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Prevalence of *Trichomonas vaginalis* Among Civilian, Noninstitutionalized Male and Female Population Aged 14 to 59 Years: United States, 2013 to 2016

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Abstract

Among the US civilian noninstitutionalized population aged 14 to 59 years in 2013 to 2016, prevalence of Trichomonas vaginalis infection in urine was 1.3% overall. Prevalence was 2.1% among females, 0.5% among males, and highest at 9.6% among non-Hispanic black females. Estimate instability limited analysis of factors beyond sex, age, and race/Hispanic ethnicity.

Trichomonas vaginalis is a treatable sexually transmitted parasitic infection associated with preterm delivery among women.[1,2] In 2001 to 2004, estimated prevalence among US civilian, noninstitutionalized females aged 14 to 49 years was 3.1%, based on polymerase chain reaction results from vaginal swab specimens collected for the National Health and Nutrition Examination Survey (NHANES).[3] We assessed T. vaginalis prevalence among US civilian, noninstitutionalized males and females aged 14 to 59 years from 2013 to 2016 by demographic, health, and sexual behavior factors using nucleic acid amplification test results from NHANES urine specimens. This is the first publication of 2013 to 2016 T. vaginalis infection estimates which includes adolescents aged 14 to 17 years.[4,5] We also examined the stability of these estimates, as well as nonresponse, which can bias estimates.

MATERIALS AND METHODS

The NHANES is a complex, multistage probability sample survey of the US civilian, noninstitutionalized population[6] administered continuously since 1999; data are released as combined 2-year cycles (e.g., 2013–2014). Demographic data are collected during a home interview. Biospecimens, and reproductive health and sexual behavior data, are subsequently collected in a mobile examination center. The NHANES is approved by the National Center for Health Statistics ethics review board; because only secondary, deidentified data were used, further institutional review board approval was not required.

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T. vaginalis infection was assessed using urine specimens from male and female participants aged 14 to 59 years with the Gen-Probe Aptima T. vaginalis assay (Hologic; Gen-Probe, San Diego CA).[7] Assay performance was verified using male and female urine specimens previously found to be positive or negative for *T. vaginalis* nucleic acid; proficiency panels provided by the College of American Pathologists were tested 3 times per year to ensure ongoing assay accuracy. *T. vaginalis* infection results and sexual behavior data for 14- to 17-year-olds were accessed from a National Center for Health Statistics Research Data Center[8]; data for other participants are publicly available.[9]

Because of the low prevalence of *T. vaginalis* infection, to increase stability of estimates, data from 2013 to 2014 and 2015 to 2016 were concatenated. Cumulative response rates (i.e., home interview participation rate, sexual behavior questionnaire participation rate, and *T. vaginalis* test completion rate among sampled participants) were assessed using age group–specific sample screening, interview, and examination participant counts.[10] Response rate calculations were limited to participants aged 20 to 59 years because participant counts were not provided for the 14- to 19-year age group. Response rates were adjusted to account for the 2015 to 2016 sample screening rate of 94.3%.[10]

Nationally representative, weighted estimates of *T. vaginalis* prevalence and 95% confidence intervals (CIs) were calculated for the total population, by sex, and by demographic, health, and sexual behavior characteristics separately among males and females. Estimates with relative standard errors (RSEs) ≥30% and <50% may be unstable and should be interpreted with caution; estimates with RSE ≥50% were not shown because these are unstable. Analyses were performed using SAS software version 9.4[11] and SAS-callable SUDAAN version 11.0.1.[12]

RESULTS

The 2013 to 2016 interview response rate among participants aged 20 to 59 years was 61.9%. *T. vaginalis* test completion was 58.4%. Sexual behavior questionnaire participation was 52.3%.

T. vaginalis prevalence among males and females aged 14 to 59 years was 1.3% (95% CI, 1.0%–1.7%; Table 1). Prevalence was2.1% (95% CI, 1.6%–2.8%) among females and significantly lower among males (0.5%; 95% CI, 0.3%–0.7%).

T. vaginalis prevalence was very low (0.7%; 95% CI,0.4%–1.5%) among females aged 14 to 19 years (Table 1). Prevalence was 2.7% (95% CI, 1.8%–4.0%) among women aged 20 to 29 years and did not differ significantly for women aged 30 to 39 or 40 to 49 years, but was lower (1.4%; 95% CI, 0.8%–2.5%) among women aged 50 to 59 years. Among males aged 14 to 19 and 30 to 39 years, estimates were unstable; no significant differences in prevalence were identified between males in other age groups, although these estimates were potentially unstable.

Compared with non-Hispanic white females (0.8%; 95% CI, 0.4%–1.5%), *T. vaginalis* prevalence was significantly higher among non-Hispanic black females (9.6%; 95% CI, 7.3%–12.5%) but not Hispanic females (1.4%; 95% CI, 0.8%–2.2%; Table 1). Prevalence

among non-Hispanic black males was 3.4% (95% CI, 2.3%–4.9%); estimates among males were unstable for all other race/ethnicity groups.

Among females, increasing poverty level, lower educational attainment, unmarried status, and having been born in the United States were significantly associated with *T. vaginalis* infection (Table 1). Similar findings were observed among males. However, most of these estimates were potentially unstable; those with RSEs ≥50% are not shown.

Among females, younger age at sexual debut, greater number of lifetime and/or past 12 months sex partners, and chlamydia infection in the past 12 months were significantly associated withT. vaginalis infection (Table 2). Among males, most of these estimates were unstable and not shown.

DISCUSSION

This is the first report of *T. vaginalis* infection prevalence in 2013 to 2016 that includes data from adolescents aged 14 to 17 years. Overall prevalence among those aged 14 to 59 years was almost 4-fold higher among females than males, and almost 11-fold higher among non-Hispanic black females than non-Hispanic white females. Prevalence was higher among people with lower family income, less education, and who were unmarried. Younger age at sexual debut and higher number of sex partners were associated with higher *T. vaginalis* prevalence among females.

These findings cannot be directly compared with 2001–2004 NHANES results. Although one study has shown identical detection of *T. vaginalis* from urine and vaginal swabs,[13] others found detection in urine is lower.[14,15] In 2001 to 2004, polymerase chain reaction testing was conducted, which is less sensitive than the nucleic acid amplification test used in 2013 to 2016.[14] Despite these differences, the current findings highlight similar disparities in burden of *T. vaginalis* infection by race/ethnicity and offer novel information on prevalence among adolescents.

Females aged 14 to 19 years seemed to have less *T. vaginalis* infection than those aged 20 to 29 years; estimated prevalence among males aged 14–19 years was unstable and not reported. Estimates among males were also unstable when stratified by race/ethnicity and by most sexual and health factors, despite combining data from two 2-year cycles. A previous publication focusing on men aged 18 to 59 years did not address the instability of many reported estimates.[4] Additional years of data might lend stability to these estimates. However, the low prevalence observed among males may be due to the use of urine specimens; penile meatal swabs have been shown to be more sensitive for detecting *T. vaginalis*.[16,17] Test sensitivity also is lower in urine specimens from males (74%) compared with females (88%).[14]

In addition, a number of estimates presented have RSEs between 30% and 50% and should be interpreted with caution, as these may be unstable. Crude and model-adjusted *T. vaginalis* prevalence among males and females aged 18 to 59 years were recently published using a single cycle (2013–2014) of NHANES data.[5] However, even when data are combined across multiple cycles, as in our analysis, stratification by additional factors within sex increases

the likelihood of unstable estimates for uncommon outcomes such as *T. vaginalis* infection. Therefore, effect measure modification (i.e., interaction) may be difficult to evaluate and account for, if necessary, in statistical models. In the stratified analyses we conducted among females to explore relationships between race/ethnicity, age group, family income, and educational attainment, most estimates were unstable.

Decreasing NHANES cumulative response is an additional concern. Only examination participants were asked to provide specimens for *T. vaginalis* testing and complete the sexual behavior questionnaire. In addition, any examination participant may decline to provide a urine specimen, or to complete the sexual behavior questionnaire. Cumulative examination response among people sampled for NHANES has decreased to 59% in 2015 to 2016[8]; among adults aged 20 to 59 years in 2013 to 2016, cumulative response to the sexual behavior questionnaire was only 52%. These low cumulative response rates further contribute to the lack of statistical power and potential instability of estimates, and may also produce biased *T. vaginalis* prevalence estimates. Postsurvey weighting adjustments to account for nonresponse across demographic subgroups and poststratification of survey weights to known population totals, both of which are used for NHANES,[18] may reduce nonresponse bias, but only if responders and nonresponders have similar response propensities and respond similarly with respect to the survey measures of interest.[19] These assumptions may be invalid, particularly for sensitive information such as sexual behavior. Although nonresponse may not necessarily result in biased survey estimates, efforts to decrease nonresponse, such as monetary incentives, which are used for NHANES,[20] may increase bias for some estimates.[19] A recent publication examining trends in chlamydia prevalence among young women using data from the National Surveys of Attitudes and Sexual Lifestyles has noted similar concerns.[21]

In conclusion, this analysis provides national estimates of *T. vaginalis* infection prevalence in urine specimens from the 2013–2016 US civilian, noninstitutionalized population aged 14 to 59 years and is the first report to include data from adolescent boys and girls during this period. Low infection prevalence among most subpopulation groups constrains detailed exploration of factors associated with this infection using NHANES data. Other data sources are needed to understand the disproportionate burden of *T. vaginalis* infection, particularly among non-Hispanic blacks.

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TABLE 1.

Percent Prevalence of *Trichomonas vaginalis* Infections by Demographic Factors Among the US Civilian, Noninstitutionalized Population Aged 14 to 59 Years, 2013 to 2016

Factor	Sex	Factor Level	Sample Size	Percent Prevalence	95% Confidence Limits		Prevalence Ratio	95% Confidence Limits	
Total			8567	1.29	0.96	1.74			
	Male		4104	0.46	0.30	0.71	Ref.	Ref.	Ref.
	Female		4463	2.10	1.57	2.81	4.57	3.23	6.48
Age group, y	Male	14–19	622	—	—	—	—	—	—
		20–29	874	0.52*	0.26	1.04	Ref.	Ref.	Ref.
		30–39	892	—	—	—	—	—	—
		40–49	848	0.55*	0.27	1.10	1.05	0.37	2.99
		50–59	868	0.70*	0.36	1.35	1.35	0.50	3.61
	Female	14–19	634	0.71*	0.35	1.45	0.27	0.11	0.68
		20–29	940	2.65	1.75	3.99	Ref.	Ref.	Ref.
		30–39	957	2.19	1.37	3.46	0.83	0.55	1.24
		40–49	1029	2.68	1.87	3.84	1.01	0.62	1.66
		50–59	903	1.39	0.78	2.46	0.52	0.30	0.92
Race and Hispanic ethnicity	Male	Mexican American or other Hispanic	1085	—	—	—	—	—	—
		Non-Hispanic white	1427	—	—	—	—	—	—
		Non-Hispanic black	854	3.38	2.31	4.90			
		Other or Multiracial	738	—	—	—	—	—	—
	Female	Mexican American or other Hispanic	1306	1.35	0.81	2.24	1.67	0.78	3.55
		Non-Hispanic white	1440	0.81	0.44	1.47	Ref.	Ref.	Ref.
		Non-Hispanic black	981	9.56	7.27	12.48	11.85	5.92	23.72
		Other or multiracial	736	1.32*	0.49	3.52	1.63	0.51	5.23
Family income	Male	At or below poverty level	882	1.34	0.81	2.23	5.22	1.84	14.82
		Above to less than twice poverty level	930	0.45*	0.20	1.03	1.75	0.59	5.17
		At or more than twice poverty level	1941	0.26*	0.12	0.57	Ref.	Ref.	Ref.
	Female	At or below poverty level	1084	6.77	5.06	9.00	13.80	7.18	26.53
		Above to less than twice poverty level	1005	2.85	1.68	4.80	5.81	2.20	15.39

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Factor	Sex	Factor Level	Sample Size	Percent Prevalence	95% Confidence Limits		Prevalence Ratio	95% Confidence Limits	
		At or more than twice poverty level	2009	0.49	0.25	0.96	Ref.	Ref.	Ref.
Educational attainment	Male	Less than high school	1191	1.09 *	0.58	2.04	4.30	1.59	11.66
		High school	934	0.41 *	0.21	0.79	1.61	0.57	4.51
		More than high school	1974	0.25 *	0.12	0.54	Ref.	Ref.	Ref.
	Female	Less than high school	1113	4.36	2.90	6.50	3.79	2.27	6.32
		High school	895	3.37	2.51	4.51	2.93	1.96	4.39
		More than high school	2449	1.15	0.75	1.76	Ref.	Ref.	Ref.
Marital status	Male	Married	1812	0.21 *	0.08	0.55	Ref.	Ref.	Ref.
		Live with partner	406	1.20 *	0.56	2.56	5.69	1.66	19.41
		Widowed/divorced/separated	361	—	—	—	—	—	—
		Never married	901	0.63 *	0.33	1.19	2.95	0.80	10.89
	Female	Married	1861	0.66	0.36	1.18	Ref.	Ref.	Ref.
		Live with partner	405	4.13 *	2.18	7.69	6.31	2.52	15.83
		Widowed/divorced/separated	669	3.03	1.85	4.91	4.62	2.09	10.23
		Never married	894	4.57	3.10	6.68	6.97	3.70	13.13
Born in the United States †	Male	Yes	2881	0.52	0.33	0.80			
		No	1222	—	—	—	—	—	—
	Female	Yes	3127	2.38	1.72	3.29	Ref.	Ref.	Ref.
		No	1335	0.91	0.54	1.54	0.38	0.20	0.75

Estimates with relative standard error ≥50% are suppressed as indicated by "—".

* Relative standard error ≥30% and <50%; estimates should be interpreted with caution.

† Born in the 50 US states or Washington, DC; does not include those born in the 5 US territories.

TABLE 2.

Percent Prevalence of *Trichomonas vaginalis* Infections by Sexual and Health Factors Among the US Civilian, Noninstitutionalized Female Population Aged 14 to 59 Years, 2013 to 2016

Factor	Factor Level	Sample Size	Percent Prevalence	95% Confidence Limits		Prevalence Ratio	95% Confidence Limits	
Pregnant at examination	Yes	129	2.71*	1.11	6.50	Ref.	Ref.	Ref.
	No	2262	2.34	1.60	3.39	0.86	0.31	2.36
Sexual orientation	Heterosexual	3169	2.07	1.51	2.82	Ref.	Ref.	Ref.
	Homosexual/bisexual/ something else/Not Sure	323	3.46*	1.73	6.83	1.67	0.88	3.19
Ever had sex	Yes	3505	2.23	1.66	3.01			
	No	422	—	—	—	—	—	—
Age at sexual debut, y	≤14	527	5.18	3.15	8.40	6.70	3.25	13.80
	15 −17	1537	2.64	1.88	3.71	3.42	1.70	6.89
	≥18	1435	0.77	0.43	1.38	Ref.	Ref.	Ref.
Ever had same-sex partner	Yes	387	3.73	2.03	6.78	1.83	1.00	3.35
	No	3112	2.04	1.50	2.77	Ref.	Ref.	Ref.
Lifetime no. sex partners	0–2	1493	0.63*	0.33	1.17	Ref.	Ref.	Ref.
	3–5	1014	1.97	1.23	3.15	3.16	1.69	5.91
	6+	1411	3.28	2.28	4.69	5.24	3.54	10.82
No. sex partners in the past 12 mo	0–1	3381	1.44	1.05	1.97	Ref.	Ref.	Ref.
	2+	542	6.39	4.33	9.34	4.43	3.04	6.47
Ever told by health care provider had genital herpes	Yes	177	1.42*	0.53	3.74	0.62	0.23	1.65
	No	3328	2.29	1.69	3.09	Ref.	Ref.	Ref.
Ever told by health care provider had genital warts	Yes	159	—	—	—	—	—	—
	No	3346	2.33	1.73	3.14			
Told by health care provider had gonorrhea in the past 12 mo	Yes	10	—	—	—	—	—	—
	No	3495	2.22	1.64	3.00			
Told by health care provider had chlamydia in the past 12 mo	Yes	61	7.56*	2.93	18.16	3.51	1.39	8.87
	No	3442	2.16	1.59	2.91	Ref.	Ref.	Ref.

Estimates with relative standard error ≥50% are suppressed as indicated by “—”.

* Relative standard error ≥30% and <50%; estimates should be interpreted with caution.