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Estimating Populations of Men Who Have Sex with Men in the Southern United States

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ABSTRACT *Population estimates of men who have sex with men (MSM) by state and race/ethnicity are lacking, hampering effective HIV epidemic monitoring and targeting of outreach and prevention efforts. We created three models to estimate the proportion and number of adult males who are MSM in 17 southern states. Model A used state-specific census data stratified by rural/suburban/urban area and national estimates of the percentage MSM in corresponding areas. Model B used a national estimate of the percentage MSM and state-specific household census data. Model C partitioned the statewide estimates by race/ethnicity. Statewide Models A and B estimates of the percentages MSM were strongly correlated ($r=0.74$; r-squared=0.55; $p<0.001$) and had similar means (5.82% and 5.88%, respectively) and medians (5.5% and 5.2%, respectively). The estimated percentage MSM in the South was 6.0% (range 3.6–13.2%; median, 5.4%). The combined estimated number of MSM was 2.4 million, including 1,656,500 (69%) whites, 339,400 (14%) blacks, 368,800 (15%) Hispanics, 34,600 (1.4%) Asian/Pacific Islanders, 7,700 (0.3%) American Indians/Alaska Natives, and 11,000 (0.5%) others. The estimates showed considerable variability in state-specific racial/ethnic percentages MSM. MSM population estimates enable better assessment of community vulnerability, HIV/AIDS surveillance, and allocation of resources. Data availability and computational ease of our models suggest other states could similarly estimate their MSM populations.*

KEYWORDS *Men who have sex with men, HIV/AIDS, Epidemic modeling, HIV/AIDS surveillance, Epidemic monitoring, Census*

INTRODUCTION

Through the first three decades of the epidemic, men who have sex with men (MSM) have suffered the greatest HIV/AIDS-related morbidity and mortality in the US.[1–3] Recent evidence includes national research studies indicating that MSM are the risk group accounting for the largest share of estimated incident[4,5] and prevalent[6] HIV

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infections. One incidence study[4] showed that MSM had steady increases in newly occurring, estimated annual HIV infections from the early 1990s through 2006, unlike those in other HIV exposure categories, who tended to have level or declining trends. Yet, the populations of MSM that give rise to HIV/AIDS morbidity/mortality and incident/prevalent HIV infections remain ill defined. Estimates of the numbers of MSM disclose the scale of populations for better assessment of and response to community vulnerability, as well as enhanced HIV/AIDS surveillance. This sense of scale aids in the targeting of outreach and prevention efforts for the benefit of HIV/AIDS program planners, researchers, prevention interventionists, policymakers, social marketers, grant writers, and grant-funding entities, as well as communities of MSM.

Populations of MSM have previously been estimated,[7–19] but estimation models and survey sampling schemes have tended to be complex and/or costly to apply and apparently have been utilized by few planning agencies. Surveys to measure the prevalence of male–male sexual orientation and behavior in male populations have been conducted at the national level and in selected locales, but have limited implications for effective targeting of primary and secondary HIV prevention initiatives at the state level. A recent report published and widely disseminated by the Southern AIDS Coalition[20] documented the disproportionate burden and prevention challenges of HIV/AIDS in the southern states, with the largest number of cases occurring among MSM. Our literature search revealed no published report that addressed the size of MSM populations by state.

In this report, we devise a set of three novel and easily applied spreadsheet models to estimate the numbers of MSM, by state and race/ethnicity, in the 17 states designated by the Centers for Disease Control and Prevention (CDC) as the southern region of the US: Alabama, Arkansas, Delaware, District of Columbia (D.C., which is treated as if it were a state), Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia. Our methods require little more than access to available data from the US Census Bureau and national MSM estimates from previously published research studies.

METHODS

We defined MSM as adult males who ever had sex with another male, without regard to the nature of sexual contact (e.g., oral or anal). This definition was selected as we relied on a key national research study that defined MSM similarly.[10] The definition also corresponded roughly to the CDC national HIV/AIDS surveillance definition of MSM, i.e., males who had sex (of an unspecified nature) with another male after 1977 and preceding the first positive HIV antibody test or AIDS diagnosis.[21] Consistency with the national surveillance definition was desirable to enable eventual computation of HIV/AIDS prevalence rates, with the numerators (prevalent HIV/AIDS cases among MSM) and denominators (numbers of MSM) similarly defined. We considered adult males to be those aged $\geq$18 years because available research on the percentage of males who are MSM tends to address adults only, although the cutoff age for adults is not always the same. We developed two models to estimate the statewide total numbers of MSM (Model A and Model B) and a third Model C to partition these estimates by race/ethnicity. The raw data we obtained were analyzed algebraically using common computer spreadsheets.

Model A

The first model was based on the premise that the estimated percentage of adult males who are MSM (the "percentage MSM") varies by state according to the proportion of the total population residing in rural, suburban, and urban areas. The research-based estimates of 1% MSM in rural areas, 4% MSM in suburban areas, and 9% MSM in urban areas[13] were assumed to be plausible and to apply throughout the South. These oft-cited estimates by Laumann and colleagues, based on a national random sample, are the only ones we found that distinguished the estimated concentration of MSM in male populations by rural, suburban, and urban areas. However, the Laumann study did not specify total population size and density of these three areas.

We obtained population data from the 2000 decennial census, indicating the total number of persons living in three distinct geographic areas in each state.[22] The US Census Bureau does not define "suburban" area, but defines three areas that we interpret as corresponding to our three areas of interest: (1) our "urban" = the Census Bureau's "urban, inside urbanized areas (densely settled territories, population >50,000)"; (2) our "suburban" = the Census Bureau's "urban, inside urban clusters (densely settled territories, population 2,500–50,000)"; and (3) our "rural" = the Census Bureau's "rural" (i.e., all other areas). Thus, we used the Laumann estimates and our interpretation of the Census Bureau's population classification scheme to compute estimates of the percentage MSM in each state, as follows:

$$\%\,\mathrm{MSM}_{\mathrm{state\,i}} = (\%\,\mathrm{rural\,pop.}_{\mathrm{state\,i}} \times 0.01) + (\%\,\mathrm{suburban\,pop.}_{\mathrm{state\,i}} \times 0.04) + (\%\,\mathrm{urban\,pop.}_{\mathrm{state\,i}} \times 0.09)$$

Model B

The second model stratified by state a national estimated percentage MSM in a procedure based on a data set that was independent of Model A. The best available national estimate of the percentage MSM was considered to be that from the National Survey on Family Growth (NSFG), which found that an estimated 6.0% of randomly sampled males aged 15–44 years in the US reported ever having sex (oral or anal) with another male.[10] The NSFG also found that 2.9% of men reported sex with another male in the previous 12 months (oral or anal), and 4.1% self-identified as homosexual or bisexual (nature of sexual behavior not specified). We selected the 6.0% figure as a national estimate for developing our southern MSM estimates because it was conceptually most consistent with numerator data (i.e., male HIV/AIDS cases with any male–male sex contact since 1977) that could be obtained for eventual computation of estimated HIV/AIDS prevalence rates.

Model B's premise was that the relative concentration of same-sex male unmarried partners (SSMP) in a state's households is an indicator of the concentration of MSM in the state. The model incorporated SSMP data from the US Census Bureau's American Community Survey[23] to construct an MSM Index. Since 1990, the Census Bureau has included an "unmarried partner" category to describe an unrelated household member's relationship to the householder. If the householder designates another adult of the same sex as his or her unmarried partner or as a husband or wife, the household counts as a same-sex unmarried partner household.

The MSM Index reflects the degree to which a given state is under- or over-represented in terms of the proportion of nationwide households with SSMP in the

state compared with the proportion of nationwide households in the state. In other words, the MSM Index is the ratio of the state's proportion of SSMP in US households to the state's proportion of households in the US. By definition, the MSM Index for the US is 1.00. For each state, the MSM Index was computed as follows:

$$\text{MSM Index}_{\text{state i}} = ((\text{No. SSMP}_{\text{state i}})/(\text{No. SSMP in US}))/((\text{No. households}_{\text{state i}})/(\text{No. households in US}))$$

For each state, the national percentage MSM estimate of 6.0% was then multiplied by the state-specific MSM Index to compute the estimated percentage MSM in the state's male population:

$$\%\,\text{MSM}_{\text{state i}} = (\text{MSM Index}_{\text{state i}}) \times 0.06$$

Combining State-level Estimates from the Two Models: the two sets of statewide estimates were combined by averaging them to obtain the *final state-level estimates* of the percentage MSM:

$$\text{Combined}\,\%\,\text{MSM}_{\text{state i}} = (\%\,\text{MSM Model A}_{\text{state i}} + \%\,\text{MSM Model B}_{\text{state i}})/2$$

These combined estimates were then multiplied by the adult (≥18 years) male populations of the states to compute the *final state-level estimates* of the numbers of MSM:

$$\text{No. MSM}_{\text{state i}} = (\text{combined}\,\%\,\text{MSM}_{\text{state i}}) \times (\text{adult male population}_{\text{state i}})$$

Model C

In the third model, we utilized a set of ratios derived from the NSFG to partition by race/ethnicity the *final state-level estimates* of the numbers of MSM and percentages MSM. In the NSFG, the estimated percentage MSM (i.e., men who ever had oral or anal sex with another male) in the US was 6.5% for whites, 5.0% for blacks, 6.2% for Hispanics and 3.3% for those of other race/ethnicity.[10] The NSFG-based ratios of the percentages MSM were thus 1.00 for whites-to-whites, 0.77 for blacks-to-whites, 0.95 for Hispanics-to-whites, and 0.51 for others-to-whites. We assumed that the same comparative relationships prevailed throughout the South. Thus, our final estimated numbers of MSM and percentages MSM by state and race/ethnicity were constructed to preserve the NSFG-based ratios.

Model C took the following five steps to estimate the numbers of MSM by state and race/ethnicity such that each state's racial/ethnic percentages MSM gave rise to the NSFG-based ratios:

1. Compute the *final state-level estimates* of the percentages MSM and the number of MSM (from Model A and Model B findings, combined).

   Example for State X: adult male population = 1,000,000 (800,000 whites, 100,000 blacks, 70,000 Hispanics and 30,000 others). Assume that the overall percentage MSM in State X (from Model A and Model B, combined) is 5.0%; thus, the total estimated number of MSM = 1,000,000 × 0.05 = 50,000.

2. Develop a schedule of intermediate MSM estimates for each state, by race/ethnicity, where the number of MSM in each racial/ethnic group equals the adult male population in that group times the *final state-level estimate* of the

percentage MSM times the NSFG-based ratio of that group to the white group.

Example for State X: the intermediate number of white MSM = 800,000 × 0.05 × 1.00 = 40,000; black MSM = 100,000 × 0.05 × 0.77 = 3,850; Hispanic MSM = 70,000 × 0.05 × 0.95 = 3,325; other MSM = 30,000 × 0.05 × 0.51 = 765.

3. Sum these intermediate numbers of MSM by race/ethnicity for each state.

Example for State X: sum = 40,000 + 3,850 + 3,325 + 765 = 47,940.

4. For each state, divide the *final state-level estimates* of the numbers of MSM (from Step 1, above) by the sum in Step 3, and multiply by the intermediate calculated number of MSM in each racial/ethnic group (from Step 2). The result is the final estimated number of MSM by state and race/ethnicity, which now sum to the *final state-level estimates* of the numbers of MSM by state.

Example for State X: final estimated number of white MSM = (50,000/47,940) × 40,000 = 1.043 × 40,000 = 41,719; black MSM = 1.043 × 3,850 = 4,015; Hispanic MSM = 1.043 × 3,325 = 3,468; other MSM = 1.043 × 765 = 798. Sum = 41,719 + 4,015 + 3,468 + 798 = 50,000. This sum is the same as State X's *final state-level estimated* total number of MSM.

5. For each racial/ethnic group, divide the *final state-level estimate* of the number of MSM by the corresponding male population to compute the final estimated percentage MSM by state and race/ethnicity.

Example for State X: final percentage MSM for whites = 41,719/800,000 = 0.052149 = 5.2% (rounded); for blacks = 4,015/100,000 = 0.04015 = 4.0%; for Hispanics = 3,468/70,000 = 0.049534 = 5.0%; for others = 798/30,000 = 0.0266 = 2.7%. Thus, the racial/ethnic ratios of the final (unrounded) percentage MSM in State X = 1.00 (whites:whites); 0.77 (blacks:whites); 0.95 (Hispanics:whites); 0.51 (others:whites). These ratios are the same as the NSFG ratios.

State-specific, midyear population estimates for 2007 were obtained from the US Census Bureau for males aged ≥18 years, by race/ethnicity.[24] Pearson correlation coefficients were computed using Microsoft Excel. Tests for statistical significance were conducted using R software (R Core Development Team [computer software] Version 2.5.1. Vienna: R Foundation for Statistical Computing; 2004).

RESULTS

According to Model A, the percentage MSM in the South varied from 3.7% (Mississippi) to 9.0% (D.C.; Table 1). The proportion of the total population living in rural areas in the South (27.2%) was significantly higher than that in the rest of the US (17.6%; $p<0.001$). Conversely, the proportion of the total population living in urban areas in the South (61.4%) was significantly lower than that in the rest of the US (72.2%; $p<0.001$). According to Model B, the percentage MSM in the South varied from 3.4% (Mississippi) to 17.4% (D.C.; Table 2). The MSM index varied from 0.57 (Mississippi) to 2.89 (D.C.; median, 0.86). The MSM Index for the South

TABLE 1 Model A: estimated percentage of adult males (≥18 years) who are MSM, southern United States, 2007

State	Population[a]				Estimated % MSM[b]
	Total	% Rural	% Suburban	% Urban	
District of Columbia	572,059	0.0%	0.0%	100.0%	9.0%
Florida	15,982,378	10.7%	5.0%	84.3%	7.9%
Maryland	5,296,486	13.9%	5.9%	80.2%	7.6%
Texas	20,851,820	17.5%	11.6%	71.0%	7.0%
Delaware	783,600	19.9%	12.3%	67.8%	6.8%
Virginia	7,078,515	27.0%	6.5%	66.6%	6.5%
Georgia	8,186,453	28.4%	10.4%	61.2%	6.2%
Louisiana	4,468,976	27.4%	15.9%	56.7%	6.0%
Tennessee	5,689,283	36.4%	11.5%	52.1%	5.5%
South Carolina	4,012,012	39.5%	13.8%	46.7%	5.2%
North Carolina	8,049,313	39.8%	13.5%	46.7%	5.1%
Oklahoma	3,450,654	34.7%	22.3%	43.0%	5.1%
Alabama	4,447,100	44.6%	11.8%	43.7%	4.9%
Kentucky	4,041,769	44.2%	17.0%	38.8%	4.6%
Arkansas	2,673,400	47.5%	20.3%	32.2%	4.2%
West Virginia	1,808,344	53.9%	17.7%	28.3%	3.8%
Mississippi	2,844,658	51.2%	24.9%	23.9%	3.7%
Total South	100,236,820	27.2%	11.5%	61.4%	6.3%
Balance of US	181,185,086	17.6%	10.2%	72.2%	7.1%
Total US	281,421,906	21.0%	10.7%	68.3%	6.8%

The states are ranked from highest to lowest estimated percentage MSM

MSM men who have sex with men

[a]Population data based on three areas are adapted from US Census 2000 (see text)

[b]Estimated % MSM = 0.01 × (% Rural) + 0.04 × (% Suburban) + 0.09 × (% Urban; see text)

was significantly lower than that for the rest of the US (0.94 vs. 1.03, respectively; $p<0.001$).

The 17 state-specific estimated percentages MSM according to Model A and Model B were strongly correlated ($r=0.74$; r-squared = 0.55; $p<0.001$; Table 3). The two distributions had similar means (5.82%, Model A; 5.88%, Model B) and medians (5.5%, Model A; 5.2%, Model B). The combined estimated percentage MSM in the South (average of Model A and Model B estimates) ranged from 3.6% (Mississippi) to 13.2% (D.C.; median, 5.4%). The combined estimated percentage MSM in the South was lower than that in the rest of the US (6.0% versus 6.7%, respectively; $p<0.001$).

In Model B, an estimated 17.4% of adult males in D.C. (the only state that is 100% urban) are MSM, which is more than twice that of Florida (7.0%). If we consider the possibility that D.C. is an outlier in Model B, and exclude it from the data, the correlation between the 16 remaining Model A and Model B estimates increases to $r=0.85$; r-squared = 0.72; $p<0.001$.

Among approximately 40.2 million males aged ≥18 years residing in the South, the final estimated number of MSM was approximately 2.4 million, including 1,656,500 (69%) whites, 339,400 (14%) blacks, 368,800 (15%) Hispanics, 34,600 (1.4%) Asian/Pacific Islanders (A/PI), 7,700 (0.3%) American Indians/Alaska Natives (AI/AN), and 11,000 (0.5%) multiracial and other MSM (Table 4). By contrast, the racial/ethnic percentage distribution of the total adult male population

TABLE 2 Model B: estimated percentage of adult males (≥18 years) who are MSM, southern United States, 2007

State	No. SSMP[a]	Percent of total US SSMP	No. households[a]	Percent of total US households	MSM index[b]	Estimated % MSM[c]
District of Columbia	2,644	0.65%	249,903	0.22%	2.89	17.4%
Florida	30,345	7.43%	7,081,267	6.34%	1.17	7.0%
Georgia	14,051	3.44%	3,371,385	3.02%	1.14	6.8%
Delaware	1,149	0.28%	322,076	0.29%	0.98	5.9%
Maryland	7,443	1.82%	2,085,712	1.87%	0.98	5.9%
Virginia	10,218	2.50%	2,908,998	2.60%	0.96	5.8%
Texas	27,594	6.75%	8,110,502	7.26%	0.93	5.6%
Tennessee	7,797	1.91%	2,383,006	2.13%	0.89	5.4%
South Carolina	5,258	1.29%	1,665,150	1.49%	0.86	5.2%
North Carolina	10,781	2.64%	3,468,261	3.11%	0.85	5.1%
Oklahoma	4,112	1.01%	1,388,609	1.24%	0.81	4.9%
Arkansas	3,169	0.78%	1,097,901	0.98%	0.79	4.7%
Louisiana	4,599	1.13%	1,612,896	1.44%	0.78	4.7%
Kentucky	4,526	1.11%	1,653,859	1.48%	0.75	4.5%
West Virginia	1,742	0.43%	739,205	0.66%	0.64	3.9%
Alabama	4,065	0.99%	1,800,354	1.61%	0.62	3.7%
Mississippi	2,264	0.55%	1,079,865	0.97%	0.57	3.4%
Total South	141,758	34.70%	41,018,948	36.72%	0.94	5.7%
Balance of US	266,812	65.30%	70,676,384	63.28%	1.03	6.2%
Total US	408,570	100.00%	111,695,332	100.00%	1.00	6.0%

The states are ranked from highest to lowest estimated percentage MSM.

MSM men who have sex with men, *SSMP* same-sex male unmarried partners

[a]SSMP and household data from the US Census Bureau, American Community Survey data, 2005–2007 (averaged)

[b]MSM index=(percentage of total US SSMP)/(percentage of total US households)

[c]Estimated % MSM =0.06×MSM Index (see text)

TABLE 3 Combined estimated percentage of adult males (≥18 years) who are MSM, southern United States, 2007

State	Estimated % MSM		
	Model A	Model B	Combined[a]
District of Columbia	9.0%	17.4%	13.2%
Florida	7.9%	7.0%	7.5%
Maryland	7.6%	5.9%	6.8%
Georgia	6.2%	6.8%	6.5%
Delaware	6.8%	5.9%	6.4%
Texas	7.0%	5.6%	6.3%
Virginia	6.5%	5.8%	6.2%
Tennessee	5.5%	5.4%	5.5%
Louisiana	6.0%	4.7%	5.4%
South Carolina	5.2%	5.2%	5.2%
North Carolina	5.1%	5.1%	5.1%
Oklahoma	5.1%	4.9%	5.0%
Kentucky	4.6%	4.5%	4.6%
Arkansas	4.2%	4.7%	4.5%
Alabama	4.8%	3.7%	4.3%
West Virginia	3.8%	3.9%	3.9%
Mississippi	3.7%	3.4%	3.6%
Total South	6.3%	5.7%	6.0%
Balance of US	7.1%	6.2%	6.7%
Total US	6.8%	6.0%	6.4%

The 17 estimates by the two models are correlated at $r=0.74$, r-squared$=0.55$ ($p<0.001$). The states are ranked from highest to lowest combined estimates

MSM men who have sex with men

[a]Combined estimates are the average of those according to Model A and Model B.

in the South in 2007 was 65% white, 17% black, 14% Hispanic, 2.5% A/PI, 0.6% AI/AN, and 0.8% multiracial and other males.[24]

Texas, the most populous southern state, had the greatest estimated number of total MSM (approximately 537,900) and Hispanic MSM (184,200). Florida, ranked second in population and estimated total number of MSM (517,300), had the greatest estimated number of white MSM (348,000) and black MSM (54,700). The third-ranked state in population and estimated MSM, Georgia, had less than half the estimated total number of MSM (220,900) as Florida. Three of the least populous states (D.C., West Virginia, and Delaware) each had fewer than 30,000 estimated total number of MSM.

The state-specific racial/ethnic estimates showed considerable variability in the percentages of the adult male populations who are MSM (Table 5). The median percentage MSM in the 17 southern states was 5.8% for whites (range, 3.9–15.3%), 4.4% for blacks (range, 3.0–11.8%), 5.5% for Hispanics (range, 3.7–14.6%), and 2.9% for MSM of all other racial/ethnic groups (range, 2.0–7.8%).

DISCUSSION

We have attempted to provide plausible estimates of the numbers of MSM in the South by state and race/ethnicity in a way that is easy to replicate elsewhere in the US. Such estimates inform the processes of HIV/AIDS surveillance and epidemic

TABLE 4 **Estimated number of adult males (≥18 years) who are MSM, by race/ethnicity, southern United States, 2007**

	Race/ethnicity												
State	White	% Row tot.	Black	% Row tot.	Hispanic	% Row tot.	A/PI	% Row tot.	AI/AN	% Row tot.	All other[a]	% Row tot.	Total
Texas	293,215	55%	47,046	9%	184,194	34%	10,132	1.9%	1,150	0.2%	2,148	0.4%	537,887
Florida	348,043	67%	54,717	11%	105,688	20%	5,800	1.1%	843	0.2%	2,208	0.4%	517,299
Georgia	147,955	67%	49,327	22%	18,916	9%	3,528	1.6%	320	0.1%	900	0.4%	220,946
Virginia	132,751	75%	26,334	15%	11,914	7%	4,600	2.6%	294	0.2%	990	0.6%	176,884
North Carolina	126,006	75%	26,407	16%	12,281	7%	1,665	1.0%	994	0.6%	602	0.4%	167,955
Maryland	92,692	67%	30,901	22%	9,208	7%	3,972	2.9%	206	0.1%	718	0.5%	137,697
Tennessee	103,462	83%	14,537	12%	4,449	4%	872	0.7%	199	0.2%	462	0.4%	123,980
South Carolina	61,399	74%	17,580	21%	3,468	4%	535	0.6%	164	0.2%	279	0.3%	83,424
Louisiana	59,221	71%	19,480	24%	2,871	3%	695	0.8%	272	0.3%	303	0.4%	82,842
Kentucky	65,634	91%	3,967	6%	1,648	2%	372	0.5%	<100	0.1%	247	0.3%	71,959
Alabama	55,111	77%	13,804	19%	1,943	3%	379	0.5%	208	0.3%	281	0.4%	71,726
Oklahoma	53,390	81%	3,944	6%	4,615	7%	666	1.0%	2,547	3.8%	1,127	1.7%	66,290
Arkansas	38,312	83%	5,069	11%	2,337	5%	263	0.6%	174	0.4%	230	0.5%	46,385
Mississippi	25,305	69%	10,199	28%	878	2%	166	0.5%	<100	0.2%	107	0.3%	36,744
District of Columbia	12,915	44%	12,413	43%	2,915	10%	589	2.0%	<100	0.2%	183	0.6%	29,065
West Virginia	25,680	96%	708	3%	264	1%	101	0.4%	<100	0.1%	<100	0.3%	26,870
Delaware	15,428	77%	3,018	15%	1,233	6%	312	1.6%	<100	0.2%	<100	0.4%	20,111
Total South	1,656,521	69%	339,449	14%	368,821	15%	34,647	1.4%	7,670	0.3%	10,955	0.5%	2,418,064

The states are ranked from highest to lowest total estimated number of MSM

MSM men who have sex with men, *A/PI* Asian/Pacific Islander, *AI/AN* American Indian/Alaska Native

[a]All other includes those of two or more races, non-Hispanic

TABLE 5 Estimated percentage of adult males (≥18 years) who are MSM, by race/ethnicity, southern United States, 2007

State	Race/Ethnicity						Total
	White	Black	Hispanic	A/PI	AI/AN	All other[a]	
District of Columbia	15.3%	11.8%	14.6%	7.8%	7.8%	7.8%	13.2%
Florida	7.9%	6.1%	7.6%	4.0%	4.0%	4.0%	7.5%
Maryland	7.5%	5.8%	7.2%	3.8%	3.8%	3.8%	6.8%
Georgia	7.1%	5.5%	6.8%	3.6%	3.6%	3.6%	6.5%
Delaware	6.8%	5.3%	6.5%	3.5%	3.5%	3.5%	6.4%
Texas	6.7%	5.2%	6.4%	3.4%	3.4%	3.4%	6.3%
Virginia	6.7%	5.2%	6.4%	3.4%	3.4%	3.4%	6.2%
Tennessee	5.8%	4.4%	5.5%	2.9%	2.9%	2.9%	5.5%
Louisiana	5.9%	4.5%	5.6%	3.0%	3.0%	3.0%	5.4%
South Carolina	5.6%	4.3%	5.3%	2.8%	2.8%	2.8%	5.2%
North Carolina	5.5%	4.2%	5.2%	2.8%	2.8%	2.8%	5.1%
Oklahoma	5.4%	4.2%	5.2%	2.8%	2.8%	2.8%	5.0%
Kentucky	4.7%	3.6%	4.5%	2.4%	2.4%	2.4%	4.6%
Arkansas	4.7%	3.6%	4.5%	2.4%	2.4%	2.4%	4.5%
Alabama	4.6%	3.5%	4.4%	2.3%	2.3%	2.3%	4.3%
West Virginia	4.0%	3.0%	3.8%	2.0%	2.0%	2.0%	3.9%
Mississippi	3.9%	3.0%	3.8%	2.0%	2.0%	2.0%	3.6%
Total South	6.4%	4.9%	6.1%	3.3%	3.3%	3.3%	6.0%
Median	5.8%	4.4%	5.5%	2.9%	2.9%	2.9%	5.4%

The states are ranked from highest to lowest total estimated percentage MSM
MSM men who have sex with men, *A/PI* Asian Pacific Islander, *AI/AN* American Indian/Alaska Native
[a]All other includes those of two or more races, non-Hispanic.

monitoring; HIV/AIDS program and community planning; resource allocation; social marketing; grant writing and funding; and structural analysis of community vulnerability. We found that an estimated 2,418,064 southern adult males are MSM (Table 4), while recognizing that the point-estimates we present have undeterminable plausible ranges or confidence intervals around them. We must view these "exact" numbers as approximations, which nonetheless could be useful to those concerned with HIV/AIDS and other sexually transmitted infections among MSM. Applications of the point-estimates include computation of population-based disease rates, evaluation of racial/ethnic disparities and assessment of service coverage among MSM. Estimates like ours can be developed inexpensively from the desktop, as they merely require population and household census data at the state level and national research-based estimates that are readily available. Basic tools like algebra and spreadsheets are all that are needed for computations.

Compared with the rest of the US, the South is significantly more rural and less urban, which are characteristics influencing the Model A findings. The relative concentration of households with SSMP determines Model B's MSM Index, which is significantly lower for the South than the rest of the country, for reasons remaining to be clarified. The resultant combined estimate of the percentage MSM in the South is significantly lower than that in the rest of the country. However, it is not yet known how the South directly compares with each of the three other regions of the US (respectively, the Northeast, Midwest, and West) with regard to the parameters entered into Model A and Model B and the consequent percentage MSM estimates.

Regional differences in social, political, or religious attitudes toward gays and MSM, as well as underlying stigma and homophobia, could influence the prevalence and/or disclosure of male–male sexual activity and the resultant percentage MSM estimates. Computation of our MSM estimates for all states and fresh empirical research examining differences are needed.

There are relatively more and less gay-friendly settings in both urban and rural contexts, which potentially might have an effect on final estimates. We cannot be certain that distributions of gay-identified men mirror that of all MSM, particularly in relation to the location of visible gay communities, whether in rural, suburban, or urban areas. Southern states are not monolithic in their acceptance of homosexuality. Some suburban areas within states perceived to be opposed to homosexuality may have a "live and let live" value system that allows MSM to live as they wish, though there may not be visible gay centers. Conversely, some urban areas, while densely populated, may present a less welcoming environment for gay men to openly display affection the way they might in Miami, or to stage pride events or rallies, the way they might in D.C. or Atlanta.

The District of Columbia was the only southern state that was 100% urban. According to Model B, it had by far the highest MSM Index (2.89) and percentage MSM (17.4%). Reasons for D.C. being a possible outlier in this model could be related to the uniquely metropolitan character of the area and socio-cultural characteristics that might differ from those in the other 16 states. Based on a New York City survey, an estimated 13.7% of males aged 18–64 years had sex with another man in the previous year.[25] The averaged percentage MSM for D.C. from our Model A and Model B estimates combined (13.2%) was comparable to the New York City estimate. Our use of the term "outlier" does not negate the likelihood that D.C. does serve as home to a higher percentage of MSM. While our purpose in disseminating our methodology is to allow policy planners, health departments, and community groups to estimate their racial/ethnic MSM populations with the least amount of resources or tools (beyond the census data and spreadsheet formulas described), we recognize that some areas may want to add a local variable that can factor results upwards or downwards based upon considerations like visible community acceptance or rejection of gay identity.

Using various study designs, other researchers have conducted surveys to determine overall estimates of the number of MSM.[8,10,12,13,25,26] Others have used models based on HIV testing data,[7] census data,[9] statistical components,[11] Internet convenience sampling,[19] and HIV/AIDS surveillance data.[14–16] Definitions of MSM were not consistent across these studies, as they tended to use different age ranges, as well as different criteria for nature and degree of same-sex behavior or gay-identification, leading to possible under- or overestimates. As with our present study, ascertainment bias was a common concern of these studies because some men do not candidly disclose same-sex behavior or sexual orientation, leading to underestimates. There are different bases for these various estimates (identity or behavior; 12 months or lifetime time frame for sexual activity), each of which will produce different estimates, though all such estimates might have a purpose.

MSM might conceal their sexual behavior both because of perceived homophobia and stigma associated with the group most burdened by HIV infection.[27] Among men who have sex exclusively with other men, racial/ethnic minorities have been found to be more likely to identify as heterosexual.[28] Other research indicates that identification of sexual orientation among minority MSM may be rooted in constructs of masculinity, as well as perceived norms and expectations.[29] Cultural

influences may cause some MSM to perceive themselves as heterosexual because they associate MSM identity with emasculation.[30–33]

In our study, national data from the NSFG[10] were used to differentiate the racial/ethnic percentages MSM in the South. Black men in the US accounted for a smaller estimated percentage MSM (5.0%) than white MSM (6.5%) and Hispanic MSM (6.2%). The ratios of these percentages were used to develop our state- and racial/ethnic-specific MSM estimates. However, these national estimates could represent an underestimate of minority MSM that rippled through our state-specific estimates. Undercounts of the number of minority MSM would lead to over-estimates in their HIV/AIDS prevalence rates, when they are computed.

There is no gold standard for estimating the percentage and the number of MSM in male populations. We examine and carefully consider the limitations of our data in the interest of improving future estimations. For Models A and B, we used separate national estimates to derive state estimates in two independent ways. In Model A, we presumed that the degree of concentration of MSM varies by rural, suburban, and urban areas in similar ways across (and within) the states. However, our estimates of the percentage MSM by these three areas were based on one study only. These percentages probably vary by state (and city) and could have changed over time. MSM-related data are more locally specific in Model B than in Model A. Generalizing the national Laumann estimates to each southern state in Model A require an assumption of a similar trend. Dissemination of our MSM findings could encourage local communities and cities to design and conduct their own studies of the prevalence of MSM behavior to refine the estimates, although this could involve considerable time and expense.

Several studies have suggested a higher percentage of MSM in gay-friendly urban settings than in rural settings.[9,13,34] Rural MSM can be geographically isolated from gay culture centers and lack venues in which to interact with other sex partners, although the Internet has recently provided other opportunities for rural MSM to meet other MSM.[35,36] A Florida study of HIV/AIDS clinic patients found that MSM were more likely than those in other HIV exposure categories to migrate to urban areas.[37]

In Model B, we presumed the under- or over-representativeness of SSMP by state (the MSM Index) was a plausible indicator of the relative concentration of all MSM in each state. The underlying assumption was that SSMP include numerous gay-identified individuals or other MSM. There is no current way to verify this assumption. For Model C, there was no previous research to aid in constructing state-specific racial/ethnic ratios of the percentage MSM; thus, we made a default assumption that the NSFG-based ratios applied across the South. We also had no way to distinguish the estimated percentage MSM among A/PIs, AI/ANs and those of other race/ethnicity, as the NSFG did not provide data in this degree of detail. Additional research at the state level would be needed to corroborate the patterns we observed in the percentages and numbers of MSM, by race/ethnicity.

The definition of MSM was not consistent in the Laumann and NSFG studies, as the former addressed self-identification as gay,[13] while the latter addressed lifetime same-sex behavior.[10] Some men would be less likely to identify as gay than to acknowledge MSM behavior. The age groups that were studied also differed: men aged 18–59 in the Laumann study and men aged 15–44 in the NSFG study. To the extent that the prevalence of these gay/MSM characteristics changes with age or over time (we have relied on source research studies conducted in different years), bias might have been introduced, since we conceptualized all those aged $\geq$18 years with a history of male–male sex contact when computing estimates of the number and percentage MSM.

Our MSM estimates, like CDC national HIV/AIDS surveillance data, capture experimenters and those without ongoing male–male sexual behavior. These MSM estimates are clearly higher than those that would be based on male–male sex in the previous year, but HIV/AIDS surveillance data for MSM also reflect male–male sex over a broad time period. By using a more inclusive definition of MSM, we can obtain comparable denominators (estimated numbers of MSM) and numerators (numbers of HIV/AIDS cases among MSM) for computation of disease rates.

Despite limitations, the estimated percentages MSM by models A and B are congruent in key respects. The estimates had very similar means and medians, and the distributions of percentage MSM by state were strongly correlated, despite their being derived in two entirely independent ways. These considerations help justify using the combined, averaged estimates.

We have presented what could be a set of plausible MSM estimates across a broad swath of the US. The number and distribution of MSM by state and race/ethnicity directly benefit program planners, community planners, researchers, policymakers, grant writers, and others. One of the most practical applications of these numbers in terms of targeting primary and secondary HIV prevention initiatives would be the computation of population-based disease rates among MSM. As of this writing, we are undertaking a study estimating HIV/AIDS prevalence rates among MSM in the southern states, by race/ethnicity. Surveillance data already collected on prevalent HIV/AIDS cases among MSM through 2007 will be analyzed and used as numerators of the HIV/AIDS prevalence rates. Using our present estimated numbers of MSM as HIV/AIDS prevalence rate denominators, the impact of HIV/AIDS on southern MSM populations will be determined, enabling evaluation of racial/ethnic disparities within and among states. In the meantime, the transparency of the methodologies described in our three spreadsheet estimation models and the general availability of the raw data necessary to generate the estimates suggest that other states and regions of the US could also estimate plausible numbers of MSM among their racial/ethnic male populations.

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