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Sonographic Measurement Of Absolute And Relative Renal Lengths In South East Nigerian Adults

*C.U. EZE AND A.O. OKARO

Department of Medical Radiography and Radiological Sciences, Faculty of Health Sciences and Technology, College of Medicine, University of Nigeria, Enugu Campus, Nigeria.

*Author for correspondence

ABSTRACT

The objective of this study was to evaluate sonographically measured absolute and relative lengths of normal kidneys according to subject height, sex and age. Real time sonography was performed on 310 subjects (135 men and 175 women) without renal impairment. Measurements of longitudinal renal diameter represented absolute renal length (ARL). Relative renal length was calculated using the kidney length: body height ratio (KBR). The subjects' ages ranged from 18 to 80 years (mean = 38 ± 10.6). The mean height of the subjects were 167 ± 8cm for men and 160 ± 8cm for women. The left kidney was absolute and relatively longer than the right kidney, regardless of sex ($P < 0.001$). The mean ARL was significantly greater in men than in women for both kidneys ($P < 0.05$), but there was no significant difference between the mean KBRs ($P > 0.05$). Renal length decreased with age, peaked at the 4th decade of life and the rate of decrease seemed to accelerate after 50 years of age. Sex was not a significant predictor of renal length when height and age were included in the multivariate regression analysis. Results suggest that relative renal length better represents kidney size than absolute renal length because it eliminates sex and height differences.

Keywords: Absolute renal length; Relative renal length; Biometry; Ultrasonography.

Estimation of the renal length is an important measurement for evaluating the kidneys in patients with clinical diagnosis of renal failure. Renal length is also an important factor when deciding whether or not to perform a renal biopsy (Madaoi, 1990). Ultrasound is a useful initial investigation in patients presenting with renal failure because it gives immediate information on the presence, size and appearance of both kidneys (Brown, 2003). Ultrasound imaging is also the modality of choice because it is non-invasive and does not produce magnification unlike intravenous urography.

Absolute renal length is a widely used parameter for the assessment of kidney size but more recently, relative renal length has been suggested as another essential parameter for assessing kidney size in adults (Miletic et. al., 1998). Measurements of Longitudinal renal diameter represent absolute renal length (ARL) while the relative renal length is calculated using the kidney length: body height ratio (KBR) (Miletic et al., 1998).

There is scanty information among the Caucasians on whether absolute renal length better represents the kidney size in the adults than relative renal length and vice versa whereas none exists for any Nigerian population. Thus, the aim of this study was to evaluate sonographically measured absolute and relative lengths of normal adult kidneys according to subject height, sex, and age among Southeast Nigerians.

MATERIALS AND METHODS

Scope

This study was carried out at University of Nigeria Teaching Hospital, Enugu and Federal Medical Centre, Abakaliki. These hospitals have the Southeast geographical zone of Nigeria as their catchments area. The study took place between August 2002 and November 2003.

Subjects

The renal length of 310 subjects (135 men and 175 women) were measured prospectively by ultrasonography. The age of the study population was between 18 80 years. Subjects were randomly selected into the study based on the following inclusion criteria:

1. No acute or chronic disease that could lead to renal impairment;
2. No personal or family history of renal disease;
3. Subjects whose renal outlines were clearly

visible on ultrasound scan;
4. Non-pregnant females.

Scanning Techniques

The subjects underwent real time ultrasound scans using a Medison's Sonoace 3200 or a Siemens SL-1 machine with 3.5MHZ transducer. Longitudinal scans were performed with the patient in the lateral decubitus position or in supine oblique position.

The major distance between the renal poles (superior and inferior) was taken as the absolute renal length (ARL). Relative renal length was calculated using the kidney length: body weight height ratio (KBR) (Miletic et al., 1998). Two operators obtained these measurements for each patient to minimize inter observer error. Apart from the renal measurements, age, sex and body height were recorded in all subjects.

Statistical Analysis:

Results are reported as mean $\pm$ standard deviation (SD). The mean renal length (ARL and KBR) of right and left kidneys in male and female were compared by z-test statistic. The differences were considered statistically significant when $P<0.05$.

The absolute and relative lengths of left and right kidneys were compared by the paired t-test. The differences were considered statistically significant when $P<0.001$.

Table 1: Mean age and height of the studied population (n=310; 135 males and 175 females).

Parameter	Gender	Mean + SD
Age (years)	Combined	38 + 10.6
Patients' Height (cm)	Males	167 + 8
	Females	160 + 8

Comparison of kidney length (ARL and KBR) in male and female by age and height was done by one-way analysis of variance (ANOVA). The differences were considered statistically significant when $P<0.001$. Multivariate regression analysis was used to test if sex was a significant predictor of renal length.

RESULTS

The mean age and height of the studied population is shown in Table-1. The mean age is 38 $\pm$ 10.6 years (range 18 80 years) while the mean height is 167 $\pm$ 8cm and 160 $\pm$ 8cm for male and female respectively (range = 145 185cm).

Table 2 shows gender distribution of mean absolute and relative renal lengths. The left kidney was absolutely and relatively longer than the right kidney, regardless of sex ($P<0.001$). The mean ARL was significantly greater in men than in women for both kidneys ($P<0.05$), but there was no significant difference between the mean KBRs in men and women for both kidneys ($P>0.05$).

The relationship between absolute and relative renal length with age is shown in Table 3 and 4. ARL and KBR decreased with age, peaked at the 4th decade of life and the rate of decrease seemed to accelerate at 50 years and older, regardless of sex ($P<0.001$).

When ARL and KBR were analyzed with respect to body height, it is shown that ARL correlated positively to those levels while KBR showed negative correlation (Table 5 and 6), ($P<0.001$). When height and age were included in the multivariate regression analysis, sex was not a significant predictor of kidney length (Table not shown).

Table 2: Gender distribution of mean absolute and relative renal lengths (n=310; 135 males and 175 females).

Sex	Mean Absolute Renal Length (mm)		Mean Relative Renal Length	
	Right Kidney	Left Kidney	Right Kidney	Left kidney
Males	104.9 + 7mm	106.7 + 7mm	0.634 + 0.047	0.644 +0.047
Females	100.8+8mm	102.4+8mm	0.642+0.053	0.649+0.053

$P<0.001$ according to paired t-test for ARL and KBR in right and left kidneys;
$P<0.05$ according to Z-test for mean ARL in men and women;
$P>0.05$ according to Z-test for mean KBR in men and women.

Table 3: Relationship between absolute and relative renal lengths with age in males (n=135).

Patient's (Years)	Mean Absolute Renal Length (mm)		Mean Relative Renal Length	
	Right Kidney	Left Kidney	Right Kidney	Left kidney
≤ 29;(n=44)	105.3	107.5	0.630	0.643
30-39;(n=24)	104.2	106.0	0.627	0.638
40-49;(n=24)	106.9	107.5	0.649	0.652
50-59;(n=22)	104.0	106.6	0.631	0.646
60-69;(n=17	103.7	105.8	0.640	0.647
≥ 70;(n=4)	99.3	100.5	0.601	0.609

P< 0.001 according to ANOVA

Table 4: Relationship between absolute and relative renal lengths with age in females (n= 175).

Patient's (Years)	Mean Absolute Renal Length (mm)		Mean Relative Renal Length	
	Right Kidney	Left Kidney	Right Kidney	Left kidney
≤ 29;(n=44)	99.1	100.2	0.626	0.633
30-39;(n=24)	102.9	104.9	0.647	0.660
40-49;(n=24)	105.4	107.0	0.677	0684
50-59;(n=22)	100.2	102.2	0.651	0.664
60-69;(n=17	95.6	98.2	0.631	0.648
≥ 70;(n=4)	95.5	98.0	0.570	0.593

P<0.001 according to ANOVA.

Table 5: Relationship between absolute and relative renal lengths with height in males (n= 135).

Patient's height (cm)	Mean Absolute Renal Length (mm)		Mean Relative Renal Length	
	Right Kidney	Left Kidney	Right Kidney	Left kidney
≤ 156; (n=15)	102.1	104.5	0.677	0.691
156 – 165; (n=52)	104.1	105.9	0.627	0.637
166 – 175;(n=54)	106.4	108.0	0.624	0.634
≥ 176;(n=14)	108.1	109.8	0.601	0.610

P<0.001 according to ANOVA

Table 6: Relationship between absolute and relative renal lengths with height in males (n= 135).

Patient's height (cm)	Mean Absolute Renal Length (mm)		Mean Relative Renal Length	
	Right Kidney	Left Kidney	Right Kidney	Left kidney
≤ 156; (n=70)	100.1	100.6	0.655	0.668
156 – 165; (n=84)	101.8	102.9	0.614	0.642
166 – 175;(n=17)	102.0	104.7	0.599	0.615
≥ 176;(n=4)	110.8	112.3	0.615	0.624

P<0.001 according to ANOVA

DISCUSSION

Present study showed a significant difference between genders for height with average of 167 ± 8cm 160 ± 8cm in men and women respectively. This implies that men are generally taller than women. Previous studies (Miletic et al., 1998 and Mario et al., 2002) showed similar findings. This observed gender differences in height may be attributed to genetic factor.

This study established a mean absolute renal length (ARL) of 104.9 ± 7mm for right kidney and 106.7 ± 7mm for left kidney in men while the mean ARL in women is 100.8 ± 8mm and 102.4 ± 8mm for right and left kidney respectively. Results also showed that the mean relative length (KBR) in men is 0.634 ± 0.047 for the right kidney and 0.644 ± 0.047 for the left kidney while the mean KBR in women is 0.644 ± 0.47 for the left kidney while the mean

KBR in women is 0.642 ± 0.053 and 0.649 ± 0.053 for right and left kidneys respectively. This implies that the kidney was absolutely and relatively longer than the right kidney, regardless of sex ($P<0.001$). Again, the mean ARL was significantly greater in men than in women for both kidneys ($P<0.05$), but there was no significant difference between the mean KBRs in men and women ($P>0.05$). Previous report in adult Croatian population (Miletic et al, 1998) agrees with these findings. However, Haughsvedt and Lundberg (1980) measuring kidney length in children could not establish any sex difference in the parameters suggesting that the observed differences may be seen only in adults.

When height and age were included in the multivariate regression analysis, sex was not a significant predictor of renal length. Thus special tables for renal length based on gender are not necessary. Previous studies (Eze and Okaro, 2004; Mario et al., 2002) analyzing kidney dimensions by ultrasound corroborated this finding.

Present study has shown that both ARL and KBR decreased in the 3rd decade of life but peaked in the 4th decade and started decreasing again. The rate of decrease seemed to accelerate at 50 years and older, regardless of sex ($P<0.001$). It was previously established that even in the absence of localized scarring, the size of the human kidney begins to diminish at about 50 years of age (Roessle and Roulet, 1932; de Leon, Garcia and de Jesus, 1933; Wald, 1937; Dunnill and Halley, 1973) suggested that the decline in renal size which occurs with ageing, particularly diffuse loss of cortical tissue is more closely related to changes in renal vasculature than to age itself.

This study showed that as subject height increases, ARL also increases strongly while KBR generally decreases, regardless of sex ($P<0.001$). This justifies the use of height parameter in reference tables for ARL and not for KBR.

Results suggest that relative renal length better represents kidney size than absolute renal length because it eliminates sex and height differences. Besides, the KBR method of estimating the kidney length is objective and does not require additional ultrasound measurements. We, therefore, suggest that in addition to absolute renal length, relative renal length should be included in the sonographic assessment of renal length in adults. Similar studies in children population is advised.

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