LETTER TO THE EDITOR

Letter in response to Ackermann et al., “Testosterone levels in healthy men are related to amygdala reactivity and memory performance”

Dr. Ackermann et al. (2012) found that salivary testosterone levels are associated with higher arousal ratings of neutral pictures, better recall for those pictures after a 10-min delay, and greater amygdala activity during encoding. These relationships were found in men but not in women. We offer one possible explanation for the null effects in women, in regards to the method of saliva collection. Salivettes with cotton collection devices artificially increase salivary testosterone levels measured by radioimmunoassays or enzyme-based immunoassays (Shirtcliffe et al., 2001), as do other cotton-based collection devices (Dabbs, 1991). Ackermann et al., who report using Salivette collection devices but not which type of device (cotton or synthetic swab), report average testosterone levels of 155.61 ± 4.47 pg/ml in men and 95.35 ± 3.49 pg/ml in women. These levels for women are much higher than we have found in multiple studies using gum or passive drool for saliva collection, which typically average between 15 and 25 pg/ml for women (e.g., Schultheiss et al., 2004, 2005; Wirth and Schultheiss, 2007; Stanton et al., 2009a,b; Liening et al., 2010; Gaffey and Wirth, unpublished data). Others have also found much lower testosterone in women than Ackermann and colleagues (Dabbs et al., 1995; Sellers et al., 2007; Mehta et al., 2008, 2009; Edelstein et al., 2011; van Anders, 2010; van Anders and Goldey, 2010). For example, Dabbs and colleagues report women’s salivary testosterone from assays conducted in nine independent laboratories; the measurements range from 50 to 100 pmol/L, equivalent to 14 to 28 pg/ml.1

In addition to the effect of cotton collection devices (Dabbs, 1991; Granger et al., 2004), storage time and temperature can drastically affect salivary testosterone measurements. For example, refrigerator storage (4 °C) can elevate measurements as much as 330% (Granger et al., 2004). Some methods may produce unreliable results for women in particular. The interference in testosterone assays caused by other collection methods, i.e. chewing gum, differs by sex (van Anders, 2010). Blood contamination in samples, as measured by transferrin levels, was found to inflate females’ salivary testosterone but not males (Granger et al., 2004). For whatever reason(s), the ratio of women’s to men’s salivary testosterone in Ackermann and colleagues’ report is much higher than expected, and so these data should be interpreted with caution.

In our research, we have sometimes (Wirth and Schultheiss, 2007; Stanton et al., 2011a,b) but not always (Schultheiss et al., 2005; Stanton et al., 2009a,b) found similar relationships in both sexes between testosterone and cognitive/behavioral outcomes, despite a 5–10-fold difference in salivary testosterone levels between the sexes. The authors are correct that sex differences exist in the neurobiology of emotionally influenced memory (Cahill, 2006). However, before it can be concluded that there is a “male-specific role for testosterone in enhancing memory” (Ackermann et al., 2012), their findings must be replicated using the most reliable saliva collection methods.

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Conflict of interest statement

The authors have no conflict of interest to report.

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References


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1 Conversion calculator available at http://www.soc-bdr.org/lds/authors/unit_tables_conversions_and_genetic_dictionaries/e5196/index_en.html.

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