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# A comparison of testosterone and cortisol levels between gay fathers and non-fathers: A preliminary investigation

Erin E. Burke*, Richard G. Bribiescas

*Department of Anthropology, Yale University, 10 Sachem Street, New Haven, CT 06511, USA*

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ABSTRACT

Humans are unique among great apes and most other mammals, in that our wide range of offspring investment behaviors includes significant paternal care and provisioning of children. Moreover, hormones play an important role in modulating male paternal investment. Despite a growing body of research on the hormonal associations with paternal care in humans, fathers who self-identify as gay have not received the same level of research attention. We explore associations between hormones that are central to reproductive effort in American gay couples ($n$ = 48 pairs, mean age 36 ± 11 SD years) with and without children. Building on previous investigations of paternal investment, we focus on testosterone and cortisol given their primary roles in the behavioral and metabolic aspects of male reproductive effort. We provide preliminary evidence that gay fathers have lower cortisol levels compared to gay non-fathers. Cortisol and testosterone also positively co-varied in all couples, independent of potential covariates. We did not find evidence for differences in testosterone levels between gay fathers and non-fathers, although sample sizes were limited. Based on this preliminary evidence, we suggest that psychosocial stress among gay fathers may differ compared to gay couples without children, or that the stress response in gay fathers is mitigated in some way compared to non-fathers. These data underscore the importance of human paternal care diversity and the value of inclusivity in human evolutionary behavior research.

## 1. Introduction

### 1.1. The behavioral endocrinology of paternal behavior

Hormone variation modulates paternal behavior in numerous organisms, including humans. For example, human fathers exhibit lower testosterone levels compared to age matched non-fathers in a variety of sociocultural contexts suggesting biological underpinnings that engage natural selection, social factors, and gene/environment interactions [43,46,49,50,52,65,70]. Moreover, differences in testosterone levels between fathers and non-fathers can be affected when fathers contribute to childcare [5,41,69,77], when fathers are married or otherwise pair-bonded to the mothers of their children [22,50] and when they cosleep with their children [44].

Recently, paternal associations with testosterone were shown longitudinally: North American men's testosterone declined over the course of their partners' pregnancy [11,35,108,128]. In Filipino men aged 21, those who had high baseline testosterone were more likely than those with lower baseline levels to be fathers at age 26. The group of fathers also had lower testosterone levels at age 26 than those men without children [42]. While attention for cross-cultural and longitudinal changes in hormones such as testosterone has grown, investigations that engage the neuroendocrinology of fatherhood and paternal investment across the spectrum of human male sexuality remains understudied.

### 1.2. Testosterone and gay fathers

To-date, investigations of hormonal associations between fatherhood and paternal engagement with their children have not considered variation in paternal sexual orientation or identity, as virtually all studies have focused on heterosexual men. van Anders and Watson [120] investigated partner status and testosterone in men and women and reported no effect of partnered status on testosterone for those partnered with men (non-heterosexual men or heterosexual women). However, they reported a significant decrease in testosterone in heterosexual men and non-heterosexual women. They concluded that the relationship between partner status and testosterone is only seen in individuals who partner with women. van Anders and Watson's results lead to the question of whether certain affiliative behaviors and their

* Corresponding author.
*E-mail address:* erin.eeb@gmail.com (E.E. Burke).

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neuroendocrine correlates are gender-specific within a pair-bond. The only other study to examine hormone levels in gay male couples found no statistically significant differences in oxytocin levels between heterosexual mothers, fathers, and gay fathers [1]. Most interestingly, there were no differences in oxytocin levels between gay biological and non-biological fathers. However, neither testosterone nor cortisol were assessed.

### 1.3. Cortisol and fatherhood

The glucocorticoid cortisol is regulated by the hypothalamic-pituitary-adrenocortical axis (HPA), and is commonly recognized as a hormone that is associated with various forms of stress, or departures from physical and/or mental homeostasis. Cortisol is involved in increasing cellular glucose availability, immune function and inflammation, metabolism, neurobiology, electrolyte balance, and reproductive physiology [26,97].

Cortisol can alter reproductive function and behavior, often through the suppression of the hypothalamic-pituitary-gonadal (HPG) axis as demonstrated extensively in rodent models [45], but also non-rodent vertebrates [24,111] including humans [30,92]. Variation in cortisol and its interaction with testosterone can therefore inform our understanding of the behavioral endocrinology of fatherhood and paternal care. Most salient for this study, cortisol has been demonstrated to have suppressive effects on testosterone levels [30] and gonadotropin releasing hormone (GnRH) and luteinizing hormone (LH) production [24,45,111].

In contrast to testosterone, the association between cortisol and fatherhood is mixed. Research has shown that positive paternal responsiveness to offspring is associated with either increased cortisol levels or reactivity in humans ([11,40,105,106,108]; but see [35]). Additionally, experimental manipulations demonstrate that cortisol declines compared to baseline after father/offspring play are greater in experienced fathers compared to inexperienced fathers, suggesting that the hormonal response can be modulated by prior paternal experience [40,107].

However, evidence for a complementary relationship between cortisol and testosterone in the context of parenting remains unclear. In certain primate species, males exhibit a positive association between parental and mate seeking investment ([31,68,82]; reviewed in [78]). In humans, a handful of studies have failed to demonstrate an inverse association indicative of a trade-off between cortisol and testosterone [43,51,55].

### 1.4. Cortisol and gay fathers

The role of cortisol in the parenting experiences of gay fathers has not been previously explored. The majority of studies relating sexuality to cortisol levels has mostly focused on gay men with HIV/AIDS. However, in the last few decades more attention has centered on the role of psychosocial stress in people who belong to sexual minority groups and often experience social marginalization. Some studies have explored cortisol's relationship to disclosing one's sexual orientation and arrived at conflicting results that suggest disclosing *or* concealing one's sexual orientation might be stressful states [58,61]. Another study demonstrated that gay men displayed lower cortisol concentrations compared to heterosexual men when confronted with an experimental stressor [60]. Similar results were found in a study of lesbian, gay and bisexual young adults where structural stigma led to a blunted cortisol response following an experimental stressor [56], however other studies did not find this effect [7].

Gay fathers can receive more social support from multiple sources, including their families (who sometimes had not previously supported the men's sexual orientation), general parenting support groups and LGBTQ-specific parenting groups [12,130]. Having this extended support network could mitigate psychosocial stress levels. On the other hand, sexual-minority headed families are still unusual in the United States, and gay fathers might experience more elevated cortisol than heterosexual parents because of the additional pressures of often not being considered socially normative [6]. Moreover, the road for a gay man to become a father can be more stressful than that of a heterosexual father. With the exception of gay men who had children in previous opposite-sex couple marriages, most gay fathers must embark upon a lengthy and costly adoption, fostering or surrogacy process when creating their families. Often this process is made more difficult by agencies, social workers or birth parents who object to gay father-headed families [13,83,109]. Remarkably, given the presumed pyschobiological toll such challenges might take, the dynamics of stress in gay families remains quite understudied.

### 1.5. Objectives of the current study

The objectives of this study are to investigate potential differences between fathers and non-fathers who self-identify as gay in hormones that have been previously shown to be associated with fatherhood and paternal care in heterosexual men as well as other organisms. The hormones in question are testosterone and cortisol. We also examine potential co-variates with paternal status that may contribute to hormone differences including age, anthropometrics, mate seeking, and socioeconomic status.

Our null hypothesis was that there are no statistically significant differences in fathers' and non-fathers' testosterone levels. The alternative hypothesis is that, similar to heterosexual fathers, gay fathers would exhibit lower testosterone levels compared to non-fathers. Because of the complexities and interactions of the HPA and HPG systems, this study poses the question of whether any significant difference between cortisol levels exists between fathers and non-fathers without any *a priori* assumptions about what direction the differences in these groups should be. In very basic terms, if these men experience more stress, cortisol levels could be increased, or the cortisol response could be blunted. This study addresses whether or not there are differences in the stress experienced by gay fathers than non-fathers, as measured by cortisol. We also investigated whether cortisol and testosterone co-varied in fathers and non-fathers, and whether the relationship between these two hormones was affected by the demographic and psychosocial co-variates mentioned above.

## 2. Materials and methods

### 2.1. Participant recruitment

This study was approved by the Yale University Institutional Review Board (Yale Human Subjects Protocol number 1306012152). Written, informed consent was obtained from all human subjects. Healthy adult American men from across the United States, between the ages of 21 and 60 in same-sex couples were asked to participate. Recruitment efforts included word of mouth, recruitment booths at LGBTQ events in various cities, and social media. Potential participants were screened for substances or health issues that could interfere with hormone assessments. These included the use of exogenous testosterone, DHEAS/DHEA, or androstenedione, other forms of hormonal therapy, medications that might alter hormone levels, metabolic disorders with known hormonal effects (e.g. diabetes, Cushing's Syndrome, etc.), blood borne infection (HIV/AIDS and Hepatitis B), having a pacemaker (to avoid interference caused by the Tanita scale used for body fat measurement), or not being a U.S. citizen (to restrict the sample demographics and to more easily compensate participants). The screening was done in such a way that participants did not have to reveal any personal medical information (e.g. HIV status) as they simply checked “yes” or “no” to whether any of these excluding circumstances applied, without indicating which applied specifically. Participants were compensated $50 per couple. In total, the final sample comprised 48 individuals: 18