Stigma and diurnal cortisol among transitioning transgender men

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\begin{abstract}
This study assessed diurnal cortisol functioning in relation to stigma-based transition-specific stressors experienced by transgender men during their transition from female to male. Sixty-five healthy transgender men undergoing testosterone therapy participated in in-person interviews through which transition-specific stressors were identified. Interviews were coded according to participant reported (1) Transitioning-identity stress; (2) Coming Out stress; (3) Gender-specific Public Bathroom stress; and (4) levels of general Perceived Stress. Participants provided fifteen salivary samples assessing cortisol diurnal rhythm over three days. Hierarchical linear models, adjusted for duration of time on testosterone therapy, body mass index, steroid-related medication use, mean awakening time, and CAR, confirmed that elevated diurnal cortisol levels at awakening were associated with transition-specific social stressors including experiencing Transitioning-identity stress, frequent Coming Out stress, and Gender-specific Public Bathroom stress. Transitioning-identity stress and Gender-specific Public Bathroom stress also predicted a steeper negative slope at awakening. General Perceived Stress was not associated with elevated cortisol or slope. These results clarify the relation of increased cortisol at awakening with a negative linear slope to perceived stigma and transition-related stress experience among transgender men.
\end{abstract}

1. Introduction

“Transgender” and “trans” are umbrella terms to describe people whose gender identity or presentation may not conform to conventional social norms associated with their assigned birth sex (IOM, 2011). Transgender people experience significant stress related to stigma-based violence and discrimination and have disproportionately high rates of distress, depression, and anxiety (Bockting et al., 2013; Bradford et al., 2013). This is consistent with minority stress theory, which states that excess stress experienced by individuals from stigmatized social categories leads to adverse mental and physical health outcomes (Meyer, 2003).

Existing research has focused on stigma among lesbian, gay and bisexual (LGB) individuals (Hatzenbuehler et al., 2013; Hatzenbuehler and McLaughlin, 2014), with few studies of transgender people (Bockting et al., 2013; Levitt and Ippolito 2014). Moreover, the majority of studies among transgender people are conducted among those assigned male at birth (i.e., trans women). By contrast, trans men who were assigned female at birth are underrepresented (Reisner et al., 2016). Critically, few studies integrate an explicit aim to consider socially derived stressors associated with gender identity and expression when examining psychobiological pathways linked to health and well-being (for review, see Reisner et al., 2016).

1.1. Transition-specific and gender-related stress

Above and beyond the minority-stressors experienced by LGB people related to sexual-orientation, transgender people experience unique sources of stress and stigma as a result of having a gender-identity or gender-presentation which falls outside rigid male-female binaries (Grant et al., 2011). Additionally, unique challenges may arise during the process of gender transition that involve: 1) social transition related to gender presentation/expression (e.g., clothing and hair) and identity (e.g., name and pronouns) and 2) physical transition, when some transgender people seek hormonal therapies and surgeries to better align their bodies with their gender identity (Bockting et al., 2013).

For trans men who physically transition, accessing gender-affirming treatments such as testosterone therapy and surgeries improve overall quality of life and health (Keo-Meier et al., 2014; Newfield et al., 2006).
Nonetheless, shifts in physical gender “cues”, including changes in male secondary-sex characteristics (e.g., facial hair) during the first few years of testosterone therapy may put trans men at risk for being “read” as gender ambiguous or contradictory. This renders them more vulnerable to gender-related stigma. Transition-related stress can be particularly pernicious in gender segregated social spaces, including bathrooms or locker rooms, and during social interactions in which gender is salient. For example, a survey of urban transgender and gender non-conforming people found 70% of respondents had experienced verbal harassment, physical assault, and denial of access to gender-specific public bath-rooms (Herman, 2013).

Changes in physical appearance during testosterone therapy typically require a “social transition.” This includes a “coming out” process whereby individuals disclose their gender status to their social net-works and request others address them using a new name/male pronoun. In addition to “coming out” processes, social transition can involve stress associated with the complexity of socially managing a transitioning identity, particularly within a social context where a rigid gender binary is expected (i.e., changes in gender recognition during physical transition). For instance, this can occur in “mixed-company” when social circles overlap, bringing together some people who may know of one’s transition/gender status and others who may not. We propose that these complex social processes and transition-related stressors can “get under the skin and skull” via modulation of stress physiology.

1.2. Minority stress and the hypothalamic-pituitary-adrenal axis

An understudied area of research for the transgender population is the psychobiological link between minority stress and physical health. A key player is the hypothalamic-pituitary-adrenal (HPA) axis responsible for the production of cortisol (Sapolsky et al., 2000), which follows a natural circadian rhythm. A normal diurnal cortisol rhythm includes a gradual rise throughout the night followed by a 50–160% increase in concentrations 30–45 min following awakening (cortisol awakening response (CAR)) (Clow et al., 2010; Stalder et al., 2016), and a decline over the day with lowest levels around bedtime (Adam, 2006).

Due to its regulatory role in multiple interconnected systems, cortisol has been implicated as a mechanism through which stress can lead to disease (Miller et al., 2007). Chronic stress-induced dysregu-lation of the HPA-axis can lead to chronically high cortisol levels or to the opposite effect where cortisol levels are decreased and a “flattening” of the diurnal slope occurs (Carpenter et al., 2007; Ice et al., 2004). Both chronically elevated cortisol levels and/or flattening of the diurnal pattern are associated with negative health outcomes (Fries et al., 2005; Marketon and Glaser, 2008). Studies examining stress and HPA-axis activation have linked psychosocial stress to both high and low cortisol awakening response (Chida and Steptoe, 2009; Adam et al., 2006); however, other studies have found no significant association (Michaud et al., 2009). Recently, Chi et al. (2015) found that stigmatization was associated with lower cortisol levels at awakening and a flatter slope.

While little research has investigated stress and HPA-axis function-ing among transgender populations, previous research has linked social-evaluative threats – stressors that represent threats to the social self – to hypercortisolemic profiles (Dickerson et al., 2004; Miller et al., 2007). For example, African Americans who report higher levels of perceived discrimination have higher waking cortisol levels and a steeper diurnal decline in cortisol compared to Whites who report experiencing discrimination (Fuller-Rowell et al., 2012). Stress linked to devaluations of closely held identities, such as an individuals’ gender identity and gender expression, may be a unique and important mechanism that helps us understand established health disparities among gender minorities. Unfortunately, there is a lack of field-based research on stress and social evaluative threats during gender transition.

To the best of our knowledge, only one study has examined the HPA-axis among trans men and trans women. Colizzi et al. (2013) reported that elevated general perceived stress and cortisol prior to hormonal therapy was related to significantly lower levels of general stress and cortisol following 12 months of hormonal therapy. The Colizzi study examined psychobiological distress only before and after hormonal treatment; however, no psychosocial data was gathered over the course of the first year of transition or following a year, as in the current study. While transitioning itself is beneficial and helps to align the body with one’s internal gender identity, stress experienced during transition may reflect unique experiences of stigma and minority-stress. In addition to general perceived stress, transgender-specific stressors may be related to elevated levels of diurnal cortisol. Previous research has shown that during the early phases of transition, psychosocial stress related to transition-specific stressors can cause physiological changes in blood pressure and levels of inflammation (DuBois, 2012). In particular, stress related to “coming out” as transgender was associated with a diminished decline in nocturnal blood pressure (i.e., blood pressure while sleeping) (DuBois, 2012). Understanding the links between transition-specific stressors and HPA-axis functioning will provide complementary insights to further understand gender-identity health disparities and develop public health strategies to improve trans men’s health.

In the current analysis, we hypothesize that (1) trans men reporting high transition-specific stress (i.e., Transitioning-identity stress; Coming Out stress; Gender-specific Public Bathroom stress) will exhibit elevated diurnal cortisol levels at awakening and (2) that trans men reporting high transition-specific stress will exhibit a steeper linear slope or rate of change in cortisol.

2. Methods

2.1. Participants

As part of the Transition Experience Study, sixty-five healthy trans men were recruited from rural western Massachusetts, Boston, and southern Vermont. Each participant was 18 years of age or older, assigned a female sex designation at birth but expressed a male/trans masculine gender identity, and was using testosterone therapy as part of his transition. Participants were ineligible for participation if they were currently taking medication for any cardiovascular or immune-related conditions.

As trans men represent a relatively hard-to-reach population, recruitment efforts focused on area support groups, social networks, and snowball techniques. Interview and biomarker data were con-ducted and collected during the period of 2009–2012 by the principal investigator of the study (LZD) who identifies as an out, transgender man. All interviews took place in the participants’ home, in private meeting rooms at area LGBT health clinics and the University of Massachusetts Amherst. Responses were transcribed onto the interview instrument and digitally recorded. Consent forms were discussed and participants documented their consent by writing their initials into a notebook rather than providing their full names on the consent forms. Each participant received $50 as remuneration. Further description of the methodology of this study has been published previously (DuBois, 2012). The project was approved by the Institutional Review Board for research involving human participants at the University of Massachu-setts Amherst.

In addition to the in-depth interview, each participant provided anthropometric and bio-impedance measures during in-person sessions. Psychometric scales and background questionnaires with demographic and biobehavioral data were distributed prior to meeting and were collected in person during the interview. Participants were asked to indicate if they were taking any steroid-based medications (e.g., for colds, allergy, or asthma) both on the background questionnaire and during the in-person interview. Salivary sample collection materials...
and both written and verbal instructions detailing procedures were provided during the interview and participants then collected their saliva after completing the interview and receiving instruction.

2.2. Biological measures

2.2.1. Anthropometry

Height was measured with a freestanding portable anthropometer. Body weight was measured using a portable digital scale (Tanita, model BC-550T). Body mass index (BMI) was then calculated from weight (kg)/height (m²).

2.2.2. Saliva sampling

Participants collected salivary samples over three consecutive days after the interview was completed: (1) upon awakening (while still in bed), (2) thirty minutes post-waking (Clow et al., 2010) (prior to coffee/tea and brushing teeth), (3) mid-morning (approximately 4 h post waking, avoiding meal time), (4) mid-afternoon (approximately 8 h post-waking, avoiding meal time), and (5) at bedtime (prior to brushing teeth). Participants used the “passive-drool” technique, using a straw and polypropylene vial to collect their saliva (Ice, 2007). Each participant was instructed to refrain from brushing their teeth, smoking, or consuming dairy, alcohol, or caffeine 30 min prior to sample collection. In addition, a compliance questionnaire was filled out with each sample collection (Powers et al., 2016).

Sleep patterns, including information on average wake times and average hours of sleep, may play a role in the functioning of the HPA-axis and were therefore also collected (Clow et al., 2010; Zeiders et al., 2011). For the waking sample, the questionnaire asked participants to note the following: time to bed the night prior, approximate time that they fell asleep, number of times they awoke, final wake time, and method used to wake (i.e., alarm). Text-messages or phone call reminders prompted participants to collect their mid-morning and mid-afternoon samples. Study participants labeled their samples with the date and time of collection and then refrigerated them until retrieved. Samples were then frozen in a lab-grade freezer (−20°) until being shipped on dry ice to the University of Dresden, Germany for analysis in the laboratory of Dr. Clemens Kirschbaum. Analysis was conducted using a chemiluminescence immunoassay (CLIA) with high sensitivity of 0.16 ng/ml (IBL-International; Hamburg, Germany). Intra- and inter-assay coefficients of variation were below 8%.

An average cortisol level for each of the diurnal assessment time points was calculated by averaging the cortisol levels at each time point across all days of data collection (Juster et al., 2011, 2013, 2016a,b). This resulted in 5 cortisol scores representing the average diurnal level (nmol/L) at each time point (waking, 30-min post waking, mid-morning, mid-afternoon, and bedtime) for each participant.

2.2.3. Time on testosterone therapy

Testosterone therapy initiates and maintains male secondary sex-characteristics (i.e., facial hair, lower voice) for trans men. The duration of time an individual has been on testosterone determines the degree to which male secondary sex characteristics are apparent and can influence the transition-specific stress experience assessed. Time on testosterone therapy was coded as a continuous variable that ranges from .04 to 13.83 years.

2.3. Transition-related psychosocial stress measures

Participants were asked to discuss their transition experience during the in-person interview and were prompted to answer specific questions about the three transition-specific stressors that were previously identified ad-hoc by the lead author based on findings from his unpublished pilot-study (Transitioning-identity stress, Coming Out stress, and Gender-specific Public Bathroom stress). As described above, findings related to Coming Out stress (referred to as “Out stress”) have been published previously in relation to ambulatory blood-pressure measures (DuBois, 2012).

2.3.1. Transitioning-identity stress

Transitioning-identity stress refers to a sense of stress related to having a public gender identity and body that is in flux. During in-person interviews, each participant was asked: Do you feel that you are known by more than one gender in your public life (e.g., some people know you as a man, others as a trans man, and others know you as a woman)? If participants answered yes to this question, they were asked to address the following: (1) Would you prefer to be known by others consistently as a man, trans man or in some other way (e.g., as gender non-binary); and (2) Do you feel stress related to how others know you in terms of your social or public gender identity?

A dichotomous variable was then created during analysis of the interview data according to the following criteria: two independent coders coded participants positively as experiencing Transitioning-identity stress if they reported to be both a) socially identified as sometimes male, sometimes female, sometimes transgender instead of having a singular and consistent public male or trans male gender identity and also b) feeling that the experience was stressful/distressing (i.e., preferring a consistent singular social identity) (yes = 1). Participants were coded as negative (0 = referent) for experiencing Transitioning-identity stress if they reported no stress/distress related to their transitioning social identity regardless of status. All differences in coding were resolved by consensus. Inter-rater reliability (Cohen’s Kappa) was .75, indicating excellent agreement (Fleiss, 1971).

2.3.2. Coming Out stress

Coming Out stress refers specifically to stress associated with the process and/or experience of being out as transgender. During in-person interviews, each participant was asked: Is being “out” or the process of “coming out” a source of stress or anxiety for you? Participants were instructed to select an answer from the following choices: never, sometimes/infrequently, most of the time, and always and responses were coded 0-3 (DuBois, 2012).

2.3.3. Gender-specific Public Bathroom stress

During the in-person interview, participants were asked to rate their stress experience when using gender-specific public bathrooms on a Likert Scale ranging from 0 (low stress) and 10 (very high stress).

2.4. General perceived stress

Each participant completed Cohen and colleagues’ Perceived Stress Scale (1983), which is the most commonly used measure of general perceived stress shown to predict numerous health outcomes (Ice, 2007). Ten questions ask participants to rate how often they felt or thought in specified ways during the last month and are summed for each participant, yielding scores ranging from 0 (low perceived stress) to 40 (high perceived stress). The coefficient alpha for the scale was .91, indicating a high degree of internal consistency among the items on the scale. The means of the individual items ranged from 1.07 to 2.59, with a mean on the total scale of 16.85 (SD = 7.22). Overall, the participants’ responses on the scale indicated that they perceived themselves as experiencing a moderate amount of stress.

2.5. Statistical analysis

Bivariate correlations and one-way ANOVAs were used to identify potential confounders of the relation of stress variables to cortisol assessments. Growth curve modeling was used to plot temporal trajectories of participants’ diurnal rhythms and to predict variance in these trajectories from participants’ transition-related stress (Transitioning-identity stress, “Coming Out” stress, and Gender-specific Public Bathroom stress) or generalized non-transition-specific stress
(general Perceived Stress Scale). We used Hierarchical Linear Modeling, Version 7 (Raudenbush and Bryk, 2002) to specify a 2-level model that accounted for the dependency of cortisol scores over the day (Adam and Gunnar, 2001). The Level 1 (within-participant) model defined three parameters – intercept, linear slope, and quadratic term – that characterized participants’ circadian cortisol trajectories. The intercept and linear parameter coefficients were allowed to take on different values for each participant while the quadratic term was fixed. The Level 2 (between participant) model included participant stress predictors to explain variance in the Level 1 coefficients. The relationship between each stressor and cortisol trajectories was examined independently adjusting for steroid-related medicines, BMI, years on testosterone, and time of waking. In addition to controlling for these potentially confounding variables, CAR was dichotomized and included as a control variable at Level 2, due to evidence that the CAR is subject to regulatory influence independent of the rest of the diurnal cycle (Clow et al., 2004).

3. Results

3.1. Descriptive and inferential statistics

Sample characteristics are shown in Table 1. Bivariate correlations and one-way ANOVAs were used to identify potential confounders of diurnal cortisol at trend level (p < .10). We identified the following covariates that were included in our main analyses: years on testosterone treatment (r = .233, p = .066), steroid-based medications (r = -.244, p = .062), BMI (r = -.307, p = .017), and mean awakening time (r = -.577, p < .001). Variables that were not related to diurnal cortisol (p > .10) included age, sexual orientation, education, relationship status, number of children, caffeine consumption, cigarette smoking, alcohol use, and hours of sleep per night and were thus excluded from analyses. Associations among the three transition-related stress variables ranged from low to moderate [Gender-specific Public Bathroom stress and Coming Out stress, r = .16; Gender-specific Public Bathroom stress and Transitioning-identity stress, r = .41; Coming Out stress and Transitioning-identity stress, r = .32] (Correlation table not shown but available upon request).

For the purposes of illustrating the relation of our primary stress variables to diurnal cortisol trajectories (Fig. 1), we employed preliminary repeated measures analysis of covariance (RM-ANCOVA) for diurnal cortisol with the aforementioned covariates entered as a function of (A) Transitioning-identity stress (no: n = 36, yes: n = 29), (B) Coming Out stress (infrequent: n = 36, frequent: n = 29) (C) Gender-specific Public Bathroom stress (no/low < 4: n = 31, medium/high 4+: n = 33), and (D) general Perceived Stress (no/low < 16: n = 31, medium/high 16+: n = 32).

3.2. Hierarchical linear models

HLM models were centered on the sample collected at awakening so that the intercept represented HPA-axis activation at the beginning of each participant’s day (Adams et al., 2006). In each of the first 3 models, one of three specific transition-related stress variables (Transitioning-identity stress, Coming Out stress, or Gender-specific Public Bathroom stress) was added as a predictor to explain variability in the cortisol intercept and slope. Table 2 presents the results for Model 1: Transitioning-identity stress. Table 3 presents the results for Model 2: Coming Out stress. Table 4 presents the results for Model 3: Gender-specific Public Bathroom stress. A final model was run with non-transition-specific general stress (Perceived Stress Scale) entered as the predictor. Table 5 presents the results for general Perceived Stress. These models provided statistical tests of the association between transition related and non-transition related stress and participants’ (a) cortisol level at awakening (intercept at centered sample), and (b) linear slope (rate of change at awakening). Steroid-related medications, BMI, years on testosterone, mean awakening time, and CAR were included in all models as controls.

3.2.1. Diurnal cortisol predicted by Transition-related stress variables

Table 2 shows that experiencing Transitioning-identity stress predicted higher cortisol levels at the awakening sample. Participants who experienced Transitioning-identity stress had an average cortisol reading of the awakening level of 1.43 higher points than participants without Transitioning-identity stress. Transitioning-identity stress also predicted a steeper falling slope at the awakening sample.
Table 3 shows that more frequent Coming Out stress predicted significantly higher cortisol levels at the awakening sample, and showed a strong trend toward a steeper falling slope at awakening. The model indicated that, for every one-unit increase in frequency of Coming Out stress, participants had an average increase in cortisol level at awakening of .96 higher points.

Table 4 shows that Gender-specific Public Bathroom stress also predicted higher awakening cortisol: For every one-unit increase in
3.2.2. Diurnal cortisol predicted by general Perceived stress awakening.

Specific cortisol reading at the awakening sample of .34 higher points. Gender-related to cortisol level at the awakening sample, or the slope at the test.

Table 4

| Gender-specific Public Bathroom stress scores predict diurnal cortisol trajectory. |
|---------------------------------|-----------------|-----------------|-----------------|
| Estimation                      | SE              | p               |
| Cortisol Level                  |                 |                 |
| Intercept                       | 11.663          | .595            | < .001          |
| Years on Testosterone           | .041            | .061            | .50             |
| Body Mass Index                 | -.152           | .056            | .099            |
| Steroid-based Medications       | .011            | 1.195           | .99             |
| Time Awake                      | -.334           | .167            | .05             |
| Cortisol Awakening Response     | .409            | .682            | .55             |
| Public Bathroom Stress          | .335            | .095            | < .001          |
| Linear Slope                    |                 |                 |
| Intercept                       | -.1388          | .115            | < .001          |
| Years on Testosterone           | -.007           | .004            | .10             |
| Body Mass Index                 | .011            | .004            | .01             |
| Steroid-based Medications       | -.032           | .096            | .74             |
| Time Awake                      | .042            | .015            | .006            |
| Cortisol Awakening Response     | -.022           | .046            | .63             |
| Public Bathroom Stress          | -.027           | .008            | < .001          |
| Curvature Across Diurnal Trajectory | .050           | .006            | < .001          |

Bold values indicate p = .05 or less.

Table 5

| General Perceived Stress scores do not predict diurnal cortisol trajectory. |
|---------------------------------|-----------------|-----------------|-----------------|
|                                 |                 |                 |
| Estimation                      | SE              | p               |
| Cortisol Level                  |                 |                 |
| Intercept                       | 11.550          | .617            | < .001          |
| Years on Testosterone           | .029            | .075            | .70             |
| Body Mass Index                 | -.160           | .055            | .005            |
| Steroid-based Medications       | -.400           | 1.084           | .71             |
| Time Awake                      | -.089           | .162            | .58             |
| Cortisol Awakening Response     | .696            | .688            | .32             |
| Perceived Stress                | .072            | .041            | .09             |
| Linear Slope                    |                 |                 |
| Intercept                       | -.1381          | .118            | < .001          |
| Years on Testosterone           | -.005           | .006            | .36             |
| Body Mass Index                 | .011            | .004            | .01             |
| Steroid-based Medications       | -.003           | .104            | .98             |
| Time Awake                      | .022            | .015            | .15             |
| Cortisol Awakening Response     | -.043           | .047            | .36             |
| Perceived Stress                | -.002           | .030            | .47             |
| Curvature Across Diurnal Trajectory | .050           | .006            | < .001          |

Bold values indicate p = .05 or less.

Gender-specific Public Bathroom stress, participants had an average cortisol reading at the awakening sample of .34 higher points. Gender-specific Public Bathroom stress also predicted a steeper falling slope at awakening.

3.2.2. Diurnal cortisol predicted by general Perceived stress

Table 5 shows that general Perceived stress was not significantly related to cortisol level at the awakening sample, or the slope at the awakening sample.

4. Discussion

This study examined transgender specific minority stress and diurnal cortisol profiles among transitioning trans men undergoing testosterone therapy. Several key findings emerged, each supporting our overall hypothesis that specific transition-related stressors are associated with amplified HPA-axis production. Specifically, we provide evidence that trans men experiencing greater transition-related stress exhibit elevated cortisol concentrations at awakening. Following these elevated levels, trans men with Transitioning-identity stress or higher levels of Gender-Specific Public Bathroom stress exhibited steeper, faster linear slope. Our findings thus confirm others who have found the awakening point (Adam et al., 2006) and diurnal slope important to examine (Adam and Gunnar, 2001). These findings provide insights into the various ways minority stressors – specific to the challenges faced by trans men during their transition – can “get under the skin and skull” and impact measures of biological stress.

Overall, these findings expand those of Colizzi et al. (2013) who identified higher waking cortisol levels among transgender men and transgender women prior to their beginning physical transition. Our findings clarify that higher waking cortisol levels continue during transition for trans men who experience stress related to the use of gender-specific public bathrooms, managing a transitioning social identity, or their coming out process. More broadly, our findings can be interpreted in light of literature demonstrating hypercortisolemic profiles in relation to perceived risk of humiliation or disinterest (Dickerson et al., 2004; Miller et al., 2007). These findings have been shown both in lab-based studies of social-evaluative threat (Dickerson and Kemeny, 2004) and naturalistic studies where feelings of anger and of being “overwhelmed” were associated with higher than average diurnal cortisol levels (Adam et al., 2006).

The trans men in this study who experienced either Transitioning-identity stress or higher levels of Gender-specific Public Bathroom Stress exhibited steeper slopes rather than the flattened profile generally associated with chronic stress (Barker et al., 2012). This steeper decline may signal healthy recovery from the increased cortisol levels experienced earlier in the day. This finding is in line with previous research that found a relationship between perceived discrimination and steeper slopes among a different minority population – African Americans – but not Whites (Fuller-Rowell et al., 2012). Fuller-Rowell et al. (2012) argued that awareness of racism in daily life might serve an important protective mechanism against HPA-axis hyperactivity.

In line with this interpretation, steep diurnal decline may indicate resilience in this population because trans men are frequently aware that there is often stigma associated with their transgender identity and they anticipate stress around gender-specific public bathroom use. Though it is important to recognize the potentially negative effects of increased morning and total daily cortisol, the finding of a steeper diurnal slope among men who report experiencing transition-related stressors may reflect a healthy response to psychosocial stress associated with stigma. Just as a flattened cortisol profile can reflect elevated bedtime levels rather than an overall blunted response (Lovell et al., 2011), this steep decline from the morning peak to bedtime seems to reflect an increased awakening response followed by a healthy evening decline.

Our finding linking transition-related stressors to elevated diurnal cortisol production suggests a potential mechanism whereby minority stress can lead to health disorders. Our findings differ from those of Chi et al. (2015) who showed that stigma was associated with lower cortisol levels at awakening among HIV positive children. Their study, however, also included measures of resilience and demonstrated that children who exhibited high levels of resilience perceived lower levels of stigma, which in turn shaped their diurnal cortisol rhythm. Regrettably, we did not measure resilience and focused on adults, which may explain the difference between study results and should be explored further.

Our finding that more frequent Coming Out stress predicted elevated cortisol levels at waking also differs slightly from that of Juster et al. (2013) who found that disclosure in terms of sexual orientation was associated with lower diurnal HPA-axis activity (Juster et al., 2013) and lower perceived stress when they are socially supported (Juster et al., 2016a,b). Our study specifically measures stress related to the process of coming out as transgender, not sexual
orientation, and is not exclusively referring to the outcome of disclosure. Our findings represent an important addition to the literature given that despite recent shifts in visibility and support for transgender rights, stigma and discrimination remains pervasive, posing a substantial threat to the health and well-being of the transgender population (IOM, 2011). Particularly during transition, gender identity and expression may not conform uniformly to culturally prescribed binary male-female categories, thus increasing the risk for both stigma and discrimination.

In addition to providing support for our hypothesis, our findings provide further evidence that stigma affects health and therefore speak to contemporary socio-political issues in the United States and abroad. Importantly, the significant associations between levels of Gender-specific Public Bathroom stress and cortisol levels directly address contemporary arguments regarding access to gender-specific public spaces. For example, in 2016, a series of “bathroom bills” were proposed in at least 18 states (Kralik, 2016). Many of these “bathroom bills” seek to criminalize the use of gender-specific bathrooms by transgender people and require they use the bathroom that corresponds with their assigned sex as listed on their birth certificate rather than according to their gender identity and physical presentation (Schilt and Westbrook, 2015; Wang et al., 2016). Particularly in the wake of the recent rescinding of protections for transgender students in public schools, these findings point to the potential serious negative effect that denial of this protection can have on transgender people.

The policy debate surrounding these bills has an enormous impact for the lives of transgender people, and transgender youth in particular who are highly vulnerable to stigma (IOM, 2011). In addition to mental health and quality of life effects, further research could examine whether these stigmatizing and discriminatory experiences related to using bathrooms directly affect physical health by forcing trans people to suppress their basic bodily needs, which can increase individual’s risk for urinary tract or kidney infections among a host of other health outcomes (Schuber et al., 2016).

The absence of a relationship between general perceived stress in our study and cortisol suggests that for people in gender transition, general measures of perceived stress inadequately assess stress experiences and its effects at the biological level. This finding is consistent with others that have shown that stress responses are not indiscriminant and that the specific characteristics of the stressor and of the individual both contribute to variation in stress physiology (Kudielka et al., 2009). Future research should focus on developing psychometrics that capture the unique experiences of trans populations that may be sensitive to biological processes.

To the best of our knowledge, this study is the first to examine psychosocial stress experiences and diurnal cortisol during gender transition among trans men. Results from this study linking transition-specific stress to HPA-axis functioning are particularly informative given the extremely high rates of discrimination and victimization experienced by the trans population (Grant et al., 2011; Lombardi et al., 2002; Reisner et al., 2014) and the potential for stigma-experience to negatively affect both mental and physical health (White Hughto et al., 2015).

4.1. Limitations

Despite these contributions, it is important to note limitations of this study. First, this study was designed to examine the stress experiences of trans men during transition, thus these findings are not generalizable to trans women undergoing gender transition, trans men who are not utilizing testosterone as part of their transition or other people who identify as transgender but who are not transitioning. Second, the study sample size is small. Notwithstanding and considering that trans men represent a hard-to-reach population, the number of participants and high level of compliance with study protocols is promising for future research.

4.2. Conclusions

This study expands minority stress models and applies a social evaluative threat framework within real-life settings by highlighting the negative effects of stigma, prejudice, and discrimination on transgender individuals (Bockting et al., 2013; Dickerson et al., 2004; Meyer, 2003). In this study that provides a first step forward in biomarker assessment among trans men, we characterize specific identity and transition-related stressors in relation to psychobiological pathways linked to health. The types of stressors that trans men described are indicative of managing social relationships (Transitioning-identity stress and Coming Out stress) and reflect cultural norms pertaining to traditional binary distinctions imposed on both gender presentation and gender identity (levels of Gender-specific Public Bathroom stress). These gender-minority and social-evaluative threat experiences illuminate the importance of facilitating the transition process itself while simultaneously providing sufficient support and coping resources for trans men during transition, particularly within sociocultural contexts where male-female gender categories are rigidly enforced. Finally, these findings speak to the importance of anti-discriminatory transgender policies, as well as increased education to reduce stigma, prejudice, and discrimination against transgender people in order to improve transgender health.

Acknowledgements

We are grateful to all of the trans men who participated in this study. We also thank The Fenway Institute and Tapestry Health Clinics for providing safe and private meeting rooms for conducting interviews. We thank Lisa Fiorenzo, Aline Sayer, and the UMass Center for Research on Families for statistical consultation.

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