

## Evaluation of Plasma Electrolyte Concentration in Pregnant Nigerian Women From Edo State, Nigeria

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### Abstract

*The renal function status in relation to electrolyte homeostasis was evaluated in a total of one hundred pregnant Nigerian women (volunteers) and thirty non-pregnant controls. The volunteers were of varying maternal age, parity, trimester, weight, height, and social status while the non-pregnant women were of approximate age to serve as control. Analysis of the results revealed that sodium ( $136.21 \pm 0.39 \text{ mmol/l}$ ), potassium ( $3.69 \pm 0.004 \text{ mmol/l}$ ), calcium ( $2.17 \pm 0.02 \text{ mmol/l}$ ), and bicarbonate ( $20.39 \pm 0.26 \text{ mmol/l}$ ) were significantly reduced ( $P < 0.05$ ) when compared to the control ( $137.97 \pm 0.46 \text{ mmol/l}$ ,  $4.29 \pm 0.09 \text{ mmol/l}$ ,  $2.59 \pm 0.03 \text{ mmol/l}$  and  $25.87 \pm 0.43 \text{ mmol/l}$  respectively). There was a significant decrease ( $P < 0.05$ ) in sodium, potassium, calcium and bicarbonate concentrations as pregnancy progressed. Maternal age is positively correlated with sodium ( $r = 0.092$ ) and potassium ( $r = 0.100$ ) but inversely correlated with calcium ( $r = -0.088$ ) and bicarbonate ( $r = -0.051$ ) concentrations. While parity is inversely correlated with sodium ( $r = -0.045$ ), potassium ( $r = -0.155$ ) and calcium ( $r = -0.175$ ), it was positively correlated with bicarbonate ( $r = 0.015$ ) concentrations. All the electrolytes have positive correlation with gestation ( $\text{Na}^+$ :  $r = 0.249$ ,  $\text{K}^+$ :  $r = 0.204$ ,  $\text{Ca}^{2+}$ :  $r = 0.004$  and  $\text{HCO}_3^-$ :  $r = 0.056$ ) while social status was inversely correlated to all the parameters ( $\text{Na}^+$ :  $r = -0.151$ ,  $\text{K}^+$ :  $r = -0.075$ ,  $\text{Ca}^{2+}$ :  $r = -0.046$  and  $\text{HCO}_3^-$ :  $r = 0.023$ ;  $P < 0.05$ ). Nutrition, environmental condition and child's spacing may have influenced the parameters and their implications with respect to proper fetal development are discussed.*

**Keywords:** Pregnancy, electrolytes.

### Introduction

Pregnancy is a normal physiological phenomenon with many biochemical changes ranging from alterations in electrolyte concentrations to more complex changes in cortisol and calcium metabolism that assist the nurturing and survival of the fetus (Lazarus and Premawardhana, 2005; Glinoer, 1997). Multiple gestations can occur in pregnancy as in the case of twins, triplets or quadruplets. Pregnancy is normally associated with an increased deposition of nutrients in anticipation for later use by and for proper development of the fetus (Onyeneke and Alumanah, 1990). Pregnancy is typically broken into three periods or trimesters, each of about three months and these distinctions are useful in describing the changes that take place over time (National Health Service, 2010). There are many symptoms experienced by pregnant women which can signify pregnancy and these symptoms include: constipation and hemorrhoid, nausea, vomiting, stretch marks, fatigue, chiloasma etc (National Health Service, 2010). A number of

early medical signs include: the presence of  $\beta$ -human chorionic gonadotropin ( $\beta$ -HCG) in the blood and urine, missed menstrual period, implantation bleeding that occur at implantation of the embryo in the uterus during the third or fourth week after menstrual period etc (American Pregnancy Association, 2008, Mayo Clinic, 2007). Pregnancy detection can be accomplished using one or more various pregnancy test, which detects hormones generated by the newly formed placenta. A balanced nutritious diet is an important aspect of a healthy pregnancy. Eating a healthy diet, balancing carbohydrate, fat and protein and eating a variety of fruits and vegetables, usually ensure good nutrition. Much of the full development of the fetal body tissue has been greatly attributed to be dependent on the quality of nutrients available to the fetus and the efficiency of the human placenta to effect nutrient transfer (Animotu *et al.*, 1994). Several micronutrients are important for health of the developing fetus, especially in areas of the world where insufficient nutrition is prevalent (Salem, 2001). During pregnancy, insufficient weight gain can compromise the

health of the fetus. Likewise, excessive weight gain can pose risk to the pregnant woman and the fetus. The several functions of the kidney include: absorption of water, glucose and amino acids, production of hormone such as calcitriol, rennin and erythropoietin and homeostatic function (Seely, 1997). There is serious health risks for both mother and baby associated with kidney disease. Assessment of kidney function involves the measurement of certain metabolites. Electrolytes play a vital role in maintaining homeostasis within the body. Its imbalance can be caused by burns, renal tubular acidosis, heart arrhythmia, diabetes insipidus etc. Most common problems occur when the level of sodium, potassium or calcium are abnormal. This research is therefore aimed at evaluating the plasma electrolyte status in some pregnant Nigerian women from Edo State, in order to establish any variance between electrolytes during pregnancy.

## Materials and Methods

**Description:** One hundred (100) healthy pregnant Nigerian women of different gestational age, height, weight, maternal age, parity and social status were used in this study to determine the electrolyte homeostatic status. The volunteers were pregnant women aged 20-44 years with no pathological symptoms attending Government Specialist Hospital, Benin City, Edo State, Nigeria. Also, thirty (30) healthy non-pregnant women of approximate age were used as control. A verbal consent of the volunteers was sort before their participation in the study.

**Sampling technique:** 5ml of venous blood was collected by venipuncture from each non fasting patient into heparinized sample bottle and were later spun with a centrifuge at 3000 revolutions per minute for ten minutes, to separate the plasma from the whole blood cells, as the supernatant. The separated plasma was extracted into labeled plain sample bottles using Pasture pipette and were analyzed immediately.

**Criteria:** There was no restriction to food habits and fluid intake. Their maternal age, height, weight, parity, trimester and social status were obtained from their clinical records. Haemolyzed samples were not used for the study.

**Biochemical parameters:** The biochemical parameters measured were electrolytes:

sodium, potassium, calcium, and bicarbonate. Sodium and potassium were analyzed using a Gallenkamp flame analyzer at 590nm and 767nm respectively after a 1:100 dilution with deionized water. Calcium was analyzed using colorimetric method according to Raysarker and Chauhan (1967) while bicarbonate was analyzed using titration method according to Davidson and Henry (1979).

**Statistical analysis:** Data of all subjects (case and control) along with biochemical parameters were measured and compared. All data were statistically analyzed using the SPSS software. A-1way analysis of variance and students t-test was performed on groups for comparison and a p -value of <0.05 was considered significant.

## Results

In this study, a total of one hundred and thirty (130) female volunteers were used to assess the renal electrolyte homeostasis. Group A (control) consists of thirty (30) non-pregnant women and group B (test) consists of one hundred (100) apparently healthy pregnant women. Biostatistics of both groups were recorded including age, weight, height, trimester, parity and social status. The values obtained were expressed as mean  $\pm$  standard error of mean (SEM).

Table 1 (pooled sample) shows the biostatistics and biochemical parameters of the pregnant women. Results obtained show that sodium ( $136.21 \pm 0.39$ mmol/l), potassium ( $3.69 \pm 0.04$ mmol/l), calcium ( $2.17 \pm 0.02$  mmol/l) and bicarbonate ( $20.39 \pm 0.26$  mmol/l) concentrations were significantly reduced ( $P < 0.05$ ) when compared to control subjects ( $137.97 \pm 0.46$  mmol/l,  $4.29 \pm 0.09$  mmol/l,  $2.59 \pm 0.03$  mmol/l and  $25.87 \pm 0.43$  mmol/l respectively).

**Table 1: Biostatistics and Biochemical Parameters of the Pregnant Women**

Parameters	Control (n=30)	Pregnant Women (n=100)
Age	27.07 $\pm$ 1.12 <sup>a</sup>	28.73 $\pm$ 0.41 <sup>a</sup>
Weight (kg)	63.97 $\pm$ 1.85 <sup>a</sup>	75.52 $\pm$ 1.47 <sup>b</sup>
Height (m)	1.57 $\pm$ 0.02 <sup>a</sup>	1.62 $\pm$ 0.01 <sup>b</sup>
Body mass index (kg/m <sup>2</sup> )	26.23 $\pm$ 0.70 <sup>a</sup>	28.86 $\pm$ 0.56 <sup>b</sup>
Na <sup>+</sup> (mmol/l)	137.97 $\pm$ 0.46 <sup>a</sup>	136.21 $\pm$ 0.39 <sup>b</sup>
K <sup>+</sup> (mmol/l)	4.29 $\pm$ 0.09 <sup>a</sup>	3.69 $\pm$ 0.04 <sup>b</sup>
Ca <sup>2+</sup> (mmol/l)	2.59 $\pm$ 0.03 <sup>a</sup>	2.17 $\pm$ 0.02 <sup>b</sup>
HCO <sub>3</sub> <sup>-</sup>	25.87 $\pm$ 0.43 <sup>a</sup>	20.39 $\pm$ 0.26 <sup>b</sup>

Values are represented as mean  $\pm$  standard error of mean Values in the same row with different alphabets defer significantly ( $p < 0.05$ )

Table 2 shows the relationship between some renal function parameters and maternal age. Results obtained show that between the age ranges of 20-24 years ( $K^+$ ;  $3.90 \pm 0.17$  mmol/l,  $Ca^{2+}$ ;  $2.12 \pm 0.09$  mmol/l, and  $HCO_3^-$ ;  $21.40 \pm 0.97$  mmol/l) concentrations, 25-29 years ( $Na^+$ ;  $135.90 \pm 0.53$  mmol/l,  $K^+$ ;  $3.66 \pm 0.05$  mmol/l,  $Ca^{2+}$ ;  $2.23 \pm 0.03$  mmol/l and  $HCO_3^-$ ;  $20.22 \pm 0.32$  mmol/l) concentrations and 30-34 years ( $K^+$ ;  $3.64 \pm 0.05$  mmol/l,  $Ca^{2+}$ ;  $2.08 \pm 0.03$  mmol/l, and  $HCO_3^-$ ;

$20.50 \pm 0.50$  mmol/l) concentrations were significantly reduced ( $P < 0.05$ ) when compared to the control ( $Na^+$   $137.97 \pm 0.46$  mmol/l,  $K^+$   $4.29 \pm 0.09$  mmol/l,  $Ca^{2+}$   $2.59 \pm 0.03$  mmol/l and  $HCO_3^-$ ;  $25.87 \pm 0.43$  mmol/l respectively). There was a positive correlation between maternal age, and  $Na^+$  ( $r = 0.092$ ;  $p < 0.05$ ) and a negative correlation between  $K^+$  ( $r = -0.100$ ;  $p < 0.05$ ),  $Ca^{2+}$  ( $r = -0.088$ ;  $p < 0.05$ ) and  $HCO_3^-$  ( $r = -0.051$ ;  $p < 0.05$ ).

**Table 2: The relationship between some renal function parameters and maternal age**

Parameters/Years	control (n=30)	20-24 (n=10)	25-29(n=49)	30-34 (n=34)	35-39 (n=5)	40-44(n=2)
$Na^+$ (mmol/l)	$137.97 \pm 0.46$ <sup>a</sup>	$136.50 \pm 1.33$ <sup>a</sup>	$135.90 \pm 0.53$ <sup>b</sup>	$136.26 \pm 0.73$ <sup>a</sup>	$138.00 \pm 0.89$	$137.00 \pm 3.00$ <sup>a</sup>
$K^+$ (mmol/l)	$4.29 \pm 0.09$ <sup>a</sup>	$3.90 \pm 0.17$ <sup>b</sup>	$3.66 \pm 0.05$ <sup>b</sup>	$3.64 \pm 0.05$ <sup>b</sup>	$3.88 \pm 0.18$	$3.60 \pm 0.30$ <sup>a</sup>
$Ca^{2+}$ (mmol/l)	$2.59 \pm 0.03$ <sup>a</sup>	$2.12 \pm 0.09$ <sup>b</sup>	$2.23 \pm 0.03$ <sup>b</sup>	$2.08 \pm 0.03$ <sup>b</sup>	$2.12 \pm 0.05$	$2.43 \pm 0.38$ <sup>a</sup>
$HCO_3^-$ (mmol/l)	$25.87 \pm 0.43$ <sup>a</sup>	$21.40 \pm 0.97$ <sup>b</sup>	$20.22 \pm 0.32$ <sup>b</sup>	$20.50 \pm 0.50$ <sup>b</sup>	$18.60 \pm 0.87$	$22.00 \pm 2.00$ <sup>a</sup>

Values represent mean  $\pm$  standard error of mean

Values in the same row with different alphabets differ significantly ( $p < 0.05$ )

Table 3 shows the relationship between some renal function parameters and various trimesters. Results obtained indicate that  $Na^+$  ( $133.33 \pm 1.20$  mmol/l),  $K^+$  ( $3.40 \pm 0.16$  mmol/l),  $Ca^{2+}$  ( $2.16 \pm 0.13$  mmol/l) and  $HCO_3^-$  ( $19.83 \pm 0.91$  mmol/l) concentrations were significantly reduced ( $P < 0.05$ ) when compared to the control ( $Na^+$ ;  $137.97 \pm 0.46$  mmol/l,  $K^+$ ;  $4.29 \pm 0.09$  mmol/l,  $Ca^{2+}$ ;  $2.59 \pm 0.03$  and  $HCO_3^-$ ;  $25.87 \pm 0.43$  mmol/l respectively) in the first trimester. In the second trimester,  $Na^+$  ( $135.67 \pm 0.75$  mmol/l),  $K^+$  ( $3.64 \pm 0.06$  mmol/l),  $Ca^{2+}$  ( $2.20 \pm 0.04$  mmol/l) and  $HCO_3^-$  ( $20.20 \pm 0.42$  mmol/l) concentrations were also reduced ( $P < 0.05$ ) when compared to the control ( $Na^+$ ;  $137.97 \pm 0.46$  mmol/l,  $K^+$ ;  $4.29 \pm 0.09$  mmol/l,  $Ca^{2+}$ ;  $2.59 \pm 0.03$  mmol/l and  $HCO_3^-$ ;  $25.87 \pm 0.43$  mmol/l respectively). In the third trimester,  $K^+$  ( $3.74 \pm 0.04$  mmol/l),  $Ca^{2+}$  ( $2.16 \pm 0.03$  mmol/l) and  $HCO_3^-$  ( $20.53 \pm 0.034$  mmol/l) concentrations were reduced when compared with the control ( $K^+$ ;  $4.29 \pm 0.09$  mmol/l,  $Ca^{2+}$ ;  $2.59 \pm 0.04$  mmol/l and  $HCO_3^-$ ;  $25.87 \pm 0.43$  mmol/l respectively) while sodium levels was elevated ( $136.73 \pm 0.46$  mmol/l) There was a positive correlation between gestation and  $Na^+$  ( $r = 0.249$ ;  $p < 0.05$ ),  $K^+$  ( $r = 0.204$ ;  $p < 0.05$ ),  $Ca^{2+}$  ( $r = 0.004$ ;  $p < 0.05$ ) and  $HCO_3^-$  ( $r = 0.056$ ;  $p < 0.05$ ) levels.

Table 4 shows the effect of parity on some renal function parameters. There was a reduced  $K^+$  ( $3.73 \pm 0.05$  mmol/l) and  $Ca^{2+}$  ( $2.20 \pm 0.03$  mmol/l) concentrations among nullipara women without any child before their present pregnancy ( $P < 0.05$ ) when compared to the control ( $K^+$ ;  $4.31 \pm 0.10$  mmol/l and  $Ca^{2+}$ ;  $2.58 \pm 0.04$  mmol/l respectively) while monopara women have reduced  $Na^+$

( $137.44 \pm 0.94$  mmol/l),  $K^+$  ( $3.71 \pm 0.09$  mmol/l),  $Ca^{2+}$  ( $2.21 \pm 0.07$  mmol/l) and  $HCO_3^-$  ( $20.56 \pm 0.60$  mmol/l) concentrations ( $P < 0.05$ ) when compared with control ( $Na^+$ ;  $139.00 \pm 0.00$  mmol/l,  $K^+$ ;  $5.1 \pm 0.00$  mmol/l,  $Ca^{2+}$ ;  $2.71 \pm 0.00$  mmol/l and  $HCO_3^-$ ;  $28.00 \pm 0.00$  mmol/l respectively). Result showed that women with two and three children have reduced  $Ca^{2+}$  ( $2.10 \pm 0.04$  mmol/l and  $2.09 \pm 0.05$  mmol/l;  $P < 0.05$ ) when compared with control ( $2.65 \pm 0.5$  mmol/l and  $2.65 \pm 0.05$  mmol/l respectively). Women with four pregnancies have their  $K^+$  ( $3.38 \pm 0.13$  mmol/l),  $Ca^{2+}$  ( $2.06 \pm 0.03$  mmol/l) and  $HCO_3^-$  ( $20.00 \pm 1.47$  mmol/l) concentrations significantly reduced ( $P < 0.05$ ) when compared to the control ( $K^+$ ;  $3.85 \pm 0.05$  mmol/l,  $Ca^{2+}$ ;  $2.65 \pm 0.05$  mmol/l and  $HCO_3^-$ ;  $26.00 \pm 1.00$  mmol/l respectively). Parity showed a negative correlation with  $Na^+$  ( $r = -0.045$ ;  $p < 0.05$ ),  $K^+$  ( $r = -0.155$ ;  $p < 0.05$ ), and  $Ca^{2+}$  ( $r = -0.175$ ;  $p < 0.05$ ) while  $HCO_3^-$  ( $r = 0.015$ ;  $p < 0.05$ ) was positively correlated to parity. Table 5 shows the effect of Body Mass Index on some renal function parameters.  $K^+$ ,  $Ca^{2+}$  and  $HCO_3^-$  concentrations were significantly reduced ( $P < 0.05$ ) in those with normal BMI ( $K^+$ ;  $3.74 \pm 0.07$  mmol/l,  $Ca^{2+}$ ;  $2.15 \pm 0.002$  mmol/l and  $HCO_3^-$ ;  $20.93 \pm 0.48$  mmol/l respectively), overweight ( $K^+$ ;  $3.62 \pm 0.06$  mmol/l,  $Ca^{2+}$ ;  $2.14 \pm 0.03$  mmol/l and  $HCO_3^-$ ;  $19.91 \pm 0.37$  mmol/l respectively) and obese ( $HCO_3^-$ ;  $20.38 \pm 0.46$  mmol/l) when compared to the control ( $K^+$ ;  $4.29 \pm 0.09$  mmol/l,  $Ca^{2+}$ ;  $2.59 \pm 0.03$  mmol/l and  $HCO_3^-$ ;  $25.87 \pm 0.43$  mmol/l respectively). Body mass index is positively correlated with  $Na^+$  ( $r = 0.144$ ;  $p < 0.05$ ),  $K^+$  ( $r = 0.069$ ;  $p < 0.05$ ) and  $Ca^{2+}$  ( $r = 0.182$ ;  $p < 0.05$ ) but inversely correlated with  $HCO_3^-$  ( $r = -0.068$ ;  $p < 0.05$ ).

**Table 3: The relationship between some renal function parameters and various trimesters**

Parameters	Control (n=30)	1 <sup>st</sup> Trimester (n=6)	2 <sup>nd</sup> Trimester (n=30)	3 <sup>rd</sup> Trimester (n=64)
Na <sup>+</sup> (mmol/l)	137.97 ± 0.46 <sup>a</sup>	133.33 ± 01.20 <sup>b</sup>	135.67 ± 0.75 <sup>b</sup>	136.73 ± 0.46 <sup>a</sup>
K <sup>+</sup> (mmol/l)	4.29 ± 0.09 <sup>a</sup>	3.40 ± 0.16 <sup>b</sup>	3.64 ± 0.06 <sup>b</sup>	3.74 ± 0.04 <sup>b</sup>
Ca <sup>2+</sup> (mmol/l)	2.59 ± 0.03 <sup>a</sup>	2.16 ± 0.13 <sup>b</sup>	2.20 ± 0.04 <sup>b</sup>	2.16 ± 0.03 <sup>b</sup>
HCO <sub>3</sub> <sup>-</sup> (mmol/l)	25.87 ± 0.43 <sup>a</sup>	19.83 ± 0.91 <sup>b</sup>	20.20 ± 0.42 <sup>b</sup>	20.53 ± 0.34 <sup>b</sup>

Values represent mean ± standard error of mean

Values in the same row with different alphabets differ significantly (p<0.05)

**Table 4: Effect of parity on some renal function parameters**

Parity	Na <sup>+</sup> (mmol/l)	Ca <sup>2+</sup> (mmol/l)	K <sup>+</sup> (mmol/l)	HCO <sub>3</sub> <sup>-</sup> (mmol/l)
0	136.24±0.48 <sup>a</sup>	3.73±0.05 <sup>b</sup>	2.20±0.03 <sup>b</sup>	20.26±0.37 <sup>a</sup>
1	137.44 ± 0.94 <sup>b</sup>	3.71±0.09 <sup>b</sup>	2.21±0.07 <sup>b</sup>	20.56±0.60 <sup>b</sup>
2	135.47±0.67 <sup>a</sup>	3.64±0.09 <sup>a</sup>	2.10±0.04 <sup>b</sup>	20.32±0.59 <sup>a</sup>
3	134.33±2.33 <sup>a</sup>	3.61±0.13 <sup>a</sup>	2.09±0.05 <sup>b</sup>	20.78±0.98 <sup>a</sup>
4	136.5±1.85 <sup>a</sup>	3.38±0.13 <sup>b</sup>	2.06±0.03 <sup>b</sup>	20.00±1.47 <sup>b</sup>
7	140±0.00 <sup>a</sup>	3.8±0.00 <sup>a</sup>	2.3±0.00 <sup>a</sup>	20±0.00 <sup>a</sup>
control	137.97 ± 0.46 <sup>a</sup>	4.29 ± 0.09 <sup>a</sup>	2.59 ± 0.03 <sup>a</sup>	25.87 ± 0.43 <sup>a</sup>

Values represent mean ± standard error of mean

Values in the same row with different alphabets differ significantly (p<0.05)

**Table 5: Effect of Body Mass Index on some function parameters**

Parameter	Control (n=30)	Normal (18-24.9) (n=29)	Overweight (25-29.9) (n=32)	Obese (30 and above) (n=39)
Na <sup>+</sup> (mmol/l)	137.97± 0.46 <sup>a</sup>	135.97 ± 0.87 <sup>a</sup>	136.19 ± 0.52 <sup>a</sup>	136.41 ± 0.62 <sup>a</sup>
K <sup>+</sup> (mmol/l)	4.29± 0.09 <sup>a</sup>	3.74 ± 0.07 <sup>b</sup>	3.62 ± 0.06 <sup>b</sup>	3.71 ± 0.05 <sup>a</sup>
Ca <sup>2+</sup> (mmol/l)	2.59 ± 0.03 <sup>a</sup>	2.15 ± 0.04 <sup>b</sup>	2.14 ± 0.03 <sup>b</sup>	2.20 ± 0.04 <sup>b</sup>
HCO <sub>3</sub> <sup>-</sup> (mmol/l)	25.87 ± 0.43 <sup>a</sup>	20.93 ± 0.48 <sup>b</sup>	19.91 ± 0.37 <sup>b</sup>	20.38 ± 0.46 <sup>b</sup>

Values are represented as mean ± standard error of mean

Values in the same row with different alphabets defer significantly (p<0.05)

**Table 6: The relationship between social status and some renal function parameters in pregnant women.**

Parameter	Control(n=30)	Class I(n=8)	Class II (n=39)	Class III (n=22)	Class IV(n=11)	Class V(n=20)
Na <sup>+</sup> (mmol/l)	137.97 ± 0.46 <sup>a</sup>	137.67 ± 1.45 <sup>b</sup>	137.12 ± 1.01 <sup>a</sup>	136.56 ± 0.63 <sup>a</sup>	135.82 ± 0.69 <sup>a</sup>	135.27 ± 0.81 <sup>a</sup>
K <sup>+</sup> (mmol/l)	4.29± 0.09 <sup>a</sup>	3.60 ± 0.12 <sup>a</sup>	3.69 ± 0.11 <sup>b</sup>	3.73 ± 0.06 <sup>b</sup>	3.69 ± 0.06 <sup>a</sup>	3.56 ± 0.10 <sup>b</sup>
Ca <sup>2+</sup> (mmol/l)	2.59± 0.03 <sup>a</sup>	2.14 ± 0.18 <sup>a</sup>	2.16 ± 0.09 <sup>b</sup>	2.20 ± 0.04 <sup>b</sup>	2.15 ± 0.04 <sup>b</sup>	2.15 ± 0.05 <sup>b</sup>
HCO <sub>3</sub> <sup>-</sup> (mmol/l)s	25.87 ± 0.43 <sup>a</sup>	22.67 ± 1.45 <sup>a</sup>	18.75 ± 0.77 <sup>b</sup>	20.62 ± 0.42 <sup>b</sup>	20.38 ± 0.43 <sup>b</sup>	20.18 ± 0.59 <sup>b</sup>

Values are represented as mean ± Standard error of mean

Values in the same row with different alphabets defer significantly (p<0.05)

Class I: Doctors and pharmacists.

Class II: Lawyers, bankers, nurse and managers.

Class III: Students, teachers and community health worker.

Class IV: Tailors, hairdressers and business women.

Class V: Housewives.

Table 6 shows the relationship between social status and some renal function parameters in pregnant women. Among doctors and pharmacists, only  $\text{Na}^+$  ( $137.67 \pm 1.45$  mmol/l) concentration was significantly reduced ( $P < 0.05$ ) when compared with control ( $138.00 \pm 0.00$  mmol/l). Among Bankers  $\text{K}^+$  ( $3.69 \pm 0.11$  mmol/l),  $\text{Ca}^{2+}$  ( $2.16 \pm 0.09$  mmol/l) and  $\text{HCO}_3^-$  ( $18.75 \pm 0.77$  mmol/l), students  $\text{K}^+$  ( $2.20 \pm 0.04$  mmol/l),  $\text{Ca}^{2+}$  ( $2.20 \pm 0.04$  mmol/l) and  $\text{HCO}_3^-$  ( $20.62 \pm 0.42$  mmol/l), tailors  $\text{Ca}^{2+}$  ( $2.15 \pm 0.04$  mmol/l) and  $\text{HCO}_3^-$  ( $20.38 \pm 0.43$  mmol/l) and housewives  $\text{K}^+$  ( $3.56 \pm 0.10$  mmol/l),  $\text{Ca}^{2+}$  ( $2.15 \pm 0.05$  mmol/l) and  $\text{HCO}_3^-$  ( $20.18 \pm 0.59$  mmol/l) concentrations were significantly reduced ( $P < 0.05$ ) when compared to the control. There was a negative correlation between social status,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  levels ( $r = -0.151, -0.075, -0.046$  and  $-0.023$ ;  $p < 0.05$  respectively).

## Discussion

Pregnancy has been reported to induce marked and widely varying circulatory and biochemical changes in women. It is a physiological phenomenon that is normally associated with an increased metabolic rate and increased deposition of nutrients in anticipation for later use by and for proper development of the fetus (Onyeneke and Alumanah, 1990). These physiological adaptations to the pregnant state are further exaggerated or altered by the effect of climate or other environmental conditions (Rowe *et al.*, 1976). The kidney is a complex organ performing diverse function in the body which functional state either in health or disease can only be assessed by a combination of series of tests. Thus renal function within the bounds of normal in a given population may be considered abnormal in another even though both the populations are healthy. Results obtained in this work indicated that sodium, potassium, calcium, and bicarbonate concentrations were significantly lower ( $p < 0.05$ ) during pregnancy, due to retention of fluids in the body of the pregnant women, and this is in agreement with the earlier study of Davison and Noble (1981), Moore (1987), and Onyeneke and Alumanah (1990). During pregnancy, minerals are mobilized from their stores, following increased hormonal homeostasis. From this work, sodium, calcium, potassium, and bicarbonate concentrations were reduced in the various trimesters but significantly increased in the second and third trimester ( $p < 0.05$ ; Table 3). This may be due to high level of progesterone associated with pregnancy, thus corroborates

earlier work of Hytten and Leitch (1971) who indicated an increase in these parameters. Ganong (1981) had also recorded an increased accumulation of calcium in the 20<sup>th</sup> and 40<sup>th</sup> weeks. Although previous reports have shown that concentrations of sodium, potassium, calcium, and bicarbonate were increased with increasing parity, the present study have demonstrated that the concentrations of these parameters decreased in pregnancy (Table 4). This could either be due to a short time interval between successive pregnancies such that the minerals depleted during the last few pregnancies may not have been replenished before the subsequent ones. There is every tendency that multiple pregnancies cause tissue damage and protein breakdown. Moreover, constant exposure to sunlight in the tropics leads to increased calcium deposition, following vitamin D synthesis, an important process for calcium accumulation in bones. Although much of the full development of the fetal body tissue is greatly dependent on the quality and quantity of nutrients available to the fetus, women who are prone to being overweight may respond to changes in carbohydrate metabolism and this may have resulted in the increase in plasma sodium, potassium and calcium concentrations with increasing BMI in the pregnant women (table 5). There is need for good nutritional management to ensure proper development of the fetus. The data generated indicated that social status of the pregnant women has an influence on their plasma electrolyte levels (sodium, potassium and calcium), with a significant decrease ( $p < 0.05$ ) in lower income pregnant women. Dietary source of these micronutrients is an important factor based on the availability and price of foods. Depending on the locality, the dietary sources may not be cheap for the low income earners and hence a decrease in their adequate dietary intake. During pregnancy, insufficient weight gain can compromise the health of the fetus; likewise excessive weight gain can pose risk to the pregnant woman and the fetus. Some of the parameters (sodium, potassium, calcium, and bicarbonate) were discovered to be either negatively or positively correlated with the physiological and clinical status of the pregnant women. The plasma potassium, calcium, and bicarbonate concentrations were found from the study to be negatively correlated with maternal age ( $r = -0.100, -0.088, -0.160$ ;  $p < 0.05$  respectively), while sodium was positively correlated ( $r = 0.092$ ). Plasma potassium, calcium and bicarbonate were positively correlated with trimester ( $r =$

0.249, 0.204, 0.004, and 0.056;  $p < 0.05$  respectively), while sodium was positively correlated ( $r = 0.249$ ). A positive correlation was also established between bicarbonate and parity ( $r = 0.015$ ;  $p < 0.05$ ), while calcium, and potassium were negatively correlated with parity ( $r = -0.155$  and  $-0.175$ ;  $p < 0.05$  respectively). This may be due to short time interval between successive pregnancies such that the lost minerals have not been replenished before the subsequent pregnancy.

With multiple pregnancies, tissue damage and protein breakdown may have occurred which is accompanied by depletion in these parameters. Adequate maternal nutrition has always been regarded as important in determining fetal quality and survival. However, quality of food and spacing of child bearing may have led to the alterations seen in these parameters. It is therefore necessary for pregnant women to eat good quality and balanced diet, take enough fluid, observe child's spacing to protect against tissue and protein breakdown, electrolyte and water imbalance and to replenish lost nutrients before subsequent pregnancies.

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