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Sexual orientation and diurnal cortisol patterns in a cohort of U.S. young adults

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ABSTRACT

Sexual minorities in the United States are at elevated risk of bullying, discrimination, and violence victimization, all stressors that have been linked to psychological and behavioral stress responses including depressive and anxious symptoms and substance use. Acute and chronic stressors may also elicit physiologic stress responses, including changes in the regulation of the hypothalamic-pituitary-adrenocortical (HPA) axis. Few studies, however, have examined the relationship between minority sexual orientation and diurnal cortisol patterns. The present study included 1670 young adults ages 18–32 years (69% female, 31% male) from the Growing Up Today Study, a prospective cohort of U.S. youth. Participants provided five saliva samples over one day to estimate diurnal cortisol patterns. Sexual orientation groups included: completely heterosexual with no same-sex partners (referent), completely heterosexual with same-sex partners/mostly heterosexual, and gay/lesbian/bisexual. Covariates included perceived stress and stressful life events in the past month. Sex-stratified multilevel models of log-transformed cortisol values were used to model diurnal cortisol patterns, and generalized estimating equations were used to model area under the curve (AUC), both with respect to ground (AUCg) and increase (AUCi). Among females, sexual minorities reported significantly more stressful life events in the past month than their heterosexual counterparts. In adjusted multilevel models, sexual orientation was not significantly associated with diurnal cortisol patterns or with AUCg or AUCi in either females or males. There were no significant interactions between sexual orientation and stressful life events. Time-varying negative mood was significantly associated with higher cortisol levels across the day for both female and male participants, after adjusting for all covariates. This study from a large cohort of U.S. young adults did not detect a relationship between sexual orientation and diurnal cortisol patterns. Despite consistent evidence indicating that, compared to heterosexuals, sexual minorities experience elevated exposure to multiple forms of stressors and adversity across the life course, we did not find differences in diurnal cortisol rhythms by sexual orientation. One possible explanation is that sexual minority participants in the study exhibited physiologic resilience.

1. Introduction

Health disparities related to sexual orientation are well-documented in the United States, with multiple studies finding sexual minorities (e.g., lesbian, gay, bisexual [LGB], and mostly heterosexual populations) reporting more depressive and anxious symptoms, post-traumatic stress disorder (PTSD), substance use,

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eating disorder symptoms, and other health risk indicators relative to heterosexual populations (Austin et al., 2013; Institute of Medicine, 2011; Ward et al., 2014). Sexual minority stress theory posits that health inequities may be explained by societal stigmatization of sexual minorities, resulting in differential exposures to acute and chronic stressors such as discrimination, abuse, and violence (Meyer, 2003; Rosario et al., 2002). In support of this theory, elevated rates of violence victimization (Austin et al., 2008; Berlan et al., 2010; Friedman et al., 2011; Katz-Wise and Hyde, 2012; Roberts et al., 2010a; Saewyc et al., 2006) and discrimination (Hatzenbuehler et al., 2015, 2010) are well-documented and have been linked to psychological and behavioral outcomes (Almeida et al., 2009b; Roberts et al., 2012, 2013a). Research on physiological markers of chronic stress will be essential to understanding the mechanisms underlying health disparities—and, more broadly, to understanding the ways that stigmatizing or hostile social environments may "get under the skin" (Hatzenbuehler et al., 2009). Relatively few studies, however, have examined markers of stress physiology across sexual orientation groups.

Chronic stressors can affect health via several pathways, including through psychological responses, coping-related risk behaviors, and neurobiological disruptions. One of the most widely studied physiological stress pathways involves the hypothalamic-pituitary-adrenocortical (HPA) axis, which governs the release of cortisol. Threats to physical and social self-preservation have been shown to influence HPA-axis regulation in numerous studies (Adam and Gunnar, 2001; Dickerson and Kemeny, 2004; Miller et al., 2007). Cortisol has a diurnal rhythm that typically peaks shortly after awakening in the morning (known as the cortisol awakening response [CAR]) and then gradually drops throughout the day. Dysregulation of diurnal cortisol rhythms may result from exposure to chronic stressors (Almeida et al., 2009a; Miller et al., 2007). For instance, experiences of adversity may be associated with hypocortisolism in adulthood, manifesting as low morning cortisol levels and shallow decreases across the day (Gunnar and Vazquez, 2001). Because cortisol is critical to regulation of other physiological systems, including metabolic and immune systems (Dickerson and Kemeny, 2004), cortisol dysregulation may have wide-ranging impacts on pathophysiology (Heim et al., 2000a; Pervanidou and Chrousos, 2012; Segerstrom and Miller, 2004). Specifically, the CAR has also been linked to psychological wellbeing and physical health status, although it not clear whether positive outcomes are associated with larger or smaller CARs (Clow et al., 2004). Flatter cortisol slopes over the course of the day have been associated with PTSD in adults (e.g., (Yehuda et al., 1996)), a history of internalizing disorders in older adolescents (e.g., (Doane et al., 2013)), and chronic conditions such as fibromyalgia and rheumatoid arthritis (Heim et al., 2000a).

Empirical data show clear disparities in victimization and discrimination adversely affecting sexual minorities (Austin et al., 2008; Berlan et al., 2010; Friedman et al., 2011; Hatzenbuehler et al., 2015, 2010; Katz-Wise and Hyde, 2012; Roberts et al., 2010a; Saewyc et al., 2006), and theoretical work offers plausible pathways through which minority sexual orientation might be linked to HPA-axis dysregulation (Meyer, 2003; Rosario et al., 2002). Given that hypocortisolism, characterized by low morning cortisol levels and a blunted decline across the day, is the most common pattern observed among people exposed to adversity (Gunnar and Vazquez, 2001; Heim et al., 2000a), such patterns might be expected among sexual minority populations; however, evidence from sexual minority samples is lacking. To date, only a handful of studies including sexual minorities have assessed cortisol reactivity in experimental settings or diurnal cortisol. One study of gay and bisexual adult men found that degree of "outness" (sexual orientation disclosure) at work was related to higher mean cortisol levels over the course of a work day (Huebner and Davis, 2005). A study of HPA-axis reactivity to a laboratory stressor found LGB young adults who grew up in states classified as highly stigmatizing to sexual minorities as adolescents had a reduced cortisol response to a stress task compared to those who grew up in states classified as having low levels of stigma (Hatzenbuehler and McLaughlin, 2014). This finding reflects prior research showing lower cortisol response following an acute stressor among individuals exposed to adversities in adolescence (Bosch et al., 2012) or in earlier life (Carpenter et al., 2007, 2011). However, much remains to be understood about what distinguishes adaptive from maladaptive cortisol responses and how these responses might be affected by other stressors or buffers relevant for sexual minority populations. For example, another study based on the same LGB sample as used in the Hatzenbuehler and McLaughlin (2014) study above found that participants with greater parental support—a potential buffer against stigma—had a reduced cortisol response relative to those with less parental support (Burton et al., 2014).

Notably, none of the above studies included a comparison group of heterosexuals. One study of LGB and heterosexual adults in Montreal found no significant differences in diurnal cortisol profiles by sexual orientation identity, although within the LGB group, sexual identity disclosure was associated with lower cortisol levels at 30 min after waking (Juster et al., 2013) A study of HPA axis reactivity in this same sample found differences by sexual orientation and gender, such that lesbian/bisexual women had higher cortisol reactivity following exposure to a laboratory stressor than heterosexual women while gay/bisexual men showed lower overall cortisol levels throughout the study than heterosexual men (Juster et al., 2015). In addition, one study examined associations between sexual orientation identity and other stress-related biomarkers in a nationally representative cohort of U.S. young adults (Everett et al., 2014; Hatzenbuehler et al., 2013). Biomarkers of inflammation and poorer immune function (C-reactive protein and Epstein-Barr virus antibodies) that may be consequences of HPA-axis activation were found to be at higher levels in sexual minority men than in both heterosexual men and sexual minority women (Everett et al., 2014). These studies underscore the importance of considering the intersectionality (Bauer, 2014) of both gender and sexual orientation when examining stress biomarkers.

New research is needed to build a more complete understanding of the relationships among sexual orientation, exposure to stressors, and HPA-axis regulation. In addition, studies are needed that include less well-understood subgroups of sexual minorities such as mostly heterosexuals and heterosexuals with same-sex sexual partners, both of which have been shown to have elevated risk of trauma compared to heterosexuals with no same-sex partners (Roberts et al., 2010a, 2012). The present study sought to address these gaps by examining diurnal patterns of salivary cortisol by gender and sexual orientation in a large epidemiologic cohort of U.S. young adults. Hypotheses of this study were:

1 Compared to heterosexual young adults, sexual minorities will exhibit lower morning levels of diurnal cortisol and shallower decreases across the day;
2 Higher rates of stressful life events among sexual minorities compared to heterosexuals will partly explain differences in diurnal cortisol dysregulation.

2. Methods

2.1. Study sample

Study participants were drawn from the Growing Up Today Study (GUTS), a national, prospective cohort of 27,324 youth. GUTS participants, who were ages 9–16 years at enrollment, are children