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# Minority Stress and Inflammatory Mediators: Covering Moderates Associations between Perceived Discrimination and Salivary Interleukin-6 in Gay Men

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## Abstract

Physical health disparities by sexual orientation are widespread yet under-investigated. Drawing upon theories of biological embedding of social adversity, we tested whether minority stress (in the form of perceived discrimination) is associated with salivary interleukin-6 (IL-6), an inflammatory mediator. Furthermore, we examined whether covering, a strategy involving downplaying a stigmatized social identity, modified this association. A community sample ($N$ = 99) of gay men ($n$ = 78) and lesbian women ($n$ = 21) completed self-report measures of minority stress and identity management and provided saliva samples which were assayed for IL-6. Among gay men, results from generalized linear models supported a hypothesized interaction between perceived discrimination and covering, such that perceived discrimination was predictive of higher levels of IL-6 for those who engaged in less covering but not for those who engaged in more covering. This interaction was robust to a number of potential covariates (alcohol, medication, body mass index, race and age). Results for lesbian women suggested a different pattern: the only statistically significant association detected was between greater perceived discrimination and lower levels of IL-6. Findings from the current study point to an important role for inflammatory processes in understanding and remediating health disparities based upon sexual orientation that stem from exposure to prejudice and discrimination.

### Keywords

minority stress; interleukin-6; perceived discrimination; covering; gay men; lesbian women

Gay men and lesbian women tend to experience higher rates of physical health disorders relative to heterosexual men and women (e.g., Conron, Mimiaga, & Landers, 2010; Sandfort, Bakker, Schellevis, & Vanwesenbeeck, 2006). To understand these disparities, some researchers have focused on the etiologic role of sexual minority stress, or chronic factors related to sexual minority identities (e.g., perceived discrimination) that create additional psychological and physiological burdens above and beyond general life stressors

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(Meyer, 1995, 2003). Although there is interest in understanding the role of minority stress in health, few studies have explored biological mechanisms that may drive long-term health outcomes among individuals exposed to chronic prejudice and discrimination. Drawing upon evidence for the central role of inflammation in biological embedding of social stress (Cohen et al., 2012; Miller, Chen, & Parker, 2011), the current study examined a primary mediator of the inflammatory response, interleukin-6 (IL-6), and its relation to perceived discrimination among gay men and lesbian women. Furthermore, this research considered how gay men and lesbian women navigate their social identities through covering, an identity management strategy whereby individuals downplay devalued identities in social situations (Goffman, 1963; Yoshino, 2006).

## Stress, Inflammatory Mediators and Health

Developed in order to explain mental health disparities between sexual minorities and heterosexuals, Meyer's (1995, 2003) minority stress theory posited that exposure to identity-related stressors, such as prejudice and discrimination, has deleterious effects on sexual minority health and well-being. Although initially focused on mental health, researchers have broadened the scope of this work to include physical health outcomes (Lick, Durso, & Johnson, 2013). This line of work presents promise for understanding sexual minority health, and potentially improving health disparities based upon sexual orientation, but few researchers have attempted to open the “black box” linking minority stress to physical health outcomes. It is critical to determine what physiological changes (or adaptations) that can affect long-term health outcomes might plausibly result from exposure to minority stress.

Upregulation of inflammatory mediators may represent one such physiological adaptation. A growing body of research suggests that increased inflammatory response is a central route by which social stressors, such as poverty and maltreatment, become embedded in the body (Cohen et al., 2012; Miller, Chen, & Cole, 2009; Miller, Chen, & Parker, 2011). According to the biological embedding of childhood adversity model (Miller et al., 2011), chronic social stressors program immune cells (monocytes/macrophages) with proinflammatory tendencies via epigenetic markings, posttranslational modifications and tissue remodeling. One manifestation of this programming is enhanced cytokine response to challenge and decreased inhibitory sensitivity. Thus, chronic social stress predisposes an individual toward greater proinflammatory cytokine (e.g., IL-6) signaling, increasing risk for chronic diseases such as cardiovascular disease (CVD; Danesh et al., 2008; Libby, Ridker, & Maseri, 2002) and cancer (Coussens & Werb, 2002; Hodge, Hurt, & Farrar, 2005).

## Perceived Discrimination and Inflammatory Biomarkers

Socioeconomic disadvantage and parental maltreatment are the two primary stressors explicated in the biological embedding of childhood adversity model (Miller et al., 2011), but other social stressors may have similar effects on the body. Minority stress, like socioeconomic disadvantage and parental maltreatment, is chronic and omnipresent for gay men and lesbian women. Though unique in that it stems from a specific social identity (Meyer, 2003), minority stress could lead to similar downstream physiological adaptations.

A few previous studies have found evidence for an association between chronic exposure to prejudice and discrimination and increased inflammatory biomarkers among racial minorities (e.g., Cunningham et al., 2012; Doyle & Molix, 2014b; Friedman, Williams, Singer, & Ryff, 2009; Lewis, Aiello, Leurgans, Kelly, & Barnes, 2010; Ratner, Halim, & Amodio, 2013). For example, perceptions of stigmatization predicted increased levels of salivary IL-6 in a community sample of black and Latina women in New York City (Ratner et al., 2013). Perceived discrimination has also been tied to elevated levels of serum IL-6 in African American men and women participating in the second wave of the Midlife in the United States (MIDUS) Study (Doyle & Molix, 2014b).

Researchers have not yet linked minority stress among gay men and lesbian women directly to the presence of inflammatory mediators, the aim of the current research. However, some past work has identified elevated levels of inflammatory biomarkers in sexual minority men relative to heterosexual men (e.g., Everett, Rosario, McLaughlin, & Austin, 2014; Hatzenbuehler, McLaughlin, & Slopen, 2013) and it has been suggested that minority stress may play a role in producing these disparities. On the contrary, sexual minority women have tended to show the opposite pattern, with lower levels of inflammatory biomarkers relative to heterosexual women (e.g., Everett et al., 2014; Hatzenbuehler et al., 2013). Although few studies have examined the intersection of sexual orientation and sex in predicting inflammatory mediators, it is plausible effects of social stressors on biological systems may differ by sex.

Overall, data on divergence of associations between chronic stress and inflammatory mediators between men and women are inconclusive, although greater prevalence of autoimmune disorders and inflammatory diseases among women (Ngo, Steyn, & McCombe, 2014) have led some to speculate about the role of different patterns of biological stress responsivity between the sexes (e.g., Kajantie & Phillips, 2006). In a review of literature on acute psychosocial stress and biomarkers of inflammation (Steptoe, Hamer, & Chida, 2007), sex was mentioned as a potential moderating factor; however, only two studies were identified reporting potentially conflicting results (earlier peak IL-6 reactivity in men in one study and greater IL-6 reactivity in women in another study). Research on psychosocial stress and the hypothalamic-pituitary-adrenal (HPA) axis (which helps to regulate inflammatory response) has somewhat consistently shown differences by sex, with men generally evidencing greater HPA axis stress reactivity compared to women (Kudielka & Kirschbaum, 2005). These systems are also mutually influenced by the hypothalamic-pituitary-gonadal (HPG) axis and circulating levels of sex hormones could reasonably be suspected to modulate the influence of chronic stress. For these reasons, among others, it is often recommended to examine men and women independently in work on biological stress responsivity (e.g., Del Giudice, Ellis, & Shirtcliff, 2011; Kajantie & Phillips, 2006). In addition to differences by sex, identity-related factors may modify associations between minority stress and inflammatory mediators.

## Concealment and Health

As individuals' in possession of a concealable stigmatized identity, gay men and lesbian women face complex decisions related to disclosure and identity management (Chaudoir &

Fisher, 2010; Pachankis, 2007). In much past work (e.g., Meyer, 2003, 2007), concealment has been conceptualized as a form of minority stress in and of itself. A comprehensive review of the literature on concealable stigmatized identities (Pachankis, 2007) identified numerous pathways, cognitive, affective and behavioral, by which concealment might negatively affect self-evaluations and well-being. Indeed, much past research suggests that disclosure (in various forms) may be generally protective for health (Smyth, Pennebaker, Arigo, 2012). For example, among HIV-negative sexual minority men participating in the Multicenter AIDS Cohort Study (MACS), disclosure was found to be associated with a lower incidence of cancer and infectious diseases (pneumonia, bronchitis, sinusitis and tuberculosis) over a five-year follow-up period (Cole, Kemeny, Taylor, & Visscher, 1996). Other research has also demonstrated protective effects of disclosure on health among sexual minority men, particularly those who are HIV-seropositive (e.g., Cole, Kemeny, Taylor, Visscher, & Fahey, 1996; Ullrich, Lutgendorf, & Stapleton, 2003).

Yet for members of stigmatized groups faced with quotidian prejudice and discrimination, such as gay men and lesbian women (Swim, Johnston, & Pearson, 2009), concealment may also represent an active coping strategy (Miller & Kaiser, 2001; Miller & Major, 2000). Specifically, it is possible that the negative health effects of minority stress may be attenuated for gay men and lesbian women who conceal their identities to some degree. Prior research addressing this topic has focused on sexual minority men rather than women. For example, one study found that HIV-positive gay men who were more sensitive to rejection by strangers and family members had better health outcomes when they concealed their sexual orientation (Cole, Kemeny, & Taylor, 1997). The authors speculated that concealment might have protected these men from a “homophobic social environment” (p. 330), representing successful adaptation in the face of potential stressors. Similarly, another study found that a greater degree of outness at work was associated with elevated diurnal cortisol among gay men (Huebner & Davis, 2005). These findings are particularly germane to the current work in that dysregulation of the HPA axis in response to stress may promote a proinflammatory physiological state (Miller, Cohen, & Ritchey, 2002). Other research with sexual minority participants (McGarrity & Huebner, 2014) found that concealment was associated with worse health outcomes for higher socioeconomic status (SES) men but better health outcomes for lower SES men. In this study, the researchers speculated that differences in the effects of concealment might be due to greater exposure to discrimination for lower SES compared to higher SES sexual minority men, highlighting the importance of considering minority stress and identity management in conjunction. Collectively, these studies indicate that some degree of concealment may indeed be protective of health for gay men exposed to greater levels of prejudice and discrimination. Whether these associations might generalize to lesbian women is presently unclear.

## Covering as Identity Management

In much past work, concealment has been examined as a binary decision to either conceal or reveal one's stigmatized identity across situations. This relatively simplistic approach to identity management involves assessing whether sexual minority individuals choose to *pass* (Goffman, 1963) as heterosexual or not (i.e., whether they are the “in the closet” or “out of the closet”). However, identity management is a more complicated process; even after

"coming out," gay men and lesbian women may still strategically self-present aspects of their sexual orientation on a daily basis (e.g., Pachankis & Goldfried, 2006). In this way, passing represents one extreme endpoint of a continuum of concealment.

Along this continuum, gay men and lesbian women may choose to openly identify their sexual orientation but downplay traits or characteristics that signal a stigmatized identity (e.g., stereotypical vocal patterns), a strategy referred to as *covering* (Goffman, 1963; Yoshino, 2006). For example, a gay man may be "out" at work but speak in a lower register or dress in a more conservative manner when in the office. This man is not attempting to pass as heterosexual, but rather downplaying a sexual minority identity for strategic purposes. According to Goffman (1963), covering allows members of stigmatized groups to keep their stigmatized identities from "looming large" in social interactions (p. 102). From a legal and ethical standpoint, the demand for covering represents an insidious threat to civil rights (Yoshino, 2006)—all people should be free to express their myriad social identities in full. Yet researchers should not ignore the fact that gay men and lesbian women may choose to engage in covering, and the possible implications of this decision for health and well-being.

## The Current Study

The present work was guided by hypotheses regarding the role of minority stress in promoting inflammatory mediators among gay men and lesbian women as well as a protective function of identity management. Overall, we hypothesized that minority stress, in the form of perceived discrimination, would be associated with higher levels of salivary IL-6 while covering would be associated with lower levels of IL-6. While these associations were hypothesized for both gay men and lesbian women, past research on inflammatory biomarkers among sexual minorities has found more consistent support among men compared to women (e.g., Everett et al., 2014; Hatzenbuehler et al., 2013) and prior theory on sex differences in biological stress reactivity (e.g., Del Giudice et al., 2011; Kajantie & Phillips, 2006) indicated that men and women should be examined separately for the aims of the current research. Finally, we hypothesized that associations between perceived discrimination and IL-6 would be modified by an interaction with covering, such that perceived discrimination would predict higher levels of IL-6 for those who engaged in relatively less covering but not for those who engaged in relatively more covering.

## Method

### Participants and Procedure

The Institutional Review Board at Tulane University approved all procedures. Participants for the current study were recruited from outdoor gay community events in New Orleans, Louisiana. In order to control for the diurnal rhythm of IL-6, which reaches a daily trough between approximately 10:00 and 19:00 (Izawa, Miki, Liu, & Ogawa, 2013), participants at each event were sampled in a three-hour block between 10:00 and 13:00. Trained research assistants were strategically positioned near main routes but away from the bulk of the crowds in order to maximize opportunities to approach potential participants. All individuals passing by were approached and offered $10.00 as compensation for their time and effort if

they met inclusion criteria, including being over 18 years of age and having consumed no more than one alcoholic beverage since the beginning of the day (Wawrzyniak & Whiteman, 2011). Alcohol consumption was also measured for inclusion as a covariate in statistical analyses.

Participation was limited to self-identified gay men ($n$ = 78) and lesbian women ($n$ = 21). The majority of participants identified as White (80%), but the sample also included individuals identified as multiracial (6%), African American (4%), Asian (3%), and Hispanic (2%). Participants were approximately 35 years old on average ($M$ = 34.60, $SD$ = 13.01) and reported a median annual household income of $60,000. The events at which participants were recruited drew individuals from across the United States (23 different states were represented), with the greatest numbers of participants residing in Louisiana (27%), Texas (12%) and California (9%).

After completing the consent form, participants were given a small cup of water to rinse out their mouths. Participants then completed survey measures for approximately 10-15 minutes (measures, described below, were selected in part for their brevity and the ease with which participants would be able to complete them during the community events). Upon completion of the survey instrument, participants were asked to expectorate 1mL of saliva via passive drool into a 2 mL IBL collection device. All saliva samples were stored in a portable cooler and promptly shipped in batch to a −80°C freezer for storage.

## Measures

**Covariates—**Factors that could potentially influence cytokine levels (alcohol consumption, medication usage, body mass index [BMI]) were assessed for inclusion as covariates in statistical models. Participants were asked to estimate the number of hours since they last consumed alcohol as well as whether they were currently taking prescription medications, with medication usage dummy coded (0 = No Medication Use, 1 = Medication Use). Finally, BMI was calculated from self-reported height and weight according to the standard formula.

**Perceived discrimination—**In order to assess perceived discrimination, two items were selected from the Everyday Discrimination Scale (developed for research with racial minorities; Williams, Yu, Jackson, & Anderson, 1997) and two new items were created for this study. The two items selected from the Everyday Discrimination Scale were chosen because they were most relevant to the everyday experiences of sexual minorities. These two items were, “You are called names or insulted because of your sexual orientation,” and, “You are threatened or harassed because of your sexual orientation.” The two new items, added in order to capture other forms of discrimination to which sexual minorities might likely be exposed, were, “You hear people use gay slurs (e.g., fag, dyke),” and, “You see other people get harassed because of their sexual orientation.” Participants indicated how often they experienced these events on a scale with points labeled as 1 (*never*), 2 (*less than once a year*), 3 (*a few times a year*), 4 (*a few times a month*), 5 (*at least once a week*) and 6 (*almost everyday*). The mean of these items was taken to indicate overall perceived discrimination. This four item measure evidenced good internal consistency, *alpha* = .77.

**Covering—**Covering was assessed via an item previously developed in a daily diary study by Pachankis and Bernstein (2012) that was reworded to reflect general experiences: “In general, I try to downplay my gay/lesbian identity with heterosexual people I know.” Participants responded on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In past work, this item was significantly associated with a theoretically related construct, public self-consciousness (Pachankis & Bernstein, 2012).

**Inflammatory Mediator—**As described previously, participants provided 1 mL saliva samples which were temporarily stored in a −80°C freezer. Samples were shipped in single-batch overnight on dry ice to a lab at Brandeis University for IL-6 assay. Assays were conducted in duplicate via commercially available enzyme-linked immunosorbent assay (ELISA) following manufacturer's instructions (Salimetrics, State College, PA) utilizing a 1:2 dilution rate. Detectable IL-6 levels were obtained for a total of 79 participants (approximately 80% of the total sample). Undetectable values are common in research with cytokine biomarkers, which are often subject to lower limits of detection (LOD; Wu, Chen, Ware, & Koyama, 2012). Consistent with past work (Hornung & Reed, 1990), undetectable values were substituted with ½ of the manufacturer specified LOD for the assay. This method of substitution has been shown to return relatively unbiased estimates in Monte Carlo simulations with samples including small to moderate percentages of non-detectable values (Cole, Chu, Nie, & Schisterman, 2009; Uh, Hartgers, Yazdanbakhsh, & Houwing-Duistermaat, 2008). The intra-assay coefficient of variability was found to be acceptable, CV = 10.22.

## Analyses

Statistical analyses were performed with R software (R Core Team, 2013). One participant opted out of completing the survey instrument and was therefore excluded from the following analyses, resulting in a total analytic sample of 98 gay men and lesbian women. Overall levels of missing data were low, but one participant did not complete the measure of perceived discrimination and four others were missing data on relevant covariates. These participants were included in descriptive analyses but listwise deletion was utilized as necessary in unadjusted and adjusted regression models.

Descriptive analyses of the dependent variable (salivary IL-6) revealed high positive skew, which is typical of inflammatory biomarkers (Mitchell, Lyles, & Schisterman, 2015; Wu et al., 2012). To best model these data, we followed procedures recommended in past work (Gustavsson, Fagerberg, Sallsten, & Andersson, 2014; Mitchell et al., 2015) and computed generalized linear models (GLM) specifying a gamma distribution and log-link function, also referred to as gamma regression. GLM permits flexible modeling of data whose error distribution belongs to the exponential dispersion family (e.g., Poisson, gamma), while the link function allows for a linear relation between specified predictors and the expected value of the response (in this case, logged).

We began by conducting two-step gamma regression analysis predicting IL-6 levels separately for gay men and lesbian women. On Step 1 we entered the main effects of perceived discrimination and covering and on Step 2 we entered an interaction term for

perceived discrimination by covering. After evaluating regression coefficients from this model, we computed a parallel adjusted model including a set of potential covariates (alcohol consumption, prescription medication usage, BMI, race and age).

## Results

Descriptive statistics and inter-correlations among study variables are shown in Table 1 for both lesbian women and gay men. Among gay men, increasing age was associated with greater medication usage as well as greater BMI. Medication usage and BMI were also significantly associated with one another. In general, racial minority men reported greater levels of sexual orientation-based discrimination compared to white men while older men reported lesser levels compared to younger men. There were no significant bivariate associations with the primary dependent variable, logged IL-6, among gay men. Among lesbian women, increasing age was associated with lesser time since alcohol consumption while greater covering was associated with greater medication usage. Lesbian women also evidenced a significant bivariate association between perceived discrimination and logged IL-6, with greater levels of perceived discrimination associated with lower levels of IL-6. Table 2 shows comparisons of mean levels of key variables, including IL-6, perceived discrimination and covering, between gay men and lesbian women. Only IL-6 differed significantly by sex, with lesbian women demonstrating lower levels compared to gay men in the current sample.

The first gamma regression analyses included only gay men. The unadjusted model (shown in Table 3) suggested a marginal main effect of covering and no significant main effect of perceived discrimination on Step 1. However, as hypothesized, the interaction between covering and perceived discrimination was statistically significant on Step 2. Examination of simple slopes (Aiken & West, 1991) revealed that perceived discrimination was associated with higher levels of IL-6 for gay men who engaged in less covering (−1 *SD*), $B = .71$, $SE = .27$, $t = 2.67$, $p < .01$, 95% CI [.15, 1.30], but not for gay men who engaged in more covering (+1 *SD*), $B = -.30$, $SE = .30$, $t = -1.01$, $p = .32$, 95% CI [−.90, .33], consistent with a protective function for identity management among gay men.

In order to examine the robustness of these findings to a number of potential covariates, the previous model was rerun with inclusion of alcohol consumption, prescription medication usage, BMI, race and age as covariates (shown in Table 4). None of these covariates attained statistical significance in the adjusted model, although increasing age was marginally associated with higher levels of IL-6. On Step 1 of the adjusted model, the main effect of perceived discrimination was marginally significant while there was no significant main effect of covering; however, point estimates for both of these main effects remained in the same general direction as in the unadjusted model. Importantly, on Step 2 of the adjusted model, the hypothesized interaction between perceived discrimination and covering remained statistically significant. Decomposition of this interaction once again revealed a significant association between perceived discrimination and higher levels of IL-6 for gay men who engaged in less covering (−1 SD), $B = .72$, $SE = .30$, $t = 1.58$, $p = .02$, 95% CI [.12, 1.40], but not for gay men who engaged in more covering (+1 *SD*), $B = -.26$, $SE = .39$, $t = -.66$, $p = .51$, 95% CI [−1.17, .68].

Parallel gamma regression analyses were conducted including only lesbian women. It is critical to note that because of the relatively small sample of lesbian women successfully recruited for the current study, results from these analyses should be interpreted with caution. Results from the unadjusted model are shown in Table 5. In this model, consistent with bivariate analyses, only perceived discrimination evidenced a statistically significant main effect, with lesbian women higher in perceived discrimination showing lower levels of IL-6. On Step 2, there was not support for a statistically significant interaction between perceived discrimination and covering among lesbian women. Because of sample size limitations, the adjusted model failed to converge for lesbian women thus limiting our ability to examine the role of potential covariates, including alcohol consumption, prescription medication usage, BMI, race and age, which should be taken into consideration when evaluating the previously described associations.

## Discussion

The current research provides some of the first evidence linking minority stress to specific physiological profiles, an important step in understanding how such stressors become biologically embedded for sexual minorities. Consistent with hypotheses, evidence was found for an interaction between perceived discrimination and covering among gay men. This interaction revealed that perceived discrimination predicted higher levels of proinflammatory cytokines in saliva for gay men who engaged in less covering but not for gay men who engaged in more covering, suggesting that covering may buffer the deleterious physical health effects of prejudice and discrimination for gay men to some extent. Results of a parallel model among lesbian women revealed evidence of divergent effects. Specifically, the only statistically significant association for lesbian women was between greater perceived discrimination and lower levels of IL-6. While intriguing in that this association potentially contradicts tenets of minority stress theory (Meyer, 2003) and the biological embedding of childhood adversity model (Miller et al., 2011), this finding should be interpreted with great prudence as it is based on a relatively small sample and could not be confirmed in adjusted regression models (leaving open the potential of unmeasured confounding).

This study utilized a relatively novel biomarker of inflammatory processes: salivary IL-6. IL-6 measured in blood is recognized as an important biomarker of chronic disease (e.g., CVD, cancer) risk (e.g., Danesh et al., 2008; Hodge, Hurt, & Farrar, 2005); however, associations between salivary IL-6 and chronic disease risk are less well defined at this point. Past work has reported relatively low correlations between concentrations of IL-6 in blood and saliva (Slavish, Graham-Engeland, Smyth, & Engeland, 2015; but see Williamson, Munro, Pickler, Grap, & Elswick, 2012, for an exception), meaning it is unclear to what extent salivary levels represent local versus systemic inflammatory processes. Salivary IL-6 is strongly related to oral health, including chronic conditions such as periodontitis and oral cancer (Nibali, Fedele, D'Aiuto, & Donos, 2012). Furthermore, recent research in an urban Japanese cohort study (Kosaka et al., 2014) revealed an association between salivary IL-6 and atherosclerosis, implying a role for oral inflammation in CVD. Overall, it is clear that the current results have implications for gay men's health as they confront the damaging effects of prejudice and discrimination.

Importantly, based upon past work (e.g., Cole et al., 1997; Huebner & Davis, 2005) as well as the current results, evidence is beginning to accumulate indicating that downplaying one's stigmatized identity may be protective of health in certain circumstances and for certain people. While deleterious effects of concealment have been well documented (e.g., Cole, Kemeny, Taylor, & Visscher, 1996; Cole, Kemeny, Taylor, Visscher, & Fahey, 1996; Ullrich et al., 2003), covering as an identity management strategy may be protective when individuals are exposed to greater levels of prejudice and discrimination. This is consistent with the view of identity management as a complex process (Goffman, 1963; Leary & Kowalski, 1990) that extends beyond binary disclosure decisions (which is often how concealment has been operationalized in past work). Although we do not recommend that covering be prescribed universally for sexual minorities, it is important for researchers and clinicians to understand how choices related to identity management may vary across situations and how this may or may not be related to health and well-being (Chaudoir & Fisher, 2010; Legate, Ryan, & Weinstein, 2012). Such an approach is especially important in framing sexual minorities as active agents with choice across situations, which may fuel feelings of empowerment (Doyle & Molix, 2014a).

## Future Directions and Limitations

In the future, work focusing on this topic should be conducted with longitudinal samples. Because it is hypothesized that minority stress programs a proinflammatory biological state, it would be maximally informative to track exposures to minority stress over time along with complementary changes in the immune system. Such data would allow researchers to investigate causal effects as well as potential moderating factors, such as developmental stage.

Future research should also aim to include sexual minority samples recruited through innovative methodologies (Meyer & Wilson, 2009). Because participants for the current study were all attending gay community events, it is unclear if results would generalize to sexual minority men who are relatively more likely to be concealing their identities entirely (i.e., passing). Future investigations should also extend the hypotheses of this study to other sexual minority groups, including bisexual men and women and transgender persons. In particular, confirmation of results from the current study in samples including larger numbers of lesbian women will be necessary. Furthermore, intersections of biological sex and gender identity will be important to investigate as these do not necessarily correspond, especially in sexual minority samples, and may pattern biological stress reactivity in unique ways (Juster & Lupien, 2012). Regarding other social identities, it is also important for research conducted with members of diverse racial groups to include assessments of perceived racism, as this construct has been shown to influence inflammatory biomarkers in past work (e.g., Cunningham et al., 2012; Doyle & Molix, 2014b; Friedman et al., 2009; Lewis et al., 2010; Ratner et al., 2013).

In addition to limitations due to sample composition, recruitment at community events necessitated a brief survey instrument composed of relatively short, ad hoc measures of some of the key constructs. Although we endeavored to select items with good face validity and adapt items from previously validated measures with good psychometric properties,

more work is needed with fuller and more nuanced measures of minority stress and identity management. Particularly, our measure of covering, although drawn from past work (Pachankis & Bernstein, 2012), was composed of only a single item. A more nuanced measure of covering, including observations of actual behavior, could reveal further costs and benefits associated with engagement in this identity management strategy.

Sampling from community events (i.e., a real world setting) also has implications for our dependent variable, IL-6. Past studies have demonstrated significant increases in salivary IL-6 following acute social stressors (e.g., Groer et al., 2010; Izawa, Sugaya et al., 2013). Therefore, it is possible that exposure to various stressors in the timeframe prior to recruitment may be an unmeasured confounder of the results observed in the current work. However, we suspect this is unlikely for two primary reasons. First, the type of acute social stressor that has been shown to trigger salivary IL-6 responses in past research includes events unlikely to have been confronted by our participants, such as a virtual reality workplace gun confrontation scenario and a stressful anatomy exam (Slavish et al., 2015). Second, all participants completed the survey measure first (spending approximately 10-15 minutes in a relatively controlled environment with the research team) and salivary IL-6 levels have been shown to return to levels indistinguishable from baseline approximately 20 minutes after the conclusion of an acute social stressor (Izawa, Sugaya et al., 2013).

While the current study focused on physical health (via an inflammatory biomarker), further research on covering and other forms of health, such as psychological health, will be important. Although covering showed protective effects for proinflammatory cytokine levels among gay men, the same may not be true for psychological health outcomes, such as depressive symptomatology. In fact, previous work strongly suggests psychological costs associated with engagement in this identity management strategy (Pachankis, 2007; Smart & Wegner, 1999). Yet it is necessary for researchers to acknowledge sexual minority agency and move away from viewing sexual minorities as passive targets of prejudice and discrimination (Doyle & Molix, 2014a).

## Conclusion

To elucidate and remedy entrenched health disparities between sexual minorities and heterosexuals (Institute of Medicine [IOM], 2011), researchers must work to uncover mechanisms linking social factors to physical health outcomes. In the current work, we approached identity management as a natural and potentially adaptive response to the threat of prejudice and discrimination. It is vital for researchers to understand how sexual minorities currently manage their stigmatized identities in order to intervene to enhance adaptive and empowering coping strategies. The current study points to an important direction for future work via analysis of a mediator of inflammation (salivary IL-6) among gay men. If, as suggested by the current data, minority stress acts on biological systems in ways similar to other social adversities (Cohen et al., 2012; Miller et al., 2009, 2011), this avenue of investigation could prove especially fruitful in explaining health disparities based upon sexual orientation.

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## Table 1

Descriptive Statistics and Inter-correlations for All Study Variables

| Measure | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Alcohol | -- | .10 | −.42 | .13 | −.53* | −.29 | .23 | .39 |
| 2. Medication | .02 | -- | −.06 | .29 | .09 | .07 | .45* | −.04 |
| 3. BMI | −.09 | .23* | -- | −.05 | .43 | −.21 | −.10 | −.29 |
| 4. Race | −.03 | −.12 | .12 | -- | −.22 | −.04 | −.08 | −.32 |
| 5. Age | −.04 | .39** | .30** | −.06 | -- | −.17 | −.21 | .08 |
| 6. Perceived discrimination | .21 | −.18 | −.17 | .26* | −.49*** | -- | .12 | −.46* |
| 7. Covering | .03 | −.08 | −.16 | −.07 | −.16 | −.05 | -- | .07 |
| 8. IL-6 | .03 | −.01 | .13 | .18 | .19 | .07 | −.15 | -- |

*Note.* Coefficients presented above the diagonal are for lesbian women and those presented below the diagonal are for gay men. For gay men $n$ = 77, for lesbian women $n$ = 21. BMI = Body mass index. Dummy codes were assigned to medication (0 = *no medication,* 1 = *medication*) and race (0 = *white,* 1 = *minority*). Alcohol represents time since last alcoholic beverage in hours. IL-6 was log-transformed.

* $p < .05$

** $p < .01$

*** $p < .001$.

**Table 2**

Comparisons of Key Variables between Gay Men and Lesbian Women

| | Gay men (*n* = 77) | | Lesbian women (*n* = 21) | | | |
|---|---|---|---|---|---|---|
| | ***M*** | ***SD*** | ***M*** | ***SD*** | ***t*** | ***p*** |
| IL-6 | .21 | 2.13 | −1.10 | 2.00 | 2.53 | .01 |
| Perceived discrimination | 2.55 | .86 | 2.92 | .93 | −1.69 | .09 |
| Covering | 2.45 | 1.31 | 2.24 | 1.22 | .66 | .51 |

**Table 3**

Unadjusted Gamma Regression Model Predicting IL-6 from Perceived Discrimination and Covering among Gay Men

| | *B* | *SE* | *t* | *p* | 95% CI |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| *Perceived discrimination* | .29 | .19 | 1.52 | .13 | [−.13, .74] |
| *Covering* | −.22 | .13 | −1.77 | .08 | [−.47, .03] |
| Step 2 | | | | | |
| *Perceived discrimination*Covering* | −.39 | .16 | −2.43 | .02 | [−.71, −.07] |

*Note. n = 76.* Results presented are from generalized linear models specifying a gamma distribution and log-link function.

**Table 4**

Adjusted Gamma Regression Model Predicting IL-6 from Covariates, Perceived Discrimination and Covering among Gay Men

| | *B* | *SE* | *t* | *p* | 95% CI |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| *Alcohol* | −.01 | .01 | −1.09 | .28 | [−.01, .01] |
| *Medication* | −.25 | .41 | −.62 | .54 | [−1.06, .59] |
| *BMI* | −.01 | .04 | −.20 | .85 | [−.07, .07] |
| *Race* | .33 | .51 | .65 | .52 | [−.66, 1.46] |
| *Age* | .03 | .02 | 1.75 | .09 | [−.01, .07] |
| *Perceived discrimination* | .48 | .25 | 1.89 | .06 | [−.06, 1.06] |
| *Covering* | −.19 | .14 | −1.32 | .19 | [−.47, .10] |
| Step 2 | | | | | |
| *Perceived discrimination*Covering* | −.39 | .18 | −2.11 | .04 | [−.76, −.01] |

*Note. n = 72.* Results presented are from generalized linear models specifying a gamma distribution and log-link function. BMI = Body mass index. Dummy codes were assigned to medication (0 = *no medication*, 1 = *medication*) and race (0 = *white*, 1 = *minority*). Alcohol represents time since last alcoholic beverage in hours.

**Table 5**

Unadjusted Gamma Regression Model Predicting IL-6 from Perceived Discrimination and Covering among Lesbian Women

| | *B* | *SE* | *t* | *p* | 95% CI |
|---|---|---|---|---|---|
| Step 1 | | | | | |
| *Perceived discrimination* | −.83 | .32 | −2.61 | .02 | [−1.41, −.23] |
| *Covering* | .09 | .24 | .38 | .71 | [−.34, .56] |
| Step 2 | | | | | |
| *Perceived discrimination*Covering* | .12 | .32 | .38 | .71 | [−.41, .74] |

*Note. n = 21.* Results presented are from generalized linear models specifying a gamma distribution and log-link function.