Predictability of Oxytocin on Several Health Factors in Young and Old Adults

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Recent studies of the neuropeptide oxytocin (OT) have focused on the overall health of a person. The literature is in high support of blood OT levels as predictive of several health factors in humans. In this research, we looked specifically at the interactions between baseline plasma OT levels and calcium, BMI, glucose, and sex hormones (testosterone and estrodiol). The existing literature supports the idea that higher levels of OT correlates with higher calcium levels and lower glucose and BMI levels. Blood draws were conducted to determine baseline plasma OT levels in 51 young participants and 54 older participants. Self-reported height and weight was used to calculate participants' BMI. Preliminary results suggest the highest levels of baseline plasma OT in young women and the lowest levels in older men. OT did not significantly predict calcium, BMI, or glucose, but was positively correlated with testosterone levels in young men and estradiol levels in old women. Results from this research may indicate that baseline OT levels are not as indicative of general health in already healthy participants. Future extensions of this research should target samples of less healthy adults to determine associations between baseline plasma OT levels and blood markers as well as hormone levels in less fit populations.

BACKGROUND

Oxytocin (OT) is a neuropeptide that occurs naturally in the body (Landgraf et al., 2004). In past research, OT has primarily been studied in terms of how it relates to pregnancy and lactation. However, recent research studies are moving beyond this focus to learn how OT affects the body. Some of the most recent work investigates how OT interacts with different health factors. The particular health factors being looked into are glucose, calcium, and body mass index (BMI).

OT has been found to have a significantly increased effect on basal levels of calcium (Ayar, 2014). This increase of calcium associated with OT is especially important in aging research due to the deterioration of calcium in the skeletal bone tissue of aging adults. Some animal studies, involving rats, have looked at the results of calcium levels in test subjects who are injected with OT (Barhoumi, 1996; Hobo, 2012). In both of these studies, it was found that calcium levels increased with OT administration.

OT has been found to increase the uptake of glucose in the heart (Florian, 2010). Again, this was found in an animal research study, but it does support the idea that OT has an interaction with glucose levels. OT has been found to increase glucose metabolism and to have responsibility in energy regulation (Lee, 2008). This raises questions as to whether OT has an effect on the energy balance in the peripheral system.

Daily OT injection has been found to improve obesity in diet-induced obese rats (Maejima, 2011). This improvement seemed to be the result of decreased appetite measured by food intake as well as increased fat usage and improvement in glucose metabolism. Mice who lacked OT receptors were found to develop late-onset obesity (Takayanagi, 2008). When the OT receptors in mice were removed, the mice body weight increased without a change in appetite or energy expenditure. OT continues to be shown as useful in treatment for diet-induced obese animal trials (Blevins, 2013). This study looked further into different aspects of the effects of OT. Energy expenditure increased, glucose metabolized better, satiety increased, and overall weight decreased. Intranasal OT has been found to be a significant treatment of obese human patients (Zhang, 2013). Patients received either OT or placebo spray. The experimental group showed significant weight loss while the control did not. Intranasal OT has been found to decrease the caloric intake in male participants (Lawson, 2015). The OT appears to have decreased the fat intake in the men without having detrimental effects in the participants. While obesity is only one facet of BMI, we could infer that OT would have an interaction with weight and BMI on a more acute level.

Although there is little existing literature on the interaction of OT and sex hormones, our research wanted to explore further into the possibilities of it.

The Current Study

Going beyond previous work, the present study had the following aims: (1) determine the relationship of baseline plasma OT levels and several health factor levels; (2) explore the effect OT has on sex hormones in young and old participants. Based on theoretical considerations, preclinical work, and the existing human and animal studies, we had the following hypotheses. We expected calcium levels to be higher in the participants with higher amounts of baseline plasma OT. We expected both glucose levels and BMI to be lower in the participants with higher amounts of baseline plasma OT. With the strong backing of the previous literature, we expected to have significant findings in all three of these health factors. For the sex hormones, we did not have a specific expectation. Little to no previous literature has looked at the interaction between plasma OT and sex hormones in older adults (Ebner et al., 2015). We specifically wanted to look at the interaction between plasma OT and estradiol in young and old female participants and plasma OT and testosterone in young and old male participants. The extent to which and the nature of these interactions had no expectations prior to data analysis.

METHODS AND MATERIALS

Participants

A total of 105 healthy volunteers participated in the study, comprising 51 young (M = 22.4 years, SD = 2.99, 18–31, 47% female) and 54 old (M = 71.2 years, SD = 4.92, 63–81, 56% female) white, English-speaking adults. Older participants scored > 30 on the Telephone Interview for Cognitive Status (TICS; Brandt et al., 1988). Participants were recruited through mailouts and fliers in the community and on campus, and were screened for physical and cognitive health via self-report during an initial phone contact and via blood draw and health review under the supervision of a clinical practitioner at the start of the in-person visit. Among the exclusion criteria were pregnancy (as confirmed with pregnancy testing), breastfeeding, psychological disorder, severe or progressive medical illness, excessive smoking or drinking, as well as known allergies to oxytocin. Participants were instructed to stay well hydrated before their visit but to abstain from smoking, caffeine, alcohol, and use of recreational drugs in the 24 hours, and from food, exercise, or engagement in sexual activity in the two hours, leading up to their appointment. All test sessions took place in the mornings, typically starting around 8AM, to control for diurnal variation in OT (Amico et al., 1989; Gordon et al., 2010; Feldman et al., 2010).

We recorded the date of participants' last menstruation, oral contraception use, and hormone replacement therapy. All older women were postmenopausal, whereas all young women were premenopausal. 92% (22 out of 24) young women were in the luteal phase of their menstrual cycle. Meanwhile, one older man and one older woman were currently on hormone replacement therapy (HRT). In addition, seven young women were currently on oral contraception.

Procedures and Measures

Reported data were part of a larger project; only variables analyzed in the present context are described. Test sessions took place at the Institute on Aging, University of Florida medical campus, and were conducted by trained research staff. After informed consent, participants completed a self-report questionnaire asking about their stress levels on the day of the experiment, the amount of sleep they were able to get the night before, exercise, physical contact (human or pet), sexual activity, food, caffeine, or alcohol consumption within the last 24 hours, current medications, whether they were running a fever, or had experienced any atypical or upsetting events immediately before coming to the experiment. This was followed by a brief self-report health review covering all major bodily systems (i.e., eyes, ears, nose, throat, pulmonary, genito-urinary, gastrointestinal, central nervous system, mental health, heart/vascular, musculo/skeletal). Participants underwent a blood draw conducted by a professional nurse for screening purposes (basic metabolic panel) and to determine baseline plasma OT, calcium, and glucose levels. At the end of the study session, a brief consultation with the clinical practitioner took place to go over current health and health history. As part of a larger project, participants came back for a second study visit, reported elsewhere. Participants were reimbursed at the end of this additional visit. The Institutional Review Board at the University of Florida approved the study protocol.

Blood Draw Processing

Six mL blood was drawn into EDTA plasma tubes. Upon filling, samples were inverted five times, and stored on ice. Samples were immediately centrifuged at 1600 x g for 15 minutes at 4oC, aliquoted, and stored in a -80oC freezer. Samples were thawed at room temperature immediately before assays. Plasma OT was measured using an Enzyme Immunoassay (EIA) purchased from Enzo Life Sciences, Inc. (Farmingdale, New York). The assays were performed according to the manufacturer's instructions. The plasma was diluted in assay buffer (at a ratio of 1:8 for the OT assay) to give results reliably within the linear portion of the standard curve. The EIA has been reported by the manufacturer to be highly sensitive [minimal detection rate = 15.6 picogram per millilitre (pg/ml) for OT] with very little antibody cross-reactivity for other neuropeptides. All samples were run at once and the inter- and intra-assay coefficients of variation were less than 8% for OT. Validation of these assays is described elsewhere (Carter et al., 2007).

RESULTS

The results of this research did not concur with the hypotheses.

For the first hypothesis, we looked at the multi-variate interaction tests to analyze the predictability of plasma OT on the intended health factors. The analysis did not yield significant findings for any of the three factors: calcium, glucose, and BMI.

While the results for the first hypothesis were unyielding of significance, it was not the same for the second hypothesis. Bivariate Pearson correlations were conducted to test the second research hypothesis. Separate correlations were analyzed for young males, old males, young females, and old females. Of the four subgroups, two were found to have significance, one was trending toward significance, and one did not result in significance.

There was no significant correlation found between plasma OT and estradiol in young females ($r(24) = 0.04$, $p = .86$). There was a trending correlation found between plasma OT and testosterone in old males ($r(23) = 0.30$, $p = 0.164$). Significance was found in the correlation between plasma OT and testosterone in young males ($r(27) = 0.48$, $p < 0.05$) (Figure 1) and plasma OT and estradiol in old females ($r(30) = 0.39$, $p < 0.05$) (Figure 2).

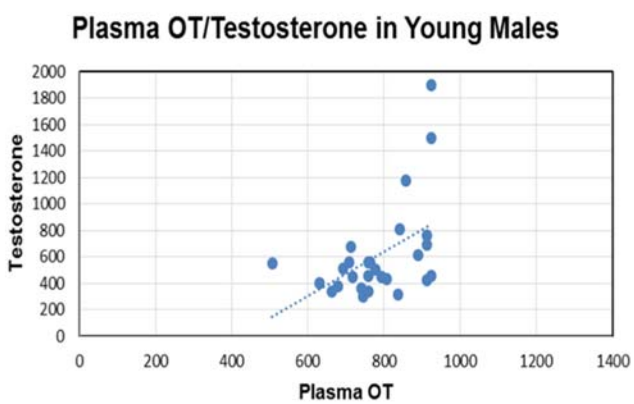

Figure 1. Interaction Between Plasma OT and Testosterone in Young Males

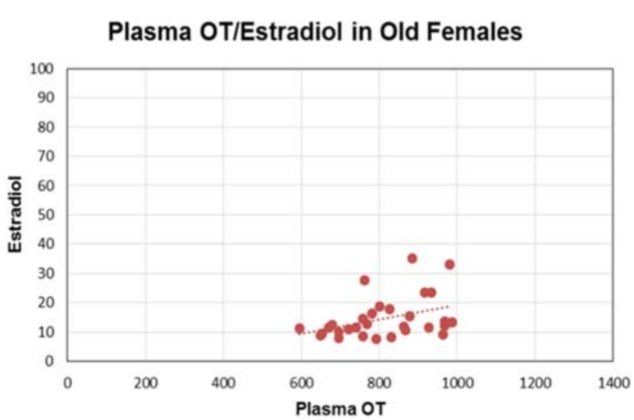

Figure 2. Interaction between Plasma OT and Estradiol in Old Females

DISCUSSION

Through the results of this study, we found some interesting and significant discoveries. The main take away for the first hypothesis was that the results from this research may indicate that baseline OT levels are not as indicative of general health in already healthy participants. Future aims should target samples of less healthy adults to determine associations between baseline plasma OT levels and blood markers, as well as hormone levels in less fit populations.

While running analysis on OT and the health factors, it was found that there was some significance between age/sex and the health factors. This preliminary data and analysis should be considered in future research of aging and health, especially with regards to healthy aging in older adults.

The results from the sex hormones and plasma OT correlations show promise for future developments in OT and aging research. Further analysis of the correlations between OT and testosterone should include the testosterone levels of both young and old female participants alongside the male participants. The same goes for estradiol in young and old men. We believe that there is much future research and discoveries to be made about the interactions between plasma OT and sex hormones.

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