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Evaluation of Anthropometric Parameters and Lipid Profile in Subjects with Sickle Cell Traits at Madonna University, Elele, Nigeria

Nnodim JK[*1], Obi-Aziekwe VN[2] and Edward U[1]

[1]*Department of Medical Laboratory Science, Faculty of Health Science, Imo State University, Owerri, Nigeria*
[2]*Department Of Medical Laboratory Science, Faculty of Health Science, Madonna University, Elele Campus, Rivers State, Nigeria*

[*]**Correspondence:** Johnkennedy Nnodim, Department of Medical Laboratory Science, Faculty of Health Science, Imo State University, Owerri, Nigeria

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Abstract

Sickle cell trait is a genetic condition that affects a substantial portion of the global population, particularly individuals of African descent. This study is aimed at evaluating anthropometric parameters and lipid profile parameters in subjects with sickle cell traits in Madonna University Teaching Hospital (MUTH), Elele. 72 subjects consisting of 30 HbAA (control), 21 HbAS, and 21 HbSS, all aged 18–40 years, were recruited for the study. Ethical clearance and informed consent were duly obtained from those involved. Blood samples were collected via venipuncture. Total cholesterol (TCH), triglyceride (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were analyzed using enzymatic spectrophotometric method. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21 for Windows 7. The result from this study suggests that there are statistically significant differences ($p < 0.05$) among the genotype variants, HbAA, HbAS, and HbSS, for the TCH, TG, HDL, LDL, and hemoglobin (Hb) levels. For the control group (HbAA), the TCH is 4.51 mmol/L, TG is 1.21 mmol/L, HDL is 0.95 mmol/L, LDL is 2.81 mmol/L, and Hb is 14.02 g/dL. For the HbAS, the TCH is 4.16 mmol/L, TG is 0.73 mmol/L, HDL is 0.92 mmol/L, LDL is 2.82 mmol/L, and Hb is 13.02 g/dL. For the HbSS, the TCH is 3.39 mmol/L, TG is 0.59 mmol/L, HDL is 0.63 mmol/L, LDL is 2.59 mmol/L, and Hb is 10.85 g/dL. Also, the BMI (kg/m^2) showed no statistically significant differences among the genotype variants, HbAA, HbAS, and HbSS ($p > 0.05$). This concludes that lipid metabolism may be altered in red cell genetic disorders such as sickle cell anemia.

Keywords: anthropometric parameters, lipid profile, sickle cell traits

Abbreviations: MUTH: Madonna University Teaching Hospital; BMI: body mass index; SPSS: Statistical Package for Social Sciences; TCH: total cholesterol; TG: triglyceride; HDL: high-density lipoprotein; LDL: low-density lipoprotein; Hb: hemoglobin; SCD: sickle cell disease

Introduction

Sickle cell trait is a common genetic mutation, particularly in people of African descent. It is a disorder marked by the presence of one normal hemoglobin gene (HbA) and one mutant hemoglobin S gene (HbS). The most prevalent genetic illness worldwide is sickle cell anemia, which is more prevalent in individuals from Saudi Arabia, India, the Caribbean, Africa, and Mediterranean nations. Natural selection is the reason why it is more prevalent in some nations than others [1]. Due to its clinical significance, sickle cell disease (SCD) has been well investigated; however, comparably, less attention has been paid to the effects of sickle cell characteristics on many aspects of health. This study aims to assess the anthropometric measures and lipid profile levels in sickle cell trait carriers, a population that has mostly been ignored in studies on metabolic and cardiovascular health.

Among the world's leading causes of death are metabolic illnesses and cardiovascular diseases, which provide serious public health issues. It is imperative to comprehend the possible correlation between sickle cell characteristics and metabolic health, as this could provide important new information on hitherto unidentified variables causing these common health issues. It is critical to close the current knowledge gap and ascertain if people with sickle cell traits are more likely to experience metabolic problems because the number of people at risk is increasing worldwide, especially in areas where sickle cell traits are very prevalent. The ultimate goal of this research is to improve the general health and well-being of sickle cell patients by helping to design more focused and efficient therapies and preventive measures [2].

Concerns regarding sickle cell traits' possible effects on metabolic health have been highlighted by the fact that sickle cell traits are a common hereditary disease that is especially common in populations of African heritage. Even with a great deal of research on sickle cell illness, we still don't fully grasp how sickle cell features could affect anthropometric measurements and lipid profile levels. The growing global burden of metabolic illnesses and cardiovascular diseases makes this information gap important. Thus, the main issue this study attempts to address is the dearth of thorough research examining the connection between sickle cell traits and markers of metabolic health, particularly lipid profiles and anthropometric parameters, which makes it more difficult for us to create focused interventions and preventive measures for sickle cell trait carriers [3, 4].

A significant percentage of people worldwide, especially those of African heritage, are afflicted with sickle cell trait, a genetic ailment. It is important to comprehend the potential effects of this feature on anthropometric measures and lipid profiles for multiple reasons. First, it may clarify possible connections between metabolic health and sickle cell characteristics, which may help in the early detection and treatment of related health problems. Second, your research may shed light on an otherwise unrecognized component that contributes to metabolic illnesses and cardiovascular diseases, two serious issues in world health. In the end, this study may enhance the general health and well-being of people who have sickle cell characteristics and may have broader implications for preventive healthcare strategies in at-risk populations. Hence, the need for this work.

Materials and Methods

Study area

This study was carried out in Madonna University Teaching Hospital (MUTH), Elele, Rivers State, Nigeria, between the periods of May and August 2023. Elele Town is located in the southeastern part of Nigeria. It is located in latitude 5° 27° - 5° and longititude 6° 55 -7° 85E. The climate of the area is tropical, with a mean daily temperature of 29°C

for most of the year. The annual rainfall in this region is between 217 and 240 cm. There are other towns and villages that surround Elele town, including Isiokpo town, Omagwa, Ahoda, Omoku, Owerri town and others.

Sample size calculation

The prevalence rate of sickle cell trait patients attending Madonna University Teaching Hospital (MUTH) is 2.4 cases, making the prevalence rate a total of 0.24%. Using the formula below, the sample size was calculated using Leslie Kish's formula.

$N = Z^2 \times p\ (1 - p) / d^2$

Where;

N = minimum sample size
d = desired level of significance (0.05)
Z = confidence interval (1.96)
p = prevalence rate or proportion of occurrence = 0.24%

Therefore

$N = 3.8416 \times 0.24\ (1 - 0.24) / 0.0025$
N = 72 samples.

Inclusion and exclusion criteria

- Inclusion criteria

Subjects included in the study were patients with sickle cell traits attending Madonna University Teaching Hospital (MUTH).

- Exclusion criteria

Subjects excluded from the study were patients with sickle cell traits and other health complications attending Madonna University Teaching Hospital (MUTH).

Subjects with sickle cell traits who didn't give their consent.

Ethical approval/ consideration

Participation was voluntary. Informed and oral consents were obtained from the subjects, and confidentiality was assured to them. Ethical approval was obtained from the hospital management. The study was carried out according to the Good Clinical Practice Guidelines of the modified Helsinki Declaration.

Sample collection and processing

A detailed family and medical history were taken. A thorough clinical examination was done on all the subjects. Systolic and diastolic blood pressure was carefully recorded. Using a sterile needle and syringe, a blood sample (5 ml) was collected from each subject by venipuncture from the antecubital vein and dispensed into a plain container and labeled for proper identification. The blood sample in the sterile plain containers was allowed to clot for about 45 min. Then, using an applicator stick, the clotted blood was dislodged and centrifuged at 12000 rpm for 5 min. The serum obtained was carefully picked using an automatic micropipette and transferred into another plain specimen container, and tightly screwed. Then, it was deep frozen at -20°C until analysis was done for the samples that could not be analyzed immediately.

Anthropometric parameters measurements

Body weight was measured (to the nearest 0.5 kg) with the subject standing motionless on a bathroom weighing scale. Each weighing scale was standardized every day with a weight of 50 kg. Height was measured (to the nearest 0.5 cm) with the subject standing in an erect position. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). BMI values of 26–29 and greater than 29 kg/m^2 were taken as cut-offs for overweight and obesity, respectively.

Laboratory assays

- Determination of total cholesterol (TCH) by enzymatic method [5]
- Determination of high-density lipoprotein (HDL) [6]
- Determination of triglyceride (TG) [6]
- Determination of low-density lipoprotein (LDL) [6]

Statistical analysis

Data analysis was conducted using Statistical Package for Social Sciences (SPSS) version 21 for Windows 7. The results were expressed as mean ± SD. Data obtained from this study were analyzed using an independent sample t-test and one-way analysis of variance, which were used to compare means, and values were considered significant at $p < 0.05$ and non-significant at $p > 0.05$.

Results

The table presents a comparative analysis of lipid profile parameters and BMI among different hemoglobin (Hb) genotype variants, specifically control (HbAA), HbAS, and HbSS (Table 1). The table includes measurements for TCH, TG, HDL, LDL, and BMI, all represented in different units. The data is presented as mean values with their respective standard deviations. TCH (mmol/L) was 4.51 ± 0.33, 4.16 ± 0.44, and 3.39 ± 0.32 in control, HbAS, and HbSS, respectively. TG (mmol/L) was 1.21 ± 0.20, 0.73 ± 0.11, and 0.59 ± 0.26 in control, HbAS, and HbSS, respectively. HDL (mmol/L) was 0.95 ± 0.16, 0.92 ± 0.22, and 0.63 ± 0.19 in control, HbAS, and HbSS. LDL (mmol/L) was 2.81 ± 0.32, 2.82 ± 0.25, and 2.59 ± 0.21 in control, HbAS, and HbSS. BMI (kg/m^2) was 23.35 ± 1.86, 22.89 ± 1.70, and 22.94 ± 1.80 in control, HbAS, and HbSS, respectively. The table also includes p-values for statistical significance, denoted by asterisks (*), with a significance threshold of $p < 0.05$. The "Post hoc" section presents p-values for pairwise comparisons between the groups. Notably, several comparisons are statistically significant (indicated by asterisks), suggesting differences in these parameters between the Hb genotype variants.

Hb genotype	TCH (mmol/L)	TG (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	BMI (kg/m^2)
Control (HbAA) (A)	4.51 ± 0.33	1.21 ± 0.20	0.95 ± 0.16	2.81 ± 0.32	23.35 ± 1.86
HbAS (B)	4.16 ± 0.44	0.73 ± 0.11	0.92 ± 0.22	2.82 ± 0.25	22.89 ± 1.70
HbSS (C)	3.39 ± 0.32	0.59 ± 0.26	0.63 ± 0.19	2.59 ± 0.21	22.94 ± 1.80
F	57.584	64.461	18.968	4.793	0.435
P	0.000	0.000	0.000	0.011	0.649
Post hoc					
A *vs.* B	0.002	0.000	0.578	0.980	0.000
A *vs.* C	0.000	0.000	0.000	0.006	0.000
B *vs.* C	0.000	0.024	0.000	0.011	0.000

Table 1: Lipid profile and body mass index (BMI) among hemoglobin genotype variants. Key: TCH = total cholesterol; TG = triglyceride; HDL = high-density lipoprotein; LDL= low-density lipoprotein; BMI = body mass index. Significant at $p < 0.05$.

The table provides a summary of BMI and lipid profiles among different genders with different Hb genotypes, namely HbAA, HbAS, and HbSS (Table 2). The table displays the mean measurements for TCH, TG, HDL, LDL, and BMI,

with their respective mean values and standard deviations for both genders. The data shows that HbAA females have the highest TCH (mmol/L) levels of 4.10 ± 0.67. HbAA males have the highest TG (mmol/L) levels of 0.90 ± 0.32. HbAS males have the highest HDL (mmol/L) and LDL (mmol/L) levels of 0.92 ± 0.98 and 2.81 ± 0.49, respectively. HbAA females have the highest BMI (kg/m^2) of 23.15 ± 2.58. However, these differences are not statistically significant, as indicated by the "F" and "P" values, all above the threshold of $p < 0.05$. In summary, the table demonstrates that there are no significant gender-based differences in BMI and lipid profiles within this study population (Table 2).

Gender	TCH (mmol/L)	TG (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	BMI (kg/m^2)
HbAA Female	4.10 ± 0.67	0.89 ± 0.36	0.80 ± 0.22	2.74 ± 0.25	23.15 ± 2.58
HbAA Male	4.17 ± 0.57	0.90 ± 0.32	0.89 ± 0.23	2.76 ± 0.33	23.68 ± 1.89
HbAS Female	4.13 ± 0.69	0.69 ± 0.17	0.89 ± 0.43	2.78 ± 0.56	22.76 ± 1.54
HbAS Male	4.18 ± 0.21	0.72 ± 0.61	0.92 ± 0.98	2.81 ± 0.49	22.27 ± 1.28
HbSS Female	3.35 ± 0.12	0.57 ± 0.28	0.59 ± 0.19	2.58 ± 0.21	22.01 ± 1.40
HbSS Male	3.62 ± 0.40	0.58 ± 0.32	0.63 ± 0.23	2.71 ± 0.33	22.51 ± 1.46
F	0.042	0.003	2.483	0.020	0.003
P	0.838	0.954	0.120	0.887	0.953

Table 2: Body mass index and lipid profile among different genders. Key: TCH = total cholesterol; TG = triglyceride; HDL = high-density lipoprotein; LDL = low-density lipoprotein; Hb = hemoglobin. Significant at $p < 0.05$.

The table provides a summary of BMI and lipid profile among different ages with different Hb genotypes, namely HbAA, HbAS, and HbSS (Table 3). The table displays the mean measurements for TCH, TG, HDL, LDL, and BMI, with their respective mean values and standard deviations for different ages. The data shows that subjects within 18–25 years had a TCH (mmol/L) of 4.08 ± 0.58, TG (mmol/L) of 0.92 ± 0.34, HDL (mmol/L) of 0.86 ± 0.20, LDL (mmol/L) of 2.72±0.29 and BMI (kg/m^2) of 22.85 ± 1.34 while subjects within 26–40 years had a TCH (mmol/L) of 4.11 ± 0.63, TG (mmol/L) of 0.73 ± 0.27, HDL (mmol/L) of 0.79 ± 0.33, LDL (mmol/L) of 2.87 ± 0.25 and BMI (kg/m^2) of 23.58 ± 1.58. However, these differences are not statistically significant, as indicated by the "F" and "P" values, all above the threshold of $p < 0.05$. In summary, the table demonstrates that there are no significant age-based differences in BMI and lipid profiles within this study population (Table 3).

Age (year)	TCH (mmol/L)	TG (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	BMI (kg/m^2)
18–25	4.08 ± 0.58	0.92 ± 0.34	0.86 ± 0.20	2.72 ± 0.29	22.85 ± 1.34
26–40	4.11 ± 0.63	0.73 ± 0.27	0.79 ± 0.33	2.87 ± 0.25	23.58 ± 1.58
F	0.029	3.329	0.919	2.618	0.418
P	0.864	0.072	0.341	0.110	0.520

Table 3: Body mass index and lipid profile among different ages (year). Key: TCH = total cholesterol; TG = triglyceride; HDL = high-density lipoprotein; LDL = low-density lipoprotein; Hb = hemoglobin; BMI = body mass index. Significant at $p < 0.05$.

Discussion

Despite extensive research on SCD, there is a notable gap in our understanding of how sickle cell traits may influence lipid profile levels and anthropometric parameters [7, 8]. This study is aimed at evaluating the lipid profile levels and anthropometric parameters in subjects with sickle cell traits at Madonna University Teaching Hospital (MUTH). From this study, the result of our lipid profile parameters: TCH, TG, HDL, LDL, and BMI, suggest that there are statistically significant differences among the genotype variants, HbAA, HbAS, and HbSS. Also, the BMI (kg/m^2) showed no statistically significant differences among the genotype variants, HbAA, HbAS, and HbSS. This is in line with other works [8, 9].

From the result, TCH (mmol/L) was 4.51 ± 0.33, 4.16 ± 0.44 and 3.39 ± 0.32 in control, HbAS, and HbSS, respectively. TG (mmol/L) was 1.21 ± 0.20, 0.73 ± 0.11, and 0.59 ± 0.26 in control, HbAS, and HbSS, respectively. HDL (mmol/L) was 0.95 ± 0.16, 0.92 ± 0.22, and 0.63 ± 0.19 in control, HbAS, and HbSS. LDL (mmol/L) was 2.81

± 0.32, 2.82 ± 0.25 and 2.59 ± 0.21 in control, HbAS, and HbSS. BMI (kg/m^2) was 23.35 ± 1.86, 22.89 ± 1.70, and 22.94 ± 1.80 in control, HbAS, and HbSS, respectively. These differences are not statistically significant, as indicated by the "F" and "P" values, all above the threshold of $p < 0.05$. Hence, it supports the work of other scholars [10, 11].

The result shows that subjects within 18–25 years had a TCH (mmol/L) of 4.08 ± 0.58, TG (mmol/L) of 0.92 ± 0.34, HDL (mmol/L) of 0.86 ± 0.20, LDL (mmol/L) of 2.72 ± 0.29 and BMI (kg/m^2) of 22.85 ± 1.34 while subjects within 26–40 years had a TCH (mmol/L) of 4.11 ± 0.63, TG (mmol/L) of 0.73 ± 0.27, HDL (mmol/L) of 0.79 ± 0.33, LDL (mmol/L) of 2.87 ± 0.25 and BMI (kg/m^2) of 23.58 ± 1.58. However, these differences are also not statistically significant, as indicated by the "F" and "P" values, all above the threshold of $p < 0.05$.

In their study, the HDL-C in SS patients (both males and females) was significantly lower than that in AS individuals (P value < 0.001). The TG in SS males was significantly lower than that in AS patients (P value < 0.001), but there was no significant difference when compared to AA controls. TG in SS females was significantly lower than those in AA (P value < 0.05). This is in agreement with other works [12–14].

Conclusion

In conclusion, there is no statistically significant difference in the mean values of lipid profile parameters and BMI in subjects with sickle cell trait when compared with apparently healthy individuals in relation to age and gender.

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