Original Article

Effect of patient height and weight on sonographically measured renal sizes in a sample of Nigerian adults without known renal disease

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ABSTRACT

Objective: To establish some preliminary data of Nigerian population and using ultrasound to determine the renal dimensions (length, width and thickness) with subjects' height and weight.

Methodology: A prospective study of 600 randomly selected healthy adults was carried out. The height and weight of the subjects were measure and results compiled.

Results: Three hundred nine were (51.5%) males and 291 (48.5%) females. In males, the mean kidney length was (10.7cm ±1.0 and 11.0cm ±0.9), while in females, it was 10.4cm ±0.9 and 10.8cm ±0.9 for the right and left kidneys respectively.

Conclusions: There was a strong positive correlation between the renal size, weight and height of respondents thus the prediction of kidney dimensions from the weight and height of individuals was scientifically justified.

KEY WORDS: Renal sizes, Height, Weight, Ultrasound, Nigerians.

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INTRODUCTION

There is a close relationship between kidney size and renal function.[1] There are several renal disorders that are associated with changes in the size of the kidneys, such as chronic pyelonephritis and acute glomerulonephritis.[2] Patients undergoing renal dialysis for greater than eight years have been found to show a gradual increase in renal size, with increased incidence of acquired renal cyst.[3]

It has been shown that the bipolar kidney length is an accurate indicator of the functional state of the kidneys.[4] Mazzotta et al[5] found that the most important measurement of renal size is longitudinal length in subjects with normal renal function whereas renal parenchymal volume is the more exact sonographic parameter in end stage renal disease with failure.

The benefits of ultrasonic measurement of renal length are to assess function of kidney and growth parameter for children.[6,7] Konus et al[8] also found a correlation between age and longitudinal dimension of the kidney in children.

Generally, the linear growth and length of the kidney are influenced directly by both nutritional and genetic factors which suggests that renal sizes in different population must be dissimilar.[9-11] A study by Odita et al[12] among Nigerians reported a shorter kidney length than those of the European. Reports in separate studies have shown a positive correlation

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between renal dimension and body weight[13-15] and this correlation has been found to be very strong.[14]

METHODOLOGY

This was a prospective study composed of ultrasonographic measurement of the renal length, width and thickness of 600 randomly selected healthy adults. The subjects were aged 18 years and above. The study was carried out between October 2004 and November 2005 in Benin-City.

The medical history was sought to exclude individuals with any renal pathology or systemic disorder known to influence renal size or congenital anomaly of the kidney. The presence of bladder outlet obstruction, serum creatinine test greater than 1.5mg/dl and refusal to volunteer a free consent were the other exclusion criteria.

Ethical approval was obtained from the Ethical Committee of the University of Benin Teaching Hospital and consent form was signed by each person. A (SONOACE, Medison & co. South Korea) real time ultrasound scan machine with a 3.5MHz curvilinear probe was used.

Scanning was done in the supine and prone positions. The kidney was examined in the longitudinal axis from which the bipolar length (L) and width (W) were measured in millimetres (mm). At the same point, with the transducer transversely oriented, the antero-posterior (AP) diameter is then measured also in millimetres (mm). The height, weight and bio-data were also recorded.

Data obtained were entered into a Microsoft office Excel database and statistically analyzed using Statistical Package for Social Science (SPSS) version 11. Continuous variables were expressed as the mean and standard deviation. The renal dimensions for both males and females were subjected to descriptive statistics. The differences in the respective renal dimensions in males and females were tested for statistical significance using the parametric unpaired t-test and p-value less than 0.05 were regarded as statistically significant

The relationships between continuous variables and the different renal dimensions in males and females were examined using the regression and correlation coefficients. The analysis of variance was performed to test the significance of regression coefficients.

RESULTS

A total of 1200 kidneys were measured from 309 (51.5%) males and 291 (48.5%) females with an age range of 18 – 84 years and a mean age of 39.2years ± 14.2 for males and 39years ± 16.2 for females. The height of subjects ranged from 1.5m–1.9m with a mean height of 1.7m ± 0.1 for males and 1.6m ± 0.1 for females (Figure-1).

The age range 21–30 years had the highest number of subjects, 161 (26.8%), while the height range of 1.56–1.65m had the highest subjects of 256 (42.7%) and the weight range of 60–64kg had the highest number of subjects, 153 (25%) as shown in Figure 2. Both kidneys were found to be significantly longer ($p<0.01$), and wider ($p<0.05$) in males than in females but were not significantly thicker ($p>0.5$) in males compared to females (Tables-I and II). The left and right kidneys were found to be longer, thicker and wider in taller and heavier individuals than in their shorter and lighter counterparts.

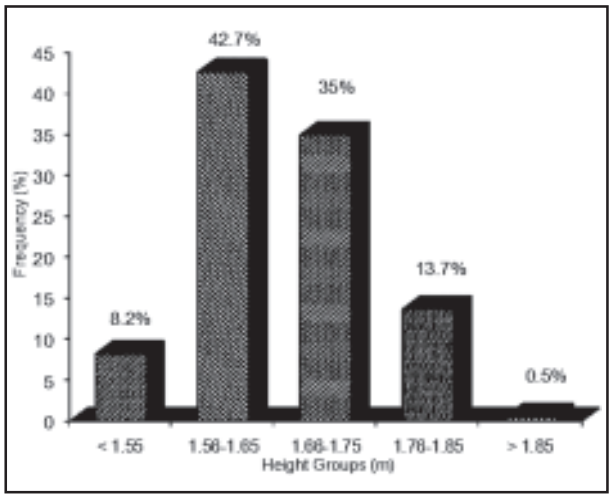

Fig-1: Bar Chart of percentage distribution of the height (in meters) (n = 600).

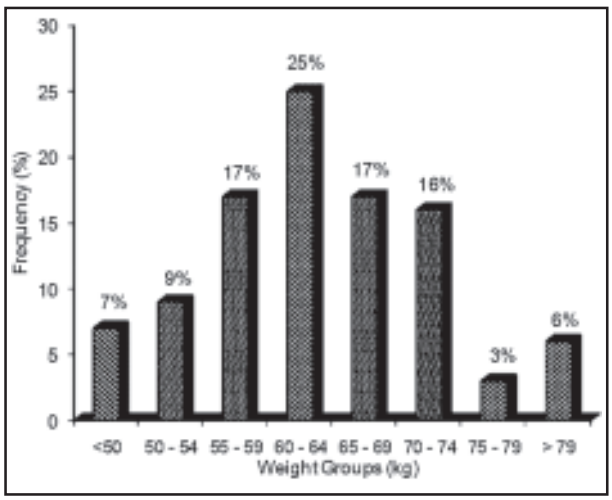

Fig-2: Bar Chart of percentage distribution of the weight (in kilogram) (n = 600).

Table-I: Renal dimensions distributed according to height (n= 600).

Height range (m)	*N*	*Length (cm)*		*Thickness (cm)*		*Width (cm)*	
		R ± S.D	*L ± S.D*	*R ± S.D*	*L ± S.D*	*R ± S.D*	*L ± S.D*
< 1.55	49	10.4±1.1	10.8±1.2	3.9±0.5	4.0±0.6	4.4±0.7	4.8±0.7
1.56-1.65	256	10.3±0.9	10.7±0.8	4.1±0.6	4.2±0.7	4.6±0.7	4.8±0.8
1.66-1.75	210	10.7±0.9	11.0±1.1	4.3±0.7	4.4±0.7	4.8±0.7	4.9±0.7
1.76-1.85	82	11.4±1.0	11.8±0.8	4.5±0.8	4.7±0.8	4.9±0.7	5.0±0.7
> 1.85	3	11.9±0.3	12.1±0.7	5.5±0.8	5.8±0.8	5.3±1.0	5.5±0.7

N = Frequency R = Right L = Left

The Pearson's coefficient of correlation between weight of subjects and right and left kidney length were r=0.32 and r=0.31 respectively (p< 0.01), between weight and thickness were r=0.17 and r=0.16 for the right and left kidney respectively (p<0.05), while between weight and width were r=0.19 and r=0.16 for the right and left kidney respectively (p<0.05).

The coefficient of correlation between height of subjects and the kidney length were r=0.36 and r=0.33 for the right and left kidneys respectively (p<0.01), between height and thickness were r=0.25 and r=0.28 for the right and left kidneys respectively (p<0.01), while between height and width were and r=0.20 and r=0.13 for the left and right kidneys respectively (p<0.05).

The length, thickness and width of the kidneys were found to show a significant positive relationship with the weight and height of individuals. Sex was not a significant predictor of length, width or thickness for the left or right kidney when age, height and weight were included in regression analysis.

DISCUSSION

In comparison with intravenous urogram, ultrasound has been found to be more accurate and does not suffer from the geometric magnification of radiographic imaging or from a possible increase in kidney size that is induced by iodinated contrast material.[15]

This study showed that there was a significant positive correlation between the kidney dimensions and weight of individuals. Thus heavier individuals have longer, wider, and thicker kidneys than their lighter counterparts. Several reports in separate studies have documented similar positive correlation between the renal dimensions and weight.[7,8,14]

The right and left kidney length, width and thickness also showed a significant direct positive correlation with height. This agrees with the reports of studies done by other authors.[5,14,15] Among Africans, similar correlation was reported by Gebrehiwot et al.[13] Oviasu et al[16] reported that total renal length, renal surface area and renal volume had significant positive correlation with the body surface area thus estimation of renal size can be made from a

Table-II: Renal dimensions distributed according to weight (n=600).

Height range (m)	*N*	*Length (cm)*		*Thickness (cm)*		*Width (cm)*	
		R ± S.D	*L ± S.D*	*R ± S.D*	*L ± S.D*	*R ± S.D*	*L ± S.D*
< 50	40	10.0±0.9	10.5±0.8	4.0±0.5	4.2±0.8	4.5±0.9	4.8±0.9
50-54	52	10.2±0.8	10.5±0.8	4.2±0.6	4.2±0.7	4.5±0.8	4.8±0.7
55-59	105	10.3±0.8	10.7±0.8	4.1±0.6	4.2±0.6	4.5±0.6	4.7±0.7
60-64	153	10.6±1.0	10.9±1.2	4.2±0.7	4.3±0.7	4.7±0.7	4.9±0.8
65-69	105	10.5±0.8	11.0±0.8	4.1±0.7	4.2±0.7	4.7±0.7	4.9±0.7
70-74	96	11.0±1.0	11.3±0.9	4.3±0.8	4.4±0.8	4.7±0.7	4.9±0.7
75-79	16	10.9±0.9	11.4±0.7	4.5±0.8	4.6±0.7	4.9±0.8	5.3±0.5
> 79	33	11.6±0.9	11.9±0.7	4.7±0.8	4.8±0.8	5.2±0.6	5.4±0.6

N = Frequency R = Right L = Left

knowledge of the body size factor. However, Tolofari[17] reported that both kidney lengths showed a weak and negligible correlation with weight and height respectively.

The significant positive correlation found in this study, between weight and height of individuals and the kidney dimensions suggest that the growth of each individual is usually associated with increase in the kidney size. The multivariate linear regression analysis done in this study can be used for predicting the normal length, width and thickness of the right and left kidney in a subject when the weight or height of the individual is known.

In conclusion, there was a strong positive correlation between the length, width and thickness of the kidneys and the weight and height of respondents thus the prediction of kidney dimensions from the weight and height of individuals was scientifically justified.

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