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No compelling evidence that more physically attractive young adult women have higher estradiol or progesterone☆,☆☆

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ABSTRACT

Putative associations between sex hormones and attractive physical characteristics in women are central to many theories of human physical attractiveness and mate choice. Although such theories have become very influential, evidence that physically attractive and unattractive women have different hormonal profiles is equivocal. Consequently, we investigated hypothesized relationships between salivary estradiol and progesterone and two aspects of women's physical attractiveness that are commonly assumed to be correlated with levels of these hormones: facial attractiveness (N = 249) and waist-to-hip ratio (N = 247). Our analyses revealed no compelling evidence that women with more attractive faces or lower (i.e., more attractive) waist-to-hip ratios had higher levels of estradiol or progesterone. One analysis did suggest that women with more attractive waist-to-hip ratios had significantly higher progesterone, but the relationship was weak and the relationship not significant in other analyses. These results do not support the influential hypothesis that between-women differences in physical attractiveness are related to estradiol and/or progesterone.

1. Introduction

Many researchers have hypothesized that human attractiveness judgments are psychological adaptations for identifying high-quality mates (Grammer et al., 2003; Little et al., 2011; Thornhill and Gangestad, 1999). Researchers have also hypothesized that fertility, as indexed by high levels of estradiol and/or progesterone, is a particularly important aspect of women's mate quality (Grammer et al., 2003; Little et al., 2011; Thornhill and Gangestad, 1999). Although this proposal has become very influential in the human attractiveness and mate choice literatures, evidence that more physically attractive women have higher estradiol or progesterone is equivocal (Grillot et al., 2014; Jasienska et al., 2004; Law Smith et al., 2006; Puts et al., 2013).

Two studies have investigated putative relationships between women's facial attractiveness and hormone levels. Law Smith et al. (2006) reported a significant positive correlation between ratings of women's facial attractiveness and estradiol. They also reported a positive correlation between facial attractiveness and progesterone, although this relationship was not significant. By contrast with Law Smith et al.'s results, Puts et al. (2013) found no evidence that women with higher levels of either estradiol or progesterone possessed more attractive faces. To date, evidence that more facially attractive women have higher estradiol or progesterone is therefore inconclusive.

Other studies have tested for evidence that women's physical attractiveness is positively correlated with estradiol or progesterone by investigating the hormonal correlates of women's waist-to-hip ratio. Jasienska et al. (2004) reported that women with lower (i.e., more attractive) waist-to-hip ratios had higher estradiol and higher progesterone. However, Grillot et al. (2014) found no evidence for these relationships. To date, evidence that waist-to-hip ratio is associated with sex hormones is therefore also inconclusive.

Given the importance of associations between hormone levels and

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☆☆ Data files and analysis scripts are publicly available at osf.io/qd9bv. No compelling evidence that more physically attractive young adult women have higher estradiol or progesterone.

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attractiveness for theories of women's attractiveness and mate choice, we tested for the hypothesized correlations between salivary estradiol and progesterone and both women's facial attractiveness and waist-to-hip ratio. Our study is the largest to date to test for putative associations between women's physical attractiveness and measured hormone levels. Our sample is more than eight times larger than that in Law Smith et al. (2006) and more than twice as large as that in Jasienska et al. (2004).

2. Methods

2.1. Participants

We recruited 249 young adult white women for the study (mean age = 21.5 years, SD = 3.30 years). All participants were students at the University of Glasgow and each completed five weekly test sessions. Participants were recruited only if they were not currently using any hormonal supplements (e.g., oral contraceptives), had not used any form of hormonal supplements in the 90 days prior to their participation, and had never used sunbeds or tanning products. None of the participants reported being pregnant, having been pregnant recently, or breastfeeding. Women participated as part of a larger study on hormonal correlates of women's behavior (Jones et al., 2018a,b,c).

2.2. Face photography and ratings

In each of the five test sessions, each participant first cleaned her face with hypoallergenic face wipes to remove any makeup. Makeup was removed because Law Smith et al. (2006) reported that estradiol and progesterone predicted facial attractiveness in a sample of women not wearing makeup, but not in a sample of women wearing makeup. A full-face digital photograph was taken a minimum of 10 min later. Photographs were taken in a small windowless room against a constant background, under standardized diffuse lighting conditions, and participants were instructed to pose with a neutral expression. Camera-to-head distance and camera settings were held constant. Participants wore a white smock covering their clothing when photographed to control for possible effects of reflectance from clothing. Photographs were taken using a Nikon D300S digital camera and a GretagMacbeth 24-square ColorChecker chart was included in each image for use in color calibration.

Following Jones et al. (2015), face images were color calibrated using a least-squares transform from an 11-expression polynomial expansion developed to standardize color information across images (Hong et al., 2001). Note that color calibration of face images eliminates differences across images due to subtle variation in factors such as lighting. It does not reduce differences among images in other aspects of facial coloration. For example, even subtle hormone-linked differences in facial coloration can be measured in images calibrated in this way (Jones et al., 2015). Each image was standardized on pupil positions and masked so that hairstyle and clothing were not visible. The 1245 face images (five images for each of the 249 women) were then rated for attractiveness using a 1 (much less attractive than average) to 7 (much more attractive than average) scale by 14 men and 14 women. Inter-rater agreement for these ratings was high (Cronbach's alpha = .93). Trial order was fully randomized. The screen was calibrated using an xRite i1 Display Pro colorimeter prior to testing. Simulations (see DeBruine and Jones, 2018) sampling from a population of 2513 raters, each of whom had rated the attractiveness of 102 faces, indicate that > 99% of 1000 random samples of 15 raters produced Cronbach's alphas > .8, indicating high reliability of ratings (90% of all alphas were > .85). Furthermore, increasing the number of raters providing attractiveness ratings has a negligible effect on the mean attractiveness ratings once ratings have been collected from 28 raters (Hehman et al., 2018).

2.3. Hormone assays

Participants provided a saliva sample via passive drool (Papacosta and Nassis, 2011) in each test session. Participants were instructed to avoid consuming alcohol and coffee in the 12 h prior to participation and avoid eating, smoking, drinking, chewing gum, or brushing their teeth in the 60 min prior to participation. Saliva samples were frozen immediately and stored at −32 °C until being shipped, on dry ice, to the Salimetrics Lab (Suffolk, UK) for analysis, where they were assayed using the Salivary 17β-Estradiol Enzyme Immunoassay Kit 1–3702 (M = 3.42 pg/mL, SD = 1.33 pg/mL; intra-assay CV = 7.13%; inter-assay CV = 7.45%) and Salivary Progesterone Enzyme Immunoassay Kit 1–1502 (M = 143.90 pg/mL, SD = 93.33 pg/mL; intra-assay CV = 6.2%; inter-assay CV = 7.55%). Hormone levels more than three standard deviations from the sample mean for that hormone or where Salimetrics indicated levels were outside the assay sensitivity range were excluded from the dataset (~1.5% of hormone measures were excluded). Reliability of hormone levels across test sessions was good for both estradiol (Cronbach's alpha = .90; Intraclass correlation coefficient = .46) and progesterone (Cronbach's alpha = .91; Intraclass correlation coefficient = .58).

2.4. Body measures

In one of the five test sessions, waist and hip circumferences were measured from 247 of the women by one researcher. Two women chose not to have waist and him circumferences measured. Waist and hip circumferences were used to calculate waist-to-hip ratio (M = 0.75, SD = 0.05).

3. Results

A linear mixed model was used to investigate the relationship between facial attractiveness and hormone levels. Analyses were conducted using R version 3.3.2 (R Core Team, 2016), with lme4 version 1.1–13 (Bates et al., 2014) and lmerTest version 2.0–33 (Kuznetsova et al., 2013). To create mean (i.e., trait) hormone values for our analyses, hormone levels were averaged across test sessions for each woman, centered on the grand mean, and scaled so the majority of the distribution for each hormone varied from −0.5 to .5 (this was done by dividing values by a constant, is done simply to facilitate calculations in the linear mixed models, and has no material effect on the results). To create current (i.e., state) hormone values for our analyses, values for each hormone were centered on their subject-specific means and scaled using the same scaling constants as above. The linear mixed model predicted face image ratings with current (i.e., state) estradiol, current (i.e., state) progesterone, rater sex (effected coded so that +0.5 was male and -0.5 was female), and their interactions entered as predictors. Mean (i.e., trait) estradiol, mean (i.e., trait) progesterone, rater sex, and their interactions were also entered as predictors. Interactions between estradiol and progesterone were included following Puts et al. (2013). Random intercepts were specified for rater, stimulus woman (i.e., each woman whose face images were used as stimuli), and individual face image. Random slopes were specified maximally, following Barr et al. (2013) and Barr (2013). The model is fully described in our supplemental materials, along with results of simplified models testing for effects of current and mean hormone levels separately (see https://osf.io/qd9bv/. Full results are shown in Table 1.

No between-women hormone-attractiveness correlations were significant. However, there was a significant interaction between the effects of current estradiol and current progesterone (estimate = –0.54, 95% CI = −1.01, –0.06, SE = 0.24, t = –2.20, p = .030). Although weak, this interaction indicated that within-woman attractiveness was particularly high both when current estradiol was high and current progesterone was simultaneously low and when current estradiol was low and current progesterone was simultaneously high (see Fig. 1).