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Perceived risk for cancer in an urban sexual minority

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Abstract

Lesbians, gay men, and bisexuals are a sexual minority experiencing elevated cancer risk factors and health disparities, e.g., elevated tobacco use, disproportionate rates of infection with human immunodeficiency virus. Little attention has been paid to cancer prevention, education, and control in sexual minorities. This study describes cancer risk perceptions and their correlates so as to generate testable hypotheses and provide a foundation for targeting cancer prevention and risk reduction efforts in this high risk population. A cross-sectional survey of affiliates of a large urban community center serving sexual minority persons yielded a study sample of 247 anonymous persons. The survey assessed demographics, absolute perceived cancer risk, cancer risk behaviors, desired lifestyle changes to reduce cancer risk, and psychosocial variables including stress, depression, and stigma. Univariate and multivariate nonparametric statistics were used for analyses. The sample was primarily white non-Hispanic, middle-aged, and > 80% had at least a high school education. Mean values for absolute perceived cancer risk (range 0–100% risk), were 43.0 (SD = 25.4) for females, and for males, 49.3 (SD = 24.3). For females, although the multivariate regression model for absolute perceived cancer risk was statistically significant ($P < .05$), no single model variable was significant. For men, the multivariate regression model was significant ($P < .001$), with endorsement of “don’t smoke/quit smoking” to reduce personal cancer risk ($P < .001$), and greater number of sexual partners ($P = .054$), positively associated with absolute perceived risk for cancer. This study provides novel data on cancer risk perceptions in

sexual minorities, identifying correlates of absolute perceived cancer risk for each gender and several potential foci for cancer prevention interventions with this at-risk group.

Keywords

Cancer risk perception; Cancer risk factors; Sexual minority; Health disparities

Lesbians, gay men, bisexual and transgender (LGBT) persons comprise a diverse sexual minority and community at elevated risk for multiple adverse health outcomes (Dean et al. 2000; Gay and Lesbian Medical Association 2001). Since the 1980's, concerns about human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) have been paramount within the LGBT community (CenterLink: The Community of LGBT Centers and Movement Advancement Project 2008; Harper and Schneider 2003). Consequently, despite cancer being second only to heart disease as the most prevalent cause of death in the general US population, cancer prevention and control for sexual minority persons have received relatively little attention (American Cancer Society 2009; Boehmer 2002), and especially for sexual minority men. Contributing to the relative inattention to cancer is the absence of data on cancer incidence and prevalence within sexual minorities. In this context researchers and advocates have highlighted data on the prevalence of *risk factors* for cancer as proxy indicators for an at-risk population (Dibble et al. 2004). Among the cancer risk factors most frequently studied are HIV infection and tobacco use (Centers for Disease Control and Prevention 2009b; Lee et al. 2009), both prevalent in the LGBT community. Although other cancer risk factors have been documented, such as infection with human papillomavirus or alcohol use (e.g., Chin-Hong et al. 2005; Gruskin et al. 2001), the sole consideration of tobacco use and HIV infection supports that sexual minority persons are likely disproportionately affected by cancer. Studies that measure diverse cancer risk factors can contribute to an emerging picture of cancer burden and health disparities in the sexual minority population.

Much of what is known about the prevalence or incidence of cancers in sexual minorities stems from work conducted within HIV and AIDS. Some 21% of gay and bisexual men are known to be HIV+, and they are the single largest group (46%) by risk factor among the HIV-infected (CDC 1993–1997). Being HIV+ is a risk factor for cancer—both AIDS-defining (Kaposi's sarcoma, non-Hodgkin's lymphoma, and invasive cervical cancer) and non-AIDS defining cancers (lung, vaginal, liver, anal, oropharyngeal, colorectal, and renal cancers, and; Hodgkin lymphoma, melanoma, and leukemia) than in the general population (Patel et al. 2008; Sackoff et al. 2006; Shiels et al. 2009). Further, smoking, associated with increased risk for over 15 cancers (American Cancer Society 2009), is prevalent among the HIV-infected, who smoke at rates some two to three times the national average (Burkhalter et al. 2005; Gritz et al. 2004; Mamary et al. 2002; Niaura et al. 1999). Substantial work has focused on anal cancer among HIV+ and HIV– gay and bisexual men. Although a relatively rare cancer in the general population, anal cancer is significantly more prevalent among gay and bisexual men than heterosexual men, regardless of HIV serostatus (Daling et al. 2004; Frisch et al. 1997, 2003; Tseng et al. 2003).

An exception to the examination of cancer risk predominantly within HIV/AIDS is a study conducted in Denmark that used population-based data from national cancer, HIV/AIDS, and homosexual partnership registries to quantify incidence of cancer in males and females in homosexual partnerships (Frisch et al. 2003). Females in homosexual partnerships had cancer risks similar to those of Danish females in general (overall relative risk (RR) = 0.9, 95% confidence interval (CI): 0.6, 1.4); however, cervical carcinoma in situ was significantly less likely for these females (RR = 0.2, 95% CI: 0.0, 0.97) compared to females

in general. The latter finding was unexpected, but the authors noted that this would be consistent with US data that lesbians were less likely to undergo Papanicolaou (Pap) smear screening than heterosexual females (Carroll 1999; Marrazzo et al. 2000), which would lower the overall likelihood of detecting early stage (in situ) cervical cancer. Men in homosexual partnerships were at higher cancer risk (RR = 2.1, 95% CI: 1.8, 2.5), due primarily to human HIV/AIDS-associated Kaposi's sarcoma (RR = 136, 95% CI: 96, 186), and non-Hodgkin's lymphoma (RR = 15.1, 95% CI: 10.4, 21.4). In addition, anal cancer also occurred in excess (RR = 31.2, 95% CI: 8.4, 79.8). After exclusion of Kaposi's sarcoma, non-Hodgkin's lymphoma, and anal cancer, cancer risk for persons in homosexual partnerships was the same as in the general Danish population (RR = 1.0, 95% CI: 0.8, 1.3). Results of this study suggested that concerns about elevated cancer incidence for sexual minorities might not be justified outside of HIV infection or AIDS. The study, however, was limited by sampling only those sexual minority individuals registered as partners, a short follow-up period of 4–5 years, and the youth of its sample. Conducting a comparable study in the US is not currently possible due to the absence of equivalent national registries and assessment of sexual orientation in cancer registries.

Cancer risk perceptions are of central importance in cancer prevention and control. Risk perception is an individual's belief about the probability of developing illness if no protective action is taken (Weinstein 2000). Cancer risk perception has been described synonymously as perceived risk, vulnerability, susceptibility, or likelihood, and subjective risk perception about cancer (Vernon 1999a). Most health behavior theories posit that the perception of being at risk for illness motivates self-protective health behavior (Cummings et al. 1980). The theoretical role of cancer risk perception has received empirical support in cancer screening studies, e.g., colorectal cancer risk perceptions are related to increased intentions and utilization of screening (MaCrae et al. 1984; Watts et al. 2003), and increased breast cancer risk perceptions are related to mammography screening (Lipkus et al. 1999, 2000). Risk perceptions are often a better predictor of health actions such as screening than objective risk status (Jacobsen et al. 1997; Lipkus et al. 1999, 2000). Further, among smokers, greater perceived risk for cancer is associated with stronger intentions to quit smoking and quit attempts (Klesges et al. 1988; Weinstein et al. 2005).

The explanatory power of cancer risk perceptions for understanding health behaviors is robust despite the lack of consensus on how best to measure them and how many items are necessary to adequately assess such risk perceptions (Weinstein 1999; Weinstein et al. 2007). Risk perceptions can be measured as *absolute perceived risk*, i.e., “What is your lifetime risk of getting cancer?” or as *relative risk*, “Thinking about others like you of similar age and gender, what is your risk of getting cancer?” and in different formats, e.g., with verbal descriptors, probabilities, as frequencies, or with pictures (Lipkus 2007). Individual assessment of personal risk for cancer entails a complex process influenced by such factors as numeracy skills, level of accurate understanding about the impact of personal risk factors on the development of particular cancers, and the use of different heuristics or “rules of thumb,” (e.g., cognitive availability of relevant information, or incidental affect), that all individuals use to make estimates or decisions (Klein and Stefanek 2007).

Accordingly, this study examined cancer risk perceptions in a sexual minority sample with the aim of describing the patterns of perceived risk and identifying correlates—the first study known to do so. These analyses constituted an extension of research aims posed in the parent study, which examined intention to quit smoking in a sample of LGBT smokers (Burkhalter et al. 2009). As such, these findings are intended to generate testable hypotheses to guide future studies. Three research questions were addressed. First, sexual minorities comprise diverse gender and sexual identities, and females and men often differ regarding perceptions of risk for the same illness threat (Hammond et al. 2007), including cancer

(McQueen et al. 2006). Therefore, the first research question was: “How were cancer risk perception values distributed, and did perceptions differ according to gender?” Perceptions of risk are formed not only from analytic (rational) reasoning but also from experiential (affective) reasoning (Slovic et al. 2004), with the latter referred to as the “affective heuristic” influencing perceptions of risk (Loewenstein et al. 2001). Sexual minority men and females are a stigmatized group who experience discrimination (Herek et al. 2009), high rates of psychological distress (Cochran et al. 2003), and stress (Meyer 2003). Those who experience higher psychological distress often report higher perceived risk for cancer (Bratt et al. 2000; Bunge et al. 2008; Rakovitch et al. 2003). Thus, it was important to assess salient affective components of sexual minority experiences linked to elevated distress in order to understand their role in perceived risk for cancer. Therefore, the second research question was: “Are psychosocial constructs germane to the experiences of sexual minorities related to their perceived risk for cancer?” Because risk perceptions are also influenced by risk-related behaviors, the third research question was “To what degree were actual cancer risk behaviors and personally relevant cancer risk reduction strategies associated with cancer risk perceptions?” Further, patterns of endorsement of cancer risk reduction strategies in this sexual minority sample were examined and compared to those observed in the general population. By answering these questions the study intended to characterize critical social-cognitive precursors of the adoption of cancer prevention and control strategies for sexual minorities.

Method

Procedure and sample

All data were collected from self-identified lesbian, gay, bisexual, and transgender adults who either attended the LGBT Community Center (the Center) in New York City, or whose names were on this organization's mailing list and received the survey via postal mail. The Center is a nonprofit service organization for LGBT persons providing clinical and educational services as well as recreational, cultural, and civic activities. At the time of the study the Center served on average over 5,000 patrons weekly and offered over 300 groups and other no-cost services. Due to the study's minimal risk and the protected anonymity of survey respondents, the study received exemption from the institutional review board of Memorial Sloan-Kettering Cancer Center and approval of the executive staff of the LGBT Community Center. Data presented here are ancillary to a larger study focused on intention to quit smoking (Burkhalter et al. 2009).

The study was a cross-sectional survey of persons who identified as LGBT and were at least 18 years old. The study used community venue sampling, a nonprobability sampling approach that is widely used to gain access to hidden or hard-to-reach minority populations (Meyer and Wilson 2009). Given that LGBT persons highly involved in the gay community may be different from those who are not (Ramirez-Valles 2002), the study used two sampling modalities within the Center venue. First, the Center's 2005 mailing list of more than 40,000 individuals from the metropolitan area was used to randomly sample 1,121 persons, with an oversampling by 10% of identifiable females to assure a sufficient sample of females. The mailing list included any individuals who were donors, supporters, members, or users of the Center, but they did not have to be active users of the Center. Second, the Center's staff (but not the research study staff) handed out surveys in person to 65 active users of the Center, i.e., attendees at Center in-house services or activities, over the course of 4 months and collected the completed surveys the same day. The sample size was derived from statistical power calculations conducted for the primary study, not this ancillary study.

All surveys included a cover letter using both institutions' logos and co-signed by two authors (JB, BW) and an incentive (i.e., movie coupon). The survey assessed demographics, cancer risk perceptions and behaviors, personal lifestyle changes to reduce cancer risk, and psycho-social variables. There were 93 core items applicable to all respondents and not subject to skip-outs, and up to 71 more items that may have been applicable to some respondents, depending on age, gender, smoking status, and other factors. Standard US mail was used and each mailing included a postage-paid, addressed return envelope. Due to incorrect addresses, 138 surveys were returned, and two surveys were unusable, yielding a net figure of 201 usable mail surveys (20.4% response rate; 75.6% of the total sample size). No attendees invited to complete the survey declined to participate, and 65 surveys were collected in person at the LGBT Community Center (100% response rate; 24.4% of the total sample size). The total sample size was 266 self-identified LGBT adults.

Measures

Sociodemographic characteristics—Participants reported age, ethnicity, education, and occupation. Sexual orientation identity (lesbian, gay, bisexual, questioning, heterosexual, or other) (Sell 2009), gender identity (female, male, or other), transgender identity (yes or no), and status of current relationship (single, coupled/partnered/married) were assessed.

Cancer risk perception measures—The primary outcome measure was one item that asked respondents to rate their absolute perceived risk for cancer in percent likelihood using a 0–100% scale (Diefenbach et al. 1993; McQueen et al. 2008). One-item measures have been shown to be efficient evaluations of perceived cancer risk in prior work, with multi-item risk perception scales offering little additional advantage in accounting for related behavioral outcomes, e.g., (Weinstein et al. 2007). The item used here was “*Using the scale below, please tell us what you think the chances are, or percent likelihood, that you will develop cancer;*” and the response scale was a 10 cm line anchored at the ends with “*0%-Definitely WON'T develop cancer*” and “*100%-Definitely WILL develop cancer.*” Respondents were asked to use the scale to mark their own opinion anywhere on the line. Those with a cancer history were instructed to answer the risk perception question “*about your chances of having cancer AGAIN.*” In addition to the primary outcome item, two additional risk perception questions were used. First, respondents were asked “In your opinion, are you likely or unlikely to develop cancer in the future?” with options to check either “*Likely*” or “*Unlikely*,” an item modeled after similar items (Diefenbach et al. 1993; Weinstein et al. 2007). Second, they were also asked what type of cancer they believed they were most likely to get and chose one of eight responses, including the six most common cancers or “other cancer,” with blank space for identifying the cancer, and one option to indicate that “I do not believe I will get cancer.”

Risk behaviors, risk reduction strategies, and disease history—Standard items were used to assess lifetime smoking of at least 100 cigarettes (yes/no), current smoking pattern (daily/occasionally, not at all), average daily use of cigarettes and other tobacco products, and years of regular smoking (United States Department of Health and Human Services 2008). Survey respondents were classified as current smokers if they had smoked at least 100 cigarettes in their lifetime and were currently smoking daily or occasionally. Several items from the 2004 CDC Behavioral Risk Factor Surveillance System were used to assess other risk behaviors (CDC 2009). Alcohol use during the past 30 days and number of occasions on which five or more drinks were consumed were assessed. Sun exposure was assessed for the prior 12 months by asking about sunburn experiences. Sexual risk behaviors were assessed by asking number of sexual partners in the past 12 months, and whether they had been treated for a sexually transmitted or venereal disease (NIMH Multisite HIV/STD

Prevention Trial for African American Couples Group 2008) in the past 5 years. One-two-part item assessed illicit substance use in the past 6 months by listing nine drugs or drug categories and assessing whether each was used and, if so, how frequently, (Stall et al. 2001). For analyses, the total number of illicit drugs was used. Participants were asked to check off those lifestyle or behavior changes (e.g., eat better, quit smoking) that they believed could reduce their personal risk for cancer. This item was modeled on a question from the *Health Information National Trends Survey* (HINTS; National Cancer Institute 2003). Because cancer risk is elevated for those living with HIV/AIDS and those with a history of cancer, self-reported HIV serostatus (HIV-positive, HIV-negative, or Don't know) and cancer history were each assessed with one item.

Stress, depression, and stigma—The four-item *Perceived Stress Scale-Brief* (Cohen et al. 1983; Cohen and Williamson 1988) was used to measure the degree to which situations in a respondent's life are appraised as stressful (Cronbach's $\alpha = 0.83$ for females; $\alpha = .81$ for males and for the total sample). Items are rated on a 5-point Likert scale, ranging from 0 (never) to 4 (very often). Depression symptoms were assessed using the *Center for Epidemiologic Studies—Depression Scale* (Radloff 1977), a 20-item self-report tool widely used to assess clinical and non-clinical levels of depression in community and clinical samples (Cronbach's $\alpha = .91$ for females and the total sample, $\alpha = .92$ for males). Scores range from 0 to 60. Likely clinically significant depression was assessed using the standard cutoff score of 16 or higher (Comstock and Helsing 1976; Weissman et al. 1977). Sexual minority stigma was assessed using five items ($\alpha = .80$ for females; $\alpha = .86$ for males; $\alpha = .85$ for the total sample) from the *Measures of Daily Gay Life*, (Frable et al. 1997), which assessed respondents' perceptions that other LGBT people in general experienced stigma. Items were adapted so as to include all LGBT persons. Internalized stigma (homophobia) was assessed with three items ($\alpha = 0.74$ for females; $\alpha = .71$ for males and for the total sample) from the *Internalized Homophobia—Short Form* (Herek et al. 2000) to examine individuals' feelings about being LGBT (e.g., I wish I weren't LGBT). Higher scores in each of these measures indicated higher levels of the assessed construct.

Statistical analyses

Univariate and bivariate statistical analyses were conducted using SPSS (Inc 2006). All continuous variables' distributions were examined for normality. No variable except age was normally distributed, as determined by Kolmogorov–Smirnov tests for normality. As the statistical distribution of the primary outcome variable of absolute perceived risk of cancer was not responsive to data transformations, nonparametric statistics were used for all analyses. For all research questions, bivariate analyses were conducted using Spearman's rank-order correlations for continuous variables, the Wilcoxon–Mann–Whitney U-test for testing differences in levels of perceived risk for dichotomous variables, or Kruskal–Wallis one-way analysis of variance tests for polychotomous variables. These bivariate tests were used to select variables for entry into each of the two nonparametric multivariate models, with variables selected if $P < .05$. Prior to entry into the multivariate models, the variables selected from bivariate analyses were examined for their inter-associations to control for potential multicollinearity. Given the hypothesis-building intention of the study and the paucity of published data on cancer perceptions for sexual minority persons, multivariate models used simultaneous entry, with each variable's contribution to the model controlled for by the presence of all other correlates in the model. For the first research question, histograms of scores were produced for absolute perceived cancer risk for each gender identity (males, females) and used a recommended statistical method to examine whether the scores were distributed uni- or bimodally (Schilling et al. 2002). Then, separate multivariate models for absolute perceived risk of cancer were constructed for males and females. For the comparison of this sample's responses to those of the general population on the HINTS item

assessing potential cancer risk reduction strategies, frequencies were used with 95% confidence intervals from a national, population-based sample (Nelson et al. 2004).

Variables that were significantly associated in bivariate analyses with absolute perceived risk for cancer were entered into a Generalized Additive Model (GAM) (Hastie 1993; Hastie and Tibshirani 1990) to examine their relative importance in explaining perceived risk. GAM differs from Ordinary Least Squares (OLS) linear regression primarily in the parametric assumptions. OLS assumes that the correlates are linearly associated with the dependent variable. In the simplest case of an OLS regression with only one correlate, OLS always assumes that the relationship is a straight line; whereas GAM determines the shape of the relationship entirely from the data. GAM relies on scatterplot smoothers, nonparametric techniques for fitting the pattern of relationship as observed in the data. Hence GAM has the following main advantages: (1) it reduces the burden of trying variable transformations; (2) it accommodates complex patterns of relationships, be they linear, curvilinear, or other more complex patterns (Hastie 1993; Hastie and Tibshirani 1990). GAM is therefore less prone to problems associated with violations of assumptions in normally-distributed and linearly-associated variables. Various scatterplot smoothers are available (Hastie 1993). The cubic smoothing spline scatterplot smoother was used and implemented in the statistical language R (version 2.11.0; Ihaka and Gentleman 1996). Regarding outlier values, no effects were observed when multivariate models were tested with and without outliers using a five percent trim.

Results

Due to the small number of transgender respondents ($n = 10$) and others who did not identify as a sexual minority ($n = 9$), these individuals were excluded from the analyses, yielding a final sample of 247 self-identified lesbian, gay, and bisexual persons. Males and females in the sample did not differ by age, level of education, or employment status (P 's $> .05$), but females were significantly more likely to belong to an ethnic or racial minority ($P < .001$), identify as bisexual, ($P = .012$), be partnered/ coupled ($P = .053$) than were males. There was a trend for males to report a higher level of absolute perceived risk for cancer than did females ($P = .109$). The findings are next reported by gender.

Females

Sample characteristics—Table 1 shows sample characteristics in the first data columns. The sample of 90 females, on average, was lesbian-identified, middle-aged, and about two-thirds non-Hispanic white, included about equal numbers of single and coupled individuals, had more than 12 years of education, and was employed. Nine (10%) females reported a history of cancer diagnosis, of which breast cancer was the most common ($n = 4$). Only one woman reported being HIV+. About one-third of females smoked and the mean number of alcohol binge episodes (5 drinks) in the prior month was one. One-third of females (33.7%) had scores of 16 or higher on the CES-D. When females were asked which cancer they were most likely to get, 30.7% indicated that they did not believe that they would get cancer, followed by breast cancer (23.9%), skin cancer (13.6%), cervical and lung cancers (10.2% each), “other” cancer (9.1%, with no single cancer being reported more than once), and colon cancer (2.3%). Analyses supported a unimodal distribution of values for absolute perceived cancer risk.

Bivariate analyses—In the third and fourth data columns of Table 1 are the results of bivariate tests of the association between absolute perceived cancer risk and each variable. Four variables were positively associated with absolute perceived cancer risk: Relationship status (being single), depressive symptoms, perceived stress, and number of sunburns

experienced in the prior 12 months. The three most commonly endorsed strategies to reduce personal cancer risk for females were exercise (70%), eating better (64%), and reducing weight/maintaining healthy weight (52%). In contrast, the HINTS survey's probability sample of the general population found that females most frequently endorsed eating better (22.1%), exercising more (15.5%) and don't smoke/quit smoking (13.9%) (Nelson et al. 2004). Other behavior changes that were frequently endorsed by females in this sexual minority sample included having a positive outlook/good state of mind (50%), self examination/be aware of body changes (50%), and limit exposure to cancer-causing agents or pollution (48.9%). None of the 18 cancer risk reduction strategies specified in the HINTS item were associated with absolute perceived cancer risk in females (all P 's > .05).

Multivariate analyses—All variables with significant bivariate associations with absolute perceived cancer risk were retained for the multivariate model. The final multivariate model for absolute perceived risk for cancer in females included four variables, and although significant ($P = .012$), no single variable was statistically significant (Table 2).

Males

Sample characteristics—Table 1 shows that the sample of males, on average, was middle-aged, identified as gay, primarily white non-Hispanic, more likely to be single than coupled, educated beyond high school, and employed. Seventeen (11%) males reported a personal history of cancer, with skin cancer being the most common ($n = 5$), followed by prostate ($n = 4$), and anal ($n = 2$) cancers. Twenty-one males (13.5%) reported being HIV+. About one-third of males smoked, and the mean number of alcohol binge episodes (5 drinks) in the prior month was two. About one-third of males (35.1%) had scores of 16 or higher on the CES-D. The three most commonly endorsed strategies to reduce personal cancer risk were eating better/better nutrition (59.1%), getting screened or tested for cancer (48.1%), and having a positive outlook/good state of mind (44.8%). In contrast, the HINTS survey found that among males the most frequently endorsed categories were: Don't smoke/quit smoking (18.6%), eating better/better nutrition (16.5%), and exercising more (9.4%) (Nelson et al. 2004). Other behavior changes that were frequently endorsed by males in this sample included reducing weight/maintaining a healthy weight (41.8%), staying out of the sun/using sunscreen (40.9%), and exercise or exercise more (39.0%). When males were asked which cancer they were most likely to get, 30.1% indicated prostate cancer, followed by lung cancer (19.6%), skin cancer (15.7%), no cancer (14.4%), colon cancer (12.4%), and other cancer (7.8%), with the most frequently specified "other cancer" being testicular, indicated by only two males. The distribution of scores for absolute perceived cancer risk was unimodal.

Bivariate analyses—In the last two columns of Table 1 are the results of bivariate tests of the association between absolute perceived cancer risk and each variable. Eleven variables were significantly associated with absolute perceived cancer risk: Being younger, self-identifying as gay rather than bisexual, having a cancer history, being HIV+, being a current smoker, having a greater number of sexual partners in the past 12 months, having been treated for an STD in the prior 5 years, and greater depressive symptoms were each associated with greater absolute perceived cancer risk. Only one personal cancer risk reduction strategy was associated with greater absolute perceived cancer risk: Don't smoke/quit smoking ($r_s = .30$, $P < .001$).

Multivariate analyses—The final model (Table 2) contained eight correlates and was significant ($P < .001$). Associated with greater perceived cancer risk were endorsing the cancer risk reduction strategy of don't smoke/quit smoking ($P < .01$), greater number of

sexual partners in past 12 mo. ($P = .054$), and having a cancer history and identifying as gay versus bisexual both trended toward significance ($P < .10$).

Discussion

To our knowledge, this study is the first to report the patterns and correlates of cancer risk perceptions in sexual minority males and females. Three research questions guided analyses and yielded new data. First, the patterns of cancer risk perceptions indicate that sexual minority males and females on average hold relatively accurate perceptions of their risk for cancer, which were not highly skewed in either the optimistic or pessimistic direction. Indeed, the overall lifetime incidence risk for all cancer types (in situ and invasive) in the general population is 41.05% for females and 45.75% for males (National Cancer Institute 2008), compared to the mean absolute perceived risk figures of 43.03 and 49.28%, respectively, in this sample. Further, in comparison to a national representative sample of adults, both sexual minority males and females endorsed at high rates various lifestyle changes to reduce personal cancer risk. Consistent with epidemiological data (American Cancer Society 2009), sexual minority males reported that if they were to develop cancer, it would be prostate cancer, and for females, breast cancer. These appraisals align with the likelihood of developing the respective gender-prevalent cancers.

The analytic approach of segmenting the sample by gender and including psychosocial correlates germane to sexual minority persons produced notable results. In addressing the second research question, i.e., “are psychosocial constructs related to absolute perceived cancer risk?” and the third research question, i.e., “how are cancer risk behaviors and potential cancer risk reduction strategies related to absolute perceived cancer risk?”, the multivariate analysis for females found no statistically significant correlates of absolute perceived cancer risk. Jointly, however, the four correlates yielded a significant model. Although speculative, it may be that the small number of females in the sample, the conservative nature of non-parametric tests in finding significant associations, and the limitations or imprecision of the measures used contributed to these null findings. Since two of the four bivariate correlates of absolute perceived cancer risk in females assessed aspects of psychological burden, i.e., perceived stigma and perceived stress, this suggests that it would be fruitful in future research to explore the affective components of perceived cancer risk in females. Indeed, a third of the females in the sample reported depressive symptoms scoring in the clinically significant range of the CES-D. Psychological distress is known to influence absolute cancer risk perceptions (Robb et al. 2004; Zajac et al. 2006). Both higher levels of perceived stress and depression are associated with poorer health behaviors, (Coker et al. 2006; Ng and Jeffery 2003; Pirraglia et al. 2004), which in turn are also associated with greater perceived cancer risk (Lipkus et al. 1996; Robb et al. 2004). Depression and certain other psychiatric disorders are more prevalent among sexual minority females and males (Cochran et al. 2004), and affect plays a critical role in the comprehension of personal health risks (Slovic et al. 2004). Minority stress induced by stigma and discrimination contribute to elevated psychological distress in sexual minorities (Bowen et al. 2007; Meyer 2003). These findings generate questions about whether sexual minority females perceiving higher stress, stigma, and absolute risk of cancer are *less* likely to engage in cancer risk reduction behaviors. Single females in the sample tended to perceive higher absolute cancer risk than did partnered females. Being partnered, as opposed to being single, can buffer individuals from life stressors, provide support for positive health behaviors, and promote better health outcomes (Burman and Margolin 1992; Kiecolt-Glaser and Newton 2001). Studies are needed to delineate the interplay of stress and distress, relationship status, health behaviors, and perceived cancer risk in sexual minority females. Further, cancer prevention and control interventions targeted to sexual minority females should consider ways to ameliorate distress and stress as potential barriers to intervention uptake and efficacy.

The multivariate model for absolute perceived cancer risk for males comprised a set of variables without overlap with those in the multivariate model for females. Males who perceived greater absolute cancer risk were more likely to endorse the cancer risk reduction strategy of “don’t smoke/quit smoking,” suggesting that they appreciated this risk factor and those who smoked could be receptive to cancer prevention communications targeting tobacco use. Smoking is the single most preventable cause of cancer (American Cancer Society 2009). Smoking among gay and bisexual males is significantly higher than among males in general (Lee et al. 2009); as such, there is an urgent need to address elevated tobacco use among gay and bisexual males in order to mitigate tobacco-related health disparities. The second correlate of absolute perceived risk for cancer in males was having had more sexual partners in the last year. This association is supported by findings that, for men who have sex with men, as the number of sexual partners increases, so does the actual risk for HIV and HPV infections (Chin-Hong et al. 2004; Koblin et al. 2006). Both are sexually transmitted infections promoting or causing cancers (Engels et al. 2008; Palefsky et al. 1998). The third correlate of absolute perceived risk for cancer in males was having a personal cancer history, which is in line with epidemiological research showing that cancer survivors have an elevated risk of a second malignancy (Fraumeni et al. 2006). Therefore, gay and bisexual male cancer survivors’ cancer risk perceptions align with their heightened cancer risk. The fourth correlate of absolute perceived risk for cancer in males was identifying as gay as opposed to bisexual; however, the sample of bisexual males was quite small. Studies that succeed in recruiting larger numbers of bisexual males are needed to characterize their cancer risk perceptions. Nevertheless, for males experiential factors were strongly associated with absolute perceived cancer risk, with two modifiable risk factors (number of sexual partners, tobacco non-use to reduce cancer risk) identified as potential intervention targets.

These data suggest that sexual minority females versus males access different information in forming their absolute cancer risk perceptions. In studies that examine gender differences in perceived risk across diverse threats, females in general tend to perceive higher risk than do males (Bord 1997). Within cancer, studies have observed differences in how perceived risk for colorectal cancer relates to colorectal screening, e.g., higher comparative (peers of the same gender and age) perceived risk was positively associated with screening test use for women, but negatively for men (McQueen et al. 2006). Gender-specific differences in cancer risk perceptions merit forethought in the design of cancer prevention and early detection messages targeted to sexual minorities. Research and community-based programs focused on cancer prevention and control are more developed for sexual minority females than for males (Bowen et al 2006; Mautner Project 2009), and little is known about risk perceptions for cancers common to both genders, such as colorectal cancer. More work is needed in building the knowledge base in cancer across the diverse constituents of the LGBT community.

Despite high levels of endorsements of potential cancer risk reduction strategies, there was not a close association between such strategies and absolute perceived cancer risk. Of the 18 specific lifestyle or behavior changes assessed, only one, i.e., don’t smoke/quit smoking, emerged as a significant correlate of absolute perceived cancer risk in multivariate models. Compared to racial and ethnic minorities, sexual minority persons have available to them a paucity of data on the prevalence of cancer within their community. This information gap, problems in health care access, and stigmatized status may lead them to underestimate, or neglect, the control they can exert on their cancer risk.

The limitations of this study are acknowledged. First, nonprobability sampling methodology has known limitations, including the potential for overinclusion or under-sampling of specific demographic characteristics within the population (Meyer and Wilson 2009). It is

important to note that the LGBT population has never been enumerated, because the US Census, which sets the benchmark for most population-based sampling, does not assess sexual orientation. As such, researchers cannot assess whether any one LGBT sample represents the sexual minority population. This study's use of two modes of sampling a large, diverse, urban community venue was an attempt to ameliorate potential biases, such as sampling only those persons most actively engaged in the community. Overall, community venue attendees in this sample tended to be younger and more ethnically and racially diverse than those responding to the mail survey, but they did not differ by education, sexual orientation (bisexual vs. gay-identified), or absolute perceived cancer risk. Importantly, the study aimed to examine relationships between cancer risk perceptions and relevant variables to generate hypotheses from the data rather than to provide incidence or prevalence data, which would entail a high level of rigor in representative sampling of the population. Despite being substantial and diverse, the sample had few bisexual and transgender persons, whose cancer risk perceptions and risk factors deserve equal attention. Cross-sectional research precludes identification of causal pathways between perceived risk, risk behaviors, and psychosocial variables. Our assessment of perceived risk for cancer relied on one item and did not include comparative risk based on others similar in age and gender, limiting our interpretation of the meaning of risk perceptions (Lyna et al. 2002). Recent research in risk perceptions, however, has confirmed the efficiency of diverse one-item risk perception measures in predicting subsequent risk behavior (Weinstein et al. 2007). Family history of cancer or knowledge about risk factors for cancer was not assessed, both of which can influence personal risk perceptions (Bowen et al. 2003; Oncken et al. 2005). As a number of constructs and behaviors were assessed, not all were as fully measured as would be recommended, e.g., one multi-level item to assess illicit drug use. Because the primary outcome variable of absolute perceived risk for cancer was not normally distributed or responsive to transformations, the use of nonparametric statistics represented a conservative analytic strategy. Future research should examine this statistical phenomenon in larger samples using methodologically rigorous strategies for sampling the sexual minority population. Finally, given that the research questions posed in this study were formative in nature and ancillary to the parent study's aims, a liberal approach was used in conducting statistical tests in the absence of adjustments of *P* values. Despite these limitations, these findings can aid in developing testable hypotheses and cancer risk communication strategies geared to the specific needs of this understudied and diverse minority group that is vulnerable to cancer.

In conclusion, this study posed novel and formative questions regarding absolute perceived risk for cancer in an understudied population and yielded findings that can stimulate the development of testable hypotheses to guide future research in this area. Notable results were gender differences within sexual minorities regarding correlates of absolute perceived cancer risk. For females, affective components of perceived stress and stigma were prominent; whereas for males, experiential factors appeared to be more salient. Although study participants endorsed at a high rate specific strategies to reduce their cancer risk, there was a general disconnect between these cancer risk reduction strategies and perceived cancer risk, with the one exception being "don't smoke/quit smoking" for males. The endorsement of "don't smoke/quit smoking" emerged as the most significant correlate of absolute perceived cancer risk, suggesting at least for males that cancer prevention communications targeting tobacco use may resonate. Cancer prevention or risk reduction interventions developed for sexual minorities should be sensitive to gender-specific targets, such as psychological distress in females, or tobacco use and risk behaviors in males, to effect changes in perceived risk for cancer.

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Table 1
Sample characteristics and univariate and bivariate statistics by gender for absolute perceived risk of cancer

Variable	Gender					
	Women			Men		
	Sample characteristics		Perceived risk	Sample characteristics		Perceived risk
	N	Mean (SD) or %	Mean (SD)	N	Mean (SD) or %	Mean (SD)
Absolute perceived cancer risk	90	43.03 ^a (23.37)	–	90	49.28 ^b (24.3)	–
Age	85	45.40 (10.68)	–0.056	157	47.10 (12.46)	–.215 ^{**}
Sexual orientation	90			157		
Homosexual	79	87.8	42.25 (25.66)	151	96.2	50.47 (23.75) ^{**}
Bisexual	11	12.2	48.28 (23.76)	6	3.8	20.74 (21.15)
Education	90			157		
High school	15	16.7	41.47 (28.08)	15	9.6	44.41 (26.74)
> High school	75	83.3	43.34 (25.01)	142	90.4	49.82 (24.06)
Ethnicity	90			157		
White non-hispanic	58	64.4	44.70 (27.00)	134	85.4	49.13 (23.35)
Minority	32	35.6	40.12 (22.39)	23	14.6	50.13 (29.86)
Relationship status	90			156		
Single	41	45.6	49.98 (22.34) [*]	91	58.3	51.09 (24.89)
Coupled	49	54.4	37.41 (26.49)	65	41.7	46.26 (23.24)
Occupation	90			156		
Employed	70	77.8	43.03 (26.07)	117	75.0	49.94 (23.88)
Retired	5	5.6	24.72 (10.32)	20	12.8	49.12 (25.04)
Other	15	16.7	48.25 (23.47)	19	12.2	42.81 (24.09)
HIV serostatus	89			155		
Positive	1	1.1	43.33 (–)	21	13.5	63.13 (22.85) [*]
Negative	74	83.1	42.04 (25.20)	123	79.4	47.07 (24.41) [*]
Don't know	14	15.7	49.21 (27.70)	11	7.1	51.52 (15.14)
Cancer history	90			152		

Variable	Gender							
	Women			Men				
	Sample characteristics		Perceived risk	Sample characteristics		Perceived risk		
	<i>N</i>	Mean (SD) or %	Mean (SD)	<i>r_s</i>	<i>N</i>	Mean (SD) or %	Mean (SD)	<i>r_s</i>
Yes	9	10.00	46.81 (24.35)		17	11.2	60.56 (19.83) *	
No	81	90.00	42.64 (25.60)		135	88.8	47.76 (24.33)	
Current smoking status	90				156			
Smoker	33	36.7	47.47 (24.39)		57	36.5	58.45 (21.83) ***	
Nonsmoker	57	63.3	40.21 (25.81)		99	63.5	44.21 (24.34)	
No. alcoholic drinks per mo.	82	20.45 (38.36)		.158	156	30.80 (44.58)		−.043
No. episodes of binge drinking/mo	85	1.03 (3.71)		.217	151	2.01 (5.17)		.101
No. illicit drugs used past 6 mo.	83	0.39 (0.92)		.131	152	0.70 (1.23)		.133
No. sexual partners in past 12 mo.	84	1.24 (2.15)		−.154	155	10.91 (18.90)		.234 **
STD in past 5 years	88				155			
Yes	4	4.5	50.83 (24.32)		32	20.6	59.64 (27.54) *	
No	84	95.5	42.53 (25.59)		123	79.4	47.23 (22.82)	
No. sunburns in past 12 mo.	84	1.00 (1.40)		.227 *	150	1.00 (1.56)		.148
CES-D	84	13.78 (10.79)		.307 **	147	13.93 (10.60)		.216 **
Perceived stress scale	84	4.67 (3.13)		.328 **	148	4.97 (2.97)		.139
Perceived stigma	84	14.79 (3.75)		.236 *	149	13.79 (4.37)		.147
Internalized homophobia	84	4.43 (2.37)		.187	150	4.31 (2.07)		.044

STD Sexually transmitted disease, CES-D Center for Epidemiologic Studies-Depression Scale, HIV Human immunodeficiency virus

* P .05;

** P .01;

*** P .001. When two means are compared for dichotomous variables, asterisks indicate significant differences at the designated P -value. For polychotomous variables, only those means with asterisks are significantly different from each other

^aWomen: Mdn = 44.44, mode = 50, range = 0–92.2

^bMen: Mdn = 50, mode = 50, range = 0–100

Table 2
Multivariate analyses by gender for absolute perceived cancer risk

Variable	df	Non-parametric <i>df</i>	Test statistic ^a	<i>P</i> -value
Women: <i>n</i> = 82				
Relationship status ^b	1		2.031	0.159
s(No. of sunburns in past 12 mo.) ^c	1	3	1.521	0.217
s(Perceived stress) ^c	1	3	0.879	0.457
s(Perceived stigma) ^c	1	3	1.723	0.170
Overall model fit: $F(13, 81) = 2.351, P = 0.012$				
Men: <i>n</i> = 141				
s(Age) ^b	1	3	0.209	0.890
Sexual orientation ^d	1		2.912	0.090*
Cancer history ^e	1		3.210	0.076*
HIV serostatus ^f	1		1.041	0.310
s(No. of sexual partners in past 12 mo.) ^c	1	3	2.613	0.054*
Treatment for STD in past 5 years ^e	1		0.313	0.944
s(CES-Depression score) ^b	1	3	1.430	0.237
Don't smoke/quit smoking ^e	1		8.781	0.004***
Overall model fit: $F(17, 140) = 3.73, P < 0.001$				

^aSmoothing splines were tested with a non-parametric *F*-statistic with the corresponding *df*. Categorical variables were tested by a log-likelihood *F*-statistic when the indicated variable was dropped

^b(0 = single, 1 = coupled)

^cCubic smoothing splines were fitted to continuous variables, denoted as s(X), where X is the continuous variable

^d(0 = homosexual; 1 = bisexual)

^e(0 = not endorsed, 1 = endorsed)

^f(0 = not known to be HIV positive; 1 = HIV positive)

* $P < 0.10$;

** $P < 0.05$;

*** $P < 0.01$