Sexual Orientation and Mortality Among US Men Aged 17 to 59 Years: Results From the National Health and Nutrition Examination Survey III

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Objectives. We investigated associations between minority sexual orientation and mortality among US men.

Methods. We used data from a retrospective cohort of 5574 men aged 17 to 59 years, first interviewed in the National Health and Nutrition Examination Survey III (NHANES III; 1988–1994) and then followed for mortality status up to 18 years later. We classified men into 3 groups: those reporting (1) any same-sex sexual partners (men who have sex with men [MSM]; n=85), (2) only female sexual partners (n=5292), and (3) no sexual partners (n=197). Groups were then compared for all-cause mortality, HIV-related mortality, suicide-related mortality, and non–HIV-related mortality.

Results. Compared with heterosexual men, MSM evidenced greater all-cause mortality. Approximately 13% of MSM died from HIV-related causes compared with 0.1% of men reporting only female partners. However, mortality risk from non–HIV-related causes, including suicide, was not elevated among MSM.

Conclusions. In the United States, the HIV epidemic continues to be the major contributing factor for premature death rates among MSM. Cohorts such as the NHANES III offer a unique opportunity to track the effects of the HIV epidemic on this population. (*Am J Public Health.* 2011;101:1133–1138. doi:10.2105/AJPH.2010.300013)

Men who have sex with men (MSM) are a well-documented group at elevated risk for HIV infection.[1] Indeed, estimates suggest that 9% to 27% of gay and bisexual men and MSM in the United States are currently living with HIV infection.[2–5] Further, recently released statistics from the Centers for Disease Control and Prevention indicate that the rate of new HIV diagnoses among MSM is more than 44 times that of heterosexual men.[6] Although mortality risk has decreased substantially since the introduction of highly active antiretroviral treatment (HAART) around 1996,[7–10] HIV infection remains a potentially fatal disease.[11] In addition, population-based surveys over the last decade have consistently documented elevated risk for suicide attempts among gay and bisexual men compared with heterosexual men.[12–23] And recently, a study[24] reported greatly elevated suicide mortality rates among Danish men in registered same-gender domestic partnerships. These findings suggest that men with minority sexual orientation may experience elevated risk for premature death from multiple causes.

Until recently, investigation of this possibility has not been feasible in the United States because of the general absence of measured markers of sexual orientation in mortality follow-back studies, death certificates, or prospective cohort studies followed until death.[25] In the 1 existing general population–based study reported to date, which was from Denmark[26] and limited to individuals in registered same-gender domestic partnerships, mortality among men in these same-gender partnerships was significantly higher than among Danish men in general. Although the underlying causes of death were unknown, mortality risk differences attributable to registered same-gender domestic partnership status decreased during the post-HAART era. The authors interpreted this as evidence that HIV-related causes were responsible for the increased risk observed. Nevertheless, mortality risk in the post-HAART era remained somewhat higher among men with registered domestic partnerships status compared with other men. The absence of cause-of-death information in this study leaves open the question of whether the increased mortality risk in both pre- and post-HAART periods reflects only the ongoing effects of the HIV epidemic or whether men with minority sexual orientation in general face greater risk for mortality, perhaps from other causes, such as suicide[24] or cardiovascular disease. Further, as it relied on registered same-gender domestic partnership status to identify gay and bisexual men, the earlier study did not account for the possible health benefits of living with a partner[27] and thus may have underestimated mortality risk for MSM in general. In the United States, for example, it is estimated[28] that only 37% to 46% of men with minority sexual orientation live in same-gender partnerships and that only about one fourth of these partnerships are registered with state agencies. Thus, estimates from men living in administratively documented partnerships likely represent only a small segment of the gay and bisexual male population.

As one of the first national health data sets in the United States to measure markers of sexual orientation routinely, the National Health and Nutrition Examination Survey in its third iteration (NHANES III; 1988–1994) initially began its assessment of sexual orientation with a restricted set of questions pertaining to lifetime histories of the genders of respondents' sexual partners. The sample at that time was limited to men aged 17 to 59 years. Mortality data linked to these NHANES III participants now provide up to 18 years of mortality follow-up, offering a unique opportunity to examine the long-term consequences of HIV infection and elevated suicide-related morbidity previously documented[22] in the sample.

We used this newly released mortality follow-up information to investigate risk for all-cause mortality—and, specifically, mortality

attributed to HIV infection and suicide—among men who varied in their histories of self-reported same-gender sexual partners. In doing so, we were able to examine risk for mortality among all men reporting histories of same-gender sexual partners, regardless of their same-gender partnership status, a critical limitation in the earlier Danish study.[26] Monitoring the mortality rates of sexual-minority men is necessary for advocating for resources and policy and, in particular, for tracking the progress of efforts to curb HIV-related illness and mortality in this population.[29]

METHODS

We used publicly available data from the NHANES III, which is a population-based health survey conducted from 1988 to 1994 by the National Center for Health Statistics. The sample is representative of the civilian, noninstitutionalized US population at that time, aged 2 months and older. Comprehensive assessments included an in-home interview followed up by an extensive physical examination and further health assessments conducted in special mobile examination centers (MECs). During this second assessment, all male participants aged 17 to 59 years (n=5719) were eligible to be asked the genders of their lifetime sexual partners. Of these, 141 men did not provide codable responses to the sexual behavior questions and were dropped from further consideration. All but 4 of the remaining 5578 men could be linked by either probabilistic or direct match to records in the National Death Index through December 31, 2006. This resulted in a final sample of 5574 men who originally participated in the NHANES III MEC examination and for whom mortality-related information through the end of 2006 was known. Further information on both the NHANES III and the NHANES III Linked Mortality file are described elsewhere.[30]

Measures

Sexual behavior history. During the MEC interview, men were initially asked the age at which they first had sexual intercourse. Those who indicated having engaged in sexual intercourse were then questioned as to their total number of lifetime sexual partners. Subsequent questions assessed numbers of both female and male partners. Following National Center for Health Statistics (NCHS) guidelines,[30] we logically recoded married and formerly married men who did not provide informative answers to the sexual behavior questions (n=242) as both sexually experienced (in general) and heterosexually experienced (in particular). We then classified men into 1 of 3 categories: not sexually experienced (n=197), any male sex partners reported (MSM; n=85), and only female sex partners reported (directly or by inference from marital status; n=5292).

Individual covariates. The NHANES III collected extensive information about individual demographics, health behaviors, and baseline health status. Within the informational limits of the public data set, we coded age into 4 categories, race/ethnicity into 2 (non-Hispanic White vs other) because of the small numbers within the MSM group, education into 2 (less than high school, completed high school), and family income into 2 (below federal poverty level vs federal poverty level or above). We coded tobacco use into 3 categories: current smokers, past smokers, and nonsmokers. Men were also asked their frequency of binge drinking (≥5 drinks per drinking occasion) in the past year. We recoded this into positive or negative reports of binge drinking 12 or more times (a frequency consistent with monthly binge drinking). We also coded any lifetime crack or cocaine use into ever or never categories. The NHANES III measured body mass index (defined as weight in kg divided by height in m^2); we recoded it into 3 categories: less than 25 kg/m^2 (normal or underweight), 25 kg/m^2 or more but less than 30 kg/m^2 (overweight), and 30 kg/m^2 or more (obese). Overall health status at the time of the MEC interview was measured by both self-rated and physician-rated reports and categorized as excellent, very good, good, fair, or poor. We recoded this into 2 categories for both of the variables: excellent or very good vs good, fair, or poor.

Mortality. The NHANES III Linked Mortality public data file provides *International Classification of Diseases, 10th Revision* (*ICD-10*)[31] classification of the underlying, or primary, cause of death in 1 of 113 precoded cause-of-death categories. For deaths prior to 1999, the original *ICD-9*[32] classifications were recoded by the NCHS into this *ICD-10* classification system. From these codes, we created 4 variables: all-cause mortality, mortality allocated to HIV-related illness (ICD-10 codes B20–B24), mortality arising from intentional self-harm or suicide (ICD-10 codes *U03, X60–X84, Y72–Y74, Y87.0), and mortality allocated to causes other than HIV-related illness. Total individual follow-up time was available in months between the second MEC assessment and December 31, 2006, or death.

Data Analysis

We analyzed data with Stata 11,[33] using both design information and weights as advised by the NCHS for analysis of NHANES data.[30] In the first set of analyses, we used multinomial logistic regression to evaluate possible demographic, health behavior, and health-related differences among men varying by sexual orientation. Where summarization of effects across groups was needed, we evaluated the contribution of individual characteristics by adjusted Wald F tests. Next, we used bivariate logistic regression to examine associations between individual characteristics, including sexual orientation, health behaviors, and health status and mortality. In a third group of analyses, we used Cox proportional hazard survival analysis to investigate sexual orientation–related differences in all-cause, HIV-related, and non–HIV-related mortality. Equations testing sexual orientation effects were adjusted for possible confounding caused by age, race/ethnicity, educational attainment, family income, health behaviors, and health status.[18,22,34–41]

Finally, we briefly examined whether the majority of HIV-related deaths in the NHANES III occurred prior to the introduction of HAART in 1996.[11] Although the public NHANES III data sets do not provide either dates of interview or dates of death, the sample could be differentiated by those interviewed in the first cycle of the NHANES III (1988–1991) and those interviewed in the second cycle (1991–1994). We contrasted the risk for HIV-related and non–HIV-related death by cycle of interview. Next, we divided HIV-related deaths into 3 groups: (1) those clearly occurring prior to the widespread introduction of HAART in 1996 (HIV-related deaths in cycle 1 prior to 48 months of follow-up and in cycle 2 prior to 12 months of follow-up), (2) those occurring during the transitional period when HAART was being introduced (for these deaths, we could not determine with precision

if follow-up was before or after 1996), and (3) those clearly occurring after 1996 (for cycle 1, a minimum of 108 months of follow-up; for cycle 2, a minimum of 72 months of follow-up). We reported the number of deaths for each time period. We estimated all confidence intervals with 95% certainty, and all significance tests were based on the criterion of $P < .05$.

RESULTS

When interviewed, approximately 3.8% (95% confidence interval [CI]=3.0%, 4.7%) of men reported lifetime histories of sex with other men. By contrast, 94.5% (95% CI=93.4%, 95.5%) of men evidenced histories consistent with heterosexuality and an additional 1.7% (95% CI=1.1%, 2.5%) of men indicated that they were as yet sexually inexperienced. As might be expected, the great majority of this last group was relatively young (Table 1). Overall, the 3 groups of men varied by several demographic and health-related characteristics, including age ($P < .001$), educational attainment ($P = .02$), race/ethnicity ($P < .01$), smoking status ($P < .001$), binge drinking status ($P = .001$), history of crack or cocaine use ($P < .001$), and physician-rated physical health status ($P = .02$).

By the end of 2006, a total of 515 men (6.9% of the sample; 95% CI=6.1%, 7.8%) had died, including 25 from HIV-related causes and 18 from intentional self-harm. In bivariate comparisons, deaths from any cause ($P < .002$), and particularly those caused by HIV-related illness ($P < .001$), differed by sexual orientation. Indeed, 21% of MSM were deceased by the end of 2006, nearly two thirds of whom had died of HIV-related causes. No

TABLE 1—Demographic Characteristics, Initial Health Status, and Mortality Among US Men Aged 17–59 Years, by Self-Reported Gender of Sexual Partners: National Health and Nutrition Examination Survey III, 1988–2006

Characteristics	Any Male Partners (n = 85), % (SE)	Female Partners Only (n = 5292), % (SE)	No Sexual Partners (n = 197), % (SE)
Demographic background			
Age at interview,* y			
17–24	16.0 (5.1)	17.5 (0.8)	82.1 (4.8)
25–34	35.2 (8.0)	30.0 (1.0)	13.4 (4.4)
35–44	27.9 (8.0)	27.0 (1.0)	3.0 (1.4)
45–59	21.0 (7.0)	25.6 (1.0)	1.5 (0.8)
High school degree or less*	45.3 (7.6)	55.2 (1.6)	73.7 (4.9)
Non-Hispanic White*	84.7 (3.8)	74.3 (1.4)	71.0 (4.3)
Family income below poverty level	14.1 (5.0)	11.8 (0.9)	19.0 (4.1)
Behavioral health history at interview			
Smoking status*			
Current smoker	43.6 (7.4)	35.9 (1.1)	8.0 (2.5)
Past smoker	10.3 (4.7)	25.5 (0.9)	0.5 (0.3)
Nonsmoker	46.1 (7.1)	38.5 (0.9)	91.5 (2.5)
Binge drinking at least monthly, past 12 mo[a],*	42.2 (6.7)	33.4 (1.5)	15.3 (4.2)
Ever used crack or cocaine*	45.2 (9.0)	17.6 (1.3)	0.9 (0.8)
Body mass index in kg/m^2			
Normal or underweight (≤25)	53.3 (7.0)	43.1 (1.1)	69.5 (4.7)
Overweight (>25 to <30)	31.9 (6.0)	38.2 (1.0)	15.5 (3.5)
Obese (≥30)	14.7 (6.3)	18.7 (0.8)	14.9 (2.6)
Self-rated health status good or excellent	56.3 (7.1)	57.8 (1.1)	58.9 (4.3)
Physician-rated health status good or excellent*	67.1 (7.1)	78.5 (2.4)	77.8 (4.6)
Mortality status			
Mean mo of follow-up*	156.7 (6.7)	176.5 (2.9)	176.4 (5.7)
Dead by end of follow-up[b],*	21.0 (5.7)	6.7 (0.4)	5.7 (2.3)
Underlying cause of death			
Intentional self-harm	0.0	0.3 (0.1)	0.0
Death allocated to HIV-related causes*	13.1 (5.0)	0.1 (0.04)	0.2 (0.2)
Death not allocated to HIV-related causes	7.9 (3.5)	6.6 (0.4)	5.5 (2.3)

Note. Differences in demographic and behavioral health history were evaluated by a multinomial logistic regression in which sexual orientation was regressed on all predictors simultaneously. Sexual orientation–related differences were evaluated by multiple regression for follow-up months and by logistic regression for mortality status (all-cause, HIV-related, not HIV-related), with adjustment for age, race/ethnicity, educational attainment, family income, smoking, drinking, crack or cocaine use status, body mass index, and self-rated and physician-rated health status.
[a]Binge drinking defined as ≥5 drinks per occasion.
[b]End of follow-up was December 31, 2006.
*$P < .05$.

deaths among MSM were attributable to intentional self-harm. When deaths were limited to those not attributed to HIV infection, we observed little evidence of a sexual orientation–related difference (P=.88). On average, men's mortality status was tracked for approximately 176.2 months (95% CI=170.4, 181.9) following their MEC interview. Length of follow-up varied by sexual orientation (P<.001), reflecting the higher death rate among MSM. Additional bivariate predictors of all-cause mortality included age (P<.001), educational attainment (P<.001), family income (P<.001), smoking status (P<.001), crack or cocaine use (P=.02), body mass index (P<.001), and self-rated (P<.001) and physician-rated (P<.001) physical health status.

Multivariate survival analysis of all-cause mortality revealed that risk of death during the follow-up period was higher for MSM than for heterosexual men (adjusted hazard ratio=3.59; 95% CI=1.91, 6.74), after adjustment for possible differences in individual demographics, health behaviors, and initial health status (Table 2). Using a second model, we found that mortality from HIV-related causes during the follow-up period was particularly elevated among MSM compared with heterosexual men. Evaluation of possible sexual orientation differences in mortality from non–HIV-related causes in a third model failed to detect significant differences between men reporting same-gender sexual partners and heterosexual men, after adjustment for possible confounding.

The NHANES III recruited respondents in 2 independent survey cycles: 1988 to 1991 and 1991 to 1994. Risk for HIV-related death was greater among men recruited in the first cycle than among those recruited in the second cycle (adjusted hazard ratio=0.33; 95% CI=0.14, 0.74). By contrast, risk for non–HIV-related death did not differ between the 2 survey cycles (adjusted hazard ratio=1.23; 95% CI=0.93, 1.62). Of the 25 HIV-related deaths, 6 occurred before the widespread introduction of HAART, 9 during a 5-year window when some NHANES III respondents would possibly have had access to HAART, and 10 during a nearly 10-year period after the introduction of HAART.

DISCUSSION

Mortality risks among men with minority sexual orientation are greatly understudied, despite this population's well-documented risk for HIV infection[1] and clear evidence of elevated reports of suicide attempts.[12–15,17–23,42] Indeed, much of the existing research on the health and mortality risk among MSM relies on data from HIV-related cohort studies,[43–46] for which samples are often selected because of elevated health risks, including prevalent HIV infection.[47] These studies are not designed to provide population-based estimates of mortality risks among MSM in the United States as a whole.[25] In this regard, the current study contributes unique information about mortality risk among MSM in the United States.

Results of this study provide both bad and good news about the mortality risks among men with minority sexual orientation. During the 18-year follow-up period, the hazard of dying from any cause was 3.6 times higher for men in the NHANES III cohort who reported any same-gender sexual partners than for men who reported only heterosexual sexual experiences. This difference was greatly influenced by an adjusted hazard for death attributable to HIV-related causes that was 157.4 times higher among MSM than among men who reported only heterosexual sexual experiences. Although precise analyses of the timing of these HIV-related deaths are beyond the scope of this report, it appears that risk for HIV-related death was somewhat greater prior to the introduction of HAART, although some HIV-related deaths continued to occur in the post-HAART period. Whether HIV-related deaths remain elevated at the present time is not determinable from the NHANES III follow-up, as currently available data track deaths only through December 2006. Both longer follow-up and greater detail as to timing of deaths are needed to provide accurate estimates of post-HAART HIV-related mortality risk in this population.

At the same time, we failed to detect any differences between MSM and heterosexual men in rates of mortality related to suicide or attributed to causes other than HIV infection. Although suicide-related deaths were relatively rare in the NHANES III sample (n=18), if they occurred among homosexually experienced men at the same rate reported in the recent study of Danish men in registered domestic partnerships,[24] it would have been detectable in the current study. These findings indicate that the elevated rates of attempted suicide seen among men with minority sexual orientation in numerous studies,[12–21,23] and in the NHANES III sample in particular,[22] may not be matched by a similar elevated risk for suicide mortality. It is also reassuring that, with the exception of deaths related to HIV infection, MSM did not appear to experience greater mortality risk than did heterosexual men despite documented differences in health behaviors related to sexual orientation.[25]

Several study limitations should be considered in contextualizing the results reported here. One is that the NHANES III assessment of sexual orientation among men was limited in 2 ways. First, only sexual behavior was

TABLE 2—Adjusted Mortality Hazards Among US Men Aged 17–59 Years, by Self-Reported Gender of Sexual Partners: National Health and Nutrition Examination Survey III, 1988–2006

Sexual History at Interview	HIV-Related Mortality, HR (95% CI)	Causes Other Than HIV-Related, HR (95% CI)	All-Cause Mortality, HR (95% CI)
Any male sexual partners	157.37 (59.77, 414.32)	1.37 (0.58, 3.21)	3.59 (1.91, 6.74)
No sexual partners	2.17 (0.17, 28.08)	1.90 (0.74, 4.88)	1.86 (0.75, 4.64)
Female partners only	1.00	1.00	1.00

Note. CI = confidence interval; HR = hazard ratio. HRs were estimated by Cox proportional hazards survival analysis, with adjustment for age, education, race/ethnicity, family income, smoking status, past year binge drinking status (≥5 drinks/occasion), lifetime crack or cocaine use, body mass index, and self-rated and physician-rated health at interview.

assessed. Although most gay-identified men report lifetime same-gender sexual experiences, this is not true of men who identify as bisexual.[25] Further, many men who report same-gender sexual experiences would identify as heterosexual if asked.[25] This discrepancy implies that generalizing findings from the current study to gay and bisexual-identified men, in general, should be done with some caution. Second, only young and middle-aged men were assessed for sexual behavior in the NHANES III, but some sexual orientation–related differences in risk behaviors are more likely to evidence their effects on mortality with increasing age. For example, several recent studies have reported higher rates of tobacco use among gay and bisexual men than among heterosexual men.[42,48-50] The cumulative effects on mortality, if present, are likely to appear in the years that lie beyond the currently available NHANES III follow-up period.[51] Thus, longer-term follow-up of the NHANES III sample may yet show diverging sexual orientation–related risks as the cohort ages.

Additional limitations in the current study include the fact that the public NHANES III data sets do not provide sufficient information to track HAART-related changes in HIV-related mortality. It may be that current all-cause mortality risk among men with minority sexual orientation is somewhat less elevated today than a decade ago, before the introduction of HAART.[8] In addition, because the NHANES sample is limited to the noninstitutionalized US population, estimates of mortality events linked to homelessness or incarceration, such as deaths associated with drug abuse, are likely to be underestimated. Finally, the number of men in the NHANES III who reported same-gender sexual experiences is small, resulting in relatively wide confidence intervals and somewhat limiting our power to detect differences in non–HIV-related mortality. The small sample also might limit our ability to capture the heterogeneity present in this population.[2]

Despite these limitations, the NHANES III is currently one of the few US data sources that allow investigation of possible relationships between sexual orientation status and mortality in the general population. Our findings document the widely anticipated increased mortality risk among MSM caused by a greater risk for HIV-related disease[11] and, at the same time, address the concern that non–HIV-related mortality rates may also be elevated in this population.[24,26]

Over the years, limitations in administrative and research data have greatly hampered quantification of health risks among individuals with minority sexual orientation,[25] including the full impact of the HIV epidemic on mortality risk among MSM. As we approach the 30th anniversary of the identification of AIDS and its terrible impact on the lives of MSM, we can only celebrate momentarily the gains in the reduction of mortality in this population attributable to the introduction of HAART. Monitoring our progress in these efforts will be greatly aided by routine collection of adequate population-based mortality data linkable to sexual orientation. Indeed, public health[52] has already seen the benefits of obtaining better mortality data in the area of maternal mortality. Changes to the quality of this data have revealed important pathways for intervening and protecting the health of women and children. The results of our study indicate that similar benefits could accrue to our ability to provide better health interventions for MSM if sexual orientation data were routinely collected, allowing it to be linked to mortality data. Routinely collecting information on markers of sexual orientation in health surveys likewise will facilitate tracking the health of people with minority sexual orientation and will reduce the impact of modifiable health threats that may be elevated among gay and bisexual men. ■

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Contributors

S.D. Cochran conceptualized the study, conducted analyses, and wrote an initial draft of the article. Both authors conceptualized the ideas for the current article, interpreted the findings, and edited drafts of the article.

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Human Participant Protection

No protocol approval was necessary because the study used publicly available, anonymous data.

References

1. Kilmarx PH. Global epidemiology of HIV. *Curr Opin HIV AIDS.* 2009;4(4):240–246.

2. Cochran SD, Mays VM. Physical health complaints among lesbians, gay men, and bisexual and homosexually experienced heterosexual individuals: results from the California Quality of Life Survey. *Am J Public Health.* 2007;97(11):2048–2055.

3. Osmond DH, Pollack LM, Paul JP, Catania JA. Changes in prevalence of HIV infection and sexual risk behavior in men who have sex with men in San Francisco: 1997–2002. *Am J Public Health.* 2007;97(9):1677–1683.

4. Xia Q, Osmond DH, Tholandi M, et al. HIV prevalence and sexual risk behaviors among men who have sex with men: results from a statewide population-based survey in California. *J Acquir Immune Defic Syndr.* 2006;41(2):238–245.

5. Xu F, Sternberg MR, Markowitz LE. Men who have sex with men in the United States: demographic and behavioral characteristics and prevalence of HIV and HSV-2 infection: results from National Health and Nutrition Examination Survey 2001–2006. *Sex Transm Dis.* 2010;37(6):399–405.

6. Centers for Disease Control and Prevention. HIV/AIDS and young men who have sex with men. June 2010. Available at: http://www.cdc.gov/nchhstp/newsroom/docs/FastFacts-MSM-FINAL508COMP.pdf. Accessed July 9, 2010.

7. Schneider MF, Gange SJ, Williams CM, et al. Patterns of the hazard of death after AIDS through the evolution of antiretroviral therapy: 1984–2004. *AIDS.* 2005;19(17):2009–2018.

8. Harrison KM, Song R, Zhang X. Life expectancy after HIV diagnosis based on national HIV surveillance data from 25 states, United States. *J Acquir Immune Defic Syndr.* 2010;53(1):124–130.

9. Wood E, Low-Beer S, Bartholomew K, et al. Modern antiretroviral therapy improves life expectancy of gay and bisexual males in Vancouver's West End. *Can J Public Health.* 2000;91(2):125–128.

10. Bhaskaran K, Hamouda O, Sannes M, et al. Changes in the risk of death after HIV seroconversion compared with mortality in the general population. *JAMA.* 2008;300(1):51–59.

11. Montagnier L. 25 years after HIV discovery: prospects for cure and vaccine. *Virology.* 2010;397(2):248–254.

12. Silenzio VM, Pena JB, Duberstein PR, Cerel J, Knox KL. Sexual orientation and risk factors for suicidal ideation and suicide attempts among adolescents and young adults. *Am J Public Health.* 2007;97(11):2017–2019.

13. Russell ST, Joyner K. Adolescent sexual orientation and suicide risk: evidence from a national study. *Am J Public Health.* 2001;91(8):1276–1281.

14. Remafedi G, French S, Story M, Resnick MD, Blum R. The relationship between suicide risk and sexual orientation: results of a population-based study. *Am J Public Health.* 1998;88(1):57–60.

15. Lhomond B, Saurel-Cubizolles MJ. Violence against women and suicide risk: the neglected impact of same-sex sexual behaviour. *Soc Sci Med.* 2006;62(8):2002–2013.

16. King M, Semlyen J, Tai SS, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry.* 2008;8:70.

17. Herrell R, Goldberg J, True WR, et al. Sexual orientation and suicidality: a co-twin control study in adult men. *Arch Gen Psychiatry.* 1999;56(10):867–874.

18. Gilman SE, Cochran SD, Mays VM, Hughes M, Ostrow D, Kessler RC. Risk of psychiatric disorders among individuals reporting same-sex sexual partners in the National Comorbidity Survey. *Am J Public Health.* 2001;91(6):933–939.

19. Garofalo R, Wolf RC, Wissow LS, Woods ER, Goodman E. Sexual orientation and risk of suicide attempts among a representative sample of youth. *Arch Pediatr Adolesc Med.* 1999;153(5):487–493.

20. Faulkner AH, Cranston K. Correlates of same-sex sexual behavior in a random sample of Massachusetts high school students. *Am J Public Health.* 1998;88(2):262–266.

21. de Graaf R, Sandfort TG, ten Have M. Suicidality and sexual orientation: differences between men and women in a general population-based sample from the Netherlands. *Arch Sex Behav.* 2006;35(3):253–262.

22. Cochran SD, Mays VM. Lifetime prevalence of suicide symptoms and affective disorders among men reporting same-sex sexual partners: results from NHANES III. *Am J Public Health.* 2000;90(4):573–578.

23. Cochran SD, Mays VM, Alegria M, Ortega AN, Takeuchi D. Mental health and substance use disorders among Latino and Asian American lesbian, gay, and bisexual adults. *J Consult Clin Psychol.* 2007;75(5):785–794.

24. Mathy RM, Cochran SD, Olsen J, Mays VM. The association between relationship markers of sexual orientation and suicide. *Soc Psychiatry Psychiatr Epidemiol.* 2011;46(2):111–117.

25. Cochran SD. Emerging issues in research on lesbians' and gay men's mental health: does sexual orientation really matter? *Am Psychol.* 2001;56(11):931–947.

26. Frisch M, Bronnum-Hansen H. Mortality among men and women in same-sex marriage: a national cohort study of 8333 Danes. *Am J Public Health.* 2009;99(1):133–137.

27. Dupre ME, Beck AN, Meadows SO. Marital trajectories and mortality among US adults. *Am J Epidemiol.* 2009;170(5):546–555.

28. Carpenter C, Gates GJ. Gay and lesbian partnership: evidence from California. *Demography.* 2008;45(3):573–590.

29. Bristol N. New hopes for tackling HIV/AIDS in the USA. *Lancet.* 2008;372(9653):1869–1870.

30. National Center for Health Statistics. National Health and Nutrition Examination Survey. May 21, 2009. Available at: http://www.cdc.gov/nchs/nhanes.htm. Accessed April 1, 2010.

31. *International Classification of Diseases, 10th Revision.* Geneva, Switzerland: World Health Organization; 1980.

32. *International Classification of Diseases, Ninth Revision.* Geneva, Switzerland: World Health Organization; 1980.

33. Stata Corporation. *Stata 11 User's Guide.* College Station, TX: Stata Press; 2010.

34. Butler AC. Trends in same-gender sexual partnering, 1988–1998. *J Sex Res.* 2000;37(4):333–343.

35. Cochran S, Mays V, Sullivan J. Prevalence of mental disorders, psychological distress, and mental health services use among lesbian, gay, and bisexual adults in the United States. *J Consult Clin Psychol.* 2003;71(1):53–61.

36. Mays VM, Cochran SD. Mental health correlates of perceived discrimination among lesbian, gay, and bisexual adults in the United States. *Am J Public Health.* 2001;91(11):1869–1876.

37. Cochran SD, Mays VM. Relation between psychiatric syndromes and behaviorally defined sexual orientation in a sample of the US population. *Am J Epidemiol.* 2000;151(5):516–523.

38. Sandfort TG, de Graaf R, Bijl RV. Same-sex sexuality and quality of life: findings from the Netherlands Mental Health Survey and Incidence Study. *Arch Sex Behav.* 2003;32(1):15–22.

39. Sandfort TG, de Graaf R, Bijl RV, Schnabel P. Same-sex sexual behavior and psychiatric disorders: findings from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Arch Gen Psychiatry.* 2001;58(1):85–91.

40. Breslau J, Aguilar-Gaxiola S, Borges G, Kendler KS, Su M, Kessler RC. Risk for psychiatric disorder among immigrants and their US-born descendants: evidence from the National Comorbidity Survey Replication. *J Nerv Ment Dis.* 2007;195(3):189–195.

41. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA.* 2003;289(23):3095–3105.

42. Easton A, Jackson K, Mowery P, Comeau D, Sell R. Adolescent same-sex and both-sex romantic attractions and relationships: implications for smoking. *Am J Public Health.* 2008;98(3):462–467.

43. Antiretroviral Therapy Cohort Collaboration. Mortality of HIV-infected patients starting potent antiretroviral therapy: comparison with the general population in nine industrialized countries. *Int J Epidemiol.* 2009;38(6):1624–1633.

44. Quinn TC. HIV epidemiology and the effects of antiviral therapy on long-term consequences. *AIDS.* 2008;22(suppl 3):S7–S12.

45. Monforte A, Abrams D, Pradier C, et al. HIV-induced immunodeficiency and mortality from AIDS-defining and non-AIDS-defining malignancies. *AIDS.* 2008;22(16):2143–2153.

46. Chesson HW, Gift TL. Decreases in AIDS mortality and increases in primary and secondary syphilis in men who have sex with men in the United States. *J Acquir Immune Defic Syndr.* 2008;47(2):263–264.

47. Cunningham WE, Crystal S, Bozzette S, Hays RD. The association of health-related quality of life with survival among persons with HIV infection in the United States. *J Gen Intern Med.* 2005;20(1):21–27.

48. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav.* 2009;23(4):620–631.

49. Pizacani BA, Rohde K, Bushore C, et al. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a population-based study from the US Pacific Northwest. *Prev Med.* 2009;48(6):555–561.

50. Gruskin EP, Greenwood GL, Matevia M, Pollack LM, Bye LL. Disparities in smoking between the lesbian, gay, and bisexual population and the general population in California. *Am J Public Health.* 2007;97(8):1496–1502.

51. Horner M, Ries L, Krapcho M, et al. SEER cancer statistics review, 1975–2006. April 1, 2009. Available at: http://seer.cancer.gov/csr/1975_2006. Accessed April 10, 2010.

52. Hogan MC, Foreman KJ, Naghavi M, et al. Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet.* 2010;375(9726):1609–1623.