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Relationship Between Obesity and Cortisol Among Young Adult Males in Ekpoma, Edo State

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Abstract

This is a cross sectional study aimed at evaluating the relationship between obesity and cortisol among young adult males in Ekpoma; the administrative head quarter of Esan West Local Government Area of Edo State. In a bid to achieved this objective, 325 adult male subjects (20 and 40 years) were recruited via simple random sampling techniques after approval by the Ambrose Alli University Health Research Committee (Registration no; NHREC/12/06/2013). Those who met the inclusion criteria completed a questionnaire and blood sample obtained (2-3ml) for the determination of serum level of cortisol following compliance with the declaration on the right of the subject. The results showed that the mean BMI of the studied population was 26.51±3.83 Kg/m^2. There was a significant difference in BMI values between these with normal BMI (22.23±1.97 Kg/m^2), over-weight (27.01±1.20 Kg/m^2) and obese (31.58±1.96 Kg/m^2). The mean serum cortisol in the adult male was 33.81±12.92 ng/dl. Comparatively, those with normal BMI presented the highest cortisol level (35.10±12.08 ng/dl) with a non-significant decrease ($p>0.05$) in the overweight group (33.42±13.44 ng/dl) and the obese group (32.75±13.06 ng/dl). There was very weak negative correlation ($r = - 0.022$) between BMI and serum cortisol level. Age was observed to have a direct relationship with cortisol as those within 20-25 years has the lowest cortisol level (32.74±13.77 ng/dl), but increases as age increases. From the findings of this study, increasing BMI has a negative impact on serum cortisol levels and this can be influence by age.

Keywords

Obesity, Cortisol, Stress

1. Introduction

Obesity is defined by body mass index (BMI) and further evaluated in terms of fat distribution via the waist–hip ratio and total cardiovascular risk factors [1]. BMI is closely related to both percentage body fat and total body fat. BMI is defined as the subject's weight divided by the square of their height. Increased hypothalamo-pituitary-adrenal axis drive has been reported in obese subjects but with paradoxically low or normal levels of plasma cortisol [2].

Studies have shown that a wide range of stressful events produce increase in cortisol levels [3], which are thought to improve performance in the short-term by increasing the amount of energy available and in the long-term, by bringing to an end the stress response and revert the organism to homeostasis [4]. On the other hand, exercise and other physical effort events [5] and non-exercise competitions [6], have been reported to also increase cortisol levels. The Cortisol and obesity connection explores the documented levels of the hormone (cortisol), chronic stress, and such health conditions as obesity [7]. Cortisol directly affects fat storage and weight gain in stressed individuals [8]. Tissue cortisol concentrations are controlled by a specific enzyme that converts inactive cortisone to active cortisol [8].

The aim of this study is to determine the relationship between obesity and Cortisol among young adult males in Ekpoma, Edo State, Nigeria. The Specific objective of the study is to determine the influence of age, BMI on serum levels of cortisol.

2. Materials and Methods

2.1. Study Design

This study is a cross sectional descriptive study.

2.2. Study Area

The study was conducted in Ekpoma, the administrative Head Quarter of Esan West Local Government Area of Edo State, Nigeria. This area lies between latitudes 60 43′and 60 45′ North of the Equator and longitudes 60 6′and 60 8′ East of the Greenwich Meridian [9]. With the recent population census, its population is estimated at 125,842 (63,785 males and 62,057 females) inhabitants.

2.3. Study Population

Young adults between the ages of 20 - 40 years were used in this study. This age group, in particular the males, are always involve in various physical and mental activities. In this community and many others, this is the age group were the foundation for feature economic power is laid. Activities relating to cortisol may be more widely influenced in this group.

2.4. Sampling Techniques

Simple random Sampling techniques was use in the study, were the subjects were picked randomly and entirely by chance, such that each subject has the same probability of being chosen at any stage during the sampling process. Following the simple random techniques, apparently healthy young male adult within the ages of 20 - 40 years who are resident of the study area (Ekpoma) were recruited.

2.5. Sample Size

Sample size were determined by the formula $n=Z^2 (P) (1-P) /e^2$ [10].

Where n = Sample size

Z= 95% confidence level were considered which is equivalent to 1.96 Z score

P = 30% which is the estimated prevalence of obesity in the study population.

e = 5% level of error precision were used, and it is equivalent to 0.05

$= (1.96)^2 (0.3)(1- 0.3) /(0.05)^2 = 3.8416 \times 0.3 \times 0.7 / 0.05^2$

$0.806736 / 0.0025 = 323$

323 participants were to be involved in the study. However, 325 subjects were sampled.

2.6. Ethical Consideration

The studies were conducted in compliance with the declaration on the right of the patient [11]. Before involvement in the study, an ethical approval with Registration no; NHREC/12/06/2013, was obtained from Ambrose Alli University Health Research Committee, and informed consent was obtained from all participants.

2.7. Inclusion and Exclusion Criteria

Only apparently healthy sampled young adult male subject within the ages of 20 - 40 years, who are resident of Ekpoma was used in the study. Subjects on drugs were excluded from the study.

2.8. Method of Sample Collection and Analysis

Questionnaire (consisting of close and open ended questions) were administered for data. Also, body weight, height, other selected body measurements and blood sample were collected using standard laboratory procedures. The administered questionnaires contain relevant data such as age, height, weight, waist size, occupation, of the subject. Measurement of participants weight (kg) using a standard electronic scale and height (m^2) were measured using a portable standiometer. Blood samples were obtained from the subject within the hour of 7 - 11am daily until the required numbers of the samples were complete. Following standard laboratory procedures, the blood samples were analysed for serum cortisol levels by ELISA.

2.9. Principles of Cortisol Measurement by ELISA

The cortisol (Antigen) in the sample competes with the antigenic cortisol conjugate with horseradish peroxidase (HRP) for binding to the limited number of antibodies anti-cortisol coated on the micro-plates (Solid phase). After incubation, the bond/free separation is performed by a simple solid -phase washing. The enzyme HRP in the bound-fraction reacts with the substrate (H_2O_2) and the TMB substrate and develops a blue color that change into yellow when the stop solution (H_2SO_4) is added. The color intensity is inversely proportional to the cortisol concentration in the sample. The cortisol concentration is then calculated through a calibration curve.

2.10. Data Analysis

The data were analyzed using the statistical package for social sciences (SPSS) version 19 software. Simple descriptive statistics (Frequencies and Percentages), as well as Pearson moment correlation were used to analyze the data. These statistical tests were performed at 95% confidence interval and value $P < 0.05$ was considered significant.

3. Results

3.1. Age Distribution of Adult Male That Participated in the Study

Table 1 shows the frequency distribution of age in the sampled male population that took part in the study. Although the mean age was 29.33±6.17 years, majority (32.6%) fall between the ages of 26 and 30 years with a mean age of 27.34±1.34 years. This was followed by those within the ages of 20 and 25 (30.20%) with a mean age of

22.69±2.09 years and then those within the ages of 36 and 40 years (24.90%) with a mean age of 37.96±1.69 years and the minority (12.3%) were within the ages of 31 – 35 with a mean age of 33.40±1.37 years. Statistically there was a significant difference ($p<0.05$) in the mean ages between the different group.

3.2. Body Mass Index Distribution of Adult Male That Participated in the Study

Table 2 shows the frequency distribution of BMI in the sampled male population that took part in the study. The mean BMI of the studied population was 26.51±3.83Kg/m^2. Based on BMI classification, 32.3% had normal BMI (18.5-24.9 Kg/M^2) with a mean BMI of 22.23±1.97Kg/m^2, while 44.9% were over-weight (BMI 25-29.9 Kg/M^2) with a mean BMI of 27.01±1.20Kg/m^2 and the remaining 22.8% were obese (BMI greater than 30.0Kg/M^2) with a mean BMI of 31.58±1.96Kg/m^2 (see Table 2). Statistically, there was a significant difference ($p<0.05$) in the mean BMI between groups.

3.3. Relationship Between Age and BMI of Adult Male That Participated in the Study

Table 3 is a cross-tabulation showing the relationship between age and BMI. The results in the table illustrate that increase in age resulted in an increase in BMI. While the increase in age was statistically significant ($p<0.05$), the increase in BMI was also statistically significant ($p<0.05$) between the groups. The relationship between age and BMI was a weak positive correlation ($r = 0.280$).

3.4. Effect of Age on Cortisol Level in Adult Male

Table 4 showed the effect of age on serum cortisol level in the study population. The mean serum Cortisol was 33.81±12.92. The youngest age group (20-25 years) had the lowest cortisol level (32.74±13.77) but increases as age increases and this was followed by the next age group but then decreases slightly by age 36 to 40 years. On the relationship between age and serum cortisol, as age increased, serum cortisol level also increase except in the age group 36 to 40 years where a decrease was observed. The differences in serum cortisol levels between the ages were not significantly different ($p>0.05$), even though there was a significant difference ($p<0.05$) in age. A weak positive correlation ($r = 0.035$) was observed between age and cortisol level.

3.5. Effect of BMI on Serum Cortisol Level in Adult Male

Table 5 showed the influence of BMI on serum cortisol level among adult male who participated in the study. The mean serum cortisol in the adult male in this studied was 33.81±12.92. The normal BMI group (35.10±12.08) presented the highest cortisol level and this was followed by the overweight group (33.42±13.44) and then the obese group (32.75±13.06) who had the lowest serum cortisol level. We observed a weak negative correlation ($r = - 0.022$) between BMI and serum cortisol. The correlation between BMI and serum cortisol level in the adult male here in studied was a very weak negative correlation ($r = - 0.022$).

Table 1. *Frequency distribution of age and mean age.*

	Variables	Frequency	Percentage (%)	Mean age within groups	Mean±SD
Age (years)	20 -25	98	30.20	22.69±2.09^a	29.33±6.17
	26 – 30	106	32.60	27.34±1.34^b	
	31 – 35	40	12.30	33.40±1.37^c	
	36 – 40	81	24.90	37.96±1.69^d	

All values are expressed as mean ± standard deviation (SD). Means in a column with different superscripts are significantly different at the p<0.05 level.

Table 2. *Frequency distribution of BMI and Mean BMI.*

	Variables	Frequency	Percentage (%)	Mean BMI with group	Mean±SD of BMI
BMI (kg/M^2)	18.5-24.9	105	32.30	22.23±1.97^a	26.51±3.83
	25-29.9	146	44.90	27.01±1.20^b	
	>30.0	74	22.80	31.58±1.96^c	

All values are expressed as mean ± standard deviation (SD). Means in a column with different superscripts are significantly different at the p<0.05 level.

Table 3. *Cross-tabulation between age and BMI.*

Variable	Variable	Frequency	Mean±SD Age (years)	Mean±SD BMI (Kg/M^2)
Age (years)	20 -25	98	22.69±2.09^a	25.32±3.42^a
	26 – 30	106	27.34±1.34^b	26.23±3.87^a
	31 – 35	40	33.40±1.37^c	26.44±4.05^a
	36 – 40	81	37.96±1.69^d	28.34±3.51^b
BMI (Kg/m^2)	18.5-24.9	105	26.95±5.07^a	22.23±1.97^a
	25-29.9	146	29.84±6.13^b	27.01±1.20^b
	>30.0	74	31.72±6.60^c	31.58±1.96^c

All values are expressed as mean ± standard deviation (SD). Means in a column with different superscripts are significantly different at the p<0.05 level.

Table 4. *Effect of age on serum cortisol level in the study population.*

	Variable	Frequency	Mean Age within groups	Mean cortisol within groups	Mean±SD cortisol
Age (years)	20 -25	98	22.69±2.09^{a}	32.74±13.77^{a}	33.81±12.92
	26 – 30	106	27.34±1.34^{b}	33.87±13.00^{a}	
	31 – 35	40	33.40±1.37^{c}	35.14±10.94^{a}	
	36 – 40	81	37.96±1.69^{d}	34.37±12.78^{a}	

All values are expressed as mean ± standard deviation. Means in a column with different superscripts are significantly different at the p<0.05 level.

Table 5. *Effect of BMI on serum cortisol level in the study population.*

Variable	Variable	Frequency	Mean BMI within groups	Mean Cortisol level within groups	Mean±SD
BMI (kg/M^{2})	18.5-24.9	105	22.23±1.97^{a}	35.10±12.08^{a}	33.81±12.92
	25-29.9	146	27.01±1.20^{b}	33.42±13.44^{a}	
	>30.0	74	31.58±1.96^{c}	32.75±13.06^{a}	

All values are expressed as mean ± standard deviation. Means in a column with different superscripts are significantly different at the p<0.05 level.

4. Discussion

In this study, variations were observed in the serum cortisol with age. Specifically, older subjects have higher mean serum cortisol level than younger subjects (table 4). By implication, age has positive associated with morning serum cortisol level in men. This age-related increase in cortisol levels was supported by findings from several studies, especially regarding nocturnal effect [12 – 17]. While it is known by studies that stressful events produces increase serum cortisol [4], the findings suggest therefore that the age related effect on cortisol might be related to the improve performance in the short term that brings an end to stress response and revert the organism to homeostasis in long term. Specifically, it was observed that serum cortisol level starts to decrease by ages 36-40 years. This finding suggests that higher cortisol in younger adult may be related to the suspected involvement of younger adult in more strenuous activities which is belief to increase the cortisol level between age 20-35 years. It was suggested that while the basal secretion of cortisol remains fairly stable with age, the negative feedback regulation of the Hypothalamic Pituitary Adrenal Axis (HPA-axis) seems to become impaired in older subjects [18]. Thus, the findings in the present study; considering the positive relationship between age and cortisol, is in accordant with this study, and suggest a reduced control function of the HPA-axis to stress with increasing age. This effect is expected to result in a prolonged periods of increased cortisol secretion in response to stress with increasing age and, thus the increased general cortisol levels in older men observed in the present study.

Also a finding of this study, it was observed that age positively correlates with BMI (table 3) and the effect was said to be significant. This finding agrees with the report by Hedley [19], who reported gradual increase in mean body weight and BMI with age in adult life, and reaches the peak values at 50-59 years in both sexes. Furthermore, the cortisol ratio among adult male in the study area ranges from 0.046 to 0.053. Increasing age and decreasing BMI determine serum cortisol level in male.

Based on the observed relationship between age and cortisol and age and BMI, it is expected that BMI will result in a positive correlation with cortisol. However, the finding of this study disagrees with this assertion as BMI negatively correlates with serum cortisol level in male (table 5). This study showed that an increase in BMI resulted in a decrease in adult male serum cortisol levels, which therefore indicate that the activities of cortisol are weakened in obese male. Considering the primary functions of cortisol in fat, protein and carbohydrate metabolism [20], and increased risk of diabetics in obesity may therefore be related to the reduced functions of cortisol in male observed in this study. This assertion correlates with the reports by several investigators that had reported high BMI; as in extreme overweigh and obesity, with increased risk of diabetes [21, 22]. This finding implicate therefore that there is reduce functions of the adrenal gland which secrete cortisol in obese individual; at least in adult male.

Certainly this reduction function of cortisol may be associated with the reason why obesity is associated with a high rate of morbidity and early mortality if left untreated [23, 24]. In line with this fact, it has long been known that central obesity is predictive of other diseases and an altered cortisol ratio is prevalent in people with type 2 diabetes, hypertension and cardiovascular disease that co-exist with obesity. In fact, the role of obesity as a health hazard in adults has been well recognized [25-28] and this study further justified this fact.

5. Conclusion

This study showed that age and BMI have influence on adult male serum cortisol. Specifically, increasing age increases serum cortisol level in the early state but start to reduce cortisol level at age 36. On the other hand, increasing BMI reduces cortisol level in adult male. Interestingly, increasing age and obesity seem to be determinants of low serum cortisol ratio with age showing greater influence.

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