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Sexual orientation and salivary alpha-amylase diurnal rhythms in a cohort of U.S. young adults

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ABSTRACT

Sexual minorities in the United States are at elevated risk of prejudice, discrimination, and violence victimization due to stigma associated with their sexual orientation. These stressors may contribute to physiological stress responses and changes in the regulation of the sympathetic nervous system (SNS). To date, no studies have examined the associations among minority sexual orientation, recent stressful events, and diurnal salivary alpha-amylase (sAA) patterns. The present study included 1663 young adults ages 18–32 years (31% men, 69% women) from the Growing Up Today Study, a prospective cohort of U.S. youth. Participants provided five saliva samples over the course of one day to estimate diurnal sAA patterns. Sexual orientation groups included completely heterosexual with no same-sex partners (CH; referent), mostly heterosexual/completely heterosexual with same-sex partners, and gay/lesbian/bisexual (LB or GB). Sex-stratified multilevel models were fit to evaluate the association of sexual orientation with diurnal patterns of log sAA. The association of recent stressful events was also evaluated. Among women, sexual minorities scored significantly higher than CH on perceived stress and number of stressful events in the past month ($p < 0.05$). Among men, sexual minorities scored higher than CH on perceived stress but not recent stressful events. In multivariable models, recent stressful events were not associated with sAA patterns, but significant sexual orientation group differences in sAA diurnal rhythm were observed among women though not among men. Compared to CH women, LB showed a blunted awakening response and elevated sAA levels across the day, both indicators consistent with SNS dysregulation. Findings suggest dysregulation of stress physiology in LB women, but not other sexual minority women or men, relative to same-sex heterosexuals. Observed dysregulation may relate to exposure among LB women to chronic stressors associated with sexual orientation stigma, although these relations and differences by sex warrant further study.

1. Introduction

Sexual orientation-related physical and mental health disparities have been well-documented in the United States. Sexual minorities report greater prevalence of depressive and anxious symptoms, post-traumatic stress disorder (PTSD), disordered eating, and other adverse health outcomes compared with heterosexual populations (Institute of Medicine, 2011). Both stress and attachment paradigms suggest that health inequities adversely affecting sexual minorities result from social stigmatization enacted through discrimination, harassment, abuse, and violence (Minority Stress Theory) (Meyer, 2003; Rosario et al., 2002) and from less secure attachment during child or adolescent development as a consequence of poor family dynamics (e.g., parental rejection) (Attachment Model for LGB Individuals) (Rosario, 2015; Rosario

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et al., 2014a, b). Dysregulation of physiological stress response pathways, such as the hypothalamic-pituitary-adrenocortical (HPA) axis, can indicate early signs of negative health effects of acute and chronic stressors (Almeida et al., 2009; Miller et al., 2007). Some evidence indicates that sexual minorities exhibit more dysregulated HPA axis response when faced with acute social evaluative stressors in laboratory settings (Hatzenbuehler et al., 2009; Juster et al., 2015). Interestingly, one study restricted to lesbian, gay, and bisexual young adults found that stronger family but not peer support was associated with less cortisol reactivity in response to social evaluative stressors in a laboratory setting.(Burton et al., 2014) In terms of research on diurnal cortisol patterns as indicators of chronic HPA axis dysregulation, two studies, including one on which the present study is based using the same salivary samples (Austin et al., 2016), have not found sexual orientation group differences (Austin et al., 2016; Juster et al., 2013). Another study restricted to gay men found black compared to white men experienced a flatter diurnal cortisol rhythm, an indicator of HPA axis dysregulation in the black gay men, which the authors suggested may be due to chronic stress of racial discrimination.(Cook et al., 2017) However, a small study restricted to gay men and lesbians that explored whether there might be a relationship between discrimination and diurnal cortisol did not find a statistically significant association (Juster and Bockting, 2017).

Another physiological stress response pathway that can become dysregulated through both acute social evaluative stressors and chronic stressors is the autonomic nervous system (ANS) (Lucini et al., 2005, 2002). The ANS maintains homeostasis through dynamic interactions between its sympathetic and parasympathetic branches. Sympathetic nervous system (SNS) activation occurs in response to stressors and other environmental challenges and mobilizes physiological resources to respond to these environmental demands (Cacioppa et al., 1998; Lucini et al., 2002). The parasympathetic nervous system serves an opposing set of functions that promote growth and restoration when the organism is at rest and facilitates a return to homeostasis following stressors (Berntson et al., 1997; Porges, 2007). Dysregulation of this system has been linked to elevated glucocorticoid sensitivity, inflammatory cytokine production, and other perturbations that have been associated with a variety of inflammatory diseases, cardiovascular disease, and cancer (Pongratz and Straub, 2014; Thoma et al., 2012a).

Salivary alpha-amylase (sAA), an enzyme synthesized and secreted from the salivary glands (Baum, 1993), is an established biomarker of SNS activity (Nater and Rohleder, 2009; Thoma et al., 2012b). A benefit of sAA is that its collection is relatively noninvasive for study participants compared to SNS activity biomarkers collected through serum or cerebrospinal fluid, such as epinephrine and norepinephrine (Thoma et al., 2012a). sAA levels have a distinct diurnal profile pattern, decreasing shortly after awakening and increasing throughout the course of the day (Nater et al., 2007). sAA dysregulation is a valid and reliable marker of stress-reactive physiological changes, which can manifest as a blunted awakening response (i.e., less of a decline in sAA level 30 min after awakening) and higher output of sAA throughout the day (Nater et al., 2006; Nater and Rohleder, 2009). For instance, sAA dysregulation has been associated with higher glucocorticoid sensitivity and inflammatory cytokine production (Thoma et al., 2012a). Chronic psychosocial stress has been linked to changes in the diurnal rhythm of sAA. For example, adults who report high levels of job strain exhibit a blunted awakening response than do those with low levels of job strain (Karhula et al., 2016). Children who report victimization by peers have higher levels of sAA in response to a peer-oriented social challenge than those who do not report peer victimization (Rudolph et al., 2010); a similar pattern has been observed among adults who experienced trauma and maltreatment as children in response to a laboratory-based stressor and trauma reminders (Kuras et al., 2017; Yoon and Weierich, 2016). Dysregulated sAA also can manifest as higher sAA output across the day (Nater et al., 2007). Elevated sAA diurnal output has been found in adolescents and adults with trauma histories and PTSD (Nater et al., 2007; Skoluda et al., 2017; Thoma et al., 2012a) and in adults with generalized social anxiety disorder (van Veen et al., 2008).

Sexual minorities consistently have been found to experience more trauma and victimization than same-sex heterosexual peers (Katz-Wise and Hyde, 2012; Roberts et al., 2010, 2012). Furthermore, some research with adolescents suggests that harassment based on a stigmatized identity compared to general harassment not related to identity results in worse decrements to mental and physical health (Russell et al., 2012). The disproportionate exposure to stressors among sexual minorities and potentially to more potent stressors may produce lasting alterations to the SNS. To date, however, no studies have examined diurnal sAA patterns across sexual orientation groups.

We undertook the present study to address this gap in the literature, examining patterns in diurnal sAA across sexual orientation groups in a national cohort of young adult women and men in the United States. We hypothesized that women and men sexual minorities, compared to same-sex heterosexuals, would experience a blunted awakening response (meaning less of a decline in sAA level after awakening) and elevated sAA levels across the day, both of which are considered indicators of SNS dysregulation. Further, we hypothesized that greater level of stress exposure would explain these patterns and that there may be a synergistic effect between sexual orientation and stressor exposure due to potentially more potent identity-based exposures experienced by sexual minorities.

2. Methods

2.1. Study sample

Study participants were from the Growing Up Today Study (GUTS), a national, prospective cohort of 27,324 youth (ages 9–16 years at enrollment in 1996 for GUTS1 cohort and 2004 for GUTS2 cohort). The GUTS cohort consists of children of women in the Nurses' Health Study 2, a prospective cohort of over 116,000 U.S. women, and surveys have been administered annually or biennially since the cohort's inception. The sample is primarily white (94%) and has a limited socioeconomic range, as all the participants' mothers have a four-year nursing degree.

The current study is based on a subset of GUTS youth who participated in the 2011–2014 GUTS Saliva Substudy; only those GUTS respondents who had completed a previous GUTS survey for the 2010-11 wave were eligible. The substudy, which has been reported previously (Austin et al., 2016), was designed to examine the association between sexual orientation and stress response physiology. All sexual minority participants were invited to participate, and a random subsample of heterosexuals were also invited. Youth were excluded if they were currently pregnant or pregnant in the past six months, if they reported any history of cancer treatment or diagnosis of diabetes, or if they reported past-month use of oral or inhaled steroids. A total of 6980 participants were invited to the GUTS Saliva Substudy by email and were screened for eligibility, of whom 1966 (28%) agreed to participate. Of these participants, 287 did not return at least one usable saliva sample and an additional 16 were missing data on wakeup time, resulting in a total analytic sample 1663 individuals. The 303 excluded, compared with the 1663 included, were more likely to be heterosexual, white, and older ($p < 0.05$), but not different by sex ($p > 0.05$).

2.2. Survey measures

2.2.1. Sexual orientation

Sexual orientation was assessed on the GUTS 2005, 2007, 2010–2011, and 2013 survey waves with two widely used measures. The first asked participants to report the sex of any past or present sexual partners (female[s], male[s], female[s] and male[s], or no sexual contact). The second measure asked participants to report which of the following best describes them: Completely heterosexual (attracted to persons of the opposite sex); mostly heterosexual; bisexual (equally