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Research Article

Electrophysiologic study of ECG and Oxidative Stress in Obese and Non Obese Adult Female in Ekpoma Nigeria

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Abstract

The study assessed oxidative stress biomarker enzyme activities, side by side a recorded surface ECG on non obese and obese amongst female adult to determine changes in ECG patterns. Twenty (20) consenting adult female subjects were recruited from Ekpoma metropolitans, Edo State. A volume of blood measuring 5ml was taken from the vein of volunteers after their consent was sought. The blood collected was placed in sample bottles customized in lithium heparin and centrifuged at 2500RPM (rounds per minute) for 10minutes.To avoid deterioration, the blood plasma was kept in plain sample bottles and stored in the fridge at appropriate temperature. It was thereafter analyzed for oxidative stress biomarkers concentrations. Oxidative stress biomarker (catalase) activities in Obese and non obese adult females were significantly different $p < 0.05$ and greater in obese. The mean value catalase of Obese was (84.99 ± 1.235) and Non obese (34.82 ± 1.590). Superoxide Dismutase (u/l) 0.4240 ± 0.008327and 0.2010 ± 0.01810 significantly $p < 0.05$ greater in obese. Glutathione peroxidase (u/ml) 7.509 ± 0.3769 and 3.389 ± 0.1967 significantly greater $p < 0.05$ in obese. The overall findings shows that oxidative stress is prominent in obese as evident in the higher values of catalase, Superoxide Dismutase biomarker and Glutathione peroxidase enzyme activities compared to non obese. The lack of these enzymes in the body contributes to the development of varying cardiovascular diseases. The activities of this enzyme was greater in obese than non obese indicating the need for more therapeutic approach that may enhance the availability of this enzymes towards promoting protective cover for individuals predisposed to complex cardiovascular diseases. A similar observation was made in the side by side recorded surface ECG on non obese which indicated an altered ECG wave patterns compared to the obese individuals. Obesity should as a matter of health concern be guided consciously to avoid some cardiovascular and other health challenges.

Keywords: Obesity; Body Mass Index (BMI)

Introduction

Obesity is a form of ill condition characterized by too much fat that causes weighty discomfort of the body and slowed overall activities of individual's health status. The classification of obese when body mass index (BMI) is considered according to WHO, is a person whose body weight in kilogram per meter (Kg/m^2) squared is 30 and above. Also when BMI is between 18.5 and 24.99, then the person is considered normal [1]. Obesity is the first wave of a defined cluster of non-communicable diseases called 'New World Syndrome's creating an enormous socio-economic and public health burden [2]. It has a strong impact on cardiovascular changes which is manifested in electrocardiogram (ECG). This has become prevalent in developed and developing countries leading to serious cases of cardiovascular compromises and death if unchecked [1]. Studies have shown that p- wave depression (Pd) prolongation is an independent risk factor for development of atrial fibrillation [3].

Oxidative stress

Epidemiological, clinical, and animal studies have shown that oxidative stress is implicated in a process especially deposition of adipose tissue leading to obese condition [4]. Oxidative stress reflects the lack of the ability to detoxify free radicals and to promote the repairs of tissue damages in the biological system. Reactive oxygen species (ROS) are sub-groups of free radical which contains oxygen.

Superoxide dismutase

Superoxide dismutase (SOD) is one of such enzymes. Superoxide dismutase (SOD) is an enzyme found in all living cells which helps break down potentially harmful oxygen molecules in cell which prevent damage to tissues. The lack in extracellular superoxide dismutase contributes to the development of hypertension. It follows therefore that therapeutic approach that may enhance the availability of this enzymes towards promoting protective cover for one predisposed to cardiovascular disease such as atherosclerosis cannot be overlooked. The different units of measurement for Glutathione Peroxidase, Superoxide Dismutase, Catalase are (U/mL, U/gHb, nmol/mg, orμmol/L) used to express the concentrations [5]. The reference value for Superoxide Dismutase antioxidant enzyme activity in man is between 0.12-0.33u/l [6].

Glutathione peroxidase

Glutathione Peroxidase (GPx) is an enzyme present in the fluid portion of the cytoplasm that speed up activities such as catalytic degradations that help reduce hydrogen peroxide to water, oxygen and alcohols oxygen. The reference value antioxidant enzyme activity in man is between 2.65-4.80u/ml [4,7].

Catalase

A catalase is an antioxidant enzymes that ease oxidative stress to a significant level by clearing and also reducing the level hydrogen peroxide present in the cells to water and oxygen. It is believed that the deficiency of catalase causes many related diseases such as diabetes mellitus, schizophrenia, anemia, Parkinson's disease, hypertension, cancer, and especially as one is aging [8].

ECG abnormalities in obesity

ECG abnormalities associated with obesity are of different kinds. Prolonged QT and QTc intervals are believed to be considerably prevalent in obese than in non-obese individuals. Such prolongation is attributable to increased sympathetic activities associated with obese individuals that may lead to increased heart rate and arrhythmia [9]. A variety of arrhythmias are more diagnosed in obese individuals, especially in those having left ventricular hypertrophy [10]. Atrial depolarisation produces the P wave on the electrocardiogram. P wave amplitude is usually not more than two squares and a half (0.25 mV) on the ECG wave tracing. The duration of the P wave should not exceed three small squares (0.12 s). Normal ECG values for waves and intervals accordingly are; RR interval: 0.6-1.2 seconds. P wave: 80 milliseconds. PR interval: 120-200 milliseconds. By comparison abnormal R–R intervals vary from sinus rhythm in their lengths. They are both associated with disorders of technical and physiological backgrounds peculiar with artefact that occurs in patients having diverse cardiovascular diseases. The measurement is normally 0.12-0.20 seconds, or 3-5 small squares in duration. The second measurement is normally the width of the QRS which normally less than 3 small squares, or less than 0.12 seconds in duration. R-R interval means beat-to-beat intervals and beats-per-min (BPM). Low RR means Bradypnea which is an abnormally slow breathing rate. The normal breathing rate for an adult is usually between 12 and 20 breaths per minute.

Materials and Methods

Materials used

- Syringes
- Lithium heparin sample bottles
- plain tubes
- Cotton wool
- ECG machine (HeartScreen 112C-1/INNOMED ZRT)
- ECG gel
- Methylated spirit
- Cotton wool

Sample size

Sample size is the number of subject or participants recruited and to which the study findings will be generalized. The sample size was calculated using the Taro Yamani's formula;

Where:

n = sample size

N = population size

d = level of precision (0.05 at 95% confidence level).

The sample for this study is 20 respondents who are non obese pre-pubertal and adult female obese from Ekpoma town, Edo State.

Subjects

Twenty (20) consenting adult female subjects were recruited from Ekpoma metropolitans, Edo State. These subjects consist of 10 non obese female with blood pressure below 120/80 mm/Hg without previous history of obesity and 10 (ten) obese female adult with previous history of obesity.

Informed consent

Written informed consent was obtained from subjects prior to commencement of the study.

Blood sampling

Five milliliters (5 ml) of venous blood was drawn from consenting participants and placed in a lithium heparin sample bottles. Blood samples was spun in a bucket centrifuge at 2500 RPM (rounds per minute) for 10 minutes after which plasma was collected and stored frozen in plain sample bottles and was analyzed for oxidative stress biomarkers concentrations.

Experimental protocols

After the subjects where identified and recruited into the study, they were taken to the lab where their ECG patterns where recorded. After which blood samples was collected by venipuncture and taken to the chemistry laboratory for analysis.

Inclusion criteria

Non obese and obese female adult, were within the age range of 20 to 40years. Adult female recruited for this study were obese with body mass index greater than 30kg/m^2 and non obese female adult with normal body mass index.

Exclusion criteria

Non obese and obese adult female who were on drugs and with a known history of hyperlipidemia, Diabetes and other comorbidity were excluded.

Statistical analysis

Data analysis was done with Graph pad Prism 8.0. The results were expressed as means ± SEM and analysed using Student t-test. $P < 0.05$ was considered statistically significant

Results

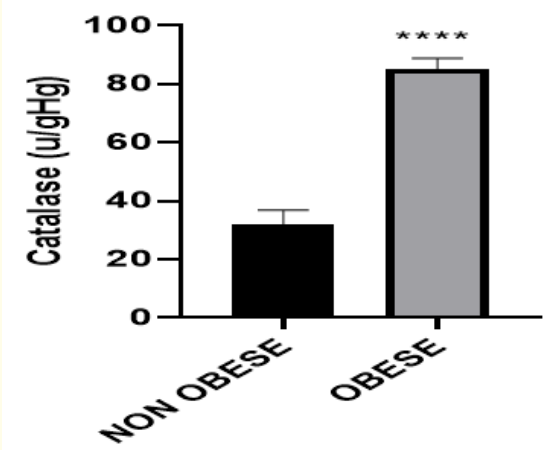

Figure 1: Compares the level of Catalase (u/gHg) in Non Obese and obese of adult female, relatively in Oxidative stress biomarkers.

N = 20 (n = 10); Mean ± SEM; *significant at $p < 0.05$ compared with control, ^significant at $p < 0.05$ compared with non obese.

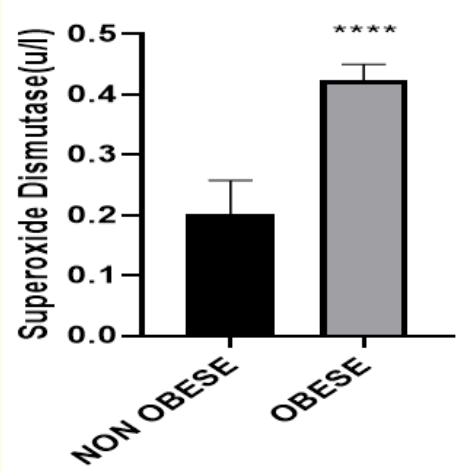

Figure 2: Compares the level of superoxide dismutase in Non Obese and obese of adult female, relatively in Oxidative stress biomarkers.

N = 20 (n = 10); Mean ± SEM; *significant at p < 0.05 compared with control, ^significant at p < 0.05 compared with non obese.

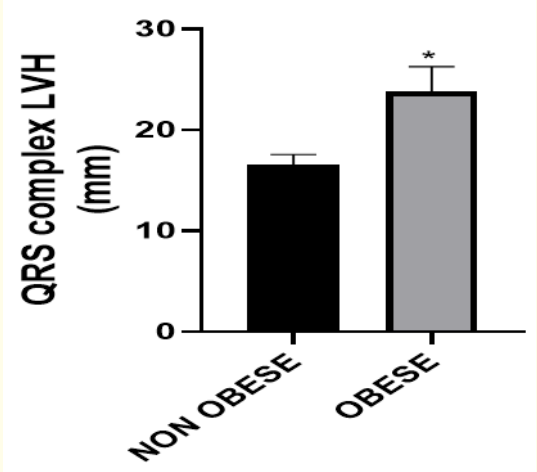

Figure 4: Compares the ECG QRS Complex Left Ventricular Hypertrophy (LVH) pattern in Non Obese and obese of adult female individuals.

N = 20 (n = 10); Mean ± SEM; *significant at p < 0.05 compared with control, ^significant at p < 0.05 compared with non obese.

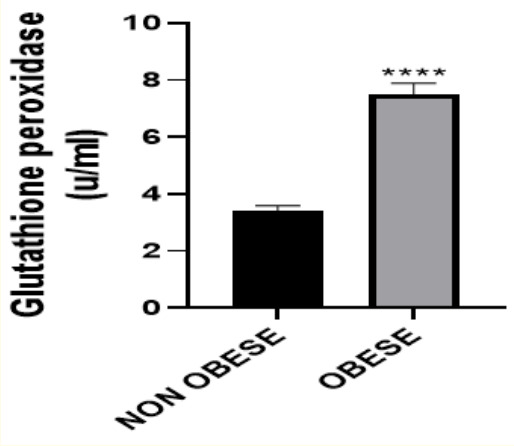

Figure 3: Compares the level of Glutathione peroxidase(u/ml) in Non Obese and obese of adult female, relatively in Oxidative stress biomarkers.

N = 20 (n = 10); Mean ± SEM; *significant at p < 0.05 compared with control, ^significant at p < 0.05 compared with non obese.

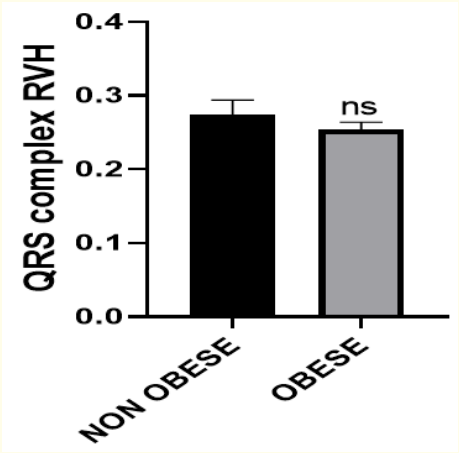

Figure 5: Compares the ECG of QRS Complex Right Ventricular Hypertrophy (RVH) pattern in Non Obese and obese of adult female individuals.

N = 20 (n = 10); Mean ± SEM; insignificant at p < 0.05 compared with control (non obese).

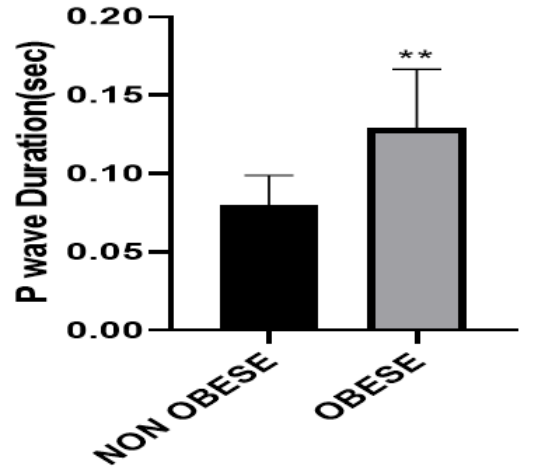

Figure 6: Compares the ECG (P wave duration-sec) pattern in Non Obese and obese of adult female individuals

N = 20 (n = 10); Mean ± SEM; *significant at $p < 0.05$ compared with control, ^significant at $p < 0.05$ compared with non obese.

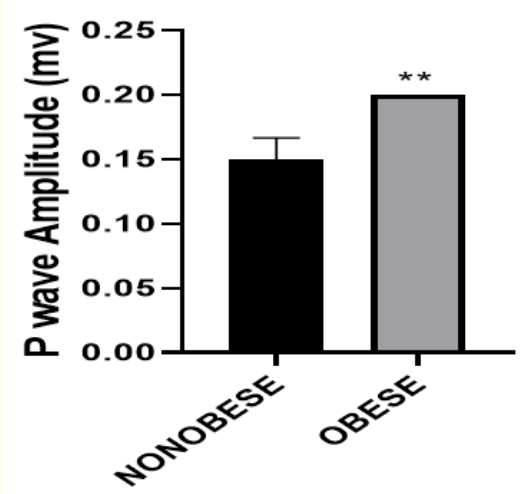

Figure 7: Compares the ECG (P wave Amplitude-mv) pattern in Non Obese and obese of adult female individuals.

N = 20 (n = 10); Mean ± SEM; *significant at $p < 0.05$ compared with control, ^significant at $p < 0.05$ compared with non obese.

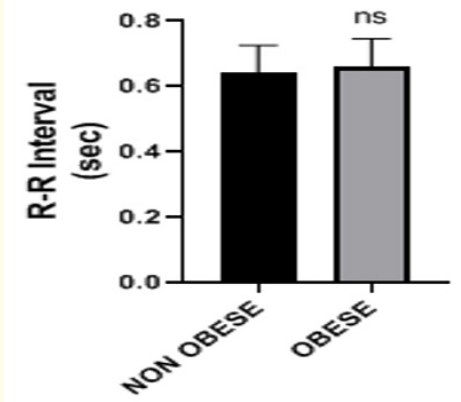

Figure 8: Compares the ECG (R-Rinterval) pattern in Non Obese and obese of adult female individuals.

N = 20 (n = 10); Mean ± SEM; not significant at $p < 0.05$ compared with control (non obese).

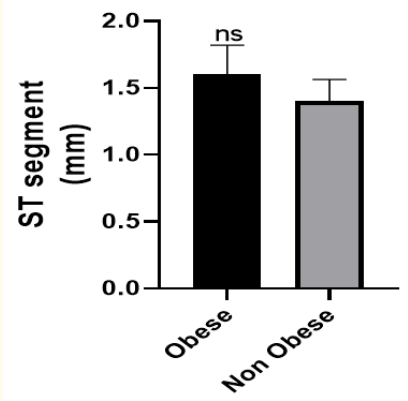

Figure 9: Compares the mean ECG (ST Segment) pattern in Non Obese and obese of adult female.

N = 20 (n = 10); Mean ± SEM; not significant at $p < 0.05$ compared with control (non obese).

Discussion

Oxidative stress reflects the lack of the body's ability to detoxify free radicals and to promote the repairs of tissue damages in the biological system. Reactive oxygen species (ROS) are sub-groups of these free radicals which contains oxygen. Superoxide dismutase(SOD) is one of such enzymes. Superoxide dismutase (SOD) is an enzyme found in all living cells which helps break

down potentially harmful oxygen molecules in cell which prevent damage to tissues. The lack in extracellular superoxide dismutase contributes to the development of hypertension. It follows therefore that therapeutic approach that may enhance the availability of this enzymes tends towards promoting protective cover for one predisposed to cardiovascular disease such as atherosclerosis [11]. The different units of measurement for Glutathione Peroxidase, Superoxide Dismutase, Catalase are (U/mL, U/gHb, nmol/mg, orμmol/L) used to express the concentrations [12]. The reference value Superoxide Dismutase antioxidant enzyme activity in man is between 0.12-0.33u/l [13].

From this study, oxidative stress biomarker (catalase) as shown in Figure 1 of Obese(84.99 ± 1.235) was significantly greater than non obese(34.82 ± 1.590) adult females $p < 0.05$. However the mean values in obese was relatively higher than normal while the non obese was consistent with normal values for antioxidant enzyme activities in human of earlier documented reports.

The reference value Superoxide Dismutase antioxidant enzyme activity is between 0.12-0.33u/l. From this study, oxidative stress biomarker (Superoxide Dismutase) as shown in Figure 2 of Obese(0.4240 ± 0.008327) was significantly greater than non obese(0.2010 ± 0.01810) adult females $p < 0.05$. However the mean values in obese was relatively higher than normal while the non obese was consistent with normal values for antioxidant enzyme activities in human of earlier documented reports.

The reference value antioxidant Glutathione peroxidase enzyme activity is between 2.65-4.80u/ml. From this study, oxidative stress biomarker Glutathione peroxidase(u/ml) as shown in Figure 3 of Obese(7.509 ± 0.3769) was significantly greater than non obese(3.389 ± 0.1967) adult females $p < 0.05$. However the mean values in obese was relatively higher than normal while the non obese was consistent with normal values for antioxidant enzyme activities in human of earlier documented reports.

The QRS complex of ECG wave tracing corresponds to the propagation of electrical signals that sweep through the ventricles associated the depolarization of the heart ventricles. The normal duration (interval) of the QRS complex is between 0.08 and 0.10 seconds. That is, 80 and 100 milliseconds. When the duration is between 0.10 and 0.12 seconds, it is intermediate or slightly prolonged. QRS duration of greater than 0.12 seconds is considered abnormal. Right ventricular hypertrophy (RVH) is an abnormal enlargement or pathologic increase in muscle mass of the right ventricle in response to pressure overload, most commonly due to severe lung disease. Right bundle branch block occurs when the electrical conduction of bundle of His-Purkinje complex is physiologically altered leading to widened QRS. QRS complex: amplitude greater than 0.5 mV in at least one standard lead, and greater than 1.0 mV in at least one precordial lead. Upper limit of normal amplitude is 2.5 - 3.0 mV. Increased QRS voltage is often taken to infer the presence of left ventricular hypertrophy. However, high left ventricular voltage (HLVV) may be a normal finding in patients less than 40-45 years of age, particularly slim or athletic individuals. There are multiple "voltage criteria" for left ventricular hypertrophy. RVH less than1mm indicates that there is no RVH and LVH less than 35mm also indicates that there is no RVH

From the ECG patterns in this study QRS complex LVH as shown in Figure 4 of Obese (23.80 ± 2.476mm) and non obese(16.50 ± 1.067 mm) adult females was significantly higher in obese compare to non obese, $p < 0.05$. However, the mean values of both were consistent generally acceptable normal range values. Also from the ECG patterns in this study QRS complex RVH as shown in Figure 5 of Obese (0.2540 ± 0.009798 mm) and non obese(0.2740 ± 0.01973 mm) adult females was significantly higher in obese compare to non obese, $p < 0.05$. However, the mean values of both were consistent generally acceptable normal range values. The normal P-wave duration is 80 milliseconds. PR interval: 120-200 milliseconds. PR segment: 50-120 milliseconds. The duration of the P wave does not usually exceed three small squares (0.12 s).

From the ECG patterns in this study, the P wave duration-sec as shown in Figure 6 of Obese and non obese adult females was significantly higher in obese compare to non obese, $p < 0.05$. P -wave Duration (sec) of Obese was (0.1289 ± 0.01252) and Non obese (0.08000 ± 0.005963) respectively. The Obese P wave Duration (sec) was abnormally higher (0.1289 ± 0.01252-0.12) with 0.0089sec while that of non obese was less than 0.12sec with 0.04sec duration. Also, the ECG (P wave amplitude) pattern in Figure 7 Obese and non obese of adult female was significantly higher in obese compare to non obese, $p < 0.05$. P wave Amplitude (mV) of Obese was 0.2000 ± 0.0000 and Non obese (0.1500 ± 0.01667) respectively. Although the mean value of (P wave amplitude) in this study was 0.2 mv, there was a significant statistical difference

between that of non obese. R-R intervals indicate the beat-to-beat intervals and beats-per-min (BPM). By comparison abnormal R–R intervals vary from sinus rhythm in their lengths. They are both associated with disorders of technical and physiological backgrounds peculiar with artefact that occurs in patients having diverse cardiovascular diseases. Normal ECG values for RR interval is from 0.6-1.2 seconds.

From the ECG patterns in this study, the mean RR intervals as shown in Figure 8 of Obese and non obese adult females were not significantly different in obese compare to non obese, $p < 0.05$. The mean RR interval (sec) of Obese was (0.66 ± 0.02667) and Non obese (0.64 ± 0.02667) respectively were not significantly different. However the mean values of this present obese and non obese were consistent with earlier reports of normal RR intervals.

ST segment abnormality could be elevation or depression resulting in myocardial ischaemia or infarction**.** An ST elevation is considered significant if the vertical distance inside the ECG trace and the baseline at a point 0.04 seconds after the J-point is at least 0.1 mV (usually representing 1 mm or 1 small square) in a limb lead or 0.2 mV (2 mm or 2 small squares) in a precordial lead [14]. From the ECG patterns in this study, the mean ST segment (mm) as shown in Figure 9 of Obese and non obese adult females were not significantly different in obese compare to non obese, $p < 0.05$. The mean ST segment (mm) of Obese was (ST segment 1.600 ± 0.2211mm) and Non obese (1.400 ± 0.1633mm) respectively were not significantly different. However the mean values of this present obese and non obese were consistent with normal ST segment (mm) acceptable values of earlier reports.

Conclusion

The overall findings shows that oxidative stress was prominent in obese as evident in the higher values of catalase, Superoxide Dismutase and Glutathione peroxidase biomarker enzyme activities compared to non obese. The lack of these enzymes in the body contributes to the development of varying oxidative stress and cardiovascular diseases. From this study, activities of these enzymes were greater in obese than non obese. This would suggest the need for more therapeutic approach that may enhance the availability of these enzymes towards promoting protective cover for individuals predisposed to complex cardiovascular diseases. A similar observation was made in the side by side recorded surface ECG on non obese which indicated an altered ECG wave patterns compared to the obese individuals. Obesity should as a matter of health concern be guided consciously to avoid some cardiovascular and other health challenges.

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