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Estimating the Prevalence of HIV and Sexual Behaviors Among the US Transgender Population: A Systematic Review and Meta-Analysis, 2006–2017

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Abstract

Background.—Transgender women (transwomen) in the United States have been shown to have high HIV risk with Black and Hispanic transwomen being particularly vulnerable. Growing research on transgender men (transmen) also shows increased HIV risk and burden, although not as much is known for this transgender population.

Objectives.—This systematic review estimates the prevalence of self-reported and laboratory-confirmed HIV infection, reported sexual and injection behaviors, and contextual factors associated with HIV risk of transgender persons living in the United States.

Search Methods.—We searched the HIV Prevention Research Synthesis database and MEDLINE, EMBASE, PsycINFO, CINAHL, and Sociological Abstracts databases from January 2006 to March 2017 and January 2006 to May 2017, respectively. Additional hand searches were conducted in December 2017 to obtain studies not found in the literature searches.

Selection Criteria.—Eligible reports were published US-based studies that included transgender persons and reported HIV status.

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CONTRIBUTORS

J. S. Becasen conceptualized and designed the study, developed search terms and inclusion criteria, created the screening questions and forms, screened study abstracts, extracted data, performed all data analyses, created all tables and figures, and drafted the initial article. C. L. Denard assisted in developing the screening questions and forms, wrote the coding manual, screened study abstracts, extracted data, conducted the hand searches, finalized the tables, drafted the introduction of the initial article, and contributed to other sections. M. M. Mullins developed the search strategy, conducted all literature searches, and drafted the systematic search section. D. H. Higa and T. A. Sipe screened study abstracts, extracted data, and contributed to all sections of the article.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

CONFLICTS OF INTEREST

We have no relevant financial interests to disclose.

HUMAN PARTICIPANT PROTECTION

Institutional review board approval was not required. The unit of analyses in this systematic review were previously published studies with aggregated data that are widely available and do not identify individual persons.

Data collection and analysis.—Data were double-coded and quality assessed. We used random-effects models employing the DerSimonian–Laird method to calculate overall prevalence of HIV infection, risk behaviors, and contextual factors for transwomen, transmen, and race/ethnicity subgroups.

Main Results.—We reviewed 88 studies, the majority of which were cross-sectional surveys. Overall laboratory-confirmed estimated prevalence of HIV infection was 9.2% (95% confidence interval [CI] = 6.0%, 13.7%; $\kappa = 24$). Among transwomen and transmen, HIV infection prevalence estimates were 14.1% (95% CI = 8.7%, 22.2%; $\kappa = 13$) and 3.2% (95% CI = 1.4%, 7.1%; $\kappa = 8$), respectively. Self-reported HIV infection was 16.1% (95% CI = 12.0%, 21.2%; $\kappa = 44$), 21.0% (95% CI = 15.9%, 27.2%; $\kappa = 30$), and 1.2% (95% CI = 0.4%, 3.1%; $\kappa = 7$) for overall, transwomen, and transmen, respectively. HIV infection estimates were highest among Blacks (44.2%; 95% CI = 23.2%, 67.5%; $\kappa = 4$). Overall, participation in sex work was 31.0% (95% CI = 23.9%, 39.0%; $\kappa = 39$). Transwomen (37.9%; 95% CI = 29.0%, 47.7%; $\kappa = 29$) reported higher participation in sex work than transmen (13.1%; 95% CI = 6.6%, 24.3%; $\kappa = 10$; $P = .001$). Most outcomes indicated high heterogeneity in the overall and subgroup analyses.

Conclusions.—The availability of more data allowed us to calculate estimates separately for transwomen and transmen. HIV prevalence estimates for US transwomen were lower than previous estimates, but estimates for HIV prevalence and participation in sex work were higher when compared with transmen. Evidence gaps remain for transmen and the syndemic relationship of HIV, risky behaviors, and contextual factors specific to the transgender experience.

Public Health Implications.—This study highlights gender disparities for HIV and risky sexual behavior, as well as evidence gaps that exist for transmen. Tailored programs and services for the transgender population need to be developed to encourage use of and access to HIV prevention services.

PLAIN-LANGUAGE SUMMARY

Transgender individuals, or persons whose gender identity is different from gender assigned at birth, have a high HIV rate in the United States. Nearly 1 million people identify as transgender; however, it is estimated that 25% to 28% of transgender persons in the United States are HIV-positive. We reviewed the literature regarding the US transgender population and updated estimates of HIV infection, reported risky sexual and drug use behaviors, and related factors that may increase HIV risk. We included 88 studies. Sixty-eight (77%) studies consisted of majority non-White participants. Laboratory-confirmed (from a blood or saliva test) HIV infection was 9.2%, and self-reported HIV infection was 16.1%. Laboratory-confirmed HIV infection was significantly higher in transwomen (born male, identify as female: 14.1%) than transmen (born female, identify as male: 3.2%). Black transwomen had a significantly higher prevalence estimate (44.2%) compared with White (6.7%) and other race/ethnicity (9.8%) transwomen. Transwomen self-reported 21% HIV infection and transmen self-reported 1.2%. Overall, 31% reported participation in sex work (trading money or goods for sex) and the percentage was higher for transwomen (37.9%) than it was for transmen (13.1%).

HIV infection is high for transgender individuals, especially for transwomen. These updated estimates add much-needed insight into the literature on transgender health.

In the United States, the burden of HIV infection has played a substantial role in health inequities among gender, racial, and sexual minorities. Notably, men who have sex with men has been one of the groups at highest risk, accounting for 82% of new HIV diagnoses among men during 2015.¹ Women account for 19% of new HIV diagnoses and, among them, 61% are Black.¹ Although our best estimates of the transgender population account for less than 1% of the population, HIV prevalence among this population is substantial (estimated at 22%–28%).^{2–5} However, these estimates reflect studies with samples reporting high proportions of risky behaviors. A recent large-scale, Internet-based survey reported similar findings.⁶ Among transgender groups, a discernable HIV disparity exists between the 2 most common transgender identities, transgender women (persons who are born male but identify as female; hereafter referred to as *transwomen*) and transgender men (persons who are born female but identify as male; hereafter referred to as *transmen*). During 2009 to 2014, 2351 US transgender persons received an HIV diagnosis, with 84% identifying as transwomen and 15% as transmen.⁷ Black transwomen had the highest HIV prevalence estimates (56.3%) followed by White (16.7%) and Hispanic (16.1%) transwomen.³

The seminal meta-analysis by Herbst et al.³ provided at that time the best prevalence estimates of HIV infection, risky behaviors, and other factors related to HIV acquisition for transgender groups. Another review by Baral et al.² provided global estimates for transgender groups in addition to US estimates. The increasing focus on the transgender population in HIV prevention research prompted this review to update prevalence estimates of HIV infection, risky behaviors, and contextual factors related to HIV risk reported in the previously published reviews by Herbst et al. and Baral et al.^{2,3}

METHODS

Transgender population subject-matter experts were consulted to develop a comprehensive search of the literature using an internal Centers for Disease Control and Prevention (CDC) database and other external databases. The subject-matter experts shared a list of key publications that the team refined to 26 references (Appendix A, available as a supplement to the online version of this article at <http://www.ajph.org>) that met our inclusion criteria. These references were used to develop a set of terms to validate the search scope. CDC's Prevention Research Synthesis project database of HIV, AIDS, and sexually transmitted diseases (STDs) literature was initially queried for citations focused on transgender populations.⁸ The Prevention Research Synthesis database consists of 4 automated searches with supplemental manual searches focused on (1) behavioral risk reduction; (2) medication adherence; (3) linkage to, retention in, and re-engagement in HIV care; and (4) systematic reviews. The automated searches include the databases (platforms) MEDLINE (OVID), EMBASE (OVID), CINAHL (EBSCOhost), Global Health (OVID), PsycINFO (OVID), and Sociological Abstracts (ProQuest; Appendix B, available as a supplement to the online version of this article at <http://www.ajph.org>; contact the corresponding author for other strategies).

We used a pool of 51 term variations to search the Prevention Research Synthesis database titles, abstracts, and keywords for 2006 to 2017. The last search was conducted in May 2017 (Appendix B). We conducted additional searches in MEDLINE, EMBASE, PsycINFO, CINAHL, and Sociological Abstracts. The search consisted of keywords and index terms with HIV, AIDS, and STD terms cross-referenced against 42 related transgender terms (e.g., transgender, transman, transwoman, male to female, and female to male). The search period spanned 2006 to 2017, with the last electronic search completed in June 2017. The electronic search as implemented in MEDLINE is available in Appendix C (available as a supplement to the online version of this article at <http://www.ajph.org>). A manual search of the literature included a reference list check of included citations, and another manual search of the journals recognized for publishing a higher volume of literature about transgender groups was conducted in December 2017. We used the PRISMA reporting checklist to guide this study.^{9,10} No protocol was registered for this review.

Study Selection and Data Extraction

Study screening and data abstraction of included studies were conducted by using DistillerSR (Evidence Partners, Ottawa, Ontario). Studies were screened by 1 of 4 researchers in a 2-step process. First, eligibility was determined by assessing the titles and abstracts for US-based studies, including US territories, and the mention of transgender persons. Second, full-text reports of studies were assessed for explicit enumeration of US-based transgender participants and their HIV seroprevalence data. Studies were excluded if HIV-negative or -positive status was a study's inclusion criterion, which would not allow for the calculation of HIV prevalence. Review papers, commentaries, and non-peer-reviewed reports were also excluded.

Data extraction was conducted independently in pairs by trained researchers who used standardized data extraction forms and coding manuals. Discrepancies were resolved by consensus. The following information was extracted: study dates, target population, location, sampling method, sample size, study design, and participant demographics.

Additional participant information included HIV serostatus; prior STD diagnoses; risky sexual behaviors, including unprotected vaginal or anal intercourse; risky drug behaviors, including injection drug use (illicit drugs, hormones, or body fillers or enhancers); and noninjection drug use (illicit drugs or hormones). Behaviors and factors that might be protective against HIV infection (e.g., HIV testing, preexposure prophylaxis [PrEP] knowledge and uptake, and condom use) were extracted. Contextual factors that might influence HIV risk, including mental health problems (e.g., depression or suicide attempts); physical, mental, or sexual abuse; gender identity discrimination; incarceration history; health insurance status; employment status; housing status; and perception of HIV risk were extracted. Because behaviors and factors were not reported uniformly across the studies, we included differing recall periods (e.g., past year or lifetime). For studies that used a cohort design or control experiment, baseline data were extracted.

Study quality was assessed independently in pairs by using an adaptation of a modified version of the Newcastle–Ottawa scale.¹¹ This scale addresses 5 key domains:

1. Sample representativeness and size of the transgender sample,
2. Measure of transgender identity,
3. Method of ascertainment for HIV serostatus (i.e., laboratory-confirmed vs self-reported),
4. Comparability between study participants and nonparticipants, and
5. Quality of statistical reporting.

Affirmative answers were summed and possible scores were 0 to 5, with a threshold determined a priori of 0 to 2 as low quality and 3 to 5 as high quality.

Data Analyses

We performed all analyses with Comprehensive Meta-Analysis software (Biostat, Englewood, NJ). We used the random effects model in calculating summary effect size and the DerSimonian–Laird methods to estimate between-study variance, and the inverse-variance to weight each study.¹² A continuity correction of 0.5 was added to all cells when 0 events existed for a study.¹³ We calculated average prevalence or mean estimates and 95% confidence intervals (CIs) separately for transwomen and transmen for the following outcomes: HIV seropositivity, STD diagnosis, risky sexual and drug behaviors, protective behaviors, and contextual factors. We considered a *P* value of < .05 statistically significant. For HIV prevalence, we also conducted a stratified analysis on ascertainment method of HIV status (self-reported and laboratory-confirmed HIV status). In addition, we analyzed HIV infection across race/ethnicity and quality score. Meta-regression assessed the impact of publication year and average study participant age. For studies that reported outcome data on the same participants, we only included 1 study to represent each set of participants and only calculated estimates when 3 or more studies reported data for an outcome of interest.

We assessed heterogeneity with the *Q* test statistic and I^2 values. The amount of heterogeneity, I^2 , can be interpreted with Higgins's index: I^2 values of 25%, 50%, and 75% correspond to low, moderate, and high heterogeneity, respectively.¹⁴ We assessed publication bias by using funnel plots (Duval and Tweedie's trim and fill).¹⁵

RESULTS

Figure 1 illustrates our selection process for study inclusion; 88 studies met the inclusion criteria (Appendix D, available as a supplement to the online version of this article at <http://www.ajph.org>). Because certain studies used the same or overlapping data sets, the number of prevalence effect sizes (κ) used in the analysis is different than the number of studies ($n = 88$) and varies for each outcome (e.g., $\kappa = 68$ for our primary outcome, HIV infection). Included studies had been conducted during 2001 to 2015 and published in English during January 2006 to December 2017; half had been published recently (2014–2017). Fifty-four (61%) studies received high-quality scores (scores ≥ 3). Forty-six (52%) of studies' locations were in San Francisco, California; New York, New York; Los Angeles, California; or Boston, Massachusetts. Eighty-one (92%) of studies were cross-sectional surveys that used convenience or snowball (i.e., respondent-driven) sampling. Eighty-five (96%) of studies

used self-reported transgender identity to identify transgender participants. Three studies identified transgender participants by using the *International Classification of Diseases, Revision 9*, diagnostic codes (302.5x, 302.6, 302.85) associated with transgender identity. 16–18

Fifty-eight (66%) studies reported HIV prevalence data for either transwomen or transmen, 7 (8%) studies reported HIV prevalence for both transwomen and transmen, and 11 (13%) studies reported only overall estimates for the transgender sample. Study sample sizes varied from 8 to 7454, transwomen varied from 8 to 2136, transmen varied from 16 to 528, and studies that did not differentiate the genders varied from 31 to 7454. Across all studies, participants were aged 16 to 66 years. The majority of the studies included only adults (aged 18 years); however, 14 (16%) included participants younger than 18 years. Sixty-eight (77%) studies consisted of majority non-White participants.

Prevalence of HIV Infection and Prior STD Diagnosis

HIV infection prevalence for transgender persons in the United States was reported in 88 studies with 68 effect sizes (Table 1). The overall mean HIV prevalence (laboratory-confirmed and self-reported) estimate was 13.7% (95% CI = 10.9, 16.9; $I^2 = 97%$; $\kappa = 68$). The prevalence estimate for transwomen was 18.8% (95% CI = 14.9, 23.5; $I^2 = 95%$; $\kappa = 43$), which was significantly higher than for transmen (2.0% [95% CI = 1.0, 4.0; $I^2 = 51%$; $\kappa = 15$]; $Q = 39.1$; $df = 1$; $P < .001$; Figure A, available as a supplement to the online version of this article at <http://www.ajph.org>).

The mean prevalence estimate for laboratory-confirmed HIV was 9.2% (95% CI = 6.0, 13.7; $I^2 = 98%$; $\kappa = 24$) among US transgender persons. The mean prevalence estimate for transwomen was 14.2% (95% CI = 8.7, 22.2; $I^2 = 96%$; $\kappa = 13$), which was significantly higher than for transmen (3.2% [95% CI = 1.4, 7.1; $I^2 = 37%$; $\kappa = 8$]; $Q = 9.1$; $df = 1$; $P = .003$; Table 1; Figure B, available as a supplement to the online version of this article at <http://www.ajph.org>). To assess HIV status by race/ethnicity, we combined self-reported and laboratory-confirmed infection data for each estimate. Black transwomen had a significantly higher prevalence estimate (44.2% [95% CI = 23.2, 67.5; $I^2 = 94%$; $\kappa = 4$]), compared with White ($P < .01$) and other ($P = .001$) race/ethnicity transwomen. The next highest prevalence estimates were for Hispanic transwomen (25.8% [95% CI = 11.7, 47.7; $I^2 = 95%$; $\kappa = 5$]), other race/ethnicity transwomen (9.8% [95% CI = 4.2, 21.1; $I^2 = 87%$; $\kappa = 6$]), and White transwomen (6.7% [95% CI = 2.6, 16.6; $I^2 = 83%$; $\kappa = 5$]). Too few studies were included to examine HIV prevalence and race/ethnicity for transmen, and the quality score analysis showed no significant difference for HIV prevalence between high- and low-quality studies. The meta-regression analysis of studies that reported average age and publication year did not yield significant results.

The self-reported HIV infection overall prevalence estimate was 16.1% (95% CI = 12.0, 21.2; $I^2 = 98%$; $\kappa = 44$; Table 1). Similarly, the self-reported prevalence estimate for transwomen was 21.0% (95% CI = 15.9, 27.2; $I^2 = 95%$; $\kappa = 30$), which was significantly higher than for transmen (1.2% [95% CI = 0.4, 3.1; $I^2 = 28%$; $\kappa = 7$]; $Q = 28.7$; $df = 1$; $P < .001$). The overall estimate for self-reported history of STD diagnosis was 21.5% (95% CI

= 16.7, 27.3; $I^2 = 98\%$; $\kappa = 17$); for transwomen and transmen, it was 21.1% (95% CI = 18.0, 24.7; $I^2 = 66\%$; $\kappa = 8$) and 28.7% (95% CI = 12.2, 53.9; $I^2 = 93\%$; $\kappa = 8$), respectively.

HIV Testing and Preexposure Prophylaxis Awareness

Approximately 72.8% (95% CI = 65.1, 79.3; $I^2 = 89\%$; $\kappa = 16$) of the participants reported a history of HIV testing, with no significant differences between transwomen (74.6% [95% CI = 64.3, 82.8; $I^2 = 91\%$; $\kappa = 9$]) and transmen (69.1% [95% CI = 55.7, 79.9; $I^2 = 89\%$; $\kappa = 6$]; $Q = 0.50$; $df = 1$; $P = .48$). Overall, 48.6% (95% CI = 25.6, 72.2; $I^2 = 95\%$; $\kappa = 5$) reported awareness of PrEP (Table 1).

Prevalence of HIV Risk Behaviors

Results for HIV sexual behaviors are listed in Table 1. An estimated 31.0% (95% CI = 23.9, 39.0; $I^2 = 97\%$; $\kappa = 39$) reported having participated in sex work. Transwomen reported higher estimates (37.9% [95% CI = 29.0, 47.7; $I^2 = 98\%$; $\kappa = 29$]) than transmen (13.1% [95% CI = 6.6, 24.3; $I^2 = 88\%$; $\kappa = 10$]; $Q = 10.2$; $df = 1$; $P = .001$). The estimated overall prevalence of engaging in any unprotected sexual intercourse was 35.7% (95% CI = 29.4, 42.5; $I^2 = 96\%$; $\kappa = 31$). No significant difference was identified in the proportion of transwomen or transmen who reported unprotected sexual intercourse: 38.2% (95% CI = 30.5, 46.5; $I^2 = 97\%$; $\kappa = 21$) and 24.5% (95% CI = 15.8, 36.0; $I^2 = 88\%$; $\kappa = 9$), respectively ($Q = 3.81$; $df = 1$; $P = .05$). An estimated 36.4% (95% CI = 28.2, 45.5; $I^2 = 95\%$; $\kappa = 16$) reported having had sex while drunk or high: 37.3% (95% CI = 28.2, 47.4; $I^2 = 95\%$; $\kappa = 13$) for transwomen and 32.4% (95% CI = 16.3, 54.0; $I^2 = 88\%$; $\kappa = 3$) for transmen ($Q = 0.19$; $df = 1$; $P = .67$). The estimated proportion who reported sex with partners who were HIV-positive or of unknown status was 20.0% (95% CI = 12.9, 29.7; $I^2 = 90\%$; $\kappa = 12$), with no difference for transwomen or transmen (20.2% [95% CI = 12.0, 31.8; $I^2 = 92\%$; $\kappa = 8$]) and 19.5% [95% CI = 8.1, 39.8; $I^2 = 80\%$; $\kappa = 4$], respectively; $Q = 0.005$; $df = 1$; $P = .94$). Similar proportions of transwomen and transmen reported having had multiple sexual partners (41.7% [95% CI = 29.0, 55.6; $I^2 = 96\%$; $\kappa = 6$]) and 43.1% [95% CI = 29.3, 58.2; $I^2 = 93\%$; $\kappa = 6$], respectively; $Q = 0.02$; $df = 1$; $P = .89$), with an overall average mean number estimate of 4 partners (95% CI = 2.0, 5.6; $I^2 = 48\%$; $\kappa = 5$) across studies.

Prevalence of Drug and Alcohol Use Behavior

Overall, estimated reported prevalence of injecting illicit drugs was approximately 10.0% (95% CI = 6.5, 15.2; $I^2 = 94\%$; $\kappa = 20$; Table 1). Similar estimates were reported for transwomen (10.7% [95% CI = 6.4, 17.2; $I^2 = 95\%$; $\kappa = 14$]) and transmen (9.3% [95% CI = 3.5, 22.5; $I^2 = 0\%$; $\kappa = 5$]; $Q = 0.07$; $df = 1$; $P = .80$). The proportion of those injecting hormones or body fillers or enhancers was higher (overall: 37.4% [95% CI = 21.3, 56.8; $I^2 = 97\%$; $\kappa = 9$]; transwomen: 32.7% [95% CI = 16.7, 54.1; $I^2 = 97\%$; $\kappa = 7$]; transmen: too few studies; $\kappa = 2$). Sharing needles for either injecting illicit drugs or injecting body fillers or enhancers was reported by 2.5% (95% CI = 1.2, 4.9; $I^2 = 72\%$; $\kappa = 9$) of participants. For noninjection drug use, alcohol use was reported by both transwomen (47.5% [95% CI = 30.9, 64.6; $I^2 = 98\%$; $\kappa = 11$]) and transmen (39.6% [95% CI = 18.6, 65.3; $I^2 = 96\%$; $\kappa = 5$]; $Q = 0.26$; $df = 1$; $P = .62$). Transmen reported illicit drug use at 38.1% (95% CI = 25.9, 52.0; $I^2 = 92\%$; $\kappa = 9$) and transwomen at 36.0% (95% CI = 28.0, 44.8; $I^2 = 96\%$; $\kappa = 17$; $Q =$

0.07; $df=1$; $P=.79$). Hormone use for overall, transwomen, and transmen was 67.1% (95% CI = 60.9, 72.8; $I^2=96\%$; $\kappa=27$), 67.7% (95% CI = 59.3, 75.1; $I^2=96\%$; $\kappa=16$), and 73.4% (95% CI = 60.2, 83.4; $I^2=95\%$; $\kappa=7$), respectively ($Q=0.57$; $df=1$; $P=.45$; Table 1).

Contextual Factors Associated With HIV Risk

We examined factors that might influence HIV risk (Table 1). High proportions of transwomen and transmen reported depression (43.6% [95% CI = 35.4, 52.0; $I^2=91\%$; $\kappa=11$] and 54.2% [95% CI = 37.7, 69.8; $I^2=0\%$; $\kappa=3$], respectively; $Q=3.54$; $df=1$; $P=.27$). Attempted suicide was also reported across the studies (24.8% [95% CI = 18.0, 33.2; $I^2=99\%$; $\kappa=6$]). Half of participants reported prior mental or physical abuse (47.8% [95% CI = 30.2, 66.0; $I^2=99\%$; $\kappa=14$]), and 39.8% (95% CI = 23.1, 59.3; $I^2=98\%$; $\kappa=11$) experienced sexual abuse. Approximately half of the transgender participants reported experiencing gender-based discrimination (47.5% [95% CI = 14.2, 83.2; $I^2=99\%$; $\kappa=4$]). Unstable housing or homelessness was reported by 30.3% (95% CI = 23.1, 38.5; $I^2=95\%$; $\kappa=20$) of the participants. Transwomen reported 39.2% (95% CI = 29.4, 49.9; $I^2=93\%$; $\kappa=14$) being employed, whereas transmen reported 56.8% (95% CI = 35.8, 75.7; $I^2=87\%$; $\kappa=4$; $Q=2.12$; $df=1$; $P=.15$) employment, either part- or full-time. A history of incarceration was reported for transwomen (43.3% [95% CI = 31.2, 56.4; $I^2=97\%$; $\kappa=17$]). The proportion of those having health insurance was 71.9% (95% CI = 58.5, 82.3; $I^2=95\%$; $\kappa=6$) of transwomen and 70.1% (95% CI = 50.7, 84.3; $I^2=64\%$; $\kappa=4$) of transmen ($Q=0.03$; $df=1$; $P=.87$).

Publication Bias

The funnel plots identified evidence of asymmetry across all studies. Potentially missing studies were those with small or large sample sizes and higher HIV prevalence (Appendix E and F, available as supplements to the online version of this article at <http://www.ajph.org>). The Duval and Tweedie's trim and fill procedure¹⁵ revealed similar estimates if missing studies were included in the analysis. For transmen, HIV infection could be doubled if the potential missing studies were included, indicating that our HIV prevalence estimate might be an underestimation of the true effect size.

DISCUSSION

Our systematic review and meta-analysis of the published literature updates previously reported estimates of HIV infection among the US transgender population, albeit having high heterogeneity in the overall and group analyses. It expands the literature by being the first to our knowledge to synthesize estimates of HIV prevalence among transmen.^{2,3} Specifically, our study identified lower estimates of HIV prevalence compared with previous reviews; however, these estimates are still substantial in comparison with other vulnerable populations. Disparities in HIV-related risk factors were also revealed between transwomen and transmen. Similar to Herbst et al.,³ we estimated a high proportion of HIV risk behaviors (e.g., unprotected intercourse and sex work among transgender persons and a high proportion of hormone use, both injection and noninjection, illicit drug use, and alcohol use). However, we identified low levels of reported needle sharing and injection of illicit

drugs. In addition, estimates of self-reported HIV testing were high (73%), but knowledge of PrEP was relatively low (48%). Finally, the estimated prevalence of reported contextual factors that might exacerbate HIV vulnerability were high.

HIV Prevalence

Our estimate for laboratory-confirmed HIV prevalence among transwomen was lower than previous estimates. This might not be indicative of decreasing HIV infection, but more likely reflects that research has begun to include transgender persons from locations and backgrounds that might be more representative of the overall transgender population. Enumeration and self-identification plays an important role in the increasing visibility of this population. For example, inclusion of improved gender identification questions that differentiate the transgender populations in more recent surveys has allowed us to synthesize estimates across the published literature, especially for transmen. Although we acknowledge that transgender persons might prefer to identify beyond the binary identifications (e.g., genderqueer or gender non-conforming), our estimates more closely reflect the state of the 2 most common identifications that fall under the transgender umbrella.⁶

We determined that transmen had lower HIV infection estimates, both laboratory-confirmed and self-reported, than transwomen. Lower participation in risky sexual behaviors and having female sexual partners might partially explain the lower HIV prevalence among transmen; however, more research regarding transmen is needed. Black transwomen had the highest HIV prevalence estimates, and Hispanic transwomen had higher estimates than previously reported.³ These differences are similar to the national trends of new HIV diagnoses among Black and Hispanic US residents being disproportionately affected by HIV¹ and indicate the need for targeted HIV prevention efforts for these affected groups.

HIV Risk Behaviors

We determined that reports of sex work were more prevalent among transwomen than transmen, and, although not statistically significant ($P = .05$), we observed a higher proportion of transwomen reporting unprotected intercourse. However, other risk factors known to increase HIV acquisition (e.g., having a prior STD diagnosis, multiple partners, sex while under the influence of drugs or alcohol, and sexual partners who were HIV-positive or of unknown status) were reported equally by transwomen and transmen. For transwomen, sex work can play an economic role or affirm a desired sense of femininity,¹⁹ but it is also associated with incident HIV and STDs and condomless anal sex.²⁰ Employment and vocational interventions can benefit transwomen, especially those engaging in sex work.^{21,22} Harm-reduction strategies (e.g., increased access to PrEP and condoms) might also be useful. Although our review determined that transmen report engagement in less sex work and condomless intercourse compared with transwomen, transmen also have HIV risk and their sexual health remains understudied.²³ Exploring transmen's sexual behavior in relation to the gender of the sexual partner and the challenges specific to transmen regarding social constructs and expectations of masculinity are promising directions for research.²⁴

Drug and Alcohol Use

Transwomen and transmen reported similar proportions of alcohol and drug use, sharing needles, and hormone use. The findings regarding increased alcohol use among transgender persons compared with nontransgender persons are mixed.^{25,26} Similar to our findings, a recent study that used an online survey also reported no differences among transgender identity groups.²⁵ For the transgender population, drug or alcohol use might be a coping mechanism in response to gender-related discrimination and gender-minority stress.^{27–29} Although needle use is associated with higher HIV risk,³⁰ it is reported more often for administering hormones than for illicit drug use by the transgender population; moreover, needle sharing is rare.^{3,31}

HIV Testing and Preexposure Prophylaxis Awareness

CDC recommends that persons at high risk get tested for HIV annually, and, although transgender persons are not included in the recommendations,³² our estimates for HIV testing among the transgender population were higher than that reported in previously published literature.^{6,33} One potential explanation for this finding might be that transgender persons who seek out transgender-supportive providers for medical services related to transitioning might also receive HIV- or STD-prevention services. Our estimates of PrEP knowledge were low, and, although transgender persons are not specifically included in the clinical guidelines for PrEP,³⁴ providers have the opportunity to educate and offer PrEP to transgender patients at high risk.

Contextual Factors

Our estimates of contextual factors related to HIV risk were high (Table 1). Similar to other findings,^{22,35–38} approximately half of the transgender participants in our review reported perceived gender discrimination, depression, and abuse. Also, we found similar estimates of attempted suicide to those of previous reviews,^{3,6} with a quarter of the participants reporting having attempted suicide. Homelessness or unstable housing was reported among a third of participants, similar to previous reviews (33%). Incarceration for transwomen (43%) was substantial and higher than previous estimates (13%).³ Having health insurance was reported by three quarters of participants and was comparable between transwomen and transmen; however, it was lower than the average 90% of the nation covered by insurance.³⁹ Approximately half of the participants reported being employed part- or full-time, which contrasts with the previous lower unemployment estimate of 23%.³ Transmen reported slightly higher employment rates than transwomen, although not statistically different. In whole, these findings indicate that transgender persons experience multiple and overlapping health, social, and economic vulnerabilities that increase their HIV risk. Addressing these contextual factors warrants multicomponent interventions that recognize and address these vulnerabilities and their intersections.^{40,41} As part of a multicomponent approach, structural interventions such as antistigma mass-media campaigns and antidiscrimination laws in employment and housing might be necessary components of a comprehensive approach for reducing HIV vulnerability for transgender persons and communities.^{22,42}

Limitations

One limitation of our study was that the majority of included studies used convenience or snowball sampling methods to obtain participants. Thus, persons at higher risk might be overrepresented, giving us spurious prevalence estimates of HIV infection and risky behaviors. From our quality assessment, 55% of the studies were representative of the general transgender population; the rest indicated that their samples were recruited from locations or for reasons that would indicate higher-than-normal risk for HIV.

Another limitation is that our analysis indicated substantial heterogeneity; therefore, caution should be taken in interpreting these results. Some heterogeneity can be explained by the differences in ascertainment method; however, little to no heterogeneity is explained between gender identities for certain outcomes; the majority of effect estimates remained with moderate-to-high heterogeneity. In addition, too few studies regarding certain outcomes of interest might have underpowered their estimates, particularly for transmen. Finally, the limited number of studies reporting multiple outcomes of interest did not allow us to look at possible moderation of study-level characteristics. Lastly, we excluded gray literature, which could provide a more comprehensive view of the available evidence.

Future Prevention and Research Directions

Health care providers can play a pivotal role by offering preventive HIV services when providing trans-specific health care to transgender patients. In addition, more research regarding contextual factors is needed. Future work is needed to improve race disparities evident with highest prevalence among Black transwomen. Although transgender identity measures continue to improve, a standardized implementation and use of such measures are needed to expand the data available for transwomen, transmen, and persons who do not conform to binary gender assignments. Finally, sensitivity in HIV prevention efforts is crucial for reaching transgender persons and creating a sense of safety that encourages transgender persons to self-identify and access HIV prevention services.

Conclusions

This review was the first to our knowledge to estimate prevalence of HIV, selected risk behaviors, and contextual factors associated with HIV acquisition for transmen, but estimates for other outcomes remain an evidence gap because too few studies reported outcomes specific to transmen. We also report HIV prevalence estimates for US transwomen to be lower than previous estimates, but higher compared with transmen. Moreover, prevalence estimates for sex work were higher for transwomen compared with transmen. This review contributes evidence that reflects recent research regarding the transgender population, but also highlights evidence gaps for transmen and the syndemic associations of HIV, risky behaviors, and contextual factors specific to the transgender experience.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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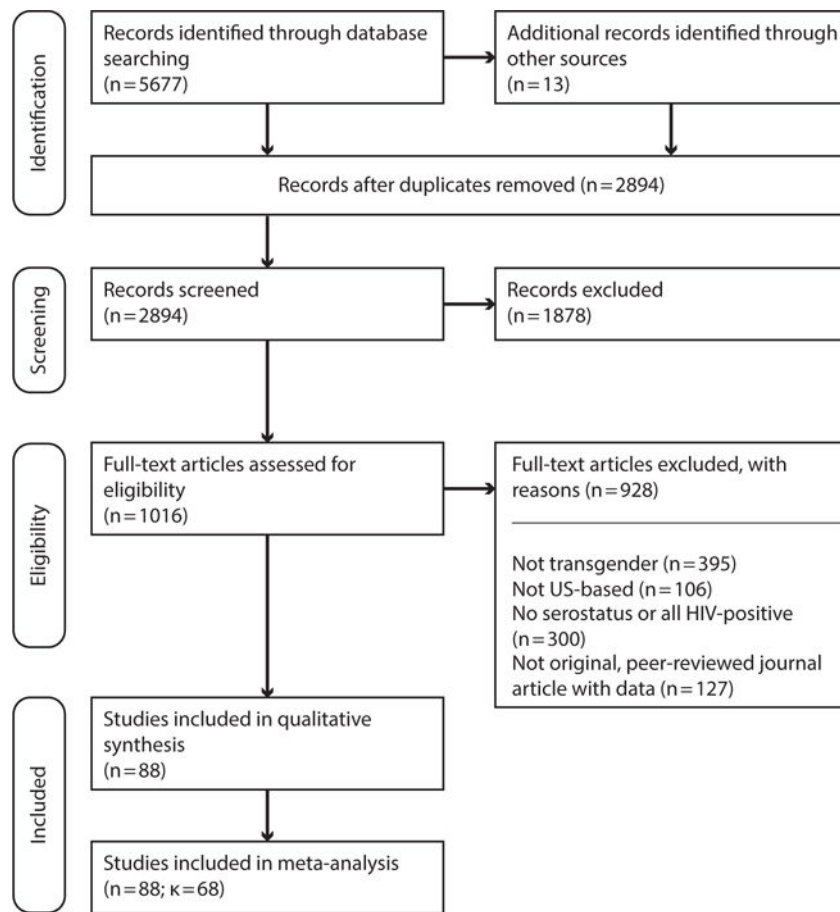


FIGURE 1—
PRISMA Flowchart

TABLE 1—

Estimated Mean Prevalence of HIV Status, Prior Sexually Transmitted Disease Diagnosis, Risky Sexual Behaviors, Drug Use, and Contextual Factors for Transgender Women, Transgender Men, and Transgender Persons Overall (n = 88 Studies): United States, 2006–2017

Outcome	Transgender Women				Transgender Men				Transgender Persons Overall ^d				
	κ	Weighted % (95% CI)	I ² %	Min–Max %	κ	Weighted % (95% CI)	I ² %	Min–Max %	κ	Weighted % (95% CI)	I ² %	Min–Max %	
HIV status and prior STD diagnosis													
HIV infection	43	18.8 (14.9, 23.5)	95	0.9–72.7	15	2.0 (1.0, 4.0)	51	0.3–10.1	68	13.7 (10.9, 16.9)	97	0.3–72.7	
Laboratory-confirmed	13	14.2 (8.7, 22.2)	96	1.0–40.7	8	2.9 (1.1, 7.3)	37	0.4–10.1	24	9.2 (6.0, 13.7)	98	0.4–40.1	
Self-reported	30	21.0 (15.9, 27.2)	95	0.9–72.7	7	1.2 (0.4, 3.1)	28	0.3–7.1	44	16.1 (12.0, 21.2)	98	0.3–60.2	
By race/ethnicity^c													
Black	4	44.2 (23.2, 67.5)	94	20.4–66.7	...	...	...	...	...	...	...	...
Hispanic	5	25.8 (11.7, 47.7)	95	7.7–60.0	...	...	...	...	...	...	...	...
White	5	6.7 (2.6, 16.6)	83	0.2–25.0	...	...	...	...	...	...	...	...
Other	6	9.8 (4.2, 21.1)	87	6.5–26.0	...	...	...	...	...	...	...	...
STD diagnosis	8	21.1 (18.0, 24.7)	66	3.0–36.4	8	28.7 (12.2, 53.9)	93	0.1–100.0	46	17	21.5 (16.7, 27.3)	98	1.2–99.6
HIV testing	9	74.6 (64.3, 82.8)	91	8.0–99.2	6	69.1 (55.7, 79.9)	89	47.6–93.3	48	16	72.8 (65.1, 79.3)	89	8.0–99.2
PrEP knowledge	3	36.6 (13.7, 67.7)	95	13.7–64.0	2	NA	NA	NA	...	5	48.6 (25.6, 72.2)	95	13.7–64.0
Risky sexual behaviors													
Sex work	29	37.9 (29.0, 47.7)	98	3.7–82.0	10	13.1 (6.6, 24.3)	88	1.2–43.8	39	31.0 (23.9, 39.0)	97	1.2–82.0	
Unprotected sex	21	38.2 (30.5, 46.5)	97	11.9–72.7	9	24.5 (15.8, 36.0)	88	8.1–43.9	31	35.7 (29.4, 42.5)	96	8.1–72.7	
Drunk or high during sex	13	37.3 (28.2, 47.4)	95	13.7–71.1	3	32.4 (16.3, 54.0)	88	25.0–45.7	67	16	36.4 (28.2, 45.5)	95	13.7–71.1
HIV-positive partners	8	20.2 (12.0, 31.8)	92	2.6–54.5	4	19.5 (8.1, 39.8)	80	3.3–50.0	94	12	20.0 (12.9, 29.7)	90	3.3–54.5
No. of partners ^d	2	NA	NA	NA	NA	NA	NA	NA	...	5	3.8 (2.0, 5.6)	48	2.8–39.4
Multiple partners	6	41.7 (29.0, 55.6)	96	29.0–58.0	6	43.1 (29.3, 58.2)	93	0.15–86.0	89	12	42.4 (32.8, 52.6)	95	15.0–86.0

Outcome	Transgender Women			Transgender Men			Transgender Persons Overall ^d						
	κ	Weighted % (95% CI)	I^2 %	Min-Max %	Weighted % (95% CI)	I^2 %	Min-Max %	I^2 %	Weighted % (95% CI)	κ	Min-Max %		
Drug use behaviors													
Injection drug use	14	10.7 (6.4, 17.2)	95	0.7–40.5	5	9.3 (3.5, 22.5)	0	1.6–15.6	80	20	10.0 (6.5, 15.2)	94	0.7–40.5
Injection of hormones	7	32.7 (16.7, 54.1)	97	0.8–69.1	2	NA	NA	NA	...	9	37.4 (21.3, 56.8)	97	0.8–91.1
Shared needles	5	2.4 (1.0, 5.7)	79	0.3–9.8	3	2.2 (0.6, 7.9)	78	0.2–5.1	.92	9	2.5 (1.2, 4.9)	72	0.2–9.8
Alcohol use	11	47.5 (30.9, 64.6)	98	7.5–88.1	5	39.6 (18.6, 65.3)	96	10.3–65.2	.62	18	45.4 (32.2, 59.3)	98	7.5–88.1
Noninjection drugs	17	36.0 (28.0, 44.8)	96	13.2–70.6	9	38.1 (25.9, 52.0)	92	9.8–98.4	.79	29	34.9 (30.0, 40.0)	96	9.8–98.4
Noninjection hormones	16	67.7 (59.3, 75.1)	96	11.6–97.6	7	73.4 (60.2, 83.4)	95	41.2–97.8	.45	27	67.1 (60.9, 72.8)	96	11.6–97.8
Contextual factors													
Depression	11	43.6 (35.4, 52.0)	91	19.6–81.8	3	54.2 (37.7, 69.8)	0	52.2–54.9	.27	16	50.3 (45.3, 55.2)	98	19.6–81.8
Suicide attempts	2	NA	NA	NA	2	NA	NA	NA	...	6	24.8 (18.0, 33.2)	99	7.1–40.3
Abuse	9	55.8 (37.1, 72.9)	98	18.9–93.7	2	NA	NA	NA	...	14	47.8 (30.2, 66.0)	99	3.7–93.7
Sexual abuse	7	53.8 (24.4, 80.8)	98	10.5–99.2	1	NA	NA	NA	...	11	39.8 (23.1, 59.3)	98	10.5–99.2
Discrimination ^e	2	NA	NA	NA	...	...	...	...	...	4	47.5 (14.2, 83.2)	99	15.5–79.8
Unstable housing ^f	16	31.7 (23.2, 41.7)	95	4.9–72.7	2	NA	NA	NA	...	20	30.3 (23.1, 38.5)	95	4.9–72.7
Employment	14	39.2 (29.4, 49.9)	93	18.3–82.4	4	56.8 (35.8, 75.7)	87	30.4–81.3	.15	22	47.6 (37.4, 58.0)	98	18.3–82.4
Incarceration	17	43.3 (31.2, 56.4)	97	50.0–90.9	1	NA	NA	NA	...	18	41.3 (29.7, 54.0)	97	5.0–90.9
Health insurance	6	71.9 (58.5, 82.3)	95	46.7–85.8	4	70.1 (50.7, 84.3)	64	52.5–78.3	.87	12	72.3 (64.2, 79.1)	93	46.7–85.8

Note. CI = confidence interval; I^2 % = the variation across studies that is attributable to heterogeneity rather than chance; κ = number of prevalence estimates used; min-max = minimum to maximum; NA = not applicable because < 3 studies reported for measure; PREP = preexposure prophylaxis; STD = sexually transmitted disease; weighted % = weighted mean percentage.

^dIncludes studies that did not differentiate between transwomen and transmen.

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- ^b Test for between-group differences for transwomen and transmen.
- ^c Any ascertainment method (laboratory-confirmed and self-reported) for race estimates among transwomen only.
- ^d Meta-analysis of continuous measure.
- ^e Gender-based discrimination.
- ^f Includes homelessness.