ASSESSMENT OF ANAEMIA IN RELATIONSHIP WITH BODY MASS INDEX AMONG ADULT FEMALE STUDENTS IN TERTIARY INSTITUTION.

Abstract

Human health can be assessed by several biochemical and anthropometric measurements, BMI and hemoglobin (Hb) levels being one of them as both obesity and anemia are the markers of imminent health issues in adults.This study aims to evaluatethe relationship between anemia and body mass index among adult female students in Niger Delta University Wilberforce Island Amassoma Bayelsa state. A total of 180 subjects were selected using a stratified random sampling technique for the study, all female students, Five (5) milliliters of blood will be collected under aseptic conditions by venepunctureand a complete blood count performed using the SYSMEXKX-2IN auto-analyzer machine. PCV (36.50±4.42) showed a non-significant decrease ($P \geq 0.005$), and RBC count showed a significant decrease ($P \leq 0.001$) as against the normal value. Results of this study indicate the increased likelihood of having anaemia in underweight individuals who displayed a non-significantly lower PCV, HGB, and WBC but showed slightly higher red cell indices when compared with their normal weight counterparts

Key words;Body mass index,Anaemia,Heamoglobin, PCV, Female ,Student

INTRODUCTION

BMI and haemoglobin (Hb) levels are two instances of biochemical and anthropometric measurements that can be utilised for assessing human health due to their ability to indicate potential health issues, such as adult obesity and anaemia. Anaemia, a symptom rather than a standalone disease, is a prevalent ailment that impacts around 2.36 billion individuals globally.[1] Anaemia is commonly defined as a condition in which the amount or capacity of red blood cells to carry oxygen is inadequate to meet the body's physiological requirements, which vary depending on factors such as age, gender, altitude, smoking habits, and pregnancy.[2] Anaemia, a condition characterised by a deficiency of red blood cells or haemoglobin, has been found to affect individuals of both genders and all age groups. However, research has shown that anaemia is more prevalent in women, particularly in cases related to inadequate nutrition (known as nutritional anaemia). Remarkably, this phenomenon has been repeatedly found across all genres, socioeconomic statuses, and strata. Anaemia can arise from a multitude of separate illnesses, but they can occur simultaneously. Even mild to moderate anaemia adversely affects well-being, resulting in fatigue, stress, and reduced work efficiency[3], as well as an increased death risk.[4] Several factors might influence an individual's anaemia, such as their ethnicity, gender, age, sociodemographic status, dietary patterns, physical and mental well-being, surroundings, gynecological/obstetric background, cancer history, usage of anti-cancer drugs, and genetic composition.[5] Anaemia can be caused by various reasons such as iron deficiency, worm infections, mutiple pregnancies, menorrhagia, postpartum haemorrhage, gastric ulcers, haemorrhoids, the use of aspirin or non-steroidal anti-inflammatory drugs, and adherence to a strict vegetarian diet [5].

The body mass index (BMI) is an invaluable measurement used to evaluate the nutritional well-being of a population. The association between body mass index (BMI), a measure of adult nutrition and health status [6], and anaemia is controversial. Previous studies have demonstrated a correlation between anaemia and low body mass index [7]. However, past

research has also indicated that anaemia can occur in both undernourished and overnourished individuals, reflecting different socioeconomic levels [8].

Adolescents, especially females, are the most vulnerable to the issue of anaemia. Anaemia in individuals within this age range can hinder immune function, leading to a heightened susceptibility to infections, decreased physical endurance and tolerance, stunted growth and cognitive abilities, impaired concentration and memory retention, ultimately affecting learning progress and performance negatively[9]. According to Durani (2014), the health and welfare of individuals deteriorate as they age, leading to negative health outcomes, increased risk of severe pregnancy and neonatal complications, and higher infant mortality rates[10]. Adolescence is a phase of life marked by distinct developmental traits, including accelerated physical maturation, rapid physical growth, and overall development[11]. The heightened iron requirements during this phase of development, along with increased blood loss during menstruation and lack of proper diet, worsen and intensify existing anaemia and its negative consequences[12]. The generally acknowledged BMI categories are as follows: underweight (below 18.5 kg/m2), normal weight (18.5 to 25), overweight (25 to 30), and obese (above 30)[13]. Consequently, examining the haemoglobin level and its correlation with BMI underscores the significance of this study. This study seeks to assess the correlation between anaemia and body mass index (BMI) among adult female students at Niger Delta University, located on Wilberforce Island, Amassoma, Bayelsa state.

MATERIALS AND METHODOLOGY

STUDY AREA

The research was carried out at Yenagoa, located in Bayelsa State. Bayelsa State was established from the former Rivers State in 1996 under the leadership of the late General Sani Abacha. Bayelsa state is situated between Latitude 4° 15' North and Latitude 59 and 23' South. It is situated between longitude 5° 22' West and 6° 45' East. The region is delimited by Delta State to the North, Rivers State to the East, and the Atlantic Ocean to the West and South. Bayelsa State boasts the largest wetland in West Africa and holds the distinction of being the first state where crude oil was discovered in significant commercial quantities. Based on the 2006 census data, the population of Bayelsa is approximately 1.7 million individuals[14].

Furthermore, the laboratory study was conducted at the Haematology Laboratory of the Federal Medical Centre Yenagoa, located in Bayelsa State.

STUDY POPULATION

The study involved a sample of 180 individuals who were recruited using a stratified random sampling technique. All of the subjects were female students from Nige Delta University, College of Health Sciences, located in Wilberforce Island, Bayelsa state.

SAMPLE COLLECTION

Aseptically, a volume of five (5) millilitres of blood will be obtained from chosen students of Niger Delta University through venipuncture and collected in an EDTA container. To prevent clotting, the obtained sample was gently flipped 5-6 times. In addition, the survey subjects' height and weight were assessed in order to calculate their Body Mass Index (BMI). Demographic information of the participants will be recorded. Subsequently, the samples were sent to the laboratory for prompt analysis.

SELECTION CRITERIA

(A) Inclusion Criteria

Adult female students of Niger Delta University, Wilberforce Island, Bayelsa state.

(B) Exclusion Criteria

Male students were excluded from this study. Also, known sickle cell students were excluded.

QUESTIONNAIRE

A survey including a sequence of inquiries was formulated and employed to get demographic information from the subjects involved in the study. The questionnaire comprised two sections: personal data and demographic data. An exemplar of this questionnaire is available in the appendix 1 part of this document.

SAMPLE ANALYSIS

The SYSMEX KX-ZIN is a haematological analyzer that does a three-part differential analysis on roughly sixty (60) samples each hour. The results are displayed on the LCD (liquid crystal display) screen. The study results yielded the distribution curves of white blood cells, red blood cells, and platelets, as well as data for 19 additional parameters [15].

LABORATORY PROCEDURES

The primary laboratory diagnostic procedure conducted was a comprehensive analysis of the blood, known as a full blood count or complete blood count.The complete blood count assesses multiple constituents of the blood, encompassing, but not restricted to, the subsequent elements; Measurement of haemoglobin levels, determination of packed cell volume (PCV), assessment of total white blood cell count (TWBC), calculation of red blood cell count (RBC), and quantification of lymphocytes count. Eosinophils. Basophils, Monocytes, packed cell volume (PCV), Haemoglobin concentration, mean cell volume, and mean cell haemoglobin concentration.

approach The approach involves employing flow cytometry, specifically the direct current method, with appropriate cell packs as specified by the manufacturer. The SYSMEXKX-2IN auto-analyzer machine equipment is used for analysing the desired cell population [15].

Quantitative data examination

All data analyses were conducted using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). The results were presented as the mean value plus the standard deviation. Comparisons between various groups were conducted using the Student's t-test. The threshold for statistical significance was established at $P < 0.005$, with a 95% confidence range.

RESULTS

Table 1: General demographics of survey participants.

	FREQUENCY	**PERCENT**	**MEAN BMI±SD**
NORMAL WEIGHT	10	33.3	23.35±2.70
UNDERWEIGHT	10	33.3	17.28±0.94

OVERWEIGHT	10	33.3	29.63±4.42
TOTAL	30	100	

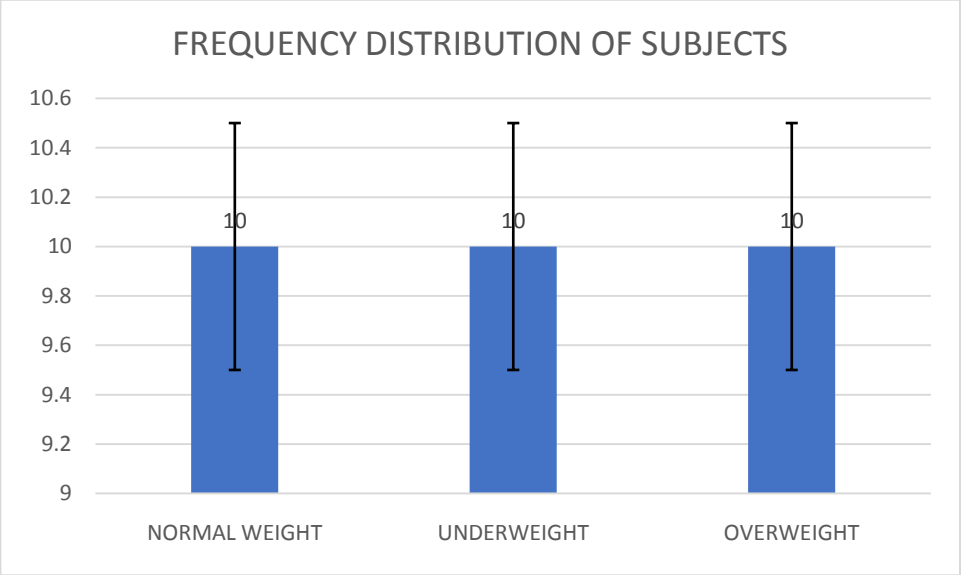

FIGURE 1: Graphical representation of the distribution of survey participants.

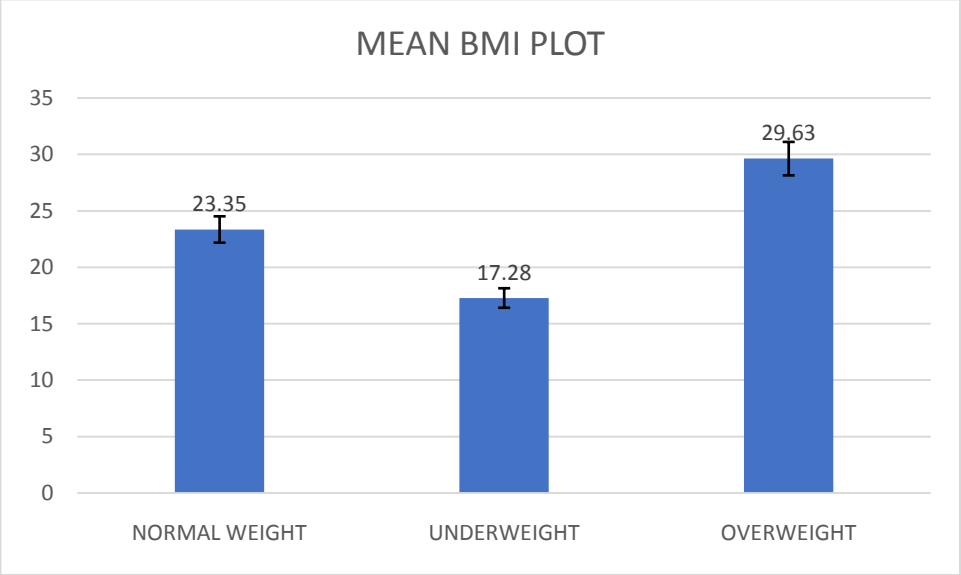

FIGURE 2: graphical representation of mean BMI of the various categories.

Table2: Statistical analysis of hematology parameters across all survey groups. Results are expressed as mean±SD.

	NORM WEIGHT	OVERWEIGHT	UNDERWEIGHT
PCV	39.10±3.81	41.60±1.65	36.50±4.25
Hb	11.40±1.17	12.40±1.17	10.10±1.73
WBC	6.47±1.71	7.78±1.36	5.78±0.54
MCHC	30.10±0.71	29.50±1.20	31.30±1.77
MCH	25.20±2.45	25.70±2.63	26.30±2.20
RBC	4.41±0.61	4.73±0.29	3.66±0.80

Table .3: Table showing the comparison statistics of the various hematology parameters under the normal weight category. Results are expressed as mean±SD. Statistical significance is calculated at a 95% confidence interval and statistical significance is set at $p \leq 0.005$

	MEAN±SD	P-VALUE	REMARK
PCV	39.10±3.81	0.635	NS
Hb	11.40±1.17	0.201	NS
WBC	6.47±1.71	0.351	NS
MCHC	29.50±0.71	0.211	NS

MCH	26.30±2.45	0.775	NS
RB	4.41±0.61	0.677	NS

KEY:

NS – NON SIGNIFICANT

S – SIGNIFICANT

Table 4: Table showing the comparison statistics of the various hematology parameters under the underweight category. Results are expressed as mean±SD. Statistical significance is calculated at a 95% confidence interval and statistical significance is set at $p \leq 0.005$

	MEAN±SD	**P-VALUE**	**REMARK**
PCV	36.50±4.25	0.170	NS
Hb	10.10±1.73	0.065	NS
WBC	5.78±0.54	0.211	NS
MCHC	31.30±1.77	0.607	NS
MCH	25.20±2.20	0.511	NS
RBC	3.66±0.80	0.001	S

KEY:

NS – NON SIGNIFICANT

S – SIGNIFICANT

Table 5: Table showing the comparison statistics of the various hematology parameters under the overweight category. Results are expressed as mean±SD. Statistical significance is calculated at a 95% confidence interval and statistical significance is set at $p \leq 0.005$

	MEAN±SD	**P-VALUE**	**REMARK**
PCV	41.60±1.65	0.077	NS
Hb	12.40±1.17	0.073	NS
WBC	7.78±1.36	0.401	NS
MCHC	30.10±1.20	0.541	NS
MCH	25.70±2.63	0.822	NS
RBC	4.73±0.29	0.152	NS

KEY:

NS – NON SIGNIFICANT

S - SIGNIFICANT

DISCUSSION

This study was done to evaluate the impact of Body Mass Index (BMI) on the haematological parameters of individuals. Prior to the main analysis, a pilot survey was conducted with a total of 30 participants. The subjects' height and weight were measured for the purpose of calculating their BMI. 10 subjects were chosen in each category: underweight (with an average BMI of 17.28±0.94), normal weight (with an average BMI of 23.35±2.70), and overweight (with an average BMI of 29.63±4.42).

Subsequently, a comprehensive study of the blood count was conducted for each category. The analytical findings are presented in table 4.2, located in chapter four above. The results of this study demonstrated that individuals in the underweight category had lower values for

parameters such as white blood cell (WBC) count (5.78±0.54), red blood cell (RBC) count (3.66±0.80), haemoglobin (HGB) level (10.10±1.73), and packed cell volume (PCV) (36.50±4.42), compared to the control group. However, these differences were not statistically significant ($P \geq 0.005$). Nevertheless, the red blood cell indices of mean corpuscular haemoglobin concentration (MCHC) exhibited no statistically significant increase in the underweight group compared to the normal weight group. The only parameter that exhibited a notable decline was the red blood cell count, with a significant drop ($P \leq 0.001$).

Within the overweight category, the WBC count (7.78±1.36), HGB (12.40±1.17), and PCV (41.60±1.65) exhibited a statistically insignificant rise compared to the normal weight category. Conversely, the RBC count (4.73±0.29) and red blood cell indices generally displayed lower values in the obese class compared to the normal weight category. None of these changes exhibited statistical significance.

The consequences of these findings indicate that underweight persons are more prone to developing anaemia, as evidenced by a decrease in packed cell volume and red blood cell indices, which suggests the presence of macrocytic anaemia. These findings align with the conclusions drawn by Nubé et al. (1998), who documented notable instances of anaemia in individuals with low body weight[16]. The study proposed that a Body Mass Index (BMI) below 18.5 kg/m2 can serve as an indicator for unfavourable demographic, economic, social, and environmental circumstances within a population.

The relationship between Anaemia and body mass index (BMI), which is a measure of the nutritional and health status of people, has been a subject of debate. Prior research has demonstrated the presence of Anaemia in persons who are both malnourished and over-nourished, representing the lower and higher socioeconomic classes, respectively. However, investigations conducted in other locations have linked Anaemia with a low body mass index [17].

Obesity has been found to have a connection with anaemia in adults in certain countries like Peru and Mexico. However, countries such as Egypt, the USA, and China have reported a contrasting association where obesity is linked to a decrease in anaemia.Obesity-related anaemia could be caused by increased hepcidin expression, which impairs the absorption of iron. The gap may be partially attributed to other factors such as the levels of iron and vitamin C intake, as well as inflammation connected to obesity [21]. While excess weight or obesity may not directly reduce the lifespan of red blood cells or hinder the production of new ones, there is a hypothesis that obesity could lead to increased blood flow due to the presence of hepcidin or other substances. Therefore, it can be deduced that individuals who are overweight or obese, a chronic inflammatory condition, may experience the release of hepcidin, a recognised inhibitor of the absorption of dietary iron. Consequently, this can result in the development of iron deficiency anemia[18].

In a distinct investigation conducted in Ebonyi state, Nigeria, Ugwuja et al., (2015) discovered a 21.7% prevalence of anaemia among adult Nigerians in the region. Pregnant women and younger age groups were found to be more vulnerable to anaemia, while sociodemographic characteristics and body mass index (BMI) did not have a significant impact on the prevalence of anaemia. With the exception of underweight individuals, who did not show any signs of anaemia, there was no notable variation in the occurrence of anaemia among the other BMI categories.

Pratima et al. (2012) found that 70.1% of adult females and 53.2% of adult men aged 20-50 years in the North Indian population had the reported condition [22]. Similarly, Bhattacharjee

and colleagues (2016) reported a prevalence of 60.2% among individuals aged 20-70 years in rural areas of North Bengal [23].

Iron deficiency is the primary cause of anaemia in poor groups, although there are many other independent or co-existing factors contributing to anaemia [22]. The presence of both parasite diseases and malnutrition has been strongly linked to a significant occurrence of Anaemia [24]. In addition to infections and insufficient iron consumption, anaemia has been linked to metal toxicity, specifically lead poisoning. A previous study conducted in the state revealed elevated levels of lead in the blood of pregnant women [25]. Lead induces Anaemia through the displacement of metal ions, such as zinc, calcium, and iron, from their natural co-factors. Additionally, it significantly inhibits enzymes (δ-aminolevulinic acid dehydratase and ferrochelatase) that are crucial for hemesynthesis[26].

Previous research has yielded conflicting findings. An negative correlation was discovered in Chinese women from Jiangsu Province between being overweight, obese, centrally obese, and having anaemia [27]. Furthermore, a correlation has been shown between lower levels of haemoglobin concentration and higher BMI in medical students at the Himalayan Institute of Medical Sciences [28]. A study conducted in North Bengal demonstrated a substantial association between haemoglobin concentration and BMI among adults from rural populations [29].

However, this does not apply to the obese population, as they exhibited an elevation in packed cell volume and an overall reduction in red blood cell indices. This suggests that although the PCV (packed cell volume) increases in these individuals, the cells themselves exhibit a reverse relationship in terms of their size and staining capabilities.

CONCLUSION

Anaemia and obesity are indicators of impending health problems in adults as they represent two extremes of malnutrition: reduced haemoglobin (Hb) levels and elevated body mass index (BMI), resulting from undernutrition and overnutrition, respectively. BMI serves as an indicator of adult nutritional status. The Body Mass Index (BMI) is a practical guideline used to roughly classify individuals into categories of underweight, normal weight, overweight, or obese, depending on their tissue mass. There has been a lack of research in this specific area of the region on the evaluation of anaemia in relation to body mass index throughout the course of several decades. In order to address this deficiency, this investigation was conducted. The findings of this study suggest that underweight individuals have a higher probability of experiencing anaemia. These individuals also exhibited somewhat lower levels of packed cell volume (PCV), haemoglobin (HGB), and white blood cell (WBC) count, but these differences were not statistically significant. However, their red cell indices were slightly higher compared to individuals with normal weight.

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