time period, times 1 year. Incidence rates were calculated separately for men and women.

Table 1. Demographic characteristics of the active-duty population at Fort Bragg, North Carolina, in 1996.

Characteristic	% of total population
Sex[a]	
Male	89.3
Female	10.7
Age, y[b]	
15–19	4.5
20–24	34
25–29	25.3
30–34	17.6
⩾35	17.7
Race/ethnicity	
White, non-Hispanic	62.2
Black	23.8
Hispanic	5.5
Other	8.6

[a] Sex of 1% of the total population was unknown.
[b] Age of 0.9% of the total population was unknown.

To facilitate comparisons between Fort Bragg population and the North Carolina and United States civilian populations, we used direct standardization to adjust the incidence rates for any potential differences in age and race/ethnicity distribution between these populations. Separate standardized procedures were performed for men and women. Estimates of the United States population in 1996, which were back-calculated from reported gonorrhea and chlamydia rates and number of cases for the same year [14], were applied as standard populations for the adjustments. Standardization and calculation of 95% CIs were performed by use of STATA, version 5.0 (STATA, College Station, TX).

Direct standardization was performed by multiplying age- and sex-specific Fort Bragg rates by the United States population for that stratum and then dividing the sum of the adjusted rates by the sum of the United States population. Gonorrhea and chlamydia rates were adjusted for male active-duty soldiers, and chlamydia rates were adjusted for female soldiers. Standardization was not performed for gonorrhea rates among female soldiers since their cases represented ⩽10% of the total reported annually during the study period. Standardized rates were calculated for gonorrhea for 1985–1996 and for chlamydia for 1991–1996.

Direct standardization was likewise performed on gonorrhea and chlamydia data for North Carolina and the United States. The North Carolina data were obtained from cases and rates reported to the Centers for Disease Control and Prevention (CDC) and the North Carolina Branch of HIV/STD Prevention. Age and sex-specific North Carolina rates were multiplied by the United States population for that stratum, and the sum of the adjusted rates was divided by the sum of the United States population to provide a standardized rate. United States gonorrhea and chlamydia rates were obtained from the CDC [14] and were also adjusted by use of the 1996 United States population as the standard. However, only 1996 United States chlamydia data were available in stratified form by age, sex, and race/ethnicity, a circumstance that limited the comparison to that single year.

Results

Characteristics of the study population. In the years 1985–1996, there were a total of 42,160 visits to the EDC Clinic

by active-duty soldiers. The total number of visits per year to the EDC Clinic was relatively stable from 1985 through 1992. From 1992 through 1993, there was a 44% increase in clinic visits (from 3264 to 4712 per year); this number decreased to ~4000 by 1996 but remained well above that seen in earlier years.

Male soldiers accounted for 34,243 visits during the study interval (81.2% of the total). The modal age group for all clinic attendees was 20–24 years, and this age group accounted for 55.4% of all visits. The majority of clinic visits were by soldiers who were in the lower enlisted ranks (E1–E4: 47.3%) and single (61.2%). Over half (54.4%) of all clinic visits over the 12-year study period were by black active-duty soldiers. The main reason for most clinic visits during this period were symptoms.

Overall, 8493 cases of gonorrhea and 399 cases of gonococcal/chlamydial coinfections were diagnosed during 1985–1996 among Army soldiers seen at the EDC Clinic. During 1991–1996, 3288 cases of chlamydia were diagnosed among the same population.

Incidence of gonorrhea in men. Among male soldiers, the crude incidence of gonorrhea peaked in 1986 at 3000 cases per 100,000 person-years (p-y; 95% CI, 2830–3177; figure 1*A*). The following years witnessed a progressive decrease in incidence to 519 cases per 100,000 p-y (95% CI, 448–598) by 1996. Rates were consistently highest among the age groups of 15–19 and 20–24 years; the rates for these groups in 1996 were 771 cases per 100,000 p-y (95% CI, 410–1312) and 897 cases per 100,000 p-y (95% CI, 740–1077), respectively. Gradual declines in incidence were observed for all age groups over time. Wither respect to racial/ethnic groups, rates of gonorrhea were highest for black male soldiers. The crude incidence in this group decreased over the period 1985–1996, from 7488 cases per 100,000 p-y (95% CI, 6955–8052) to 1958 cases per 100,000 p-y (95% CI, 1664–2290).

After age and race adjustment, the incidence of gonorrhea among male soldiers was found to be substantially lower than the crude rate, but it remained generally higher than the adjusted incidence for men in North Carolina and the United States from 1985 through 1993 (figure 1*B*). The largest difference between adjusted rates at Fort Bragg and the state and national rates was evident in 1986, when the adjusted incidence of gonorrhea among male soldiers was 1070 cases per 100,000 p-y (95% CI, 948–1193). This was >2-fold greater than the adjusted statewide incidence for the same year (414 cases per 100,000 p-y; 95% CI, 406–422).

By 1994, the adjusted gonorrhea incidence at Fort Bragg decreased to levels that were similar to adjusted rates for North Carolina and for the United States. In 1996, the adjusted incidence of gonorrhea among male soldiers was 194 cases per 100,000 p-y (95% CI, 151–236), compared with 204 (95% CI, 199–209) and 166 cases per 100,000 p-y (95% CI, 165–167) for men in North Carolina and the United States, respectively.

Incidence of gonorrhea in women. The crude incidence of gonorrhea among female active-duty soldiers at Fort Bragg reached its highest level in 1985: 3034 cases per 100,000 p-y (95% CI, 2409–3771). There was a gradual decline over time; by 1996, the rate was 508 cases per 100,000 p-y (95% CI, 322–763). Because the number of cases per age or race stratum was small, no further analysis of these data was performed.

Incidence of chlamydia in men. Among men, the maximum crude incidence of chlamydial infection in 1993 was 1866 cases per 100,000 p-y (95% CI, 1728–2012; figure 2*A*). By 1996, the incidence decreased to 718 cases per 100,000 p-y (95% CI, 634–809). The incidence of chlamydia was highest for men aged

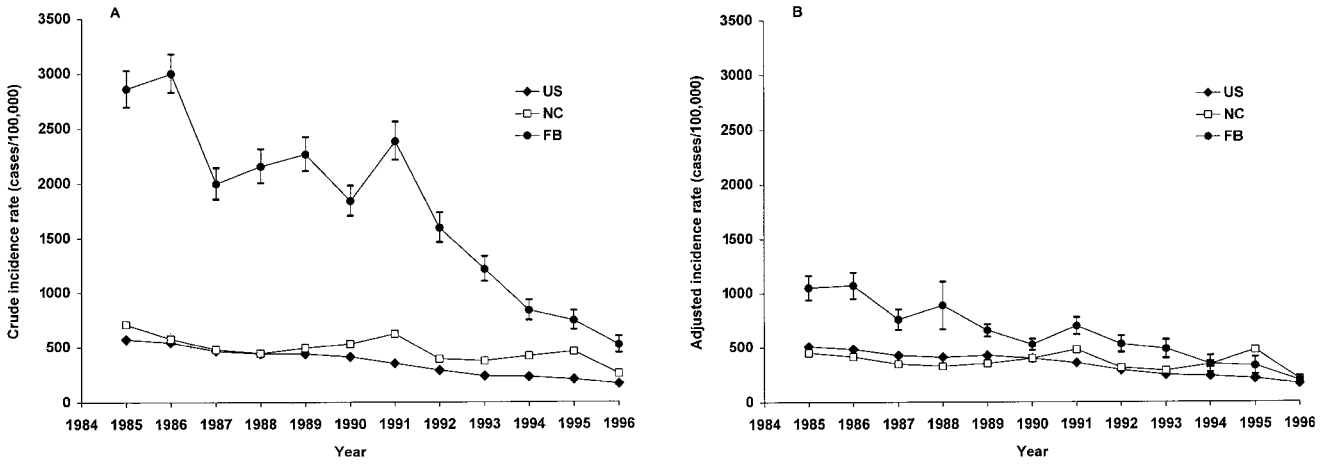

Figure 1. Annual incidence of gonorrhea among male active-duty soldiers at Fort Bragg *(FB),* North Carolina, compared with that among men in North Carolina *(NC)* and the United States *(US)* during 1985–1996. *A,* Crude incidence rates of gonorrhea. *B,* Incidence rates of gonorrhea after adjustment for age and race/ethnicity. The 95% confidence intervals are shown for the Fort Bragg data in both figures. Confidence intervals for the North Carolina and United States data were small and are not shown.

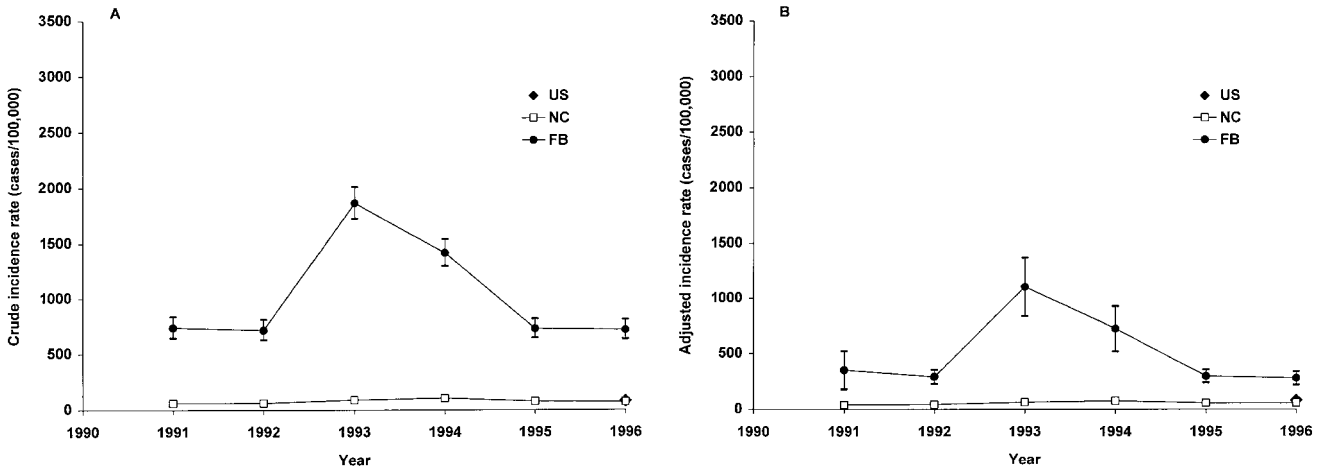

Figure 2. Annual incidence of chlamydia among male active-duty soldiers at Fort Bragg *(FB),* North Carolina, compared with that among men in North Carolina *(NC)* and the United States *(US)* during 1991–1996. *A,* Crude incidence rates of chlamydia. *B,* Incidence rates of chlamydia after adjustment for age and race/ethnicity. For the United States data, only those for 1996 were stratified by age, sex, and race/ethnicity [14], which limited the comparison to that single year. 95% CIs are shown for the Fort Bragg data in both figures. CIs for the North Carolina and United States data were small and are not shown.

20–24 years: in 1996, the crude incidence was 1353 cases per 100,000 p-y (95% CI, 1158–1571). The highest crude incidence of chlamydia throughout the study period was among black men. In 1996, the rate of chlamydial infection among black male soldiers was 1821 cases per 100,000 p-y (95% CI, 1538–2142).

After age and race adjustment, the incidence of chlamydia among male active-duty soldiers at Fort Bragg remained higher than the adjusted incidence for North Carolina throughout the 1991–1996 study period and the adjusted incidence for the United States for 1996 (figure 2*B*). In 1993, the adjusted incidence among male soldiers increased 4-fold from the previous year, to a rate of 1103 cases per 100,000 p-y (95% CI, 837–1369). The adjusted rate of chlamydia among male soldiers decreased to 277 cases per 100,000 p-y (95% CI, 218–336) in 1996 but was still 4 times greater than the rates for North Carolina and the United States, which were 65 (95% CI, 52–60) and 79 cases per 100,000 p-y (95% CI, 79–80), respectively.

Incidence of chlamydia in women. The crude incidence rate for female active-duty soldiers was 4342 cases per 100,000 p-y (95% CI, 3739–5014) in 1996 (figure 3*A*). Women aged 15–19 years had chlamydial infection at persistently high rates throughout the study period; in 1996, the rate was 17,225 cases per 100,000 p-y (95% CI, 12,067–23,846). Among black female soldiers the incidence of chlamydia between 1993 and 1996 was also high: in 1996, the rate was 5812 cases per 100,000 p-y (95% CI, 4802–6970).

The adjusted incidence among female soldiers at Fort Bragg was found to be 3- to 7-fold higher than the adjusted incidence for North Carolina during the 6-year period of analysis (figure 3*B*). In 1996, among female active-duty soldiers, the adjusted incidence of chlamydia was 2388 cases per 100,000 p-y (95% CI, 1510–3266), compared with 343 (95% CI, 333–352) and 373 cases per 100,000 p-y (95% CI, 372–374) for North Carolina and the United States, respectively.

Discussion

We examined the epidemiology of STDs in a representative military population by estimating annual incidence rates of gonorrhea and chlamydia among active-duty soldiers at Fort Bragg, North Carolina, one of the US Army's largest facilities. Like findings in other recent studies, our results have shown that STDs constitute a major problem for soldiers during peacetime at a fixed military installation. However, our study has also shown trends of disease over time and provided a comparison of rates to those for the civilian population with use of direct standardization. Over the 12-year study period, the crude incidence of gonorrhea among Fort Bragg soldiers peaked in 1986 and then decreased steadily until 1996. Although the base population remained fairly stable over this period, the number of gonorrhea cases declined, suggesting a true reduction in morbidity.

With institution of testing for chlamydia infection, a rapid apparent increase in crude incidence was observed from 1991 through 1993, due to the detection of both prevalent and incident cases. The next 3 years witnessed a reduction, however, perhaps due to increased treatment of previously undetected disease in the population.

After adjustment for the age, sex, and racial/ethnic distribution of this military population, the adjusted incidence of gonorrhea and chlamydia among Fort Bragg soldiers was

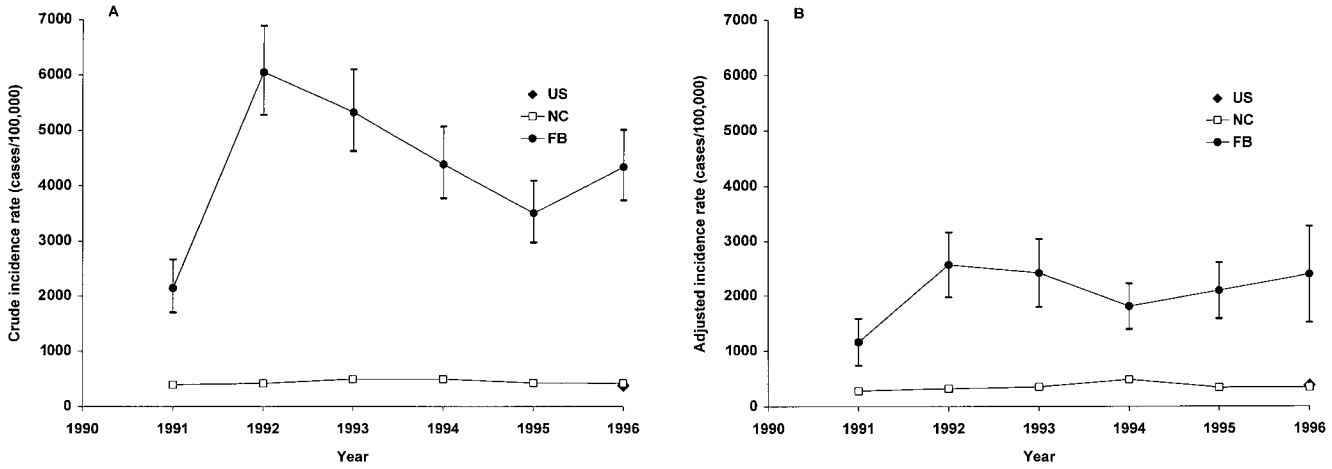

Figure 3. Annual incidence of chlamydia among female active-duty soldiers at Fort Bragg *(FB),* North Carolina, compared with that among women in North Carolina *(NC)* and the United States *(US)* during 1991–1996. *A,* Crude incidence rates of chlamydia. *B,* Incidence rates of chlamydia after adjustment for age and race/ethnicity. For the United States data, only those for 1996 were stratified by age, sex, and race/ethnicity [14], which limited the comparison to that single year. 95% CIs are shown for the Fort Bragg data in both figures. CIs for the North Carolina and United States data were small and are not shown.

higher than comparable state and national rates during the respective period of analyses. The adjusted incidence of gonorrhea gradually declined to levels that were lower than the adjusted rates for North Carolina in 1994 and 1996. For chlamydia, the adjusted 1996 rates among both male and female active-duty soldiers remained 3- to 6-fold higher than respective rates for the state and country as a whole.

The adjusted incidence rates suggest that the elevated crude rates of gonorrhea and chlamydia were partially explained by the demographic characteristics of the Fort Bragg population. Standardization allowed the calculation of hypothetical rates for Fort Bragg as if this military population had the same age, sex, and racial distribution as the United States population. Because the differences between the incidence rates of Fort Bragg, North Carolina, and the United States were diminished by standardization, the age, race, and sex distributions of active-duty personnel are responsible for some of the observed elevation in crude rates.

This study is limited by several factors. The incidence of STDs determined through our analysis of EDC Clinic records is probably an underestimate of the true rate of disease among this military population. Although the EDC Clinic at Fort Bragg is the centralized management facility for STDs at the installation, it is unlikely that all STDs are reported to this clinic. The EDC Clinic database includes information on the majority of patients whose STDs are diagnosed at military clinics at Fort Bragg, but it may miss active-duty personnel who seek care privately from other providers, on- or off-post. We estimate that the percentage of missed reports is <5% of the actual total (authors' unpublished observation). The underestimate is probably greatest for officers and soldiers in the higher enlisted categories, who may seek STD evaluation at private clinics. Similarly, soldiers in certain "elite" units tend to obtain care from specifically assigned providers, who may provide syndromic therapy in the absence of laboratory confirmation. Incidence may be further underestimated because asymptomatic persons may not seek care.

There are inherent limitations in the data available for comparison from the state and national levels. Although the EDC Clinic database probably captures the majority of symptomatic STD cases in the military population because of mandatory referral and reporting practices, state and national rates are likely to be underestimated because of varying collection and reporting practices at these levels. Low rates of chlamydia may be reported in some states because of low rates of testing, even though the actual associated morbidity is high [15]. Rates of chlamydia for men in the United States may be greatly underestimated because there is considerably less testing among this group than among women [16].

Differing clinic practices with regard to diagnosis can also result in either underestimates or overestimates of disease. The differences in reporting, testing, and clinical practices probably exaggerate the rates of STDs at Fort Bragg, compared with state and national rates.

EIA was the technology available for chlamydia testing at Fort Bragg and perhaps at most clinics in North Carolina and the United States during the project interval. However, this test has a sensitivity of only 60%–85% in comparison with the sensitivity of culture, the "gold standard," and it is even lower when compared with newer DNA amplification techniques [17]. For this reason, too, the incidence of chlamydia determined in our analyses is a conservative estimate.

STD trends during peacetime in the military have been infrequently documented. Earlier reports described high STD

rates in military populations [18–20], but these investigations were limited because they did not adjust for potential differences of these populations and the civilian sector with respect to age, sex, and race/ethnicity. Melton et al. [19] described the frequency of gonorrhea and nongonococcal urethritis among active-duty US Navy and Marine Corps personnel, using outpatient cases reported to the Navy Medical Data Services Center as the source of data. They found that crude gonorrhea rates among naval personnel in each naval district were 3–14 times greater than the total rate reported for comparable civilian populations. They found that nongonococcal urethritis rates equaled or exceeded gonorrhea rates in most geographical areas that they examined.

Other, more recent studies have shown a high prevalence of chlamydial disease among military recruits and various military populations. Gaydos et al. [4] screened >13,000 female Army recruits for *C. trachomatis* by means of urine-based ligase chain reaction (LCR) assays and found a prevalence of 9.2% for chlamydial infection. In a separate study in which they used this technology, the same investigators documented a 7% prevalence of chlamydia infection among military women presenting for routine Papanicolaou (Pap) smears [8]. Brodine et al. [6] also determined the prevalence of asymptomatic chlamydial and gonococcal infections with use of urine-based ligase chain reaction assays among 1300 male and female military personnel. They found an overall prevalence of 4.2% for chlamydia but no gonococcal infections. In this Army population, the prevalence of these STDs is probably higher because of undetected asymptomatic disease among soldiers on-post who have not been screened in the clinics.

High rates of STDs in the military population are of concern, particularly in light of the fact that STDs facilitate HIV transmission [21, 22]. Since the implementation of the US Army HIV testing program in 1985, HIV screening has been performed among donors at Army blood banks, applicants to the military, active-duty soldiers, the Army Reserves, and the National Guard [23]. In 1994, ~650 of ~378,000 active-duty soldiers who were screened were found to be HIV-positive, a prevalence of 0.2%. Because applicants who are found to be HIV-positive are not allowed to enter the Army, any HIV infections detected among active-duty soldiers are presumably incident cases of infection acquired in the service. The occurrence patterns of other STDs have been used to predict future AIDS trends [24]. Therefore, the high rates of other STDs found among active-duty soldiers at Fort Bragg serve as a marker for the presence of high-risk behaviors for HIV infection in this military population [25].

A social interplay between military and civilian communities has been demonstrated in previous studies of gonorrhea transmission [26, 27]. A recent study involving syphilis trends in Fort Bragg recognized the relation between the military and the surrounding civilian community [7]. Therefore, STD rates at Fort Bragg would be expected to impact the surrounding area and vice versa, because of social networks and sexual partnerships between active-duty soldiers and civilians. However, the incidence rates in this military population may be more than a reflection of rates in Cumberland County and North Carolina. The characteristics of southern states and rural areas that have been associated with high STD rates, such as poverty, income inequality, and limited accessibility and use of health care services, theoretically should be less important factors in the military [28, 29]. Frequent deployment and movement of active-duty soldiers would also suggest some STD acquisition outside of the surrounding community.

The risk factors, sexual behaviors, and external influences that may be contributing to STDs in this military population require further elucidation. Although this study has shown that high rates of gonorrhea and chlamydia persist among Army soldiers, with the highest incidence noted among those 15–24 years of age, we were not able to assess the factors contributing to these rates in this retrospective study. In the past and during times of war, deployment and contact with sex workers overseas have been reported as risk factors for STDs among military personnel [10].

The determination of factors such as travel history, numbers of sexual partners, and sexual contact with sex workers will therefore be important in targeting interventions toward high-risk groups in this population. Focused interventions could involve risk-reduction counseling and routine STD screening for groups such as soldiers returning from recent deployment or leave [25]. Given the results of our study, periodic routine STD screening for all enlisted soldiers aged <25 years may be prudent, until further information about specific risk factors is available.

The control of STDs has long been a challenge to the military. Past strategies have included financial penalties for soldiers with STDs and punitive measures for officers who were held responsible for the incidence of STDs among their troops [2]. Currently, the military embraces a more enlightened approach, focusing on general education and liberal access to STD screening and testing.

Future strategies should be based on a better understanding of risk factors, such as age, race, rank, sexual history, and travel/deployment status, and targeted interventions toward those at highest risk for STD and HIV acquisition. Policies for STD control should emphasize cooperation among state, local, federal, and military agencies for education, behavior change, and contact-tracing. In light of the military-civilian interface and the ~1.5 million active-duty personnel in the United States Armed forces, the control of STDs among military populations should be considered a future component of national efforts to prevent the spread of STDs and HIV.

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