



Relationship of Sonographic Kidneys measurements and body indexes in athlete Saudi Population

Qurain Turki Alshammari¹, Alaa Ahmed Alkayyat², Salman Abdullah Alomaireeni³, Ali Mohammed Tawhari⁴, Raghad Fahad Alshammari¹, Reem Mubarak Alsaad⁵, Mohsen Maithed Alshaibani⁶, Mohammed Abdulaziz AlGhazwi⁷, Alanoud Saad Alshammari⁸, and Mariam Qassim Alzawad⁹

¹Diagnostic Radiology Department, College of Applied Medical Sciences, University of Hail, Hail, **Saudi Arabia**

²Department of Radiological Science, College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Jeddah, **Saudi Arabia**

³Department of Medical Imaging, King Fahad Specialist Hospital, Qassim Cluster Health, Qassim, **Saudi Arabia**

⁴Radiology Department, Samtah General Hospital, Jazan, **Saudi Arabia**

⁵Radiology Department, Najran General Hospital, Najran, **Saudi Arabia**

⁶Radiology Department, Security Forces Hospital, Riyadh, **Saudi Arabia**

⁷College of Medicine, Butterjee Medical College, Jeddah, **Saudi Arabia**

⁸Radiology Department, King Salman Specialist Hospital, Hail, **Saudi Arabia**

⁹Radiology Department, Imam Abdulrahman Bin Faisal University Hospital, Eastern Province, **Saudi Arabia**

*Correspondence: g.algrain@uoh.edu.sa Received: 07 November-2023, Revised: 20 December 2023, Accepted: 25 December 2023 e-Published: 31 December 2023

Ultrasound (US) technique is a simple medical modality, affordable, reproducible and widely used for the abdominal organs measurement. The size of various abdominal organs including kidney may varies in athlete people, as an intensive physical activity may altered demand of kidney respond. The aim of this study was to assess the relationship of kidneys volumes of athlete subjects with body indexes using ultrasound technique. Ultrasound of kidney measurements was performed for 100 university athlete students from both genders. All participants underwent an ultrasonographic scan and the kidney measurement was measured. Total volume and parenchymal volume were also calculated. Age, sex, weight and height of the subjects were recorded. The mean length of right and left kidney was 103 ± 5 cm and 105 ± 8 cm, respectively. The mean total volume and parenchymal volume of right kidney was 167 ± 32 cm³ and 126 ± 32 cm³, respectively. The mean total volume and parenchymal volume of left kidney was 175 ± 40 cm³ and 133 ± 36 cm³. Mean kidney volume and parenchyma volume was significantly larger in male compared to female ($p < 0.05$). Kidney measurements were positively correlated with body height and weight. Kidney measurement of athlete is associated with body height and weight. Our study suggested the defining the normal values of kidney in athlete people will be helpful in diagnosis of internal organ disease. More larger participants studies for athlete would be recommended and valuable.

Keywords: Ultrasound, kidney total volume, kidney parenchymal volume, kidney measurement, height, weight.

INTRODUCTION

Computed Tomography (CT), Magnetic resonance imaging (MRI) and Ultrasonography (US) can be applied to measure the abdominal organs such the kidney dimensions and volume (Eric Umeh et al. 2015). The high cost of MRI scan and the high dose of ionizing radiation in CT have made these modalities not so appealing in the studies of normal abdominal values. However, US is a simple, affordable, free of ionizing radiation, reproducible and widely used for the abdominal organ measurement (Eric Umeh et al. 2015).

Kidney measurements are considered essential parameter that can be applied in the clinical assessment

of renal growth and abnormalities. The athlete could significantly alter the various tissue and organs. These changes have been increased the metabolic rate of muscle (Hawley et al. 2014). In terms, the internal organ such as kidneys would respond to this functional alteration (Ekun et al. 2017). In addition, the athlete's kidney measurement could be affected by the overall body factors including age, height, weight, body mass index (BMI) and body surface area (BSA). Also, Many diseases such as infection can affect the kidney size in athlete. Thus, having a reliable reference for kidney length in athlete is useful for clinical assessment (Snoobar, et al. 2004).

In addition, normal renal values depends on ethnicity of population. It is thus essential to have benchmark parameters in each population group (Snobar Gul, et al. 2004; Jacobs et al. 2009; McCorkle et al. 2010; Stricker et al. 1993).

The aim of this study is to assess the relationship of kidneys measurement of athlete subjects with body indexes using ultrasound technique.

MATERIALS AND METHODS

This was an observational cross sectional study which has been conducted for athlete University students.

The study samples included in this study were 100 athlete students from both genders of University students, aged 18 yrs and above. These athletes trained physically regularly at least 7 hrs a week. Volunteer's age, height in meters, weight in kg and Body Mass Index were measured and recorded. BMI of all subjects has been calculated by applying following formula: $BMI = \text{Weight (kg)}/\text{height (m)}^2$

Subjects will be excluded if has any of chronic disease such as Hypertension, previous heart surgery or disease, pregnancy, obesity ($>25 \text{ kg/m}^2$), steroid drugs, or abnormal findings in Ultrasound examination regarding size, shape and echo structure.

All Individuals then underwent a sonographic examination for kidneys dimensions (a Logiq e ultrasound machine with 3-5MHz transducer) were used. Standard protocols of abdominal US of both kidneys length were applied for all subjects in a supine and in cubital position slightly in the right or left lateral direction. Kidneys length, width, and thickness, volume (total volume and sinus volume) were measured. The sinus volume was calculated by: $\text{length} * \text{thickness} * \text{width} * 0.523$. The

parenchymal volume then obtained by total volume – sinus volume.

A data collection sheet was used that included all the variables needed for the study. Statistical Package for the Social Sciences (SPSS24) program was used for analysis. Frequency, percentage, cross-tabulation, and chi-square tests were used.

RESULTS

One hundred participants (43 female and 57 male) were included in this study. The mean age, BMI and weekly training time was 24 ± 4 yrs, $22.03 \pm 1.70 \text{ kg/m}^2$, and 6.29 ± 0.8 hr, respectively. The demographic data of volunteers shown in table 1. The kidney measurements shown in Table 2.

Mean kidney volume and parenchymal volume was significantly larger in male compared to female ($p < 0.05$). Kidney measurements were positively correlated with body height and weight. There was a significant correlation between height of volunteers with mean kidney length and mean kidney total volume ($p < 0.05$), in both right and left kidneys. Also, There was a significant correlation between weight of volunteers with mean kidney length, mean kidney total volume and mean Parenchymal Volume ($p < 0.05$), in both right and left kidneys.

Table 1: Demographics data of volunteers

Characteristics	male	female	P
Number of volunteers	57	43	-
Age (yrs)	24 ± 3	22 ± 2	>0.05
Weight (kg)	74 ± 9	69 ± 8	>0.05
Height (cm)	171 ± 11	162 ± 8	<0.05
BMI (kg/m^2)	23 ± 4	21 ± 3	>0.05

Table 2: Kidney's measurement

Mean \pm SD	Male		female		Total	
	Right Kidney	Left Kidney	Right kidney	Left Kidney	Right kidney	Left Kidney
Length (cm)	106 ± 6	107 ± 8	101 ± 5	104 ± 9	103 ± 5	105 ± 8
Total Volume (cm^3)	171 ± 35	179 ± 44	163 ± 29	170 ± 37	167 ± 32	175 ± 40
Parenchymal Volume (cm^3)	132 ± 35	139 ± 40	121 ± 29	127 ± 32	126 ± 32	133 ± 36

DISCUSSION

This study assessed the kidney measurements, and it showed a correlation of kidney length and volume with body indexes in athlete student university population.

Measurement of length and volume of kidney are useful to make decision of renal pathological abnormalities. A kidney measurement with US is a simple, free of ionizing radiation and reproducible technique. It is also a great parameter of renal function and has excellent correlation with body indexes (Widjaja E et al. 2008). Our US kidney measurements are correlated with previous studies (Naglaa M et al. 2008; M. M. Platts et al. 1984; Zerlin JM, 1994; Zeb Saeed et al. 2012; Kalpana Purohit et al. 2017; Seyed Alireza et al. 1993; ÇELIKTAS, M et al. 2015; Somnath Chakraborti et al. 2016; Yared Tekle et al. 2018; Amna Yousaf, et al. 2022). However, a minor variation of kidney measurements between studies and may mostly related to a difference on the race, gender age, BMI and duration of activities per week.

Kidneys are positioned in the retroperitoneal space at the T12-L3 level vertebra. The kidney is correlated to the body height ie. Low to medium range of body height showed small range of kidney length (7-10 cm). The alteration of kidney size is important in the diagnosis of variation disease such as hypertension in athletes. Therefore, the define the normal size of kidneys in athlete is vital and important in evaluation of clinical cases.

El-rashaid et al. concluded that the increasing in age did not affect the kidney length, however, it reduced the glomerular filtration rate (El-Reshaid et al. 2014). For athlete people, the relationship between increasing age and kidney size needs a further and larger investigation.

The higher training exercise program in the athlete would lead to noticed reduced in the urine volume, flow of kidney plasma and circulation of blood flow in kidney and renal filtration rate (. Jacobs et al. 2009). This may cause marked decrease in right and left kidney length in athlete compared to non-athlete people.

In addition, reduced in both renal cortical thickness and glomerular filtration rate of the subjects of athlete would provide further explanation of decreasing the kidneys size in athlete compared to non-athlete subjects (Ekun et al. 2017).

CONCLUSION

Kidney volume and length of athlete population are correlated with body indexes including height and weight. Our study suggested that defining the normal values of kidney measurements in athletes will be useful in diagnosis of kidney abnormalities. More larger participants study for athlete would be recommended and helpful.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization, Q.T.A. and A.A.A.; methodology, A.M.T.; M.Q.A. and M.M.A.; formal analysis, R.F.A, M.A.A, and R.M.A.; Data Collection, Q.T.A and S.A.A.; writing-original draft, Q.T.A and A.S.A.; supervision, QTA. All authors read and approved the final version.

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