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Sonographic Evaluation of Renal Size and its Correlation with Laboratory Indices among Healthy Pregnant Women in Kano, Nigeria.

[*]Aliyu Abdullahi Hassan, [1] Joseph Chikwuemeka Eze, [2]Mohammed Sidi, [3]Abdu Hamisu Dambatta, [3]Mansur Yahuza, [2]Anas Ya'u, [2]Umar Mansur, [2]Abubakar Aminu Abubakar

[*]Radiology Department,
Aminu Kano Teaching Hospital Kano,
Nigeria.

[1]Department of Radiography and Radiological Sciences
Faculty of Health Sciences and Technology
Nnamdi Azikiwe University Awka,
Nigeria.

[2]Department of Medical Radiography,
Faculty of Allied Health Sciences,
College of Health Sciences,
Bayero University Kano, Nigeria.

[3]Radiology department,
Aminu Kano Teaching Hospital/
Bayero University Kano, Nigeria.

Email: xray2rad16@gmail.com

Abstract

In pregnancy, sonographic measurements of the renal length and volume are important for the evaluation and follow up of patients with renal pathologies. Change in renal size is an indicator for many physiological and pathological conditions. This study was aimed at establishing normative value of renal dimension among apparently healthy pregnant women in Kano. This was a cross-sectional study conducted at Aminu Kano Teaching Hospital, Kano from April 2021 to March 28, 2022. Using a convenience sampling method, 196 pregnant women were recruited. An ultrasound machine coupled with 3.5MH curvilinear transducer was used as instrument of data collection. The subjects were scanned in supine and lateral decubitus. The renal size and parenchymal echogenicity were recorded on data capture sheet. The data were analyzed using IBM SPSS Version 23.0. The statistical significance level was set at $p < 0.05$. The mean right and left renal length, height, width and volume 10.4 ± 0.7, 6.1 ± 0.5, 4.7 ± 0.4, 155.0 ± 24.5, 11.0 ± 0.7, 6.2 ± 0.5, 4.8 ± 0.4, 170.7 ± 23.9 respectively. The mean $CD4^+$ cells count, serum creatinine and urea were 787.8 ± 227.5; 64.0 ± 11.2; 2.9 ± 0.6 respectively. There was a statistical significant difference between right and left renal length and volume ($p < 0.05$). The renal size shows a weak positive correlation with $CD4^+$ cells count, serum creatinine and urea. Reference values for renal dimensions, CD4 cells count serum creatinine and urea were established among healthy pregnant women in Kano metropolis.

Keywords: Sonography, Renal, Dimension, Pregnancy.

**Author for Correspondence*

Introduction

Renal system develops from the intermediate mesoderm (mesodermal ridge) which forms a longitudinal elevation along the dorsal wall called the nephrogenic cord which forms pronephros, mesonephros and metanephros (Sadler, 2012; Dudek, 2000). Kidneys are bean shaped retroperitoneal organ positioned at the level of T12-L3 vertebrae. They lie obliquely with their upper pole more medial and more posterior than their lower pole. At the concave medial margin of each kidney is vertical cleft called renal hilum which serve as the entrance and exit point of vessels, nerves lymph vessels and structures that drains urine from kidneys (Moore *et al.,* 2010; Ryan *et al.,* 2004).

Pregnancy is a period during which one or more offspring develop within the uterus. Various renal physiological changes occur during pregnancy. Glomerular filtration rate increases by 50 % and renal plasma flow (RPF) increases up to 80 % as compared with non-pregnant levels. Also, volume of kidneys increases up to 30% during pregnancy due to increased kidney vascular and interstitial volume. (Cheung and Lafayette, 2013; Suarez *et al.,* 2018).

Ultrasound assessment of renal dimensions is simple, reliable and non-invasive. The sound energy has no adverse effects on the developing fetus and it can be used at any stage of pregnancy. Ultrasound has an advantage over conventional radiography and computed tomography due to the fact that it does not have ionizing radiation (Kamble and Kohar, 2017). It allows clear visualization of the kidney in various planes, including the sagittal and transverse planes, both at rest and during dynamic maneuvers. Renal diseases are diagnosed at sonography using combination of changes in renal size and parenchymal echogenicity (Sidi *et al.,* 2020). Change in kidney size is an indicator of a number of physiological and pathological conditions including uni-nephrectomy, diabetes mellitus, and chronic electrolyte imbalances (Jain *et al.,* 2016). The renal volume and length are shown to be the parameters which are affected by pregnancy and serve as an important parameter used to assesses the health of the kidneys (Ugboma *et al.* 2012). Hence, in pregnancy, sonographic measurements of the renal volume and length are important for the evaluation and follow up of patients with renal pathologies (Ugboma *et al.* 2012).

In standard practice every population are expected to have a documented normative reference values for renal dimensions. However, intensive literature review shows that there is a paucity of published data on renal dimensions among healthy pregnant women in the northern region of Nigeria. This may lead to false positive diagnosis which in turn may affect the management and treatment of renal pathologies during pregnancy. Hence, this prompted the researchers to conduct this study. The findings of this study will serve as a guide to radiologist, radiographers and physicians in the diagnosis and management of pathological conditions affecting kidneys during pregnancy. This study was aimed at establishing sonographic reference values for renal dimensions among apparently healthy pregnant women in Kano.

Materials and Methods

This was a cross-sectional study conducted at Aminu Kano Teaching Hospital (AKTH) in Kano Nigeria. An ethical clearance to conduct the study was obtained from the Human Research and Ethics Committee of AKTH. Informed consent was obtained from each participating subject. A purposive sampling method was employed and 196 apparently healthy pregnant women between the age of 18 years and 45 years in different trimesters were recruited for the study of which, 60 (30.61%) were in first trimester, 70 (35.71%) were in second trimester and 66 (33.67%) were in third trimester. The sample size was obtained using Cochran formula (Uakarn *et al.,* 2021) as shown below:

$$n = \frac{Z^2\ pq}{d^2}$$

Where n= minimum sample size

z= percentage point of distribution at 95% confidence interval (1.96)

p= prevalence from other previous study = 15% (0.15)

q = 1-p (complimentary probability) = 0.85

d = maximum sample size error = 5% (0.05)

Therefore; $n = ((1.96)^2 (0.15)(0.85)) \div (0.05)^2$

$n = ((3.8416)(0.13)) \div (0.0025)$

$n = (0.490) \div (0.0025)$

$n = 196$

Procedure for Ultrasound Scan

The ultrasound scan was performed using Mindray "Expert" digital diagnostic ultrasound imaging system; DC – 6 model and P/N:- 2111-CT0-S01 fitted with curvilinear transducer of 3.5MHz. Only one qualified radiographer performed the scan and took the measurements. To take care of the intra-observer variability, the measurements were taken three times on separate occasions by the same radiographer at interval of at least 15mins between measurement and the average was taken. There was no special pre-examination preparation required. The subjects laid supine on a couch with the radiographer on the right side of the subject. An ultrasound gel was applied to the patient's right flank. Then a curvilinear ultrasound transducer of 3.5MHz was positioned gently at that flank. The right kidney was examined along longitudinal axis through the mid-clavicular, anterior or mid axillary line subcostaly, by angling the transducer obliquely the liver will be visualized and act as an acoustic window (Kamble and Kohar, 2017), in situations where there might be hydronephrosis which may be caused by mechanical compression of the bulky uterus, the patients were positioned in left decubitus for at least 5mins to relief the weight of the pregnancy on the ureters, the probe was continuously manipulated until the appropriate coronal section was acquired. The image of the right kidney was acquired with the liver, so as to make comparison of the liver echo-texture when evaluating the right renal parenchymal echogenicity (Zeb *et al.,* 2012). An ultrasound gel was then applied to the patient's left flank, the left kidney was examined with the patients in either, supine or right lateral decubitus position. With the patient in supine the left kidney was scanned along the longitudinal axis sub-costally through the midclavicular, mid or anterior axillary line. With the subject in the right lateral decubitus position, the left arm was extended over the head and the coronal view was obtained by positioning the transducer also along the longitudinal axis through the midclavicular, anterior or mid axillary line with the left side of the patient raised from the supine position by at least 45^0 to 90^0 (Kamble and Kohar, 2017). The decubitus and oblique position were continuously varied with different probe angulations until the kidney is seen completely and appropriately. The image of the left kidney was acquired with spleen to make comparison of left renal parenchymal echogenicity with that of spleen.

Renal Echogenicity Grading

Regarding the renal echogenicity grading, the renal echogenicity was graded into five groups as follows;

Grade 0: When the cortical echogenicity was slightly lower than the parenchymal echo-texture of liver on the right and lower than that of the spleen on the left and was considered to be normal.

Grade I: When the renal cortical echogenicity equal to that of the liver on the right or that of the spleen on the left with good cortico-medullary differentiation.

Grade II: When the renal cortical echogenicity was greater than that of the liver on the right or that of the spleen on the left but less than the renal sinus echo with good cortico-medullary differentiation.

Grade III: When the renal cortical echogenicity was greater than that of liver and spleen but equal to the renal sinus echo on both sides respectively with loss of cortico-medullary differentiation.

Grade IV: When the kidney shrunken in size with additional features of grade III (Nwafor *et al.,* 2018).

Renal Dimension

Concerning the renal dimensions, the maximal length of the right kidney was acquired with the patient in left posterior oblique or left lateral decubitus position by scanning through the posterior axillary line sub-costaly. Likewise, the maximal length of the left kidney was acquired with the patient in the right posterior oblique or right lateral decubitus position by scanning through the posterior axillary line sub-costaly (Kamble and Kohar, 2017). Using the same position and at the level of renal hilum the transverse section of the kidneys was obtained (Kamble and Kohar, 2017). The renal length (L) was taken as the longest distance between the renal pole and the renal width (W) as the maximum transverse diameter, while the renal thickness or depth (D) was obtained as the average of maximum distance between the anterior and posterior wall of the mid-portion of the kidney in both longitudinal and transverse scan plane as shown in figure 1 below. Then the volume (V) was obtained by using the prolate ellipsoid formula ($L \times W \times (D_1 + D_2/2) \times 0.523$) (Nwafor *et al.,* 2018). The dimensions and volumes of right and left kidneys and the parenchymal echogenicity was recorded on data capture sheet.

Maternal Anthropometric Measurements, $CD4^+$ Cells Count and Biochemical Parameters

The maternal height was measured in the scanning room using height measuring tool in meter, the actual maternal weight was determined by weighing the mother using weighing scale in kilogram and then subtract the estimated fetal weight from it. The estimated fetal weight was obtained using an inbuild obstetric ultrasound software which automatically compute the fetal weight by taking fetal Bi-Parietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC) and Femoral Length (FL). The maternal Body Mass Index (BMI) in Kg/m^2 and Body Surface Area (BSA) in m^2 was determined using the predetermined values of maternal height and weight from the formula below.

BMI= Weight (kg)/height (m^2)

BSA= $\sqrt{Height(cm) x\ weight(kg)}/3600$ (Mosteller formula)

Then, the patient was accompanied to laboratory were a blood sample was taken for CD4+ cells count, serum creatinine and urea and urine sample for proteinuria. The results were recorded in the data capture sheet.

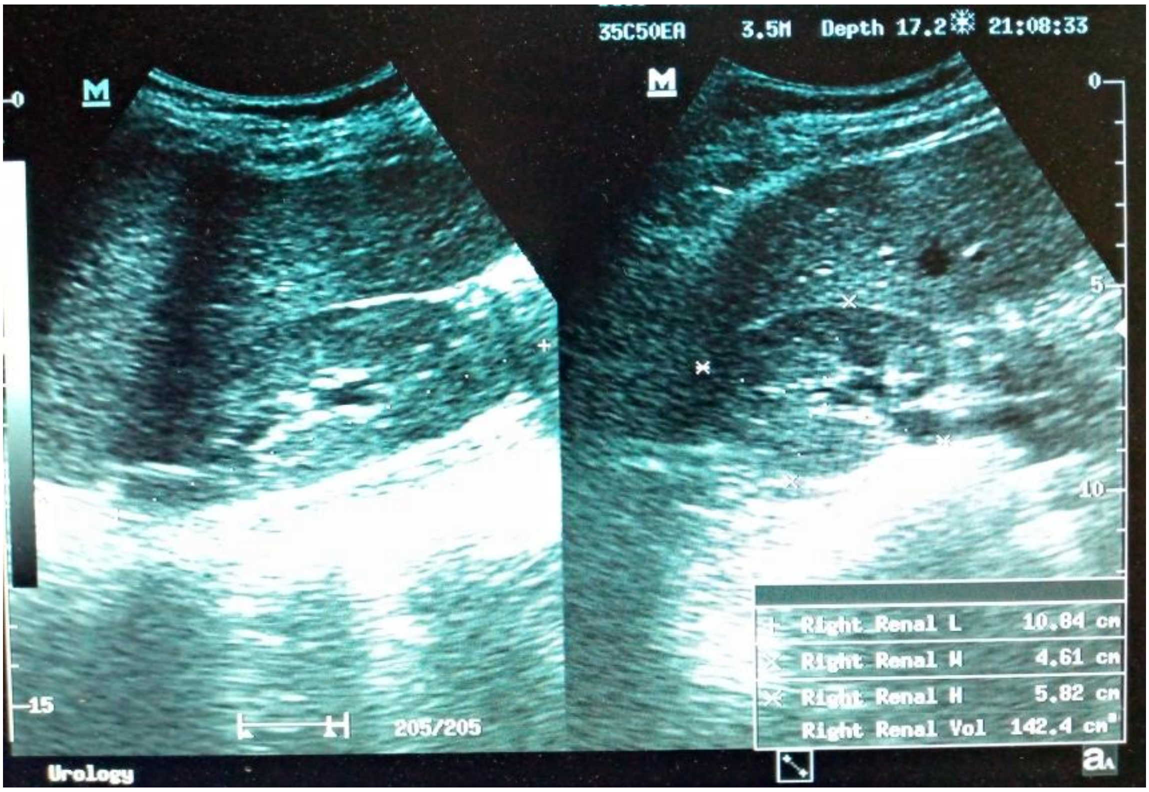

Figure 1: A longitudinal and transverse image of the right maternal kidney showing renal measurements at 32 weeks of gestation.

Statistical Analysis

The normality test was carried out on the obtained data using Shapiro Wilk test and data passed the test, therefore parametric data analysis was used. Both descriptive and inferential statistics were employed for the data analysis. The means, ± standard deviations (SD) of subject's renal dimensions, CD4+ cells count, serum creatinine and urea were determined using descriptive statistics. The independent two sample *t*-test was used to compare the mean values between right and left renal dimensions. One-way ANOVA was used to compare the mean values of the renal dimensions, CD4+ cells count, serum creatinine and urea between the trimesters. Pearson's correlation was employed to determine the relationship of renal dimensions with CD4+ cells count, serum creatinine and urea. The data was analyzed using Statistical Package for Social Sciences (IBM SPSS) Version 22.0. Statistical significance was considered at $p < 0.05$.

Results

Table 1 shows that, the mean ± SD of the right and left renal length, height, width and Volume for subjects in first trimester were 10.8 ± 1.0cm, 6.0 ± 0.5cm, 4.7 ± 0.5cm, and 161.2 ± 31.1cm^3; 11.0 ± 1.0cm, 6.1 ± 0.5cm, 4.8 ± 0.4cm and 171.1 ± 30.4cm^3 respectively, for subjects in second trimester were 10.5 ± 1.0cm, 6.0 ± 0.6cm, 4.7 ± 0.4cm, and 157.3 ± 34.1cm^3; 10.9 ± 1.1cm, 6.2 ± 0.6cm, 4.8 ± 0.5cm and 171.3 ± 40.6cm^3 respectively, and for those in third trimester were 10.8

± 1.0cm, 6.2 ± 0.5cm, 4.9 ± 0.5cm, and 175.0 ± 37.7cm^3; 11.3 ± 1.1cm, 6.3 ±0.5cm, 4.9 ± 0.5cm and 181.6 ± 44.6cm^3 respectively.

Table 1: Renal dimension among apparently healthy pregnant women.

Trimester	Renal dimensions: Right Kidney				Left Kidney			
	Length	Height	Width	Volume	Length	Height	Width	Volume
1st	10.5 ±0.7	6.2 ±05	4.8 ±0.3	162.2 ±25.1	11.0 ±0.6	6.2 ±0.4	4.7 ±0.4	170.1 ±23.4
2nd	10.3 ±0.7	6.4 ±0.6	4.6 ±0.3	149.3 ±41.1	10.9 ±0.8	6.2 ±0.5	4.8 ±0.4	168.3 ±27.1
3rd	10.4 ±0.6	6.2±0.5	4.8 ±0.4	172.0±24.3	11.0 ±0.7	6.2 ±0.5	4.8 ±0.4	172.1 ±24.3
Total	10.4 ±0.7	6.1 ±0.5	4.8 ±0.4	155.0 ±24.5	11.0 ±0.7	6.2 ±0.5	4.8 ±0.4	170.3 ±23.9

Table 2 shows that, the mean ± SD of CD4$^+$ cell count, creatinine and urea for subjects in first trimester were 788.5 ± 245 .6 count/µL, 62.6 ± 10.6 µmole/L and 2.9 ± 0.6 mmole/L respectively, for those in second trimester were 766.8 ± 211.2 count/µL, 63.5 ± 11.2 µmole/L and 2.8 ± 0.6 mmole/L respectively, and for those in third trimester were 807.9 ± 228.8 Count/µL, 65.8 ± 11.6 µmole/L and 3.0 ± 0.7 mmole/L respectively.

Table 2: CD4$^+$ cell count, creatinine and urea among apparently healthy pregnant women.

Trimester	Laboratory Indices: CD4$^+$ (Count/µL)	Creatinine (µmole/L)	Urea (mmole/L)
1st	788.5 ± 245.6	62.6 ± 10.6	2.9 ± 0.6
2nd	766.8 ± 211.2	63.5 ± 11.2	2.8 ± 0.6
3rd	807.9 ± 228.8	65.8 ± 11.6	3.0 ± 0.7
Total	787.8 ± 227.5	64.0 ± 11.2	2.9 ± 0.6

Table 3 shows that there was a statistical significant difference between right and left renal length, height and volume among apparently healthy pregnant women.

Table 3: Comparison of renal dimensions between Right and Left kidneys among apparently healthy pregnant women.

Renal Dimensions	Right Kidney	Left Kidney	Mean Diff.	P-value
Length	10.4 ± 0.7	11.0 ± 0.7	-0.6	0.000*
Height	6.1 ± 0.5	6.2 ± 0.5	-0.1	0.006*
Width	4.7 ± 0.4	4.8 ± 0.4	-0.1	0.068
Volume	155.0 ± 24.5	170.3 ± 23.9	-15.3	0.000*

***: P-value < 0.05**

Table 4 shows that there was a statistical significant difference between right and left renal length, and volume across all the trimesters.

Table 4: Comparison of renal dimensions between Right and Left kidneys based on trimesters among apparently healthy pregnant women.

RD	1st Trimester				2nd Trimester				3rd Trimester			
	RK	LK	MD	P-v	RK	LK	MD	P-v	RK	LK	MD	P-v
L	10.5±0.7	11.0±0.6	-0.6	0.00*	10.3±0.7	10.9±0.8	-0.6	0.00*	10.4±0.6	11.0±0.7	-0.6	0.00*
H	6.2±0.5	6.2±0.4	-0.1	0.53	6.4±0.6	6.2±0.5	-0.2	0.04*	6.0±0.5	6.2±0.5	-0.2	0.05
W	4.8±0.3	4.7±0.4	0.04	0.59	4.6±0.3	4.8±0.4	-0.2	0.02*	4.7±0.5	4.8±0.4	-0.1	0.15
V	162±25	170±23	-8.4	0.04*	149±41	168±27	-19.3	0.00*	154±22	172±24	-18.3	0.00*

Keys: L= Length (cm), H= Height (cm), W= Width (cm), V= Volume (cm^3), RK=Right Kidney, LK = Left Kidney, MD=Mean Difference, P-v = P-Value < 0.05 (*).

Table 5 shows that, a statistical significant difference was observed only in the right renal volume (*p = 0.031*) between trimesters among apparently healthy pregnant women.

Table 5: Comparison of renal dimensions between the trimesters among apparently healthy pregnant women.

Renal Dimensions	F*-ratio	P-value
RL	1.6	0.198
RH	1.5	0.226
RW	2.0	0.139
RV	3.5	0.031*
LL	0.8	0.450
LH	0.3	0.755
LW	0.9	0.422
LV	0.6	0.527

Keys: Keys: RL=Right Renal Length (cm), RH=Right Renal Height (cm), RW=Right Renal Width (cm), RV=Right Renal Volume (cm^3), LL=Left Renal Length (cm), LH=Left Renal Height (cm), LW=Left Renal Width (cm), LV=Left Renal Volume (cm^3), (*) = P-value < 0.05

Tukey Post Hoc test for multiple comparison revealed that the statistical significant difference was found in right renal volume between subjects in second and third trimesters (*p = 0.024*).

Table 6 shows that there was no statistical significant difference in the CD4 cells count, creatinine and urea between different trimesters among apparently healthy pregnant women.

Table 6: Comparison of $CD4^+$, creatinine and urea between the trimesters among apparently healthy pregnant women.

Lab. Variables	F*-ratio	P-value
$CD4^+$ (count/µL)	0.5	0.582
Creatinine (µmole/L)	1.5	0.227
Urea (mmole/L)	0.8	0.433

Table 7 shows significant week positive correlation between right renal length and serum creatinine (r=0.22, p=0.002) and serum urea (r=0.21, p=0.003), between right renal width and serum urea (r=0.15, p=0.003) and between right renal volume and serum creatinine (r=0.20, p=0.006) and serum urea (r=0.18, p=0.012). Also, there was significant week positive correlation between left renal width and $CD4^+$ cell count (r=0.17, p=0.020), serum creatinine (r=0.16, p=0.022) and serum urea (r=0.15, p=0.032) and between left renal volume and serum urea (r=0.15, p=0.032).

Table 7: Correlation between renal dimension with CD4+, Creatinine and Urea among HIV seronegative subjects.

Renal Dimension	CD4+		Creatinine		Urea	
	r	*p*	*r*	*p*	*r*	*p*
RL	0.17*	0.015	0.22*	0.002	0.21*	0.003
RH	0.03	0.644	0.08	0.264	-0.01	0.915
RW	0.05	0.475	0.10	0.157	0.15*	0.003
RV	0.11	0.117	0.20*	0.006	0.18*	0.012
LL	0.13	0.067	0.05	0.485	0.03	0.728
LH	0.04	0.578	0.10	0.161	0.11	0.137
LW	0.17*	0.020	0.16*	0.022	0.20*	0.005
LV	0.14	0.049**	0.14	0.045	0.15**	0.032

Keys: Keys: RL=Right Renal Length (cm), RH=Right Renal Height (cm), RW=Right Renal Width (cm), RV=Right Renal Volume (cm^3), LL=Left Renal Length (cm), LH=Left Renal Height (cm), LW=Left Renal Width (cm), LV=Left Renal Volume (cm^3).
*: Correlation is significant at the 0.01 level (2-tailed)
**: Correlation is significant at the 0.05 level (2-tailed)

Discussion

The findings of the current study as shown in Table 1 reported a mean renal volume approximately similar to the findings of the studies conducted by Ugboma *et al.* (2012) and Ugochinyere *et al.* (2021) in port Harcourt and Enugu respectively. The similarity might be due to the fact that both studies were conducted on pregnant women and in the same country. This implied that the same reference value can be used across Nigeria despite possible environmental and ethnic differences which was confirmed to have effect on renal size by some studies (Arooj *et al.,* 2011). The findings of this study were in agreement with the findings of the study conducted by Velasco *et al.* (2018) with respect to renal length and height for the right and left kidneys. This may be due to the fact that both the studies were conducted on pregnant women. Furthermore, Kamble and Kohar, (2017) in India reported a mean renal volume lower than the mean renal volume in this study. The possible reason for the difference might be due to racial, dietary and socioeconomic differences. More so, the mean left renal length, height and volume were higher than that of the right. This was in agreement with the findings of Ugboma *et al.* (2012), Kamble and Kohar, (2017), Sidi *et al.* (2020) and Ugochinyere *et al.* (2021). The possible reason for the similarity was due to the fact that anatomically left kidney is larger than the right kidney (Moore *et al.,* 2010). Also, this study reported the highest mean renal length, height, width and volume in third trimester and lowest in first trimester. This might be due to gradual and progressive change in renal physiology and anatomy during pregnancy which result to an increase in renal length by 1 – 1.5cm and renal volume by 30% (Cheung and Lafayette, 2013). The renal physiologic changes include change in renal hemodynamics which result in progressive increase in renal glomerular filtration rate (GFR) and which in turn result to decrease serum creatinine, nitrogen and uric acid. Also, there is change in renal tubular function which cause water retention as well as net gain in serum sodium and potassium (Cheung and Lafayette, 2013).

More so, study conducted by Ekwempu *et al.* (2012) in Jos reported lower mean CD4+ than what was reported in the current study among pregnant women as shown in Table 2. This difference might be due to socioeconomic differences. However, the findings of the current study were in similar to the findings of the related study conducted by Sidi *et al.* (2021b) on apparently healthy non-pregnant women. These similarities might be due to the fact that both studies were conducted in the same location and the study population might be of the same socioeconomic status. This implied that, pregnancy has less effect on the CD4 cells count in this population. Furthermore, the highest mean CD4+ cell count in third trimester followed by first and second trimester respectively. This was contrary to the findings of the study by Ekwempu *et al.* (2012) who reported the lowest $CD4^+$ cells count in third trimester, however, $CD4^+$ cells count in first trimester and second trimester was approximately the same and were found to be highest.

Furthermore, as shown in Table 2, this study reported higher mean serum creatinine and urea among healthy pregnant women than what was reported in the previous study conducted by Ekun *et al.* (2018) in Lagos. This difference might be due to the socioeconomic and ethnic differences. However, this study reported mean serum creatinine and urea similar to what was reported by Sidi *et al.* (2021b) among non-pregnant women. This might imply that, there was a negligible change in renal hemodynamic among pregnant women in this study area. Furthermore, a related study conducted by Afrifa *et al.* (2017) reported lower mean serum creatinine and urea than what was reported in the current study. More so, the findings of this study reported the highest mean serum creatinine and urea in third trimester followed by second and first trimesters respectively. The increase in serum creatinine and urea levels might probably be a reflection of gradual decrease in the GFR and a fall in the renal clearance as the pregnancy is advancing (Cheung and Lafayette, 2013).

More so, as shown in Table 3 and 4 there was a statistical significant difference between left and right renal length and volume across the entire trimesters ($p < 0.05$). This was in agreement with the previous studies by Ugboma *et al.* (2012), Kamble and Kohar, (2017) and Ugochinyere *et al.,* (2021). This similarity might be due to natural anatomical difference between right and left kidney. Also, the findings of the current study were similar to the findings of the study conducted by Ya'u *et al.* (2020) who reported a significant difference between right and left renal length and volume among healthy non-pregnant women. Furthermore, as shown in Table 5 a statistical significant difference was only found in right renal volume between subjects in second and third trimesters ($p < 0.05$).

Current study reported that there was no statistical significant difference in $CD4^+$ cells count between the trimesters among healthy pregnant women ($p > 0.05$) as shown in Table 6. This might be due to the fact that the mean $CD4^+$ cells count across the gestational period were closely similar.
The current study as shown in Table 6 also reported that, there was no statistical significant difference in serum creatinine and urea between trimesters ($p > 0.05$). This might further explain the reason for the similarity of the current study with the study by Sidi *et al.* (2021b) among non-pregnant women, which means changes in renal hemodynamics among healthy pregnant women were less pronounced.

Furthermore, this study reported a significant weak positive correlation between left renal width and CD4 cells count. Also, a significant weak positive correlation was reported between right renal length and CD4 cells count. However, non-significant weak positive correlation was obtained in right and left renal height and volume with CD4 cells count. This imply that, renal size was independent of $CD4^+$ cells count among healthy pregnant individuals.
In addition, this study reported a significant weak positive correlation in right and left renal volume with serum creatinine and urea among healthy pregnant women ($p < 0.05$). Similarly, significant weak positive correlation was observed in right and left renal width with serum urea ($p < 0.05$).

Conclusion

Although previous studies have established reference values with respect to renal dimensions, CD4 cells count serum creatinine and urea among healthy non-pregnant women in kano. Hence, this study provided the reference values among apparently healthy pregnant women, which could be used to enhance the diagnosis and management of renal pathologies among pregnant women. There was no statistical significant difference in renal dimension, $CD4^+$ cell count and biochemical parameters between trimesters. However, there was a progressive increase in renal dimension with advancement of pregnancy. Furthermore, renal size showed a weak positive correlation with $CD4^+$ cells count, serum creatinine and urea.

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