


Burden of trichomoniasis among older adults in the United States: a systematic review

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ABSTRACT

Despite being one of the most common sexually transmitted infections (STIs) in the United States, the epidemiology of trichomoniasis remains understudied. One population that has been historically overlooked regarding STIs is that of older adults, despite many individuals remaining sexually active well into their older years. We investigated the reported prevalence and incidence of trichomoniasis in adults aged ≥ 45 years in the United States using a systematic literature review. Twelve articles were included in the review, all assessing prevalence of trichomoniasis in this age group. Notably, no included articles assessed trichomoniasis incidence. Data collected encompassed several decades, from 1993 to 2016. Estimates of infection prevalence varied widely and ranged from 0.2% to 21.4% in included populations, with the highest prevalence typically seen among individuals seeking diagnostic testing for STIs. Several studies found increased risk for trichomoniasis in older patients compared to younger age groups. This is the first review to examine the risk of trichomoniasis in older adults, and the surprisingly high prevalence suggests that older adults may merit increased screening for trichomoniasis and sexual health education.

Keywords: aging, epidemiology, infection, neglected infectious disease, protozoal infections, sexual health, STIs, trichomonas, trichomoniasis.

Introduction

Trichomoniasis, a treatable sexually transmitted infection (STI) caused by the protozoan parasite *Trichomonas vaginalis* (TV), is estimated to be the most common non-viral STI in the United States. There were an estimated 2.6 million prevalent and 6.9 million incident infections in 2018 among all persons in the United States, with the majority of prevalent infections among women.¹ As TV is not a reportable STI in the United States and is not routinely screened for, these figures are likely underestimates. TV is commonly asymptomatic, contributing to its under-diagnosis. However, untreated infection can result in adverse health outcomes such as inflammation in the reproductive tract leading to pelvic inflammatory disease, and may be a risk factor for cervical and prostate cancer.^{2–6} Concerningly, TV infection may increase risk of acquiring other STIs, and has been associated with increased HIV transmission and viral shedding.^{2,7} However, there is limited knowledge of the true public health impact and epidemiology of this infection in the United States. Indeed, TV has been considered a neglected parasitic disease.^{8,9}

Interestingly, while adolescents and young adults typically experience the majority of infections for most STIs, this trend is not true for trichomoniasis. In 2018, the 15–24-year-old age group accounted for more than half of both incident and prevalent gonorrhoea and chlamydia infections nationwide.¹⁰ In contrast, this age group comprised only 15.6% and 16.3% of estimated prevalent and incident TV infections in the same year.¹⁰ Additionally, a recent study found a threefold increase in prevalence of TV infection among 40–59-year-olds compared to 18–24 year-olds.¹¹

While sexual health education and interventions often focus on young adults or high-risk populations, many older adults are also sexually active. In 2017, the National Poll on Healthy Aging found that among adults aged 65–80 years, 51% of men and 31% of

women were sexually active. Yet only 17% of those surveyed reported speaking to a healthcare provider in the previous 2 years about their sexual health.¹² Case rates of reportable STIs in Americans aged 45 years and older have been increasing since 2014.¹⁰ Many factors contribute to increased STI risk among older Americans, including psychosocial changes such as divorce or loss of a spouse leading to partner change, and increases in traditional sexual risk behaviours such as unprotected sex.¹³ Further, physiologic changes of ageing, such as weakened immune system and decreased vaginal lubrication, may increase the risk for STIs.¹³ However, older adults are not often screened for common STIs, and knowledge of STIs in this population is relatively low.¹⁴ As a result, STIs may be under-diagnosed and under-treated in older adults. A lack of screening and appropriate treatment may contribute to the rising prevalence of STIs in this age group. We conducted a systematic literature review to assess the prevalence and incidence of *T. vaginalis* infection among older adults in the United States and investigate contributing risk factors to this disease in the older demographic.

Materials and methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Guidelines.¹⁵

Inclusion and exclusion criteria

Studies were eligible for inclusion if they reported the prevalence or incidence of trichomoniasis in adults aged 45 years or older in the United States. Studies were excluded if they only examined prevalence or incidence of trichomoniasis in individuals aged <45 years or did not stratify by age groups ≥ 45 years. Studies were also excluded if they only reported case counts, assessed STI in a population outside the United States, or were not reported in the English language. Conference abstracts were eligible for inclusion if they met all other criteria.

Search strategy

Five medical research databases (PubMed, Embase.com, CINAHL Complete via EBSCO, Web of Science Core Collection, and Global Health via Ovid) were searched for articles published from inception to 26 January 2021. The following Medical Subject Headings and keywords were used appropriate to each database: 'United States', 'aged', 'aged patient', 'senior', 'older adult', 'trichomonas vaginalis', 'trichomoniasis', 'trichomoniasis infections', and 'sexually transmitted disease'. Additionally, reference lists of included studies were hand searched to identify any additional articles meeting inclusion criteria and not

identified through database searching. The full search strategy is available in Supplementary material Appendix S1.

Screening

Articles retrieved through database searching were imported into Covidence software where duplicate articles were automatically removed. The eligibility of each article was initially assessed through title and abstract review independently and in duplicate by two of three reviewers (KH, SO, JM). Irrelevant articles were excluded. Following title and abstract review, the full texts of remaining articles were reviewed for eligibility independently and in duplicate (KH, SO, JM). Articles that did not meet eligibility criteria were excluded. Any discrepancies between reviewers were resolved by a third reviewer (PK).

Data collection

All included studies were extracted using a pre-specified extraction spreadsheet by two of three independent reviewers (KH, ARL, SO, JM). Data gathered from full text articles included population demographics, study design, study setting, prevalence or incidence of TV among the study population, and contributing factors for TV prevalence or incidence described in the study. The primary summary measure was the reported prevalence or incidence of trichomoniasis.

Results

After abstract and full text screening, 12 articles met inclusion criteria (Fig. 1). Five of these studies were identified through hand searching reference lists of articles included from database searching.^{5,16–19} Characteristics of included studies are in Table 1.^{5,16–26} Data collected encompassed the years 1993–2016. One study conducted a retrospective chart review for recorded diagnosis of TV infection,²⁴ while the remainder collected biological samples to assess infection status. Urine was the most commonly collected sample type ($n = 6$), followed by endocervical or cervical samples ($n = 3$), vaginal swabs ($n = 2$), and penile swabs ($n = 1$). Eight studies utilised some type of nucleic acid amplification tests to identify infection status, while one study diagnosed TV infection via wet mount microscopy. Additionally, two studies assessed history of infection via plasma antibody IgG enzyme-linked immunosorbent assay (ELISA).^{5,18} Seven studies included a population recruited from the entire United States, while two studies included a subset of several states, and three were within a specific state or city. Three studies utilised data from NHANES in the 2013–2014 and 2015–2016 cycles.^{20,21,26}

None of the included articles assessed the incidence of new TV infections. Prevalence of infection varied both between and within the included studies. Estimated prevalence proportions among females ranged from 0.2% to 21.4%,

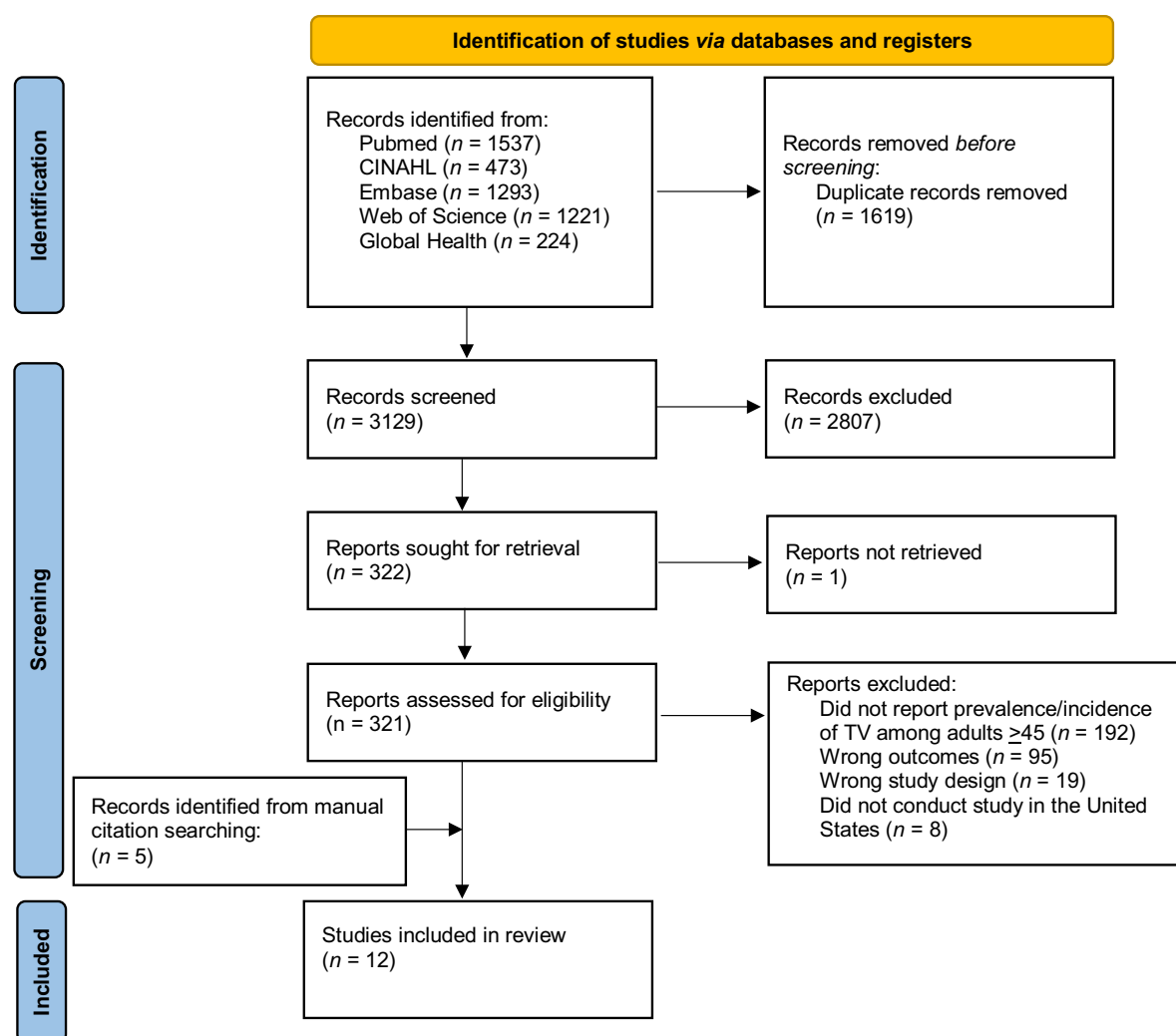


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) Flow Diagram. 'Report' refers to a full-text of a document, while 'record' refers to the title, abstract, or both of a report, per the PRISMA statement.¹⁵

while for males estimates ranged from 0.7% to 12.6% (Fig. 2). The highest prevalence was seen among women aged 50+ years attending an STD clinic in Baltimore, MD,¹⁹ while the lowest was among married, Medicare-eligible women aged 67–99 years.²⁴ Two different samples of the Health Professionals Follow Up Study found similar proportions of TV antibodies among participants (9.4% and 9.2%), with higher prevalence seen among prostate cancer cases (12.6%).^{5,18} In general, populations visiting sexual health clinics had a high prevalence of TV. Schwebke *et al.* found similar prevalence between the 45–49 years and 50+ years age groups (14.6% and 14.7% overall, respectively), with women having higher rates than men.¹⁷ Another diagnostic testing study across three states also found similar rates between the 46–55 years and 56–65 years age groups (5.5–7.3% and 5.4–7.0%, respectively). However, the 66–75 years age group had substantially lower prevalence (1.8–1.9%).²⁵ Sex-specific prevalence of TV pooled across

the 2013–2014 and 2015–2016 National Health and Nutrition Examination Survey (NHANES) cycles for the 50–59-year-old age group was 0.7% among men and 1.39% for women,^{20,21} while the overall estimate for all participants aged 50–59 years in the 2013–2014 cycle was 1.2%.²⁶

In most of the included studies, the older age group was not the primary focus, and risk factors specific to this age group were not often identified. Several studies found that older individuals were more likely to be infected with TV than younger ages.^{16,19,22} Additionally, infected older individuals were more likely to report drug use and high alcohol consumption.^{19,23} Although TV has been linked as a risk factor for HIV transmission, none of the included articles examined TV prevalence specifically among people living with HIV, and only three articles reported HIV status in their study population.^{19,20} In the 2013–2016 NHANES population, a greater proportion of TV-positive men were positive for HIV compared to TV-negative men, though the

Table 1. Characteristics of included studies investigating prevalence of trichomoniasis in US adults aged ≥ 45 years.

Article	Study design and setting	Gender	Age (years)	Location	Timeline	Sample size	Sample source	Diagnostic method	Prevalence (%)
Sutcliffe (2006) ⁵	Nested case-control, Health Professionals Follow-Up Study	M	46–81	National	1993–1995	1382	Plasma	IgG ELISA	9.4, 12.6
Smith and Christakis (2009) ²⁴	Retrospective cohort, married Medicare beneficiaries	F	67–99	National	1993–2002	841 580	N/A	Medical record diagnosis	0.2
Sutcliffe (2009) ¹⁸	Prospective cohort, Health Professionals Follow-Up Study	M	46–81	National	1993–1995	651	Plasma	IgG ELISA	9.2
Ginocchio (2012) ¹⁶	Cross-sectional, diagnostic testing at multiple clinical settings	F	50+	21 U.S. states	2010	NR	Vaginal, endocervical, urine	NAAT	13.0
Stemmer (2012) ²⁵	Cross-sectional, diagnostic testing at OBGYNs	F	46–75	Florida, New Jersey, Texas	2005	7476	Cervical	qPCR	1.8–7.3
Gaydos (2013) ²²	Cross-sectional, sexually active men recruited via internet	M	50+	Alaska, Colorado, DC, Illinois, Maryland, West Virginia	2006–2012	91	Penile self-swab	NAAT	2.2
Hearn (2015) ²³	Cross-sectional, injection drug users in NEURO-HIV Study	F, M	45+	Baltimore, MD	NR	126	Urine	PCR-based ELISA (F), TMA (M)	19.1
Tuddenham (2017) ¹⁹	Cross-sectional, diagnostic testing at STI clinics	F	51+	Baltimore, MD	2005–2010	4461	Vaginal	Wet mount microscopy	21.4
Schwebke (2018) ¹⁷	Cross-sectional, diagnostic testing at STI and family planning clinics	F, M	45+	Alabama	2012–2013	5592	Endocervical (F), urine/urethral (M)	TMA	6.3–16.7
Daugherty (2019) ²⁰	Cross-sectional, population-based (NHANES)	M	50–59	National	2013–2016	868	Urine	TMA	0.7
Flagg (2019) ²¹	Cross-sectional, population-based (NHANES)	F, M	50–59	National	2013–2016	1771	Urine	TMA	0.7, 1.39
Tompkins (2020) ²⁶	Cross-sectional, population-based (NHANES)	F, M	50–59	National	2013–2014	897	Urine	NAAT	1.2

M, male; F, female.

difference was not significant.²⁰ While Tuddenham *et al.* found that more older women (>50 years) than younger had self-reported HIV or a new diagnosis of HIV at their first clinic visit, they did not examine TV prevalence stratified by HIV status.¹⁹

Discussion

This review is the first to examine trends of *T. vaginalis* infection risk among older adults in the United States. Overall, we found the prevalence of TV infection was unexpectedly high within this age group. As trichomoniasis is not a reportable condition, the CDC estimates prevalence using information from NHANES, three studies of which were included in this analysis. The prevalence seen in the NHANES studies was markedly low compared to other articles included in this review. Prevalence of infection was

generally higher among populations seeking diagnostic testing compared to population-based screening. As women, particularly over 50 years of age, do not routinely receive asymptomatic screening for TV, those who are symptomatic are more likely to be tested, increasing the positivity rate. Only one study examined TV in an older population typically considered high risk for STIs and found 19.1% prevalence in this sample.

The majority of studies assessing current infection utilised a version of a nucleic acid amplification test or quantitative PCR, which have high sensitivity (76–100%) and specificity (96–100%) for detecting *T. vaginalis*.²⁷ One study utilised the wet mount microscopy method, which has nearly 100% specificity but poor sensitivity (44–68%).²⁷ Interestingly, this study had the highest reported test positivity of all included articles.²³

Notably, none of the articles included in this review assessed incidence or rate of new *T. vaginalis* infection among the older population and most of the studies were

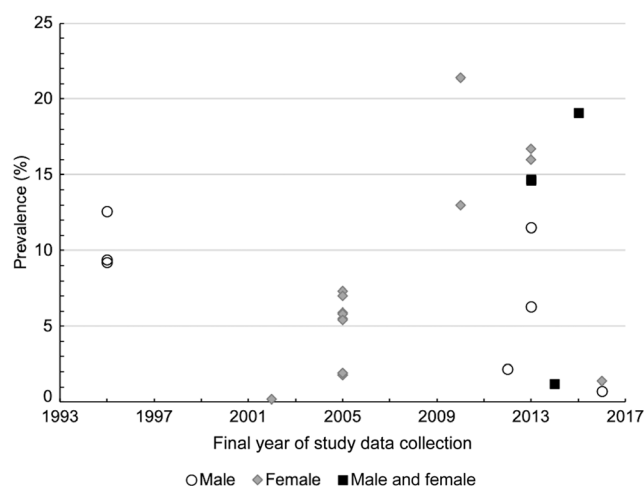


Fig. 2. Trichomoniasis prevalence proportions reported in included studies, stratified by reported gender. Male only (open circle), female only (grey diamond), or male and female (sex-stratified prevalence not reported; black square).

not population-based or assessed period prevalence. Thus, it is difficult to determine from this data whether rates of new TV infections are truly increasing in this age group. The epidemiology of TV among older persons needs further evaluation.

One common finding in this review was higher TV prevalence in older ages compared to young adults. As there is no systematic screening for TV in any age group, it is unknown whether older age is a true risk factor for TV or if this is simply screening artefact. TV has been known to persist undetected for several months.^{28,29} Moreover, there is a high rate of repeat TV infections after treatment using metronidazole, though it is unknown whether these represent reinfections or treatment failure.^{30,31} Thus, increased TV rates among older women could be a reflection of a high rate of prior and persistent infections. Again, the lack of screening makes this finding difficult to interpret.

The main limitation of this review is the low number of included studies. However, the search and screening protocol was extensive, and we believe the small sample is ultimately due to a general lack of studies on sexual health risks and behaviours in this demographic, and a general lack of studies assessing frequencies of TV in the population at large. Additionally, two of the articles included assessed historical evidence of infection *via* antibody testing and one article examined medical records, which may be less informative for examining epidemiologic trends. However, we felt it important to include these articles given the limited availability of data in this population, as previously mentioned.

The results of this review indicate that future research into the prevalence and incidence of trichomoniasis in older adults is highly necessary. Though certain health consequences of TV such as pregnancy complications and adverse birth

outcomes are less of a concern among older adults, TV also causes inflammation, facilitates transmission of other STIs (including HIV), and can increase risk of cervical cancer and prostate cancer.^{2–7} Further, while older adults generally experience lower rates of STI than their younger counterparts, TV may represent an instance where the older population is at increased risk. Future studies should investigate this association and identify subgroups of the older population that may be at higher risk for trichomoniasis or TV complications.

Supplementary material

Supplementary material is available [online](#).

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