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Gender-related Differences in Correlations among BMI, Salivary Testosterone and Cortisol and Depression and Alexithymia Scores in University Students

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ABSTRACT

Introduction: Women have high anxiety and depression incidence compared to men. In the present study, gender-related differences in correlations among BMI, salivary testosterone and cortisol and depression and alexithymia scores in university students.

Methods: A total of 88 Nigerian university students were involved in the study. Participants were 20 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 Self-Reporting Questionnaire (SRQ) 20 adapted from WHO was used to screen for depression. Toronto Alexithymia Scale was used to assess the points associated with alexithymia.

Results: In the present study, there was a significant 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.

Discussion: The gender difference in the relation of salivary testosterone with depression showed again that gender is a very important factor in behavioral studies including depression. It can be stated that testosterone can be an important hormonal factor to prevent or decrease depression or depressive thoughts in men but not in women. The positive correlations between depression and alexithymia scores suggest that high depression in female university students is related to social and environmental factors, but not low testosterone.

Conclusion: These results suggest 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.

Key words: BMI, Gender, Depression, Alexithymia, Salivary testosterone, Salivary cortisol

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INTRODUCTION

Women have mood disorders including anxiety and depression more than twice compared to men [1,2]. This gender-related difference indicates a potential role for gonadal hormones in the pathophysiology of mood abnormalities. It has been well known that women are more likely to experience mood disturbances, anxiety, and depression during times of hormonal flux, such as puberty, menopause, premenstrual and post-partum periods [3,4]. While hormonal flux in females increases the frequency of mood disturbances, some studies in males suggest that testosterone has some protective effects against anxiety and depression. The impact of androgen levels, androgen replacement therapy and pharmacologic androgen deprivation on depression and depressive symptoms are active

areas of investigation. Recent studies reported that testosterone replacement therapy in men with low testosterone may improve depression and androgen deprivation therapy in men with prostate cancer may cause depression [5]. In soldiers, both high testosterone and cortisol were protective in controlling for pre-deployment depression; whereas CO_2 inhalation-stress-reactivity measures of these hormones had depress genic effects that were amplified by pre-deployment depression [6].

In a recent study, there were no significant differences in anxiety prevalence in premenopausal obese women compared with normal-weight controls and both obesity and anxiety were associated with the high testosterone. However, women with anxiety symptomatology had non-significantly higher estradiol levels than women without anxiety symptomatology, whereas obesity was associated with lower estradiol levels compared with those in the normal-weight group. Women with anxiety symptomatology had also significantly higher testosterone and estradiol composition [7].

It has been believed that the salivary testosterone represents extracellular hormone levels, thereby providing an alternative to serum free testosterone in the assessment of androgen status. In contrast to the collection of serum, the salivary testosterone is not invasive and expensive; the collection of saliva is relatively straightforward and requires minimal training. The measurement of salivary testosterone is a reliable and accurate method [8]. A validation study comparing samples from the same individuals found that salivary testosterone in adult men and women was correlated more strongly with calculated serum free testosterone than serum total testosterone [9] and was also unaffected by variations in sex hormone-binding globulin [10]. The physiological and health-related behavioral correlates of the salivary testosterone have not yet been explored [11].

While some recent studies were consistent with the hypothesis in which low testosterone is associated with the high risk of depression in especially men [12,13] and some studies reject this relationship [7,14]. The gender-related relationships between testosterone and cortisol hormone levels and depression and alexithymia have not been unequivocally established. To this end, this study was conducted to investigate the gender-related relations among BMI, salivary testosterone and cortisol and depression and alexithymia scores in university students.

METHODS

Participants

Students (eighty-eight) 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 (20 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). 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 Self-Reporting Questionnaire (SRQ-20) to get a depression score. All questionnaires were distributed only among first-year students on the university campus. The study was made between September 2019 and November 2019.

Inclusion criteria

1. Willingness to participate.
2. Only students were allowed to participate.
3. Only undergraduate students studying were included in the study.

Exclusion criteria

1. The study excluded participants that were not willing to be involved.
2. Students with a hormonal flux such as menstruation
3. Students with respiratory, metabolic, cardiac, psychiatric or central and autonomic

nervous system disease that might change the depression, alexithymia, and salivary testosterone and cortisol levels were not involved.

Measurement of weight

Weights were measured in all participants using a WHO standardized weighing scale. Calibration was normally done at the beginning and end of each examining day by balancing with both sliding weights at zero and the balance bar aligned. The scale was checked using the standardized weights and calibration was corrected if the error is greater than 0.2 kg. Participants were asked to remove their heavy outer garments (jacket, coat, trousers, skirts, etc.) and shoes. The participant stands in the center of the platform; weight distributed evenly to both feet as standing off-center may affect the measurement. The weights were moved until the beam balances (the arrows are aligned). The weights were recorded to the resolution of the scale (the nearest 0.1 kg or 0.2 kg).

Measurement of height

Height measurement was done for all the participants using a WHO standardized stadiometer. At the beginning and end of each examination day, the height rule was checked with standardized rods and corrected if the error is greater than 2 mm. Each participant was asked to remove his or her footwear (shoes, slippers, sandals, etc.), headgear (hat, cap, hair bows, comb, ribbons, etc.). The participant was asked to stand on the board facing the researcher, with the feet together, heels against the backboard, knees straight at the same time asking the participant to look straight ahead and not lookup. It was made sure that the eyes were at the same level as the ears. The measuring arm was moved gently down onto the head of the participant and the participant asked to breathe in and stand tall. The height was read in centimeters at the exact point while asking the participant to step away from the measuring board. The height measured was recorded in centimeters.

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 8:00 am. This method was used because it is both cost-effective and approved for use with almost all analytes and maintains sample integrity [15, 16]. 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 [17] and testosterone [18] 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 depression

The English version of a structured self-administered World Health Organization's questionnaire (Self Reporting Questionnaire, SRQ-20) was used to collect the data on depression [19,20]. The SRQ-20 was developed and validated for international use. Compared to other scales for analysis of depression, the SRQ-20 has better validity and is widely used to assess depression among University students [21,22]. The SRQ-20 scale includes 20 dichotomous (yes/no) questions asking whether participants experienced symptoms of anxiety, depression, or somatic symptoms during the last 30 days before the study [21,22].

Assessment of alexithymia

Toronto Alexithymia Scale [23] was used to assess the points associated with alexithymia. Its reliability and validity have been well-demonstrated in adults by Lee et al. in 1996 [24] and in adolescents by Seo et al. in 2009 [25]. Volunteers 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."

Statistical analyses

Measured values are given as a mean +/- standard deviation (SD). Statistical analysis was performed using SPSS for Windows version 18. The Pearson correlation analysis was used. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In the total sample, male and female subjects, there were no significant correlations between BMI and other parameters (salivary testosterone and cortisol levels, depression and alexithymia scores).

There were statistically significant positive Pearson correlations between testosterone and cortisol levels in the total sample, men and women (total sample: r=0.341, p=0.001; men: r=0.403, p=0.04; women: r=0.321, p=0.008) (Table 1). There was a statistically significant negative Pearson correlation between testosterone and depression in only men (r=-0.502, p=0.024), but not in the total sample and women. In the total sample, male and female subjects, there were no significant correlations between salivary cortisol and other parameters (BMI, depression and alexithymia scores), except salivary testosterone. There were statistically significant positive Pearson correlations between depression and alexithymia scores in the total sample and women (total sample: r=48, p=0.00; p=0.04; women: r=589, p=0.00) (Table 1).

DISCUSSION

Decreased testosterone is associated with lots of symptoms such as the decrease in libido, erectile dysfunction, increased fat store, decreased muscle mass, decreased energy expenditure and depression [26]. The relationship between depression and testosterone levels is complex because a lot of health conditions including HIV/AIDS, and obesity, stress, smoking, and alcohol abuse are independently related to depression and testosterone level. While the literature does not support a consistent relationship between testosterone levels and depressive symptoms, most studies suggest that lower testosterone levels are associated with depressive symptoms [26,27].

In the present study, there was a significant negative correlation between testosterone and depression in only men, but not in the total sample and women. This gender difference showed again that gender is a very important factor in behavioral studies including depression and school achievement. Previous studies reported the higher depression scores in female than in male subjects [28-30]. It can be stated that testosterone can be an important hormonal factor to prevent or decrease depression or depressive thoughts in men but not in women. Another gender-related difference about depression was reported that there was a negative correlation between Grade Point Average (GPA) and depression score in men and a positive correlation in women [31].

The major challenges of efforts to reveal biological risk factors and biomarkers of depression include the complexity of underlying systems, interactions with other systems, and contextual factors governing their expression. Altered endocrine function is believed to be a central contributor to depression, but across studies, evidence for a link between endocrine markers and depression has been mixed, inconclusive, or conditional [6]. In the present study, there were significant positive correlations between depression and alexithymia scores in the total sample and women, but not in men. That is to

Table 1: Correlation statistics (r and p) among BMI, salivary testosterone, salivary cortisol, depression score, alexithymia score.

	Testosterone	Cortisol	Depression	Alexithymia
Total Sample (N=88)				
BMI	0.022, 0.839	-0.14, 0.194	-0.044, 0.686	-0.182, 0.09
Testosterone	-	0.341, 0.001	-0.077, 0.478	-0.078, 0.468
Cortisole	0.341, 0.001	-	0.058, 0.593	0.082, 0.45
Depression	-0.077, 0.478	0.058, 0.593	-	0.48, 0.00
Male Subjects (N=20)				
BMI	0.082, 0.73	-0.327, 0.16	-0.029, 0.903	-0.393, 0.087
Testosterone	-	0.403, 0.04	-0.502, 0.024	-0.064, 0.788
Cortisole	0.388, 0.091	-	-0.66, 0.782	0.228, 0.333
Depression	-0.502, 0.024	-0.66, 0.782	-	0.302, 0.195
Female Subjects (N=68)				
BMI	0.014, 0.912	-0.089, 0.472	0.03, 0.806	-0.125, 0.31
Testosterone	-	0.321, 0.008	0.083, 0.501	-0.111, 0.366
Cortisole	0.321, 0.008	-	0.106, 0.391	0.032, 0.799
Depression	0.083, 0.501	0.106, 0.391	-	0.589, 0.00

say, there is a gender-related difference in this relationship too. A recent study supported this gender difference in which alexithymia score was higher in female than in male subjects [32]. Previous reports support the relationships between alexithymia and depression [33,34]. The results of the present study and a previous study [34] may designate that the primary (independent factor) is alexithymia and the dependent factor is depression in the relation between depression and alexithymia because there was no significant correlation between testosterone and alexithymia scores in the total sample, men and women.

In a recent study, it has been reported that partnered adults tend to have lower risks of depression than do single individuals, while parents are more commonly depressed than non-parents [35]. Men's and women's depression prevalence did not vary based on testosterone [35]. Partnered fathers had lower testosterone than single (never married, divorced) non-fathers, but were less commonly depressed than those single non-fathers. High testosterone, high socioeconomic status fathers had the lowest prevalence of mild depression, whereas low testosterone, low socioeconomic status non-fathers had the highest. Compared to other mothers, low socioeconomic status; low testosterone mothers had an elevated prevalence of mild depression. Overall, low socioeconomic status, high testosterone non-mothers had substantially elevated depression risks compared to other women. They suggested that depression is influenced by the social (e.g. partnering and parenting status; socioeconomic gradients), cultural (e.g. gender and family life domains), and ecological (e.g. the lived environment, particularly related to low socioeconomic status and poverty) contexts in which individuals find themselves [35].

Additionally, there were significant positive correlations between salivary cortisol and salivary testosterone in the total sample, male and female subjects in the present study. These well-known relations between cortisol and testosterone suggest that hormone analyses in the present study are correct or reliable. Also, in the total sample, male and female subjects, there were no significant correlations between salivary cortisol and other parameters (BMI, depression and alexithymia scores), except salivary testosterone. These results suggest that high depression in female healthy university students [30] is maybe due to social, cultural, and ecological factors [35], but not hormonal (cortisol and testosterone) factors.

CONCLUSION

These results suggest 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.

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