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The relationship between indices of hepatocellular injury and anthropometric measurements in some Babcock University Students, Ilisan, Ogun State, Nigeria

Jamiu A. Akamo*[,1], Regina N. Ugbaja[2], Gogonte H. Amah[1], Ifeoluwa Fabuluje[1], Joy O. Edaferiemu[1], Nankang G. Lepzem and Kehinde O. Oyekale[3]

[1]Department of Biochemistry, Benjamin Carson (SRN) School of Medicine, Babcock University, Ilisan, Ogun State, Nigeria. *Email: ajayngng@yahoo.com.
[2]Department of Biochemistry, College of Biosciences, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
[3]Department of Agronomy and Landscape Design, School of Agriculture and Industrial Technology, Babcock University, Ilisan, Ogun State, Nigeria.

Abstract. The anthropometric measurements of some apparent healthy Babcock University students (53 male and 47 female) were investigated in this study with a view to estimating the various anthropometric parameters, blood pressure components and hepatocellular injury indices (Aspartate aminotransferase - AST, Alanine aminotransferase - ALT, and Alkaline phosphatase - ALP) in different blood groups. Blood pressure, fasting plasma glucose (FPG), AST, ALT, ALP, weight, height, unblical circumference (UC), waist circumference (WC), hip circumference (HC), were determined using standard procedures; body mass index (BMI), body fat percentage (BF%), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR) and other body composition [body surface area (BSA), fat free body mass (FFBM), fat mass, total body water (TBW), intracellular fluid (ICF), extracellular fluid (ECF)] were calculated to assess overweight and obesity. While no significant difference ($p > 0.05$) was observed in the age, diastolic blood pressure (DBP), heart rate, FPG, weight, BMI, BSA, UC, WC, HC and WHR values of male when compared with the female counterpart; a significant ($p < 0.05$) decrease was observed in BF%, fat mass and WHtR, however a significant ($p < 0.05$) increase was found in systolic blood pressure (SBP), pulse pressure (PP), mean arterial pressure, height, FFBM, TBW, ICF and ECF of male when compared with the female subjects. No significant difference ($p > 0.05$) was observed in the activities of AST, ALT and ALP of male when compared with the female counterpart. Also there was no significant difference in AST, ALT when stratified according to various ABO blood groups of both male and female subjects. A significant positive relationship was observed between the ALP and FFBM ($r = 0.369$, $p < 0.01$); and BSA ($r = 0.284$, $p < 0.01$) male. Also AST significantly correlated positively with WC ($r = 0.448$, $p < 0.01$), HC (0.292, $p < 0.05$), UC ($r = 0.402$, $p < 0.05$), WHR ($r = 0.410$, $p < 0.01$) and WHtR ($r = 0.429$, $p < 0.01$) in the female subjects. ALP was directly correlated significantly with fat mass ($r = 0.289$, $p < 0.05$) in the female subjects. Thus these findings in young adults suggest potential clinical utility of including WC, HC,

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UC, WHR, WHtR as biomarkers in liver dysfunction and cardiovascular diseases assessment formulations.

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Introduction

Anthropometry in physical anthropology refers to the measurement of living human individuals for the purposes of understanding human physical variation. Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue (Chumlea et al., 1984). Anthropometry data such as height, weight, skin folds, girths, body mass index, body fat percentage, waist (abdominal) circumference, hip (buttocks) circumference are used for assessing growth, body fat distribution, and for provision of reference data. Measures of subcutaneous adipose tissue are important because individuals with large values are reported to be at increased risks for hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, and some forms of cancer (Dalton et al., 2003).

The liver is one of the vital organs of the body and plays a key role in the metabolism of carbohydrates, proteins, and lipids. It aids in the maintenance, performance, and regulation of homeostasis of the body (Adewusi *et al.*, 2010). It also has a wide range of functions, including the storage of glycogen, vitamin A, B12, and D, the production of several coagulation factors, growth factors, hormones, and biochemical necessary for digestion, and the detoxification and elimination of drugs (Kiran et al., 2012). If the detoxification functions of the liver are impaired by hepatotoxin agents such as medicines and alcohol, malnutrition, anemia, infection (Althnaian et al., 2013) and aflatoxin (Devendran and Balasubramanian, 2011), there will be many disorders in the body. Therefore, strengthening liver function is a fundamental step to achieving or maintaining perfect liver health (Shanmugasundaram and Venkataraman, 2006). Since liver perform different kinds of biochemical, synthetic and excretory functions, so no single biochemical test can detect the global functions of liver.

Liver Function Tests (LFTs) are one of the most commonly requested screening blood tests. Whether for the investigation of suspected liver disease, monitoring of disease activity, or simply as ‘routine’ blood analysis, these tests can provide a host of information on a range of disease processes. The title ‘liver function tests’ is, however, somewhat of a misnomer; only the bilirubin and albumin given in this panel offer information regarding the functional capacity of the liver. At a basic level the evaluation of liver enzymes simply gives information as to whether a patient’s primary disorder is hepatitic or cholestatic in origin. However, much more may be interpreted from these assays with knowledge of enzyme ratios and pattern recognition (Hall and Cash, 2012).

Liver disease is often clinically silent until late in its course. For this reason, laboratory tests are usually needed for recognition and characterization of the type of liver injury present. The most common cause of liver injury worldwide is infection with viruses that primarily infect the liver, often termed hepatitis viruses. Serologic and nucleic acid based tests are required to document exposure to and presence of these viruses, and are also used to monitor treatment of infected individuals. A number of other diseases may also cause liver injury, particularly autoimmune disorders and congenital or acquired disorders of metabolism. Laboratory tests are critical for recognition of these other diseases, particularly in patients who lack evidence of viral infection. Also, exposure to ethanol and other drugs can cause hepatic injury; clinical information is the most reliable means to recognize these potential causes of liver damage (Dufour, 2000).

The Anthropometric parameters and makers of hepatocellular injury would be useful tools in diagnosis and possibly to the physicians to monitor therapeutic response to treatment in some hepatitic or

cholestatic diseases. Since anthropometry is inexpensive and non-invasive measure of the general nutritional status of an individual or a population group. We are not aware of studies reporting the corellation between makers of hepatocellular injury with anthropometric parameters and ABO blood group in Nigeria. Also literature is lacking in reports relating blood groups with anthropometric measurement in indigenous sub-Saharan populations. In view of this, this study aimed at corellating anthropometric measurements with hepatocellular injury indices and blood pressure components in some apparent healthy Babcock University students.

Materials and method

Chemicals and reagents

Assay kits used for the determination of fasting plasma glucose, Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) and Alkaline phosphatase (ALP) were products of Cypress Diagnostics, Langdorpsesteenweg 160, 3201 Langdorp, Belgium. Antisera, anti A, anti B and anti D were procured from Helena laboratories, Beaumont, Texas. All other chemicals were of analytical grade and highest purity.

Laboratory equipment and other materials

UV/Visible spectrophotometer used for spectrophotometric studies was a product of Jenway Limited, Feldsted, Dunmow Essex (model 6405). The sphygmomanometer used in taking blood pressure was a product of Omron Health Care Inc., 300 Lakeview Parkway Vernon Hills, Illinois 60061, USA (model HEM-412C). Other equipment used included Centrifuge (JOL-802, Finlab, UK, model TDL-80-2). Jorita jeet needles and syringes were used to collect blood from the subjects. These were products of Anhui Tiankang Co., Limited, South Renhe, China. The heparinised tubes used were products of Sterling Products, Essex, England. Sterile latex surgical gloves and cotton wool were products of Neomedic Limited, Middlester, United Kingdom, Bathroom scale, stadiometer, stopwatch, tape rule, cotton wool, methylated spirit, refrigerator, freezer, Pasteur pipette, paper tape and Eppendof tubes were also used.

Study area and subjects

The study was carried out in Babcock University, Ilishan, Ogun State, Nigeria. Ilishan is an urban township in Southwestern Nigeria. They basically consume typical Nigerian low fat, high carbohydrate and protein diets. Apart from this, they live an active life-style in the community. The protocol for the study was approved by the Research and Ethics Committee of the Babcock University. Excluded from the study during routine interviews, clinical investigations and laboratory tests were patients with a history of smoking, drinking alcohol, human immunodeficiency virus (HIV), systemic lupus erythematosus, systemic inflammation or systemic infection, taking oral contraceptives, lipid lowering drugs. Age and sex-matched apparent healthy students of the University, on no medication served as subjects. Participation in the study by individual subject was voluntary. Before enrollment in the study, all subjects were informed about the objectives and requirements of the study, as well as the risks and discomfort that might be involved in participating in the study. Questionnaire interviews were conducted to gather information on variables such as current smoking status, alcohol consumption, education status, age, sex and race.

Measurement of blood pressure

Blood pressure and pulse were measured two times on the left arm in each subject in a supine position using Omron manual inflation blood pressure monitor (model HEM. 412C, Omron Healthcare Inc. Illinois, USA). Each measurement was spaced twenty minutes apart and was usually performed before collection of blood samples. The average of the two measurements was used for all analyses. To obtain the final measure of blood pressure, the mean of the first two readings was calculated, unless the difference between these readings was greater than 10 mmHg, in which case the mean of the two closest of three measurements was used as the SBP

and DBP values. Pulse pressure (PP) was calculated as SBP minus DBP. Mean arterial pressure (MAP) was estimated as (SBP+2DBP)/3 (Akamo et al., 2014).

Anthropometric measurements

Anthropometric measurements were carried out as described by Dalton et al. (2003).

Height: was measured to the nearest 0.5 cm without shoes using a stadiometer. Each participant stood with heels, buttocks and shoulders resting lightly against the backing board so that the Frankfort plane (a line connecting the superior border of the external auditory meatus with the infraorbital rim) was horizontal (i.e. parallel to the floor).

Weight: Weight was measured after removal of shoes and when wearing light clothing only, using a digital bathroom weighing scale, and was recorded to the nearest 0.1 kg.

Body mass index (BMI): was calculated by dividing the body weight (in kilograms) by the square of height (in meters).

Unblical circumference: was measured using a flexible but inelastic calibrated measuring tape, with measurements made at the navel in a horizontal plane. Each participant stood erect with the abdomen relaxed, arms at the sides and feet together, with the tape making contact with the skin.

Waist circumference: was measured halfway between the lower border of the ribs, and the iliac crest in a horizontal plane.

Hip circumference: was measured at the widest point over the buttocks. For each of unblical, waist and hip circumference, two measurements to the nearest 0.5 cm were recorded. If the variation between the measurements was greater than 2 cm, a third measurement was taken. The mean of the two closest measurements was calculated.

Waist-to-hip ratio (WHR): was obtained by dividing the waist circumference by the hip circumference.

Waist-to-height ratio (WHtR): was obtained by dividing the waist circumference by the height.

Body fat percentage (BF %) was estimated from the BMI as described by Deurenberg *et al*., 1991.

Other body composition

Body Surface Area (BSA), Body Fat Mass (BFM), Fat Free Mass Index (FFMI), Total Body Water (TBW), Intracellular Fluid (ICF) and Extracellular Fluid (ECF) were calculated from weight and height (Ademuyiwa et al., 2005).

Collection of blood samples

Blood samples (10 mL) were collected between 8:00 am to 11:00 am from the antecubital vein of the subject after an overnight fast for 12 to 14 hours by placing a tourniquet on the upper arm and tightening it sufficiently prevent venous vein. The sites were cleansed with 70% alcohol and dried with sterile gauze. The vein was punctured with sterile needle attached to a syringe. After the vein was entered, the procedure was completed; sterilized gauze was used to apply pressure over the punctured side to stop bleeding. The needle was removed from the syringe and the blood was transferred into a lithium heparin anticoagulated tube, and mixed gently by inverting the stoppered tube several times. The blood samples were stored in a cooler box and transferred to the laboratory for analyses. Plasma was separated from erythrocyes and stored at -20 °C for further analysis.

Determination of biochemical parameters

The concentrations of AST, ALT, ALP were determined by adopting standard procedures (Tietz et al., 1994). Also ABO blood groups was defermined by standard method (Akamo et al., 2014).

Statistical analysis

Data obtained were entered into SPSS (Statistical Package for Social Sciences) software for Window version 16 (SPSS Inc., Chicago, Illinois, USA). Data were expressed as Mean±S.E.M. Qualitative variables were expressed as count and percentage of status or category. Analysis of Variance (ANOVA) was carried out to test for the level of homogeneity among the groups. Where

heterogeneity occurred, the groups were separated using Duncan Multiple Range Test (DMRT). The level of interaction among the parameters was determined using Pearson correlation. p values of < 0.05 were considered to be statistically significant.

Results

The demograhic and clinical characteristics of the subjects is shown in table 1. While no significant difference ($p > 0.05$) was observed in the age (21.43 ± 0.35 year vs 19.34 ± 0.27 year), DBP (131.21 ± 1.86 mmHg vs 119.30 ± 1.57 mmHg) and heart rate (75.72 ± 1.88 mmHg vs 79.14 ± 1.98 mmHg) of male when compared with the female counterpart; a significant ($p < 0.05$) increase was however found in SBP (131.21 ± 1.86 mmHg vs 119.30 ± 1.57 mmHg), pulse pressure (PP) (57.58 ± 1.83 mmHg vs 47.43 ± 1.57), mean arterial pressure and fasting plasma glucose (FPG) (132 ± 7.92 mg/dL vs 120 ± 8.88) of male when compared with the female subjects.

The anthropometric characteristics and body composition of the subjects are shown in Table 2. While no significant difference ($p > 0.05$) was observed in the weight (68.08 ± 1.47 kg vs 63.62 ± 1.46 kg), BMI (22.16 ± 0.49 kg/m² vs 23.69 ± 0.58 kg/m²), BSA (1.84 ± 0.02 m² vs 1.70 ± 0.02 m²), UC (80.65 ± 2.08 cm vs 76.21 ± 1.26 cm), WC (85.22 ± 1.04 cm vs 84.68 ± 1.2 cm), HC (94.68 ± 1.57 cm vs 97.16 ± 1.19 cm), WHR (0.92 ± 0.03 vs 0.87 ± 0.006) values of male when compared with the female subjects; a significant ($p < 0.05$) decrease was observed in BF% (15.32 ± 0.61% vs 22.07 ± 0.73%), fat mass (11.38 ± 1.06 kg vs 19.10 ± 1.05 kg) and WHtR (0.49 ± 0.006 vs 0.57 ± 0.008), however a significant ($p < 0.05$) increase was found in height, FFBM, TBW, ICF and ECF of male when compared with the female counterpart.

The frequency of the various ABO blood group types of the subjects is shown in Table 3. The number of male with O, A and B blood group are 39, 7 and 7, respectively. Also the number of female with O, A and B blood group are 28, 7 and 12 respectively. The total number of Rh.D+ and Rh.D- in male and female subjects are 46 vs 7 and 44 vs 3, respectively.

Table 4 shows the frequency of Rhesus factor (Rh.D) in the various ABO types. 33, 6, 7, 6 and 1 male subjects have O+, O-, A+, B+ and B- respectively. Likewise, 26, 2, 7, 11 and 1 female subjects have O+, O-, A+, B+ and B- respectively.

Table 5 and Table 6 show the correlation coefficient between anthropometric characteristics and hepatocellular injury indices in the male and female subjects respectively. A significant positive relationship was observed between the ALP and FFBM ($r = 0.369$, $p < 0.01$); and BSA ($r = 0.284$, $p < 0.01$) male. Also AST significantly

Table 1. Demograhic and clinical characteristics of the subjects.

	Male (n = 53)	**Female (n = 47)**
Age (years)	21.43 ± 0.35[a]	19.34 ± 0.27[a]
SBP (mmHg)	131.21 ± 1.86[b]	119.30 ± 1.57 [a]
DBP (mmHg)	73.62 ± 1.39[a]	71.87 ± 1.57 [a]
PP (mmHg)	57.58 ± 1.83[b]	47.43 ± 1.57 [a]
MAP (mmHg)	92.82 ± 1.30[b]	87.68 ± 1.38 [a]
Heart rate (beats/min)	75.72 ± 1.88[a]	79.14 ± 1.98 [a]
FPG (mg/dL)	132 ± 7.92[b]	120 ± 8.88 [a]

Each value represents the mean ± S.E.M. Values within the same row with different superscripts are significantly different at $p < 0.05$. SBP, systolic blood pressure; DBP, diastolic blood pressure; PP, pulse pressure; MAP, mean aterial pressure; FPG, fasting plasma glucose.

Table 2. Anthropometric characteristics and body composition of the subjects.

	Male (n = 53)	Female (n = 47)
Weight (kg)	68.08 ± 1.47[a]	63.62 ± 1.46[a]
Height (cm)	175.45 ± 0.87[b]	164.09 ± 0.88[a]
BMI (kg/m²)	22.16 ± 0.49[a]	23.69 ± 0.58[a]
Body Fat %	15.32 ± 0.61[a]	22.07 ± 0.73[b]
BSA (m²)	1.84 ± 0.02[a]	1.70 ± 0.02[a]
FFBM (kg)	56.70 ± 0.60[b]	44.52 ± 0.53[a]
Fat Mass (kg)	11.38 ± 1.06[a]	19.10 ± 1.05[b]
TBW (litre)	40.37 ± 0.49[b]	32.96 ± 0.43[a]
ICF (litre)	22.20 ± 0.27[b]	18.13 ± 0.23[a]
ECF (litre)	18.17 ± 0.22[b]	14.83 ± 0.19[a]
UC (cm)	80.65 ± 2.08[a]	76.21 ± 1.26[a]
WC (cm)	85. 22 ± 1.04[a]	84.68 ± 1.20[a]
HC (cm)	94.68 ± 1.57[a]	97.16 ± 1.19[a]
WHR	0.92 ± 0.03[a]	0.87 ± 0.006[a]
WHtR	0.49 ± 0.006[a]	0.57 ± 0.008[b]

Each value represents the mean ± S.E.M. Values within the same row with different superscripts are significantly different at $p < 0.05$ WC, waist circumference; HC, hip circumference; UC, umbilical circumference; WHR, waist to hip ratio; WHtR, waist to height ratio; BMI, Body mass index; BSA, Body Surface Area; FFBM, fat free body mass; TBW, Total Body Water; ICF, Intracellular Fluid; ECF, Extracellular Fluid.

Table 3. Frequency of the various ABO types of the subjects.

Group	Male (n = 53)	Female (n = 47)
O	39 (73.6)	28 (59.6)
A	7 (13.2)	7 (14.9)
B	7(13.5)	12 (25.5)
AB	-	-
Rh.D+	46 (86.8)	44 (93.6)
Rh.D-	7 (13.2)	3 (6.4)

Values are frequencies. Figures in parentheses are in percentage.

Table 4. Frequency of Rhesus factor (Rh.D) in the various ABO types of subjects.

GROUP	Male (n = 53)	Female (n = 47)
O+	33 (62.3)	26 (55.3)
O-	6 (11.3)	2 (4.3)
A+	7 13.2)	7 (14.9)
A-	-	-
B+	6 (11.3)	11 (23.4)
B-	1(1.9)	1 (2.1)
Total	53(100.0)	47 (100.0)

Values are frequencies. Figures in parentheses are in percentage.

Table 5. Correlation coefficients of anthropometric characteristics and hepatocellular injury indices in the male subjects.

	ALT	AST	ALP
Weight	0.090	-0.085	-0.022
Height	-0.225	-0.021	0.096
BMI	0.199	-0.073	-0.074
WC	0.154	0.035	0.018
HC	0.069	-0.029	-0.097
UC	0.159	-0.105	-0.112
WHR	0.050	0.001	0.108
WHtR	0.260	0.045	-0.026
BF	0.177	-0.019	-0.039
FFBM	0.219	0.174	0.369**
FM	0.185	-0.008	-0.007
BSA	0.239	0.123	0.284*
TBW	0.235	0.130	0.275
ICF	0.235	0.130	0.275
ECF	0.235	0.130	0.275

Values with superscript * and ** are significantly different at $p < 0.05$ and $p < 0.01$ respectively.

Table 6. Correlation coefficient for anthropometric characteristics and hepatocellular injury indices in the female subjects.

	ALT	AST	ALP
Weight	0.057	-0.041	0.081
Height	0.056	-0.047	0.085
BMI	0.000	0.186	-0.001
WC	-0.053	0.448**	-0.050
HC	0.029	0.292*	-0.130
UC	-0.103	0.402*	0.001
WHR	-0.173	0.410**	0.142
WHtR	-0.065	0.429**	-0.071
BF	-0.060	-0.082	0.008
FFBM	-0.195	-0.067	0.093
FM	-0.187	0.014	0.289*
BSA	-0.187	-0.027	0.160
TBW	-0.161	-0.055	0.050
ICF	-0.161	-0.055	0.050
ECF	-0.161	-0.055	0.051

Values with superscript * and ** are significantly different at $p < 0.05$ and $p < 0.01$ respectively.

correlated positively with WC ($r = 0.448$, $p < 0.01$), HC (0.292, $p < 0.05$), UC ($r = 0.402$, $p < 0.05$), WHR ($r = 0.410$, $p < 0.01$) and WHtR ($r = 0.429$, $p < 0.01$) in the female subjects. ALP was directly correlated significantly with fat mass ($r = 0.289$, $p < 0.05$) in the female subjects.

Figure 1.A shows the systolic blood pressure (SBP) in the various ABO blood groups of the subjects, the mean values of the SBP of the various ABO blood groups in both male and female subjects are statistically significant ($P < 0.05$), female with A blood groups have the highest SBP, however the lowest was found in female with A blood group when compared with other blood groups.

The representation of diastolic blood pressure (DBP) in the various ABO blood group of both male and female subjects is shown in Figure 1.B. The mean values of the DBP for the ABO blood groups of both sexes in this study were not statistically significantly ($p > 0.05$) except in B female blood group.

The mean values of the pulse pressure in the various blood groups is statistically significant ($p < 0.05$) with the

A female blood group having the lowest mean value and the A male group having the highest mean value as shown in Figure 1.C.

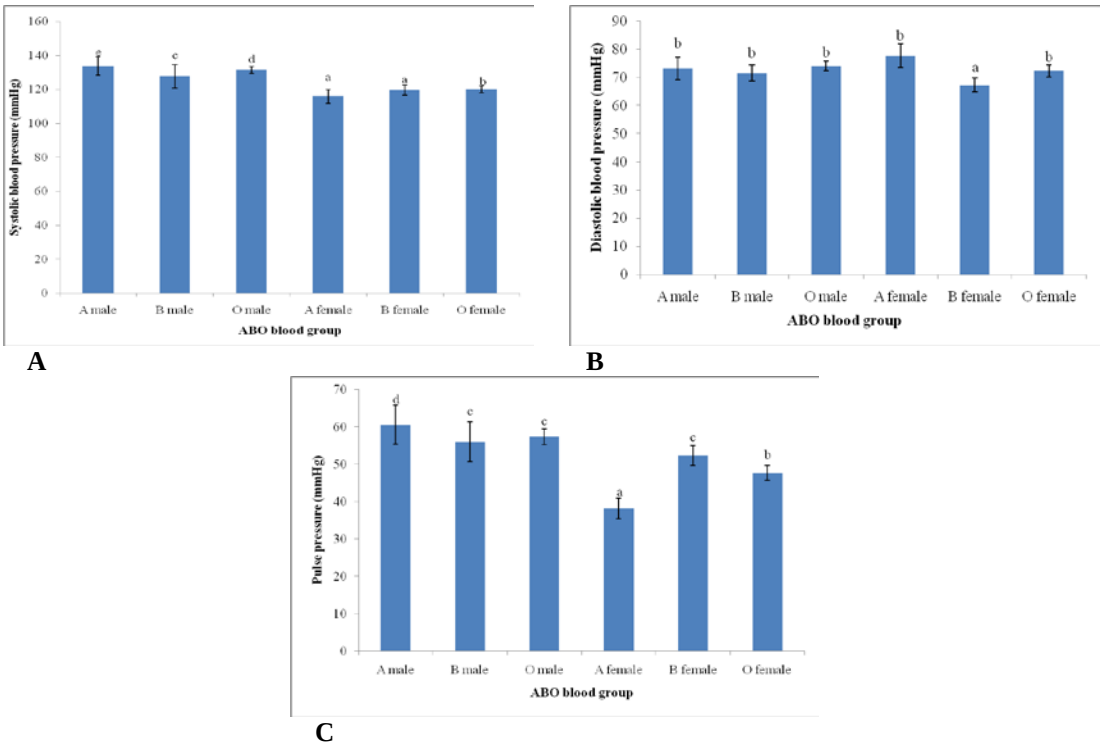

Figure 1. Systolic blood pressure (A), diastolic blood pressure (B) and pulse pressure (C) in ABO blood groups of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

The mean values of the mean arterial pressure (MAP), pulse rate, weight, body mass index, waist circumference, hip circumference, waist to hip ratio and fasting blood glucose are not statistically significant ($p > 0.05$) in the various blood groups of both male and female subjects for this study as shown in Figure 2 (A to H), respectively, are not significant statistically in to various ABO blood groups.

The mean value of height (Figure 3.A), body fat (Figure 3.B), free fat body mass (FFBM, Figure 3.C), total body water (TBW, Figure 3.D) intracellular fluid (ICF, Figure 3.E) and extracellular fluid (ECF, Figure 3.F) for the subjects in the ABO blood of both genders are statistically significant ($p < 0.05$). When the subjects are stratified according the ABO blood groups there was no significant different among various ABO group in male only and in female only. However the various ABO in male were significantly higher with the corresponding ABO blood groups in female for height, FFBM, TBW, ICF and ECF except BF% where the reverse was the case.

Figure 4 shows the unblical circumference in ABO blood group, in this study, the mean value of the unblical circumference is statistically significant ($p < 0.05$), the A and B female subjects have the least mean value, the O female, O and B male have the similar range of mean values and the A male has the highest mean value.

The mean value for the waist to height ratio according to the ABO blood group of both male and female in this study is statistically significant ($p < 0.05$). Blood group A male has the least mean value, B and O male, A and B female are in the same range while the O female has the highest mean value as shown in Figure 5.

The mean value for Fat mass in the ABO blood group of male and female subjects is statistically significant ($p < 0.05$) in both sexes as shown in Figure 6. O

female has the highest mean value, A and B female group are likewise high compared to the male B and O, meanwhile A male group has the least mean value.

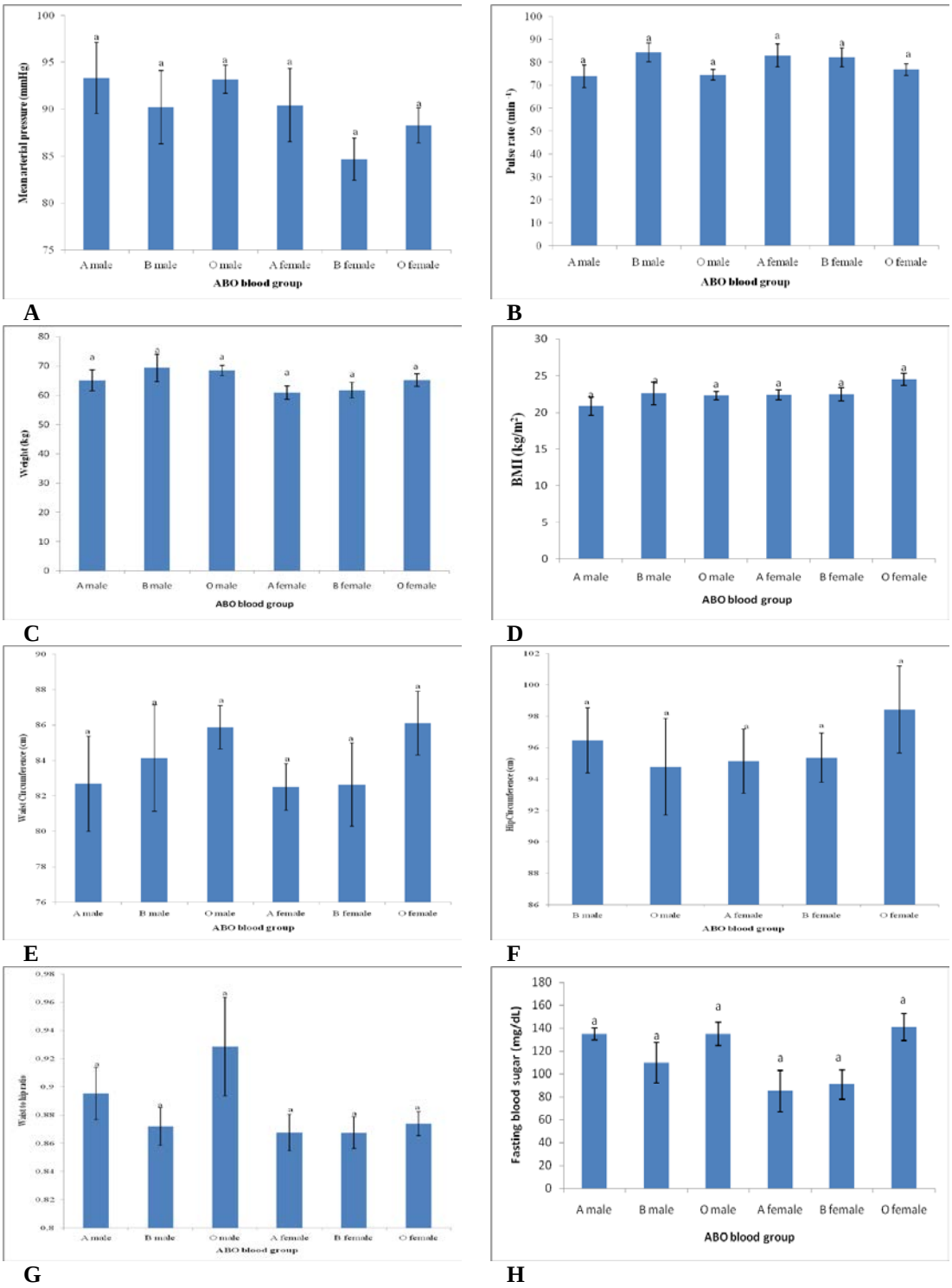

Figure 2. Mean arterial pressure (A), pulse rate (B), weight (C), body mass (D), waist circumference (E), hip circumference (F), waist to hip ratio (G), and Fasting blood sugar (H) in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

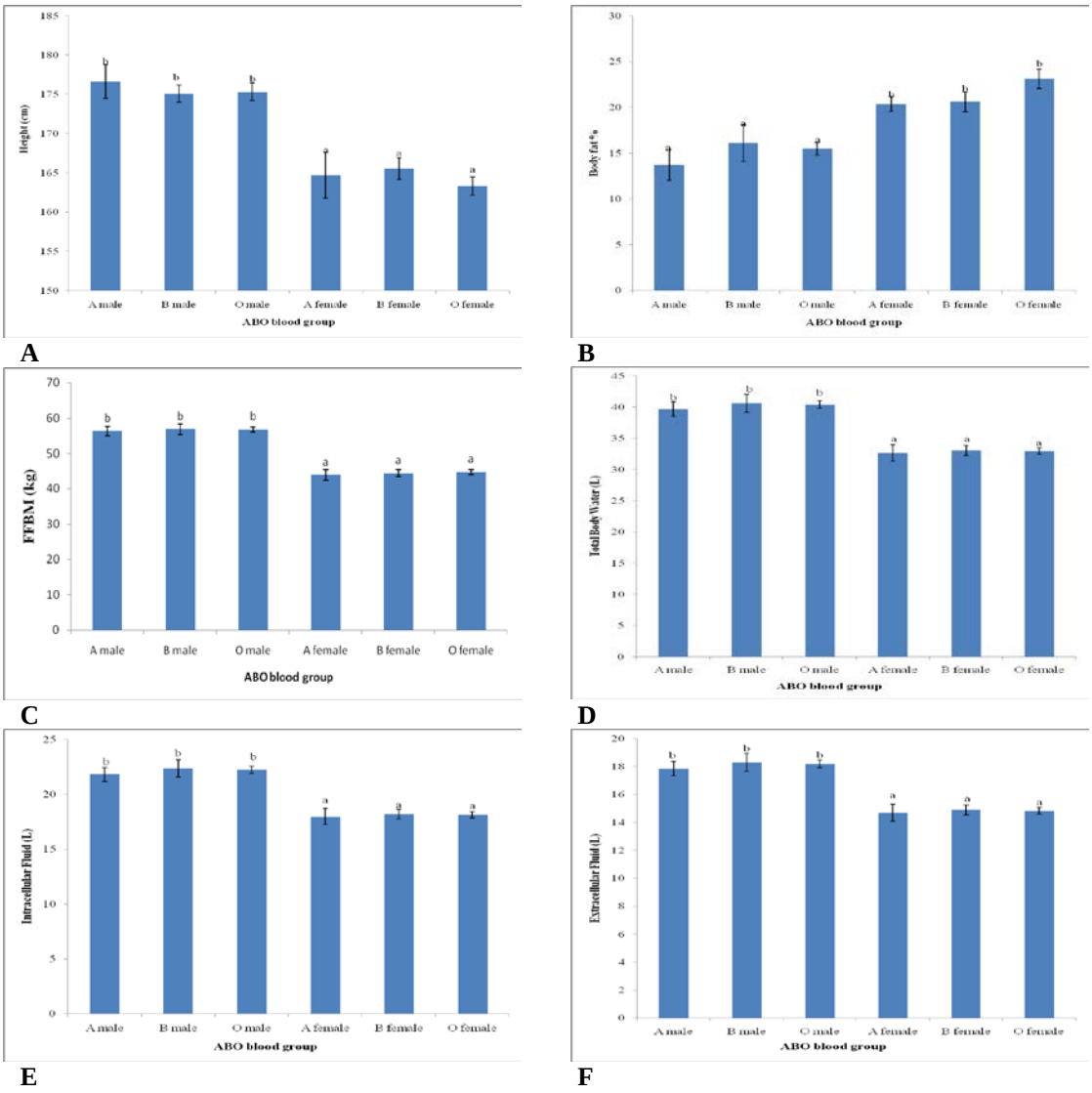

Figure 3. Height (A), body fat percent (B), free fat body mass (C), total body water (D), intracellular fluid (E), extracellular fluid (F) in ABO blood group of the male and female subjects. Each bar represents the mean±S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

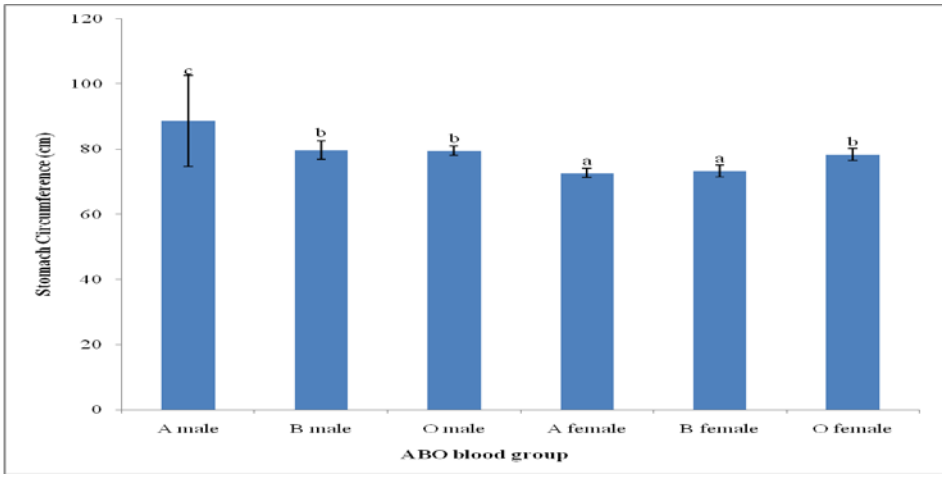

Figure 4. Umblical circumference in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

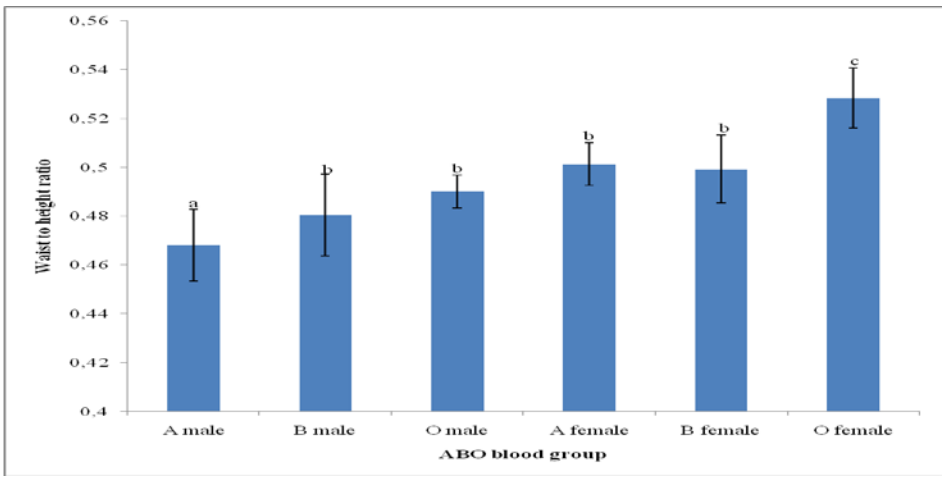

Figure 5. Waist to height ratio in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

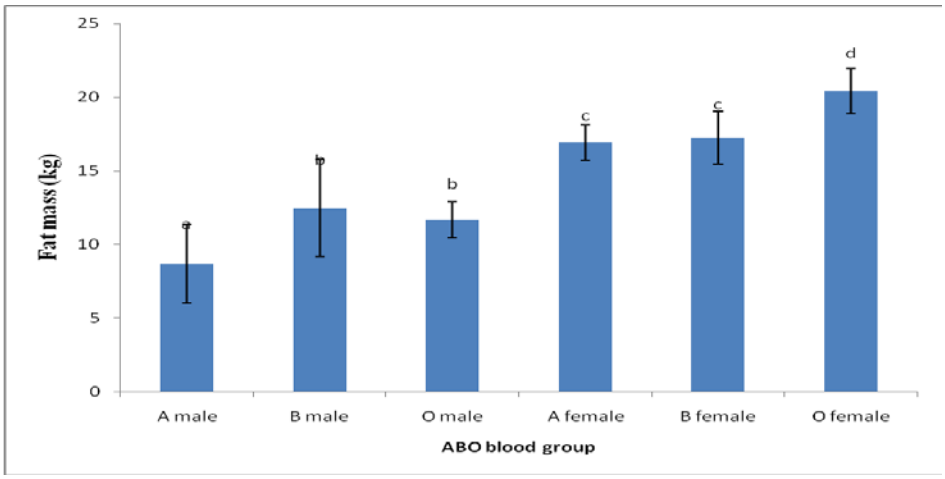

Figure 6. Fat mass in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

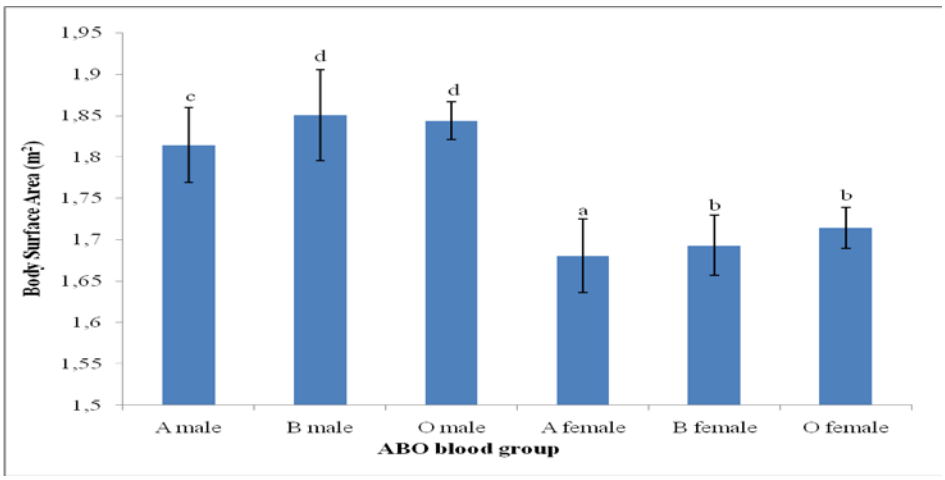

Figure 7. Body surface area in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

Figure 7 shows the mean value for body surface area (BSA) in ABO blood groups of male and female subjects. The A female has the least mean value, B and O female have the same mean value range, B and O male have the highest mean value.

The fasting blood sugar, AST, ALT and ALP in ABO blood group of male and female subjects are shown in Figures 2.H, 8, 9, and 10, respectively. No significant difference ($p > 0.05$) was observed in the concentration of fasting blood sugar and the activities of AST, ALT and ALP of male when compared with the female counterpart. Also there was no significant difference in these biochemical parameters when stratified according to their various ABO blood groups.

Discussion

This is the first study to the best of our knowledge that assessed the relationship between hepatocellular injury indices and anthropometric parameters in an African population. This study employed and also consistent with anthropometric measures, which have been reported to be associated with CVD risk. These factors include WC, HC, WHR, BMI, BF % (Schneider et al., 2006). The result shows that a significant ($p < 0.05$) decrease was

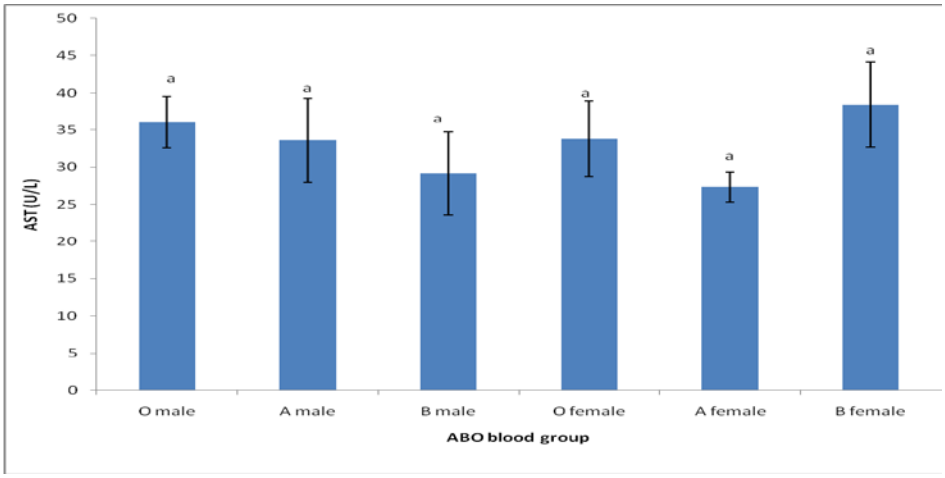

Figure 8. Aspartate aminotransferase in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

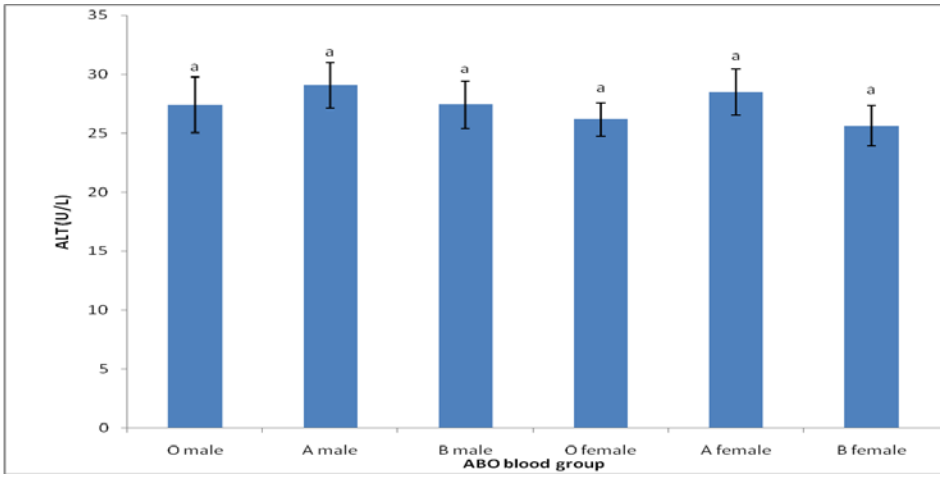

Figure 9. Alanine aminotransferase (ALT) in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

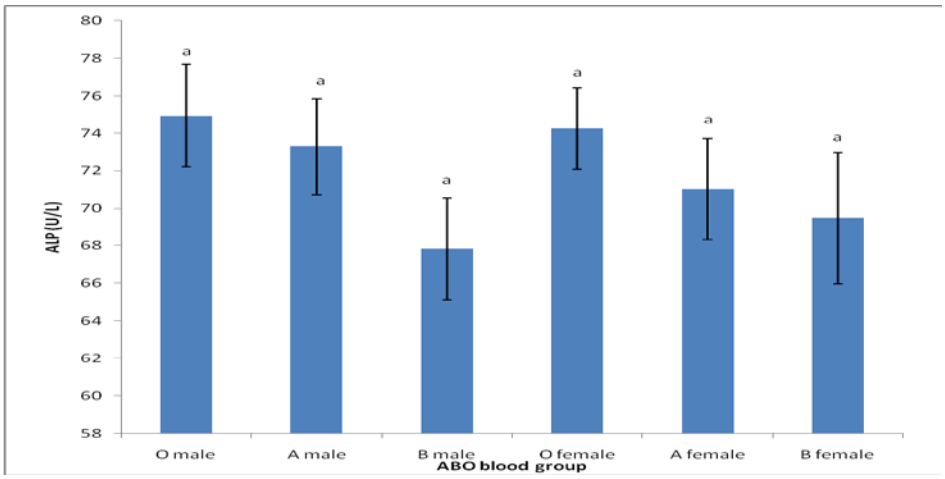

Figure 10. Alkaline phosphatase (ALP) in ABO blood group of the male and female subjects. Each bar represents the mean ± S.E.M. Bars with different alphabets are significantly different at $p < 0.05$.

observed in BF%, fat mass and WHtR, however a significant ($p < 0.05$) increase was found in systolic blood pressure (SBP), pulse pressure (PP), mean arterial pressure, height, FFBM, TBW, ICF and ECF of male when compared with the female subjects. The results showed that both men and women in the high-WHR category had higher ferritin concentrations than those in the normal-WHR category. A positive association between ferritin concentrations and BMI, WC, WHR, percentage body fat and SSF was demonstrated for both men and women; although this disappeared after adjusting for age, BMI and smoking. WC and WHR increased with increasing ferritin concentrations in both men and women. Serum iron concentrations decreased with increasing BMI in women only. No significant difference ($p > 0.05$) was observed in the activities of AST, ALT and ALP of male when compared with the female counterpart. Also there was no significant difference in AST, ALT when stratified according to various ABO blood groups of both male and female subjects. A significant positive relationship was observed between the ALP and FFBM ($r = 0.369$, $p < 0.01$); and BSA ($r = 0.284$, $p < 0.01$) male. Also AST significantly correlated positively with WC ($r = 0.448$, $p < 0.01$), HC (0.292, $p < 0.05$), UC ($r = 0.402$, $p < 0.05$), WHR ($r = 0.410$, $p<0.01$) and WHtR ($r = 0.429$, $p < 0.01$) in the female subjects. ALP was directly correlated significantly with fat mass ($r = 0.289$, $p < 0.05$) in the female subjects.

The liver enzyme profile should always be assessed in conjunction with a thorough history and clinical examination. Despite these invaluable tools, there are many occasions when doubt persists over an underlying diagnosis. For example, does an overweight diabetic [with high level of BMI and BF % – indicators of general obesity or with high level of HC, WC, WHR, WHtR – indicators of central/abdominal/visceral obesity] who enjoys a few glasses of wine at the weekend have alcoholic or non-alcoholic fatty liver disease? In such circumstances the absolute liver enzyme levels and ratios may point the clinician in the right direction. Furthermore, the pattern of enzymes will assist, not only with differentiating between cholestasis and hepatitis, but will aid diagnosis when there is a mixed picture (Hall and Cash 2012).

Mechanical biliary obstruction results in raised levels of ALP, GGT and often bilirubin. ALP will usually be markedly raised in comparison with ALT. Levels of ALP and GGT elevated in similar proportions signify a hepatobiliary source. Otherwise alternative causes of single enzyme elevation should be considered.

When due to choledocholithiasis, the levels of ALP and GGT tend to fluctuate (in comparison to stricture forming disease) and may be associated with a normal bilirubin (Anciaux et al., 1986) Enzyme titres tend to rise and fall

gradually and may be preceded by a peaked rise in liver transaminases which can reach > 1000 I/U (Nathwani et al., 2005).

The AST:ALT ratio (De Ritis ratio) may assist in differentiating the site of biliary obstruction. When associated with a cholestatic picture, an AST:ALT ratio of < 1.5 suggests an extrahepatic obstruction. In such circumstances the ALT titre is frequently considerably higher than AST. An AST:ALT ratio of > 1.5 indicates intrahepatic (mechanical or medical) cholestasis is more likely (McClatchey, 2002).

Drug-induced cholestasis usually presents with a preferential rise in ALP, rather than GGT, or with an ALT:ALP ratio of < 2. Causative drugs would include: antibiotics, immunosuppressants, tricyclic antidepressants and angiotensin converting enzyme inhibitors (Velayudham and Farrell, 2003).

In primary biliary cirrhosis, an autoimmune condition of the intrahepatic biliary ducts, the level of ALP is generally greater than that of GGT. In this case, transaminases are invariably normal or only minimally elevated. Both the European Association for Study of the Liver (EASL) and the American Association for Study of Liver Disease (AASLD) recommend that a diagnosis of PBC may be based on cholestatic liver enzyme levels in conjunction with the demonstration of antimitochondrial antibodies (European Association for the Study of the Liver, 2009; Heathcote, 2000; Hall and Cash, 2012). If either of these two criteria is absent, imaging and liver biopsy become necessary.

AST and ALP are used within some scoring criteria to monitor the effects of ursodeoxycholic acid in the management of PBC. A recent study has shown that a raised AST:ALT ratio outperforms other non-histological indicators of cirrhosis in PBC, but still only achieves a low sensitivity and a specificity of 65-79% (Alempijevic et al., 2009).

Considering the variations in the anthropometric parameters, blood pressure components and activity of the enzymes of the hepatocellular injury indices (AST, ALT, ALP) in the male and female subjects, the subjects can be declared healthy and not predisposed to hepatocellular injury when compared with the standard values for these parameters (Hall and Cash, 2012).

Knowledge of how to correctly analyse liver enzymes is essential in the diagnosis, monitoring and treatment of liver disease vis-a-vis the measurement the antropometric parameters – which are cheap, non-invasive and require less expertise. Although a variety of laboratory and imaging investigations are readily available to aid in this process, an enhanced knowledge of liver enzyme patterns can help prevent unnecessary investigations and expedite interventions, such as liver biopsy, when required.

Conclusion

So, AST, ALT, ALP and antropometric parameters are related to various ABO blood groups in varying extent. Also These findings in young adults suggest potential clinical utility of including WC, HC, UC, WHR, WHtR as biomarkers in liver dysfunction and cardiovascular diseases assessment formulations.

Conflict of interest statement

Authors declare that they have no conflict of interests.

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