Journal of Institute of Medicine Nepal
Institute of Medicine, Kathmandu, Nepal

OPEN ACCESS

Original Article

JIOM Nepal. 2023 Apr;45(1):35-40.

Ultrasonographic Assessment of Renal Parameters in Apparently Healthy Medical Students of A University Hospital

Sushma Thapa[1], Ujjwal P Khanal[2], Sharma Paudel[3], Mahesh R Sigdel[1]

Author(s) affiliation

[1]*Department of Nephrology and Transplant Medicine, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu, Nepal*

[2]*Maharajgunj Medical Campus, Institute of Medicine, Maharajgunj, Kathmandu, Nepal*

[1]*Department of Radiology, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu, Nepal*

Corresponding author

Sushma Thapa, MBBS, MD
sushmathapanmc@gmail.com

Submitted
Jan 18, 2023

Accepted
Mar 12, 2023

ABSTRACT

Introduction
Ultrasonography is a commonly used medical imaging technique to evaluate the kidneys and has become the preferred modality for the assessment of renal pathology. However, limited data are available on the normal renal parameters in Nepalese adults. The aim of this study was to establish normal reference ranges for renal size in healthy medical students using ultrasonography.

Methods
A total of 100 healthy undergraduate medical students (64 males; 36 females) between the first and internship years (age 19-29 years) were studied. Ultrasonography was performed using a single and specific ultrasound machine with 1-7MHz transducer.

Results
The study showed the left kidney was slightly longer than the right (10.46 ± 0.68cm vs 10.13 ± 0.65cm; p=0.04), but the right kidney had a significantly larger thickness (2.80 ± 0.76cm vs 2.99 ± 0.68cm; p=0.01) and volume. A strong positive correlation was found between the renal parameters of one side with another side (Length: r=0.63,p<0.001; Breadth: r=0.42, p<0.001; Thickness: r=0.51, p<001; Volume: r=0.57, p<0.001). There were significant differences in renal length and volume based on sex, height, weight, and body mass index while other parameters were not significant. Weight was found to affect renal length more than height.

Conclusion
The left kidney was slightly longer than the right kidney. There was a strong positive correlation between the right and left kidney parameters. The study also found significant associations between renal length and height, weight, and body mass index.

Keywords
Renal size; ultrasonography

INTRODUCTION

Ultrasonography, also known as sonography, has become the preferred modality for the assessment of renal pathology, replacing traditional radiographic techniques.[1] This is because renal size abnormalities, a common finding in various nephropathies, can be accurately assessed using standardized ultrasonographic measurements. While a limited number of studies[2,3,4] have been conducted on the use of ultrasonography to measure renal parameters in Nepalese adults without nephropathies, further data is needed in this population. Establishing a reference standard for renal parameters in Nepali young adults can aid in the early diagnosis of nephropathies and serve as a screening tool for identifying renal morbidities and anatomic variations in otherwise healthy Nepalese youth.

This study aims to establish normal reference ranges for renal size in healthy Nepalese adults students of Tribhuvan University teaching hospital (TUTH) using ultrasonography, in order to provide a more applicable standard for comparison when evaluating renal morbidities. The findings will be relevant to healthcare practitioners in Nepal.

The specific objectives of the study were to measure sonographic renal length, width, thickness, and volume, as well as sonographic cortical thickness. The values obtained were compared based on demographic parameters such as sex, height, weight, and body mass index (BMI).

METHODS

This was a descriptive study done from November 2022 to January, 2023. The Study aimed to assess the normal sonographic renal size and cortical thickness in healthy Nepali adult medical student of TUTH. The study included undergraduate medical students between the first and internship years. The study was conducted after obtaining ethical approval from Institutional Review Committee and informed consent from participants. However participants with prior renal disease, previous renal surgery, and systemic diseases affecting the renal system, pregnancy, or extreme obesity were excluded from the study. The principal investigator collected all sonographic data and the study was conducted at TUTH, Nepal.

The subjects were instructed to come with an empty stomach and full urinary bladder for the ultrasound examination. The patient was requested to lie on their back and the investigator after applying gel began the examination by moving the transducer over the right upper abdomen and followed by a transverse scan to obtain a clear picture of the kidneys, the subjects were encouraged to take deep breaths and hold them. If the left kidney was obscured by intestinal gas, the subjects were advised to drink water to assist displace the gas and optimize vision. Samsung Company RS80 EVO model ultrasound with CA1-7A curved transducer with frequency 1-7.0 MHz for adults was used and adjusted the gain to obtain the best image of the renal parenchyma. The procedure was completed with the subjects in the left lateral position to visualize the right kidney in a coronal view, and then with the subjects on the right side to visualize the left kidney. Maximum dimension were recorded (e.g. oblique coronal plane for length).

Renal volume was calculated using the formula : Volume=length x thickness x width x 0.52.

One Hundred and four subjects were studied; however 2 were excluded due to hypertension while 2 had nephrolithiasis.

A sample size of 100 cases was analyzed using relevant statistical test (Chi squared test for categorical data, Student t test for continuous data, Pearson's correlation test for finding correlation of two parameters and multiple regression test to evaluate the impact of different factors on renal parameters). Normality of all continuous data was ensured by relevant test. Statistical Test were done in MS Excel, SPSS ver 20 and SOFA - Statistics Open For All ver 1.4.6 and interpreted according to the study objectives.

RESULTS

A total of 100 subjects were studied. The subject included of 64 males and 36 females. The age ranged from 19 to 29 years with average age of 23.38 ±2.71 years. Average height was 65.17 ±3.5 inches, while weight was 61.29±10.46 Kg. Mean BMI was 22.27 ±2.8 Kg/m2. The baseline profiles of the studied subjects [Table 1].

The left kidney was slightly longer than the left, however right kidney thickness was significantly larger and hence had significantly more volume. Breadth and cortical thickness were similar in both sides [Table 2].

There was very strong positive correlation between left and right kidney in all dimensions and volume as shown in the Table 3.

Table 1. Baseline profiles of the studied subjects

Characteristics	Mean	Min	Max
Age (years)	23.38±2.71	19.00	29.00
Height (cms)	165.53±8.89	147.32	185.42
Weight (kg)	61.29±10.46	35.00	83.00
BMI	22.27±2.80	16.13	28.23
SBP (mmHg)	113.80±9.62	90.00	126.00
DBP (mmHg)	76.36±7.66	60.00	84.00

Table 2. Comparison of left and right kidney parameters

Parameters	Left Kidney	Right kidney	p-value
Length (cm)	10.46±0.68	10.13±0.65	0.04
Breadth (cm)	5.59±0.44	5.66±0.67	0.24
Cortical thickness (cm)	1.52±0.21	1.51±0.28	0.42
Thickness (cm)	2.80±0.76	2.99±0.68	0.01
Volume (cc)	82.57±28.11	88.92±28.12	0.02

Table 3. Pearson's R Statistics of left and right kidney parameters

Parameters	r	p-value
Length	0.63	< 0.001
Breadth	0.42	< 0.001
Cortical thickness	0.24	0.016
Thickness	0.51	< 0.001
Volume	0.57	< 0.001

Renal length of both sides were significantly longer in males as compared to female, however other dimensions were comparable. The difference may be due to significantly taller males than females (M vs F : 170.31 vs 160.79 cms, p<0.001) [Table 4].

There was strong positive correlation of renal length with subject height. A statistically significant correlation was present with renal volume with subject height while other parameters were similar as shown in Table 5 and Figure 1.

There was strong positive correlation of renal length with subject weight. A statistically significant correlation was present with renal volume with subject weight while other parameters were similar as shown in Table 5 and Figure 1.

There was strong positive correlation of renal length with subject BMI (left kidney: r=0.43,p< 0.001; Right kidney: r= 0.27,p=0.01). A statistically significant correlation was present with renal volume with subject's BMI (left kidney: r=0.22, p=0.03; Right kidney: r=0.18,p=0.07) while other parameters were similar.

Multiple regression Analysis was done to evaluate the impact of height and weight on renal parameters, controlling the effect of one parameter from another [Table 6]. Only weight were found to significantly affect left and right kidney length when the effect of height was controlled for but not vice versa (p= <0.001 and 0.04). Both height and weight were NOT found to significantly affect each other on left and right kidney breadth, cortical thickness and thickness.

Table 4. Sex-wise comparison of left and right kidney parameters

Parameters	Left Kidney			Right Kidney		
	Female	Male	p-value	Female	Male	p-value
Length (cm)	9.98±0.65	10.73±0.53	<0.001	9.99±0.66	10.56±0.56	<0.001
Breadth (cm)	5.53±0.49	5.63±0.41	0.28	5.60±0.87	5.70±0.52	0.48
Cortical thickness (cm)	1.46±0.22	1.50±0.21	0.3	1.46±0.19	1.54±0.32	0.15
Thickness (cm)	2.70±0.72	2.85±0.79	0.35	2.83±0.53	3.08±0.74	0.08
Volume (cc)	75.89±30.70	86.34±26.04	0.07	80.58±27.01	93.61±27.84	0.02

Table 5. Correlation of left and right kidney dimensions with subjects height and weight

Parameters	Height				Weight			
	Left Kidney		Right Kidney		Left Kidney		Right Kidney	
	Pearson's R statistic	p-value	Pearson's R statistic	p-value	Pearson's R statistic	p-value	Pearson's R statistic	p-value
Length (cm)	0.53	< 0.001	0.4	< 0.001	0.62	<0.001	0.41	<0.001
Breadth (cm)	0.14	0.16	0.178	0.08	0.16	0.10	0.18	0.08
Cortical thickness (cm)	0.09	0.38	0.20	0.05	-0.02	0.86	0.20	0.04
Thickness (cm)	0.14	0.15	0.17	0.09	0.20	0.05	0.23	0.02
Volume (cc)	0.24	0.016	0.25	0.01	0.30	<0.001	0.28	<0.001

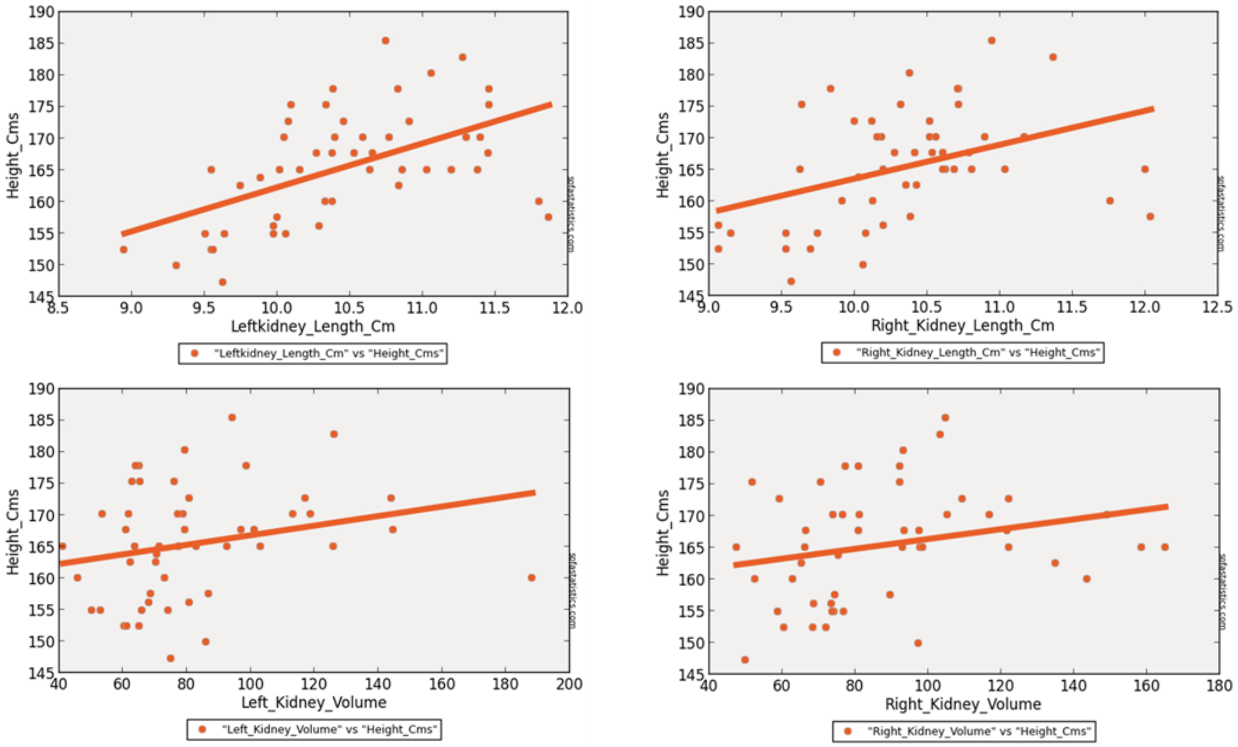

Figure 1. Correlation of renal length and volume with subjects Height

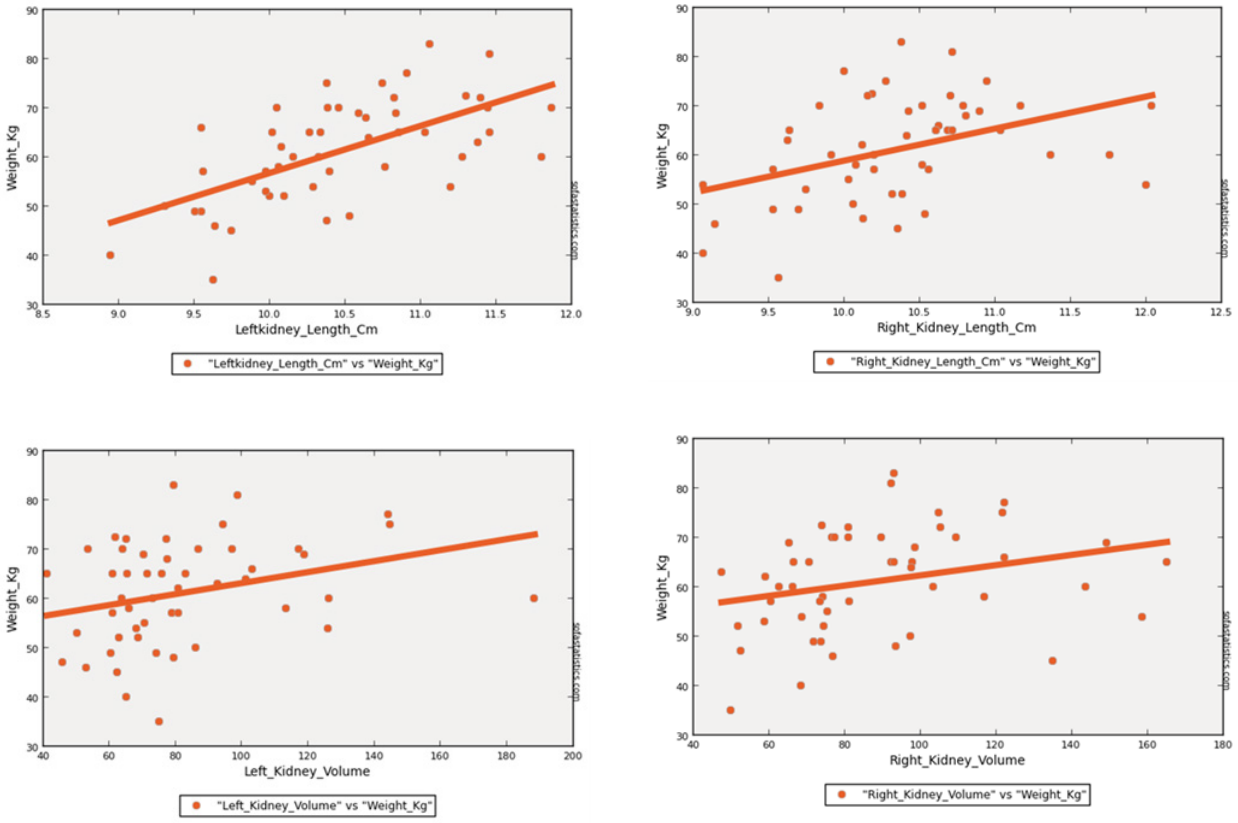

Figure 2. Correlation of renal length and volume with subjects weight

Table 6. Multiple regression analysis of height and weight on renal parameters

Parameters	Left Kidney length			Right Kidney length		
	Coefficients	t Stat	p-value	Coefficients	t Stat	p-value
Intercept	6.09	5.45	< 0.001	6.70	5.33	< 0.001
Height	0.04	1.77	0.08	0.04	1.73	0.09
Weight	0.03	4.53	< 0.001	0.02	2.02	0.05

DISCUSSION

The study of kidney size is critical in medical science to access renal function as well as to diagnose and monitor progression of renal diseases. We evaluated renal size by USG and investigated whether kidney size varies with gender, side and physical profile (height, weight and BMI) of the study subjects. Our study discovered that all three of the aforementioned factors influence kidney size.

In our study, the left kidney was found to be slightly longer than the right kidney, while breadth and cortical thickness were similar. The right kidney was observed to be thicker and have more volume compared to the left kidney. These findings were similar to those observed in the Nepali population in studies conducted by Badu M et al[2], Mansur DI et al[3], and Koirala R et al[5]. These findings were also observed in many other studies [6,78], but Muthusami et al9 and Buchholz et al[11] found no difference in length between the left and right kidneys.

A strong positive correlation was found between the renal parameters of both sides, with changes in one side consistently corresponding with similar changes in the opposite side. This finding was also reported by Badu et al., who found a strong correlation between left and right renal length, but did not examine other dimensions.

Renal length and volume were found to be significantly larger in males compared to females, but other parameters were not significantly different. These findings were similar to those observed in most studies conducted in Nepal[3,5] and other studies6,8, but Muthusami et al[9] found no difference between males and females.

It was observed that there is a positive association between height, weight, and BMI with renal length and volume, while there was no correlation between renal breadth, thickness, and cortical thickness. Previous studies by Raza et al. and Su et al. found a positive correlation between renal length and these physical characteristics, but Badu et al. did not find any correlations with any of the renal dimensions. Muthusami et al. found a moderate positive correlation between weight and renal length but weak correlation with height. This finding was also observed in our study.

Nepalese people have smaller parameters of kidneys in comparison to other countries. This finding has been observed in Pakistani[6], Chinese[8], American[7], and African[10] populations, but a study conducted in the Indian population[9] had very similar dimensions to those observed in the Nepali population. The size of the kidney is determined by weight and height, and Nepalese people have lower weight and height compared to Westerners, which may explain why they have smaller kidneys.

Ultrasonography (USG) has several advantages over other diagnostic imaging modalities due to its ability to provide excellent detailed renal anatomy and its convenience for bedside use without requiring the patient to be moved to an unmonitored setting. In addition it is free from radiation. Determining renal size can be crucial for identifying underlying renal conditions and morbidity, and for adjusting treatment modalities accordingly..[12]

CONCLUSION

The left kidney was slightly longer than the right kidney. There was a strong positive correlation between the right and left kidney parameters. The study also found significant associations between renal length and height, weight, and BMI. These results provide valuable data for future research on renal anatomy and function in this population.

FINANCIAL SUPPORT

The author(s) did not receive any financial support for the research and/or publication of this article.

CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

1. Gulati M, Cheng J, Loo JT, et al. Pictorial review: Renal ultrasound. Clin Imaging. 2018; 51: 133-154. doi:10.1016/j.clinimag.2018.02.012
2. Badu M, Rajbhandari SBS, Regmi P. Normal kidney size in Nepalese females at KMCTH. J of Universal Coll Med Sci. 2019 Dec; 7(2): 51-53.
3. Massur DI, Karki S, Shrestha P, et al. A sonographic study of kidney

dimensions among Nepalese children. J Nepal Paediatr Soc. 2020; 40(3):164-171.

4. Ray B, Gupta N, Ghosh S. Renal dimensions in Nepalese population: a preliminary study. Nep Med Coll J. 2004, 6(2), 119–122.
5. Koirala RP, Pradhan S, Aryal SK. Ultrasonic measurement of kidney length in Nepalese people. J Nep Phys Soc 2017; 4:49.
6. Raza M, Hameed A, Khan MI. Ultrasonographic assessment of renal size and its correlation with body mass index in adults without known renal disease. J Ayub Med Coll Abbottabad. 2011;23(3):64-68.
7. Emamian SA, Nielsen MB, Pedersen JF, et al. Kidney dimensions at sonography: correlation with age, sex, and habitus in 665 adult volunteers. Am J Roentgenol. 1993;160(1):83-86. doi:10.2214/ajr.160.1.8416654
8. Su HA, Hsieh HY, Lee CT, et al. Reference ranges for ultrasonographic renal dimensions as functions of age and body indices: A retrospective observational study in Taiwan. PLoS ONE. 2019: 14(11): e0224785.
9. Muthusami P, Ananthakrishnan R, Santosh P. Need for a nomogram of renal sizes in the Indian population- findings from a single centre sonographic study. Indian J Med Res. 2014; 139 (5):686-693.
10. Okoye IJ, Agwu KK, Idigo FU. Normal sonographic renal length in adult southeast Nigerians. Afr J Med Med Sci. 2005; 34(2):129-131.
11. Buchholz NP, Abbas F, Biyabani SR, et al. Ultrasonographic renal size in individuals without known renal disease. J Pak Med Assoc. 2000; 96(1): 12-16.
12. Noble, VE, Brown DFM. Renal ultrasound. Em Med Clinics North Am. 2004; 22(3), 641-659. https://doi.org/10.1016/j.emc.2004.04.014s