

# A Post Mortem Study of Age Related Changes in Kidneys.

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## ABSTRACT

**Background:** For any study and forensic diagnosis, normal anatomical ranges should be first described, so that any deviation from these normal ranges would indicate a pathological condition. It has been found that these normal ranges are not constant universally and may vary from place to place and population to population. Therefore, this study was conducted to update the normal ranges of the dimensions, weight and volume of the kidneys postmortem in our geographical area. **Methods:** 68 pairs of human kidneys were taken post mortem from unclaimed bodies from our hospital morgue. The collected samples were divided into 3 groups to demonstrate the age related changes. Group A consisted of age group between 10–20, Group B between 21 – 40 , Group C between 41-60 and Group D >60. The length, breadth, thickness, weight and volume of the kidneys were measured. **Results:** the age group between 21–40 years showed the largest kidneys in terms of size (9.46 x 4.92 x 2.97), weight (97.7gms) and volume. The left kidney was larger than the right. **Conclusion:** Attempt has been made to develop a proper reference range so that pathology of kidneys can be easily identified in future.

**Keywords:** Age related, Post-mortem, Size of kidney, Volume of kidney.

## INTRODUCTION

Kidneys are a pair of essential organs in the body which perform excretion of metabolic activities and excess water. These actions are essential for the control of concentrations of various substances like electrolyte balance and water balance in the body fluid.<sup>[1]</sup> They convert about 1700 liters of blood per day into about 1 liter of urine.<sup>[2]</sup> A normal kidney measures 10-12 cm in length, 5-7cm in breadth and about 3cm in thickness antero-posteriorly<sup>[3]</sup> and weighs about 130gms.<sup>[4]</sup> The kidneys of the females are known to be smaller than that of the males.<sup>[5]</sup> The renal mass in the kidneys tend to increase from the time of birth to about the fourth decade of life. Gradual decrease of about one-fifth of the renal mass is seen between the fourth and 8<sup>th</sup> decade of life.<sup>[6,7]</sup> Ageing is a natural process which results in gradual loss of functioning of organs and tissues even in those persons who do not have any disease related changes. The renal mass tends to decrease and sclerotic glomeruli tend to increase, resulting in reduction of glomerular filtration rate and renal blood flow.<sup>[6]</sup>

For any study and forensic diagnosis, normal anatomical ranges should be first described. Any deviation from these normal ranges would indicate a pathological condition. Therefore, the length, breadth, thickness and weight play a very important role in defining the association between trauma and disease.<sup>[8-10]</sup> Also, they may help define the degree of atrophy or hypertrophy of a particular organ inflicted by certain diseases.<sup>[11]</sup>

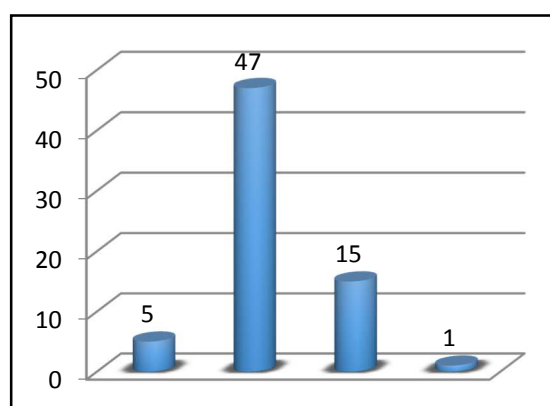
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It has been found that these normal ranges are not constant universally and may vary from place to place and population to population. Therefore, this study was conducted to update the normal ranges of the dimensions, weight and volume of the kidneys postmortem in our geographical area.

## MATERIALS AND METHODS

This study was conducted in the Department of forensic Medicine at Kakatiya Medical college from May -2012 to March-2015.68 pairs of human kidneys were taken post mortem from unclaimed bodies from our hospital morgue. Kidneys from cases of poisoning, or injury to kidneys, or cases with renal disease or gross abnormality were excluded from the study. The collected samples were divided into 3 groups to demonstrate the age related changes. Group A consisted of age group between 10 – 20, Group B between 21 – 40 , Group C between 41-60 and Group D >60.



**Figure 1:** Age-wise distribution of kidneys.

**A**-10-20 years, n=5  
**B**-21-40 years, n=47  
**C**-41-60 years, n=15  
**D**->60 years, n=1

The kidney was collected and preserved in 10% formal saline. During processing, they were washed to avoid burning and irritation to the eyes and nasal mucosa, and dried with blotting paper. They were then placed in a metallic tray and all the fat and other unwanted structures were removed carefully. The length, breadth and thickness were measured using a slide calipers graduated in cm. For accurate measurement, the fractions of cms were measured using a vernier calipers graduated in mm. The length was measured from pole to pole. The breadth and thickness were measured from the middle portion at the level of hilum. The volume was measured by

using prolate ellipsoid formula i.e. length × breadth × thickness × π/6.

**RESULTS**

Most of the kidneys obtained were in the Group B i.e in age group between 21-40 years [Figure 1]. Only one case was seen who as above 70 years old. 24 cases (35.3%) were females and 44 were males. The average size of the kidneys were 7.85 x 4.21 x 2.12 amongst the very young while in Group B it was the largest measuring 9.46 x 4.92 x 2.97. Again in group C, the size had grown smaller [Table 1].

**Table 1:** Mean size and weight of the kidneys.

Group	Length (cm)		Breadth (cm)		Thickness (cm)		Weight (gms)	
	Left	Right	Left	Right	Left	Right	Left	Right
<b>A</b> (n=5)	10.85±0.71	10.01±0.43	6.21±0.41	6.06±0.32	2.62±0.45	2.23±0.45	90.2± 1.3	86.5 ±0.98
<b>B</b> (n=47)	11.46±0.45	11.23±0.55	7.92 ± 0.5	7.56± 0.49	3.97± 0.5	3.43± 0.41	169.1±3.8	157.3 ± 2.9
<b>C</b> (n=15)	8.23±0.87	7.99 ± 0.65	5.44±0.39	5.13± 0.33	3.09± 0.4	3.01± 0.48	74.7 ± 2.1	72.9 ± 1.5
<b>D</b> (n=1)	8.31	8.23	5.12	5.04	2.86	2.63	68.4	62.8
<b>Total</b>	9.71 ± 0.68	9.37 ± 0.54	6.17±0.43	5.95± 0.38	3.14±0.48	2.83± 0.43	100.6 ± 2.4	94.88± 1.79

The volume was calculated as per the formula and the left kidney showed a considerable decrease in

volume compared to the right kidney. The maximum volume was seen in the Group B [Table 2].

**Table 2:** Volume of left and right kidneys.

Group	Left kidney (cm <sup>3</sup> )	Right kidney (cm <sup>3</sup> )
<b>A</b>	91.80 ± 1.57	70.34 ± 1.23
<b>B</b>	187.37 ± 3.23	151.43 ± 2.85
<b>C</b>	71.92 ± 2.04	64.16 ± 1.78
<b>D</b>	63.28	56.73

**DISCUSSION**

Kidney size, weight and renal volume are influenced by many factors. Some diseases are known to enlarge the organs while some are known to reduce the organs in size.<sup>[12]</sup> The variation in kidney size weight and volume is not only observed in live individuals but are observed in post mortem also. As a result the reference tables many a times become obsolete. Since histo-pathological examinations are rarely conducted in forensic cases, errors in judgment of pathological features based on the reference tables are common.

In the present study, the average size of the kidney (length x breadth x thickness) was 9.54 x 6.06 x 2.99cm. The weight was 97.74gms. This study was consistent with other studies where Hassan et al<sup>[13]</sup> reported the size to be 8.68 cm, 4.48 cm and 2.37 and Mullick et al reported 9.85 cm, 4.70 cm and 3.60 cm.<sup>[14]</sup>

Our study has shown that the left kidney is smaller than the right kidney in almost all the cases. This was corroborated by Emamian et al<sup>[15]</sup> and Buchholz et al.<sup>[16]</sup>

In our study, we observed that the weight of the cases were lesser in Group A, were raised in Group B and reduced in Group C. This was observed by Alam et al and Anderson and Brenner<sup>[6,17]</sup>. Basmajian stated that, in adult, the kidney weighs about 130 to 150 gm.<sup>[18]</sup>

The volume was the maximum in group B compared to the other groups in our study, with it being more in the left kidney than the right. Emamian et al also reported similar findings in their study.<sup>[15]</sup> Buchholz et al also reported that the left kidney has more volume than the right. In contrast, Rasmussen et al found no demonstrable difference between volumes of right and left kidneys.<sup>[16]</sup>

There is both increased volume of functional glomeruli and decreased glomerular density with

aging, as thought to be responsible for shrinkage of kidney size with aging process.<sup>[1]</sup>

The main disadvantage of autopsy studies for studying normal aging is that the underlying renal pathology may have contributed to the cause of death. Another limitation of the cadaveric study is that measurements obtained from cadavers cannot be considered equivalent to those of living kidneys, as the circulatory blood has to be taken into consideration. Shrinkage of kidneys in elderly is thought to be because of increased volume of functional glomeruli and decreased glomerular density with aging.<sup>[19-21]</sup>

## CONCLUSION

We have tried to formulate a reference table for the length, breadth, thickness, weight and volume of both kidneys for our geographical area. The observations and results of the present study are expected to provide an idea about the changes of the kidney in relation to age. These findings are expected to help to standardize the various measurements obtained by other researchers so as to determine the abnormal evidences in forensic medicine.

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