Sonographic Evaluation of Renal dimensions in a healthy adult Nigerian Population

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Abstract

Background: This study is on sonographic evaluation of renal dimensions in the healthy adult Nigerian population.

Aim: The objective of the study was to determine normal dimensions of the kidney sonographically and to correlate the measurements with the sex, age, height, weight and body mass index, in the adult Nigerian population.

Methodology: This was a prospective hospital based ultrasound study of five hundred (500) apparently healthy adults that were 20 years and above as at the time of data collection, Renal dimensions, length, width and cortical renal thickness were measured. A questionnaire was used for inclusion and exclusion criteria. Consent was obtained from the individuals before the study and strict confidentiality was maintained. Descriptive and inferential statistics were deployed to realize the objectives. The data was analyzed using SPSS statistical package version 20.0. The mean, median, variance, standard deviation of the kidney sizes were evaluated and correlated with the age, sex, weight, height and body mass index of the subjects.

Result: The mean right kidney length measured 94.2+8mm for male and 91.8+9mm for females with a range of 64.0-113mm and 76.0-123mm for males and female respectively. The left mean kidney length measured 99.4+8.1mm and 95.5+9.5mm with a range of 76.0-119.0mm and 76.0-114.mm for males and females respectively while the width was 40.7±3.4mm for males and 40.5±3.4mm for females with P values of 0.599mm which is not significant. Mean left kidney width was 44.7±5.8mm for males and 44.5±9.5mm for females with ranges of 33.0-65.0mm and 30.0-61.0mm for males and females respectively with P values of 0.719 which is not significant. Males had a mean renal cortical thickness of 18.3±2.9mm while females had 16.6±2.9mm with P values of 0.000.

Conclusion: The renal cortical thickness in males is greater than in females. The left cortical renal thickness is greater than the right. There is positive correlation of the left cortical renal thickness with age, but not with body mass index and height. Males have greater kidney length than females but the differences in length are not significant. Also, Males have greater kidney width than females. When correlated with age, height, weight and body mass index of the subjects.

Keywords: Sonography, kidney Sizes, Measurement

Introduction

The kidneys are a pair of excretory organs that are bean shaped and are located retroperitoneally at the upper part of the posterior abdomen. When fully developed, the kidneys are roughly the size of a fist. The average size of an adult human kidney is about 10 to 13 cm (4 to 5 inches) long, approximately 5 to 7.5 cm (2 to 3 inches) wide and about 2 to 2.5 cm (1 inch) thick.[1] Sonographically, the kidneys can be differentiated into the cortex and the medulla. The

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cortex has a medium echo similar to that of the liver while the medulla is echogenic. There are many imaging modalities that can be used to evaluate the kidney dimensions such as Plain film, CT scan, MRI, Ultrasound and others. Ultrasound is chosen over other imaging modalities because it requires no sedation, it is non ionizing, cheap, readily available and reproducible. It has replaced the conventional radiography in the visualization and estimation of renal dimensions.[2] Ultrasound is also useful in the diagnosis of renal diseases as well as in renal biopsy1 and transplant surgeries.

 Over the years renal length has been an essential parameter in assessment of renal size which is very useful in disease conditions like hypertension, renal cystic diseases, kidney stones, renal arterial stenosis, recurrent urinary tract infections, vesicoureteral reflux, chronic kidney disease, kidney tumors etc.[3] The renal length, width and cortical renal thickness can be evaluated accurately with ultrasound.[4] Sonographic evaluation of the renal length has proven to be the best clinical parameter in the estimation of renal size.[5] Rosenberg et al[6] in their study of the spleen sizes in the paediatric population noted that there is significant correlation between spleen sizes, height, weight and body surface area of individuals. Publications have revealed that sonographic assessment of kidney dimensions in healthy adults are not much in Enugu State.[7-9]

Materials and methods

This was a prospective ultrasound evaluation of renal dimensions in 500 apparently healthy adults that were 20 years and above at the time of data collection with 195 (39%) males and 305 (61%) females. Renal measurements were taken from the upper pole of the kidney to the lower pole and renal width taken from the renal hilum while the cortical renal thickness was taken from the outer margin of the renal cortex to the inner margin of the cortex. Subjects were scanned in supine position using digital real time Siemens ultrasound machine with 3.5MHZ convex transducer. Data was entered into Microsoft Excel data base.

The data collected was sorted out, coded and imputed into SPSS version 20.0 statistical package. Frequency table and charts were generated for relevant variables. Descriptive statistics such as mean, median, range, variance and standard deviation were used to summarize quantitative variables (age, height, weight, BMI, and organ dimensions) while categorical variable like sex was summarized by proportions. The t-test was used to test for significant difference in organ dimension between dichotomous variable. While One-way Analysis of Variance was used to test for significant difference in organ dimension for more than two categorical variables. Scatter diagrams were presented for better illustration of correlations. Pearson's moment correlation coefficients were reported to show relationship of organ dimension with age, BMI, height and weight. All analysis was done at the 5% level of significance, with p-value < 0.05 considered statistically significant.

Inclusion criteria: subjects should not be less than 20years of age as at the time of the study, should not have any history of renal disease or any debilitating illness like cancer and others while exclusion criteria include patients with renal disease and other debilitating illness, polycystic kidney disease and transplanted patients as well as patients with haemoglobinopathes. Ultrasonography was chosen because it is devoid of radiation, non-invasive, real-time and gives accurate measurements.

Approval for the study was sought and obtained from the Research and Ethics Committee of University of Nigeria Teaching Hospital, Enugu.

The sample size is estimated using the following formula[13]

$$N = \frac{Z^2 S^2}{d^2}$$

N = Sample size

Z = The standard normal deviate usually set at 1.96, which corresponds to the 95 percent confidence interval.

S = Best estimate of organ dimension variance from literature 0.56

d = degree of accuracy desired usually set at 0.05

Thus $N = \frac{(1.96)^2 \times (0.56)^2}{0.05^2}$

$= \frac{3.8416 \times 0.3136}{0.0025} = 481$

The minimum sample is 481 subjects however allowing for 5% attrition and non-compliance rate;[14] the minimum sample size becomes 506 subjects.
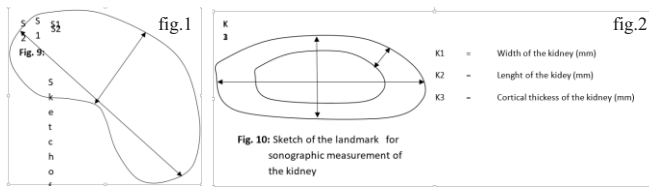
Figure 1 Landmarks for measurement; Figure 2 Sample size determination

Table 1: Biodata of study participants

Characteristics	Frequency	Percentages
Sex		
male	195	39.0
female	305	61.0
Age(Years)		
20-25	89	17.8
25-34	182	38.4
35-44	85	17.0
45-54	61	12.2
55-64	22	4.40
65-74	27	5.40
75+	34	6.80
BMI (kg/m²)		
Underweight (<18.5)	13	2.6
Normal weight(18.5-24.9)	289	57.8
Overweight (25.0-29.9)	178	35.6
Obese (<30)	20	4.0
Total	500	100.0

Results

The mean right kidney length measured 94.2+8mm for male and 91.8+9mm for females with a range of 64.0-113mm and 76.0-123mm for males and female respectively. The left mean kidney length measured 99.4+8.1mm and 95.5+9.5mm with a range of 76.0-119.0mm and 76.0-114.mm for males and females respectively while the width was 40.7±3.4mm for males and 40.5±3.4mm for females with P values of 0.599mm which is not significant. Mean left kidney width was 44.7±5.8mm for males and 44.5±9.5mm for females with ranges of 33.0-65.0mm and 30.0-61.0mm for males and females respectively with P values of 0.719 which is not significant. Males had a mean renal cortical thickness of 18.3±2.9mm while females had 16.6±2.9mm with P values of 0.000.

The mean right kidney length was 94.2±8.1mm for males and 91.8±9.1mm for females with P values of 0.000 which is not significant showing that males have longer right kidney length than females. The mean right kidney width was 40.7±3.4mm for males and 40.5±3.4mm for females with P values of 0.599mm which is not significant.

The mean left kidney length was 99.4±8.1mm for males and 95.5±9.5mm for females with P values of 0.000 which is significant. Showing that males have longer left kidney length than females. Mean left kidney width was 44.7±5.8mm for males and 44.5±5.5mm for females with P values of 0.719 which is not significant.

The mean right renal cortical thickness was 16.3±3.1mm for males and 15.1±2.8mm for females with P values of 0.000 showing that cortical thickness in males was greater than in females.

Table 2: Organ dimension according to sex

Organ		Sex	Number	Mean ± (SD) (mm)	Minimal-Maximum (mm)	Median (mm)	Range (mm)	Variance (mm)
Right	length	Male	195	94.2+8.1	64.0-113.0	90.0	49.0	82.3
kidney		Female	305	91.8+9.1	76.0-123.0	94.0	47.0	82.4
		Total	500	93.0+9.2	64.0-123.0	92.0	59.0	85.5
				t=4.458	p-value=0.000*	df= 498		
Right	Width	Male	195	40.7+3.4	32.0-48.0	41.0	16.0	12.2
Kidney		Female	305	40.5+3.4	33.0-55.0	40.0	22.0	21.2
		Total	500	40.6+4.2	32.0-55.0	40.0	23.0	17.7
				t=0.526	p-value=0.599	df= 498		
Left	Length	Male	195	99.4+8.1	76.0-119.0	100.0	43.0	66.3
Kidney		Female	305	95.5+9.5	76.0-114.0	95.0	38.0	90.9
		Total	500	97.9+8.9	76.0-119.0	98.0	43.0	79.4
				t=4.742	p-value=0.000*	df= 498		
Left	Width	Male	195	44.7+5.8	33.0-65.0	46.0	32.0	34.2
kidney		Female	305	44.5+5.5	30.0-61.0	44.0	31.0	30.1
		Total	500	44.6+5.6	30.0-61.0	44.0	35.0	31.6
				t=0.360	p-value=0.719	df= 498		
Right	cortex	Male	195	16.3+3.1	9.0-26.0	16.0	17.0	9.4
Kidney		Female	305	15.1+2.8	9.0-27.0	15.0	18.0	8.3
		Total	500	15.6+3.0	9.0-27.0	15.0	18.0	9.1
				t=4.483	p-value=0.000*	df= 498		
Left	cortex	Male	195	18.3+2.9	12.0-27.0	18.0	15.0	8.2
Kidney		Female	305	16.6+2.9	10.0-26.0	16.0	16.0	9.1
		Total	500	17.3+3.0	10.0-27.0	17.0	17.0	9.1
				t=6.324	p-value=0.000*	df= 498		

**There is a statistically significant relationship with p-value < 0.05.*

Table 3: Right kidney length by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	93.2±8.9	76.0-107.0	95.0	31.0
	F	57	90.7±8.5	76.0-106.0	95.0	30.0
	Total	89	92.3±8.8	76.0-107.0	93.0	31.0
25-34	M	54	94.2±10.6	78.0-145.0	94.0	67.0
	F	128	93.2±9.4	79.0-113.0	92.0	34.0
	Total	182	94.0±10.3	78.0-145.0	94.0	67.0
35-44	M	22	93.5±3.3	92.0-102.0	96.0	10.0
	F	63	87.2±10.2	64.0-104.0	85.0	40.0
	Total	85	91.9±7.8	64.0-104.0	92.0	40.0
45-54	M	34	92.4±6.2	86.0-104.0	90.0	18.0
	F	27	91.1±10.1	76.0-103.0	89.0	27.0
	Total	61	91.8±8.1	76.0-104.0	90.0	28.0
55-64	M	8	96.4±2.5	92.0-102.0	96.0	10.0
	F	14	91.1±2.5	88.0-93.0	93.0	5.0
	Total	22	94.5±4.0	88.0-102.0	94.0	14.0
65-74	M	11	95.6±6.2	80.0-103.0	92.0	14.0
	F	16	85.2±8.8	80.0-103.0	81.0	23.0
	Total	27	91.4±8.9	80.0-103.0	90.0	23.0
75 and above	M	34	85.5±9.0	73.0-102.0	88.0	29.0
	F	-	-	-	-	-
	Total	34	85.5±9.0	73.0-102.0	88.0	29.0

F – value = 4.542, df = 499, p-value < 0.0001
There is a statistically significant relationship between age and right kidney length.

Table 4: Right kidney cortex by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	18.0±4.2	10.0-26.0	19.0	16.0
	F	57	14.1±2.2	9.0-18.0	14.0	9.0
	Total	89	15.5±3.6	9.0-26.0		
25-34	M	54	15.1±3.6	9.0-21.0	15.0	12.0
	F	128	15.5±3.6	10.0-27.0	14.0	17.0
	Total	182	15.1±3.6	9.0-26.0	15.0	18.0
35-44	M	22	17.7±1.8	15.0-21.0	18.0	6.0
	F	63	15.0±2.4	10.0-19.0	15.0	9.0
	Total	85	15.7±2.5	10.0-21.0	16.0	11.0
45-54	M	34	15.8±2.1	12.0-20.0	16.0	8.0
	F	27	15.1±2.1	11.0-18.0	16.0	7.0
	Total	61	15.5±2.1	10.0-21.0	16.0	11.0
55-64	M	8	16.3±2.6	13.0-20.0	15.0	7.0
	F	14	13.7±1.0	13.0-15.0	13.0	2.0
	Total	22	15.4±2.5	13.0-20.0	15.0	7.0
65-74	M	11	19.7±4.3	11.0-22.0	22.0	11.0
	F	16	13.8±3.1	10.0-19.0	13.5	9.0
	Total	27	16.2±4.6	10.0-22.0	16.0	12.0
75 and above	M	34	15.7±1.3	13.0-18.0	16.0	5.0
	F	-	-	-	-	-
	Total	34	15.7±1.3	13.0-18.0	16.0	5.0

Table 5: Left kidney cortex by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	19.8±3.5	14.0-27.0	20.0	13.0
	F	57	15.4±2.2	11.0-20.0	16.0	9.0
	Total	89	17.0±3.4	11.0-27.0	17.0	16.0
25-34	M	54	16.7±2.3	12.0-25.0	17.0	13.0
	F	128	16.8±3.5	10.0-26.0	16.0	16.0
	Total	182	16.8±3.2	10.0-26.0	17.0	16.0
35-44	M	22	18.5±1.8	16.0-21.0	18.0	5.0
	F	63	16.9±2.3	13.0-22.0	17.0	9.0
	Total	85	17.3±2.3	13.0-22.0	17.0	9.0
45-54	M	34	17.4±2.0	14.0-21.0	17.0	7.0
	F	27	17.4±2.0	15.0-21.0	18.0	6.0
	Total	61	17.4±2.0	14.0-21.0	17.0	7.0
55-64	M	8	18.0±2.8	14.0-22.0	17.0	8.0
	F	14	16.7±1.0	16.0-18.0	16.0	2.0
	Total	22	17.5±2.4	14.0-22.0	16.0	8.0
65-74	M	11	21.1±3.5	14.0-23.0	23.0	9.0
	F	16	15.4±2.0	14.0-20.0	15.0	6.0
	Total	27	17.7±3.9	14.0-23.0	15.0	9.0
75 and above	M	34	19.5±2.0	17.0-23.0	20.0	6.0
	F	-	-	-	-	-
	Total	34	19.5±2.0	17.0-23.0	20.0	6.0

F – value = 4.488, df = 499, p-value < 0.0001
There is a statistically significant relationship between age and left kidney cortex.

Table 6: Right kidney width by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	41.9 ± 4.6	34.0-55.0	41.0	21.0
	F	57	39.9 ± 3.1	36.0-45.0	38.0	9.0
	Total	89	41.2 ± 4.2	34.0-55.0	41.0	21.0
25-34	M	54	41.0 ± 5.1	33.0-55.0	40.0	20.0
	F	128	40.5 ± 4.0	33.0-48.0	40.0	15.0
	Total	182	40.9 ± 4.8	33.0-53.0	40.0	20.0
35-44	M	22	40.0 ± 4.2	35.0-46.0	40.0	11.0
	F	63	39.6 ± 3.1	32.0-42.0	41.0	10.0
	Total	85	40.0 ± 3.7	32.0-46.0	40.0	14.0
45-54	M	34	41.0 ± 1.4	35.0-45.0	41.0	10.0
	F	27	38.4 ± 2.4	33.0-46.0	42.0	13.0
	Total	61	39.3 ± 2.4	33.0-46.0	41.0	13.0
55-64	M	8	41.0 ± 1.4	40.0-43.0	40.0	3.0
	F	14	38.4 ± 2.4	35.0-43.0	39.0	8.0
	Total	22	39.3 ± 2.4	35.0-43.0	39.0	8.0
65-74	M	11	40.0 ± 3.7	33.0-43.0	42.0	10.0
	F	16	34.8 ± 1.9	33.0-38.0	34.0	5.0
	Total	27	37.1 ± 3.9	33.0-43.0	36.0	10.0
75 and above	M	34	42.7 ± 2.8	34.0-48.0	43.0	14.0
	F	-	-	-	-	-
	Total	34	42.7 ± 2.8	34.0-48.0	43.0	14.0

F – value = 6.412, df = 499, p-value < 0.0001
There is a statistically significant relationship between age and right kidney width.

Table 7: Left kidney length by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	97.6 ± 9.8	76.0-115.0	98.0	39.0
	F	57	97.4 ± 7.0	88.0-110.0	97.0	22.0
	Total	89	97.5 ± 8.9	76.0-115.0	97.0	39.0
25-34	M	54	99.3 ± 8.0	80.0-114.0	100.0	34.0
	F	128	99.3 ± 8.7	78.0-119.0	99.5	41.0
	Total	182	99.3 ± 8.5	78.0-119.0	100.0	41.0
35-44	M	22	100.9 ± 5.1	92.0-112.0	100.0	20.0
	F	63	90.8 ± 9.3	76.0-105.0	92.0	29.0
	Total	85	98.3 ± 7.8	76.0-112.0	99.0	36.0
45-54	M	34	96.5 ± 6.8	86.0-106.0	95.5	20.0
	F	27	95.7 ± 6.9	87.0-104.0	92.0	17.0
	Total	61	96.1 ± 6.8	86.0-106.0	95.0	20.0
55-64	M	8	104.5 ± 7.6	94.0-110.0	110.0	17.0
	F	14	103.0 ± 8.7	93.0-110.0	110.0	17.0
	Total	22	104.7 ± 7.8	93.0-110.0	110.0	17.0
65-74	M	11	102.2 ± 2.2	98.0-105.0	103.0	7.0
	F	16	86.4 ± 7.2	81.0-101.0	83.0	20.0
	Total	27	95.8 ± 9.2	81.0-105.0	101.0	24.0
75 and above	M	34	90.6 ± 11.6	76.0-108.0	90.0	32.0
	F	-	-	-	-	-
	Total	34	90.6 ± 11.6	76.0-108.0	90.0	32.0

F – value = 7.673, df = 499, p-value = 0.0001
There is a statistically significant relationship between age and left kidney length.

Table 8: Left kidney width by age and sex

Age group (years)	Sex	Number	Mean ±S.D (mm)	Minimum-Maximum (mm)	Median (mm)	Range (mm)
20 – 25	M	32	46.6 ± 5.8	30.0-61.0	45.0	31.0
	F	57	44.0 ± 6.3	36.0-57.0	42.0	21.0
	Total	89	45.6 ± 6.1	33.0-65.0	45.0	31.0
25-34	M	54	44.8 ± 5.6	34.0-65.0	46.0	31.0
	F	128	44.1 ± 5.8	33.0-57.0	44.0	24.0
	Total	182	44.3 ± 5.7	33.0-65.0	45.0	32.0
35-44	M	22	45.6 ± 2.4	42.0-50.0	47.0	8.0
	F	63	44.6 ± 4.7	36.0-53.0	44.0	17.0
	Total	85	44.8 ± 4.2	36.0-53.0	45.0	17.0
45-54	M	34	46.0 ± 2.4	35.0-54.0	49.5	19.0
	F	27	44.6 ± 4.7	39.0-52.0	43.0	13.0
	Total	61	44.8 ± 6.2	35.0-54.0	43.0	19.0
55-64	M	8	46.2 ± 1.8	44.0-49.0	45.5	5.0
	F	14	43.3 ± 3.2	42.0-44.0	44.0	2.0
	Total	22	45.2 ± 2.1	42.0-49.0	45.0	7.0
65-74	M	11	47.3 ± 3.2	41.0-49.0	49.0	8.0
	F	16	41.3 ± 5.8	35.0-51.0	41.0	16.0
	Total	27	43.8 ± 5.7	35.0-51.0	41.0	16.0
75 and above	M	34	42.8 ± 6.4	33.0-54.0	43.0	21.0
	F	-	-	-	-	-
	Total	34	42.8 ± 6.4	33.0-54.0	43.0	21.0

F – value = 1.375, df = 499, p-value = 0.223
There is no statistically significant relationship between age and left kidney width.

Table 9: Correlation analysis of kidney dimension with age, BMI, heigth and weight of subjects

		Age	Body mass index	Height	weight
Subject's right kidney length	Pearson correlation	0.364	0.131	0.055	0.099
	Sig (2tailed)	0.001*	0.003*	0.218	0.026*
Subject's right kidney width	Pearson correlation	0.146	0.097	0.145	0.006
	Sig (2tailed)	0.303	0.030*	0.001*	0.888
Subject's left kidney length	Pearson correlation	0.174	0.054	0.031	0.041
	Sig (2tailed)	0.002*	0.230	0.488	0.362
Subject's left kidney width	Pearson correlation	0.083	0.088	0.148	0.175
	Sig (2tailed)	0.063	0.048*	0.001*	0.000*
Subject's right kidney cortex	Pearson correlation	0.032	0.039	0.114	0.108
	Sig(2tailed)	0.479	0.380	0.011*	0.016*
Subject's left kidney cortex	Pearson correlation	0.199	0.046	0.080	0.091
	Sig(2tailed)	0.003*	0.301	0.074	0.043*

*There is a statistically significant correlation with p-value < 0.05.

Males had a mean renal cortical thickness of 18.3±2.9mm while females had 16.6±2.9mm with P values of 0.000 which is significant showing that cortical thickness in males was greater than in females.

Discussion
The right kidney showed a mean length of 94.2±8.1mm for males and 91.8±9.1mm for females with a range of 64.0-113.0mm and 76.0-123.0mm for males and females respectively, while the mean left kidney was 99.4±8.1mm for males and 95.5±9.5mm for females with a range of 76.0-119.0mm for males and 76.0-114.0mm for females. These results suggest that males had greater kidneys lengths than females and that the left kidney length is usually longer than the right. Similar findings were also seen in the kidney width dimensions, where the mean right kidney width was 40.7±3.4mm for males and 40.5±3.4mm for females with range of 32.0-48.0mm and 33.0-55.0mm for males and females respectively. While the mean left kidney width was 44.7±3.8mm for males and 44.5±9.5mm for females with ranges of 33.0-65.0mm and 30.0-61.0mm for males and females respectively.

This further buttressed the fact that the dimensions of the male kidneys is greater than that of the females and that the left kidney is usually greater than the right. These facts are further buttressed by Ryan et al[10] and Anibor[9] who in their separate studies observed that the left kidney is usually longer than the right kidney but their differences in size should not be greater than 20mm otherwise it becomes pathological. Okoye et al[11] in their sonographic measurement of kidney in 200 adults with normal renal and cardiac status also stated that the mean kidney length of males were slightly higher than those of females, and that the renal length correlated positively with the subject's weight but not with the height or age of the subjects. In this study, it was found that kidney lengths correlated positively with subject's age, body mass index, weight of subject but not with height of subjects and the result is in tandem with Oyuela-Carrasco et al[8] where a decline in renal length was associated with age. However, kidney width correlated positively with subject's body mass index, weight, height but not with age.

The findings in this study are comparable to results of Okoye et al[11] whose normal kidney length ranged from (8.3-12.8) cm and (8.0-12.5) cm for the left and right kidneys respectively. The results of this present study is also compatible with the study done in Karachi, Pakistan by Buchholz et al[12] in their sonographic measurement of renal sizes in 194 adults individuals without renal disease. They found the mean kidney length to be 10.4±0.8cm and mean width 4.5±0.6cm. While the cortical thickness was 1.6±0.2cm. The mean right cortical renal thickness in this study was 16.3±3.1mm for males and 15.1±2.8mm for females while it is 18.3±2.9mm and 16.6±2.9mm for males and females respectively on the left, with P values of 0.000. This shows that the left cortical renal thickness is greater than the

right. There is positive correlation of the left cortical renal thickness with age p values 0.003, weight p values 0.043 but not with body mass index and height, although the right kidney cortex showed positive correlation with height p values 0.011 and weight p values 0.016. These findings are in conformity with that of Buchholz et al[12] who stated that the mean renal size correlated with age, sex and body mass index of the subjects.

Conclusion

Males have greater kidney length than females but the differences in length are not significant. Also, Males have greater kidney width than females when correlated with age, height, weight and body mass index of the subjects. The renal cortical thickness in males is greater than in females. The left cortical renal thickness is greater than the right. There is positive correlation of the left cortical renal thickness with age, but not with body mass index and height.

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