



## Gender Related Relationships Among Salivary Cortisol and Testosterone Hormones and Self-Esteem and Aggressiveness in University Students

Muhammed Jimoh Saka<sup>1</sup>, Sikiru Abayomi Biliaminu<sup>2,3</sup>, Emmanuel Oladipo Sanni<sup>4</sup>,  
Jibril Imran<sup>5</sup>, Imoleayo Oyeniran Oluwatosin<sup>6</sup>, Senol Dane<sup>6\*</sup>

<sup>1</sup>Department of Epidemiology and Community Health, University of Ilorin, Ilorin, Nigeria

<sup>2</sup>Department of Chemical Pathology and Immunology, University of Ilorin, Ilorin, Nigeria

<sup>3</sup>Department of Chemical Pathology and Immunology, Nile University of Nigeria, Abuja, Nigeria

<sup>4</sup>Department of Hematology, Faculty of Basic Clinical Sciences, Nile University of Nigeria, Abuja, Nigeria

<sup>5</sup>Department of Medical Microbiology, Faculty of Basic Clinical Sciences, College of Health Sciences, Nile University of Nigeria, Abuja, Nigeria

<sup>6</sup>Department of Physiology, Faculty of Basic Medical Sciences, College of Health Sciences, Nile University of Nigeria, Abuja, Nigeria

### ABSTRACT

*Introduction: In animals, there is a strong positive relationship between testosterone and aggression. However, in humans, especially in adolescents, reports are less consistent. This study aims to investigate the gender related relationships among salivary cortisol and testosterone hormones and self-esteem and aggressiveness in university students.*

*Materials and Method: A total of 91 Nigerian university students were involved in the study. Participants were 23 men and 68 women who were 17-25 years of age. Salivary assay of cortisol and testosterone were done using Enzyme-linked Immunosorbent Assay Kits. The Rosenberg Self-esteem Scale was used to screen for self-esteem. Aggression scale was used to assess the points associated with aggressiveness.*

*Results: Men had higher salivary cortisol, testosterone levels and aggressiveness score compared to women. There were positive correlations between salivary cortisol and salivary testosterone and between salivary testosterone and aggressiveness score in total sample. Also, there was positive correlation between salivary testosterone and aggressiveness in male subjects and there was positive correlation between salivary cortisol and salivary testosterone in female subjects.*

*Conclusion: Low aggressiveness in female subjects can be due to the positive correlation between cortisol and testosterone or the parallel secretion of these two hormones by adrenal cortex. It can be stated that cortisol has a moderating effect on the relationship between testosterone and aggression in especially female subjects. Also, it can be stated that cortisol inhibits the positive enhancing effect of testosterone on aggressiveness in women.*

**Key words:** Cortisol, Testosterone, Self-esteem, Aggressiveness

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**Corresponding author:** Senol Dane

**e-mail** ✉: senol.dane@nileuniversity.edu.ng

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### INTRODUCTION

Cortisol is the main glucocorticoid and catabolic hormone secreted from the adrenal cortex

in humans. Exercise as a physical stressor increases the secretion of cortisol [1]. Most of effects of cortisol occur after exercise during the early recovery [2]. Testosterone is a key anabolic hormone with multiple physiological functions in the human body. Testosterone has especially important role in the growth of skeletal muscle and bone, and in the proliferation of red blood cells in the bone marrow [3]. Low intensity

exercise if prolonged enough in duration can increase testosterone level [4], the same is true for cortisol [5].

Self-esteem refers to feelings of one's personal self-worth [6]. Self-esteem is a criterion about person's evaluation about his or her own worth. Self-esteem is defined as one's overall subjective emotional thinking of his or her own worth. Also, self-esteem was defined as our thoughts about ourselves, as well as our positive or negative evaluations [7]. Self-esteem is an important indicator of some characteristics, such as school success [8], happiness [9], achievement in marriage and other relationships [10], and criminal behavior [10]. There are many synonyms of self-esteem such as self-worth, self-regard, self-respect, and self-integrity.

Aggressiveness refers to destructive behavior that can cause inconvenience for others. The aggression scale used in the present study was developed by Orpinas, et al. in 2013 [11]. Testosterone is especially important in determining aggression and self-confidence. It has been reported that acute testosterone changes in men are positively correlated with aggressiveness for people with more independent self-construal, whereas basal testosterone is negatively associated with aggression for individuals with more interdependent self-construal [12]. It is suggested that self-construal is important role in moderating the association between testosterone and aggression.

In a recent study, sex, age, and body weight and education level and department is not important in modulation of self-esteem in African university students. However, left-preferent students had higher self-esteem scores compared to right-preferent ones [13]. Also, in a previous study, testosterone replacement had neither detrimental nor beneficial effects, compared to placebo, on measures of quality of life, self-esteem, and several measures of mood in women with primary ovarian insufficiency despite significant elevations of serum testosterone levels during treatment [14].

In the present study, gender related relationships among salivary cortisol and testosterone hormones and self-esteem and aggressiveness in university students were investigated.

## MATERIALS AND METHODS

### Participants

Students (ninety-one) who had classes at the time of the study were approached and requested to participate in the study. All of them accepted to participate in this study (23 men, average age=21.34 years, standard deviation, SD=1.78; 68 women, average age=20.85, SD=2.31). They were all students of the Faculty of Basic Medical Sciences at Nile University of Nigeria, a private tertiary institution in Abuja, Nigeria. The age of the participants was not different statistically by sex.

The experimental protocol was by following international ethical standards. The study was performed per under the Helsinki Declaration (1975, revised in 1996-2013) [15]. It was a descriptive cross-sectional study. The aims and objectives of the study were explicitly explained to the participants before the commencement of the study. All participants voluntarily gave written informed consent to participate in the study. The study was anonymous. A paper- and pencil-based method of filling questionnaires was utilized. Participants were administered the Rosenberg Self-esteem Scale to get a self-esteem score. The study was made between January 2020 and March 2020.

### Inclusion criteria

Willingness to participate.

Only students could participate.

Only undergraduate students studying were included in the study.

### Exclusion criteria

The study excluded participants that were not willing to be involved.

Students with a hormonal flux such as menstruation

Students with respiratory, metabolic, cardiac, psychiatric, or central and autonomic nervous system disease that might change the self-esteem, aggressiveness and salivary testosterone and cortisol levels were not involved.

### Saliva collection

Participants were asked not to eat, drink, smoke or chew gum for 30 minutes before taking the saliva samples and not to remove the plastic film from the funnel lid that contains the clear

liquid and then to spit into the open funnel until the amount of saliva (not bubbles) reaches the fill line. The passive drool method was used for saliva collection at 9:00 am. This method was used because it is both cost-effective and approved for use with almost all analytes and maintains sample integrity [16,17]. For most participants, to fill the tube took 2 to 5 minutes. To avoid problems with analyte retention or the introduction of contaminants validated polypropylene vials of 2 ml cryovials were used for collection. Vials were sealed tightly and stored frozen at -20°C pending analysis within five days.

**Measurements of salivary cortisol and testosterone**

Measurements of the salivary cortisol [18] and testosterone [19] were done using Enzyme-linked Immunosorbent Assay Kits manufactured by Monobind Inc. Lake Forest, CA 92630, USA and supplied by NUMS Diagnostics Nigeria Limited, Suleja, Niger State, Nigeria.

**Assessment of self-esteem**

Rosenberg Self-esteem Scale [20] was used to assess the points associated with self-esteem. The reliability and validity of Rosenberg Self-esteem Scale have been well demonstrated [21,22]. The participants were asked to rate the degree to which they agree with each of the statements using a five-point Likert rating scale that ranges from “strongly agree” to “strongly disagree.”

**Assessment of aggressiveness**

The Aggression Scale developed and validated by Orpinas, et al. was used to assess the points associated with aggressiveness [11]. The participants were asked the number of behaviors

in each question during the last 7 days using a seven-point Likert rating scale that ranges from “zero times” to “6 or more times.”

**Statistical analyses**

Measured values are given as a mean ± standard deviation. Statistical analysis was performed by using SPSS for Windows (version 20) statistical program. Student’s t-test (independent sample test) and Pearson correlation tests were used. A p-value less than 0.05 was considered significant.

**RESULTS**

In the present study, there were statistically significant gender related differences in salivary cortisol, testosterone levels and in aggressiveness score but not in self-esteem. Men had higher salivary cortisol (t=2.325, p=0.02), testosterone (t=2.923, p=0.04) levels and aggressiveness score (t=2.334, p=0.02) compared to women (Table 1).

In total sample, there were statistically significant positive Pearson correlations between salivary cortisol and salivary testosterone (r=0.24, p=0.02) and between salivary testosterone and aggressiveness score (r=0.23, p=0.03) (Table 2).

In male subjects, there was statistically significant positive Pearson correlation between salivary testosterone and aggressiveness (r=0.54, p=0.01) (Table 3).

In female subjects, there was statistically significant positive Pearson correlation between salivary cortisol and salivary testosterone (r=0.43, p=0.00) (Table 4).

**Table 1: The gender related differences in the salivary cortisol and testosterone levels and self-esteem and aggressiveness scores in university students.**

	Men	Women	t	p
Cortisol	19.595 ± 5.849	17.128 ± 3.554	2.325	0.02
Testosterone	4.247 ± 4.208	2.035 ± 2.128	2.923	0.04
Self-esteem	17.6 ± 6.047	19.309 ± 4.637	1.348	0.18
Aggressiveness	12.35 ± 10.688	6.853 ± 5.812	2.334	0.02

**Table 2: The pearson correlations among salivary hormone levels (cortisol and testosterone) and self-esteem and aggressiveness scores in total sample.**

	Cortisol	Testosterone	Self-esteem	Aggressiveness
Cortisol	-	r=0.24, p=0.02	r=0.08, NS	r=0.01, NS
Testosterone	r=0.24, p=0.02	-	r=0.05, NS	r=0.23, p=0.03
Self-esteem	r=0.08, NS	r=0.05, NS	-	r=0.14, NS
Aggressiveness	r=0.01, NS	r=0.23, p=0.03	r=0.135, NS	-

**Table 3: The Pearson correlations among salivary hormone levels (cortisol and testosterone) and self-esteem and aggressiveness scores in male subjects.**

	Cortisol	Testosterone	Self-esteem	Aggressiveness
Cortisol	-	r=0.06, NS	r=0.12, NS	r=0.02, NS
Testosterone	r=0.06, p=0.02	-	r=0.19, NS	r=0.54, p=0.01
Self-esteem	r=0.12, NS	r=0.19, NS	-	r=0.24, NS
Aggressiveness	r=0.12, NS	r=0.54, p=0.01	r=0.24, NS	-

**Table 4: The Pearson correlations among salivary hormone levels (cortisol and testosterone) and self-esteem and aggressiveness scores in female subjects.**

	Cortisol	Testosterone	Self-esteem	Aggressiveness
Cortisol	-	r=0.43, p=0.00	r=0.04, NS	r=0.07, NS
Testosterone	r=0.43, p=0.00	-	r=-0.17, NS	r=0.09, NS
Self-esteem	r=0.04, NS	r=0.18, NS	-	r=0.15, NS
Aggressiveness	r=0.07, NS	r=0.09, NS	r=0.15, NS	-

**DISCUSSION**

The aim of the current study was to investigate the relationship between testosterone, cortisol, and self-esteem and aggressiveness in female and male university students. In the present study, there were gender related differences in salivary cortisol, testosterone levels and in aggressiveness score but not in self-esteem. Men had higher salivary cortisol, testosterone levels and aggressiveness score compared to women. Also, there were positive correlations between salivary cortisol and salivary testosterone and between salivary testosterone and aggressiveness score in total sample. Besides, there was positive correlation between salivary testosterone and aggressiveness in male subjects and there was positive correlation between salivary cortisol and salivary testosterone in female subjects. These findings provide support for the hypothesis that cortisol exerts a moderating effect on the relationship between testosterone and aggression in especially female subjects [23]. It can be stated that cortisol inhibits the positive enhancing effect of testosterone on aggressiveness in women because of a positive correlation between salivary cortisol and salivary testosterone in female subjects but not in male subjects.

In a recent study, there was a negative correlation between testosterone and depression in only men, but not in the total sample and women. There were significant positive correlations between depression and alexithymia scores in the total sample and women, but not in men [24]. They concluded that high depression in female healthy university students is may be due to social, cultural, and ecological factors, but

not hormonal (cortisol and testosterone) factors [25,26].

Previous results demonstrate pharmacological levels of cortisol have a highly significant negative effect on circulating testosterone concentrations [27, 28]. However, the findings of another study [29] indicated a significant negative relationship between cortisol and total testosterone in exercise and a significant positive relationship between cortisol and free testosterone following exercise; possibly due to an adrenal cortex contribution of free testosterone or disassociation of free testosterone from sex hormone binding globulin. They suggested that the in vivo relationships between cortisol and testosterone were associative and not causal in nature.

**CONCLUSION**

Low aggressiveness in female subjects can be due to the positive correlation between cortisol and testosterone or the parallel secretion of these two hormones by adrenal cortex. It can be stated that cortisol has a moderating effect on the relationship between testosterone and aggression in especially female subjects. Also, it can be stated that cortisol inhibits the positive enhancing effect of testosterone on aggressiveness in women.

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