



## SONOGRAPHIC EVALUATION OF BLADDER WALL THICKNESS AMONG APPARENTLY HEALTHY ADULTS IN KANO METROPOLIS, NIGERIA

\*Mohammed Sidi and <sup>1</sup>Nura Isah Ibrahim

<sup>\*1</sup>Department of Medical Radiography, Faculty of Allied Health Sciences, Bayero University Kano

\*Corresponding author: msidi.radg@buk.edu.ng, +2348039264238

### ARTICLE INFO

#### Keywords:

Normogram,  
Bladder wall,  
Thickness, Adults,  
Ultrasound

### ABSTRACT

**Background:** In a standard practice every locality should have a documented record of the urinary bladder wall thickness (BWT) of the apparently healthy adults that could be used as a reference in making diagnosis of the pathological conditions. Similar study had not been conducted in the locality

**Aims of the study:** The study aims at evaluating the bladder wall thickness among apparently healthy adults in Kano metropolis, Nigeria using ultrasonography.

**Materials and Methods:** This study was prospective and cross-sectional conducted among apparently healthy adults in Kano metropolis from March 2020 to October 2020. Three hundred and Eighty Four (384) adult participants were recruited using convenient sampling method. A portable digital ultrasound machine, Sonostar SS-7 with 3.5 MHz curvilinear transducer was used to obtain the anterior, posterior, left lateral and the right lateral walls of the urinary bladder. The data were analyzed using SPSS version 23.0. The preset p-value was 0.05.

**Results:** The mean  $\pm$  SD of the anterior, posterior, left lateral and right lateral BWT for males were  $2.86 \pm 0.26$ ,  $2.90 \pm 0.23$ ,  $2.75 \pm 0.27$  and  $2.75 \pm 0.25$  while that of females were  $2.75 \pm 0.29$ ,  $2.81 \pm 0.26$ ,  $2.67 \pm 0.31$  and  $2.68 \pm 0.30$  respectively. There was statistical significance difference in bladder wall thickness between males and females ( $p < 0.05$ ).

**Conclusion:** This study has established the normal values of bladder wall thickness for apparently healthy adults in Kano metropolis, Nigeria. There was statistical significance difference in bladder wall thickness between males and females. A significant weak positive correlation was observed between bladder wall thickness with age, weight, BMI and BSA.

### INTRODUCTION

The urinary bladder is a temporary reservoir for urine and varies in size, shape and position. It is a hollow viscus with strong muscular walls characterized by its distensibility. When empty, the adult urinary bladder is located in the lesser pelvis, lying partially superior to and partially posterior to the pubic bones. It is separated from these bones by

the potential retro-pubic space and lies mostly inferior to the peritoneum, resting on the pubic bones and pubic symphysis anteriorly to the prostate in males or anterior wall of the vagina in females posteriorly.<sup>1</sup> It stores the urine, allowing urination to be frequent and controlled. The bladder is lined by layers of muscular tissues that stretched to hold urine to a capacity 400-600ml.<sup>2</sup> During

micturition, the bladder muscles squeeze, and two sphincters open to allow urine to flow out of the body through urethra. The urethra is longer in men; 8 inches and 1.5 inches in women. Hoffman<sup>2</sup>

The pathological conditions that affect the urinary bladder include; Cystitis, Urinary calculi, bladder cancer, urinary incontinence, overactive bladder, urinary retention, cystocele, dysuria. Furthermore, Schistosomiasis, bladder polyps are also pathological conditions that can affect urinary bladder.<sup>3</sup> Ultrasound with high frequency transducers is invaluable in precise measurement of bladder wall thickness. It is not associated with pain, invasiveness risk of infection, ionizing radiation and high cost. It is also adaptable for all age groups.<sup>4</sup>

In a standard practice every locality should have a normal value for the bladder wall thickness that would be used as a reference for making a diagnosis of the pathological conditions affecting the bladder. However, there is paucity of data on urinary bladder wall thickness on apparently healthy adults in Kano metropolis, Nigeria. The findings of the study are expected to serve as a guide to sonographers, sonologist and physicians in the diagnosis and management of patients with urinary bladder diseases. The study is aimed at evaluating the bladder wall thickness among the apparently healthy adults in Kano metropolis, Nigeria.

## MATERIALS AND METHODS

This was a prospective and cross sectional study conducted in Kano state metropolis, Nigeria from March 2020 to October 2020. Ethical approval to conduct the study was obtained from the Human Research and Ethics Committee of Kano State Ministry of Health and the informed consent was obtained from all the selected participants. Non-probability convenient sampling method was employed and 384 participants were recruited. Apparently healthy adults age ranged 18 years-65 years were included in the study. The exclusion criteria include; participants with urinary tract infections or surgery, with any history of urological complaints, urological interventions, and catheterization, pregnant women, women with fibroids and women with pelvic organ

prolapse, men with benign prostatic enlargement or prostatic neoplasm, bladder cancer, dementia, history of diabetes mellitus that would affect functions of lower urinary tract, renal disease and patients who had open wound in or around suprapubic area. A portable digital ultrasound machine, Sonostar SS-7 with 3.5 MHz curvilinear transducer was used as an instrument for data collection. Before, the ultrasound scan, the participants were asked to take enough water and waited until when the bladder was full. The participant was supine on the table and relaxed, lying comfortably and breathing quietly and ultrasound gel was applied at the suprapubic region. A transverse scan was performed from the pubic symphysis upwards to the umbilicus, followed by longitudinal scans, moving from one side of the lower abdomen to the other. These scans were usually sufficient, but some participants were rotated 30-45° to demonstrate the positions of the lateral walls more clearly. Any area that appeared abnormal was viewed in several projections. Bladder wall thicknesses were obtained as the distance from the interface of urine and internal mucosal layer of the bladder to the outer part of adventitial hyper echoic line as shown in figures 1, 2 and 3, using this method, anterior, posterior, left lateral and right lateral walls were measured.



a) Anterior wall (arrows)



b). Left lateral wall (calipers)



c. Right lateral wall (calipers)

The obtained data was categorized into males and females and further categorized into six different age groups; 18-20 years, 21-30 years, 31-40 years, 41-50years, 51-60years and 61-65years. The mean  $\pm$  SD and range of the age, weight, height, BMI and BSA were obtained using descriptive statistics. The differences between males and females BWT was obtained using student's t- test while difference of the BWT between the different age groups was obtained using one way ANOVA. Furthermore, the difference of one group from the other groups was obtained using Turkey post hoc test of multiple comparism. The correlation of the BWT with age,

weight, height, BMI and BSA was obtained using Pearson's correlation. The data was analyzed using SPSS version 23.0. The Preset  $p$  value  $<0.05$ .

**Results**

The age, weight, height, BMI and BSA of the male participants were  $31.70\pm11.22$  years,  $59.63\pm8.01$  kg,  $147.00\pm5.80$  cm,  $27.78\pm4.22$  kg/m<sup>2</sup> and  $1.55\pm0.11$  m<sup>2</sup> respectively while female participants were  $29.40\pm12.15$  years,  $53.38\pm7.96$  kg,  $144.88\pm4.33$  cm,  $25.40\pm3.81$  kg/m<sup>2</sup>, and  $1.46\pm0.11$  m<sup>2</sup> respectively (mean  $\pm$  SD)

**Table 1: Anthropometric variables of the participants**

Anthropometric Variables	Male (n=192)	Female (n=192)	Total (n=384)
	(mean $\pm$ SD)	(mean $\pm$ SD)	(mean $\pm$ SD)
Age (years)	$31.70\pm11.22$ (18-65)	$29.40\pm12.15$ (18-65)	$30.56\pm11.73$ (18-65)
Weight (Kg)	$59.63\pm8.01$ (40-80)	$53.38\pm7.96$ (37-75)	$56.55\pm8.59$ (37-80)
Height (cm)	$147.00\pm5.80$ (140-167)	$144.88\pm4.33$ (135-165)	$145.96\pm5.24$ (135-167)

Anthropometric Variables	Male (n=192)	Female (n=192)	Total (n=384)
	(mean ± SD)	(mean ± SD)	(mean ± SD)
BMI(Kg/m <sup>2</sup> )	27.78±4.22 (18.37-46.88)	25.40±3.81 (17.78-37.86)	26.60±4.19 (17.78-46.88)
BSA (m <sup>2</sup> )	1.55±0.11 (1.25-1.79)	1.46±0.11 (1.20-1.76)	1.51±0.12 (1.20-1.79)

Table 2 shows the mean and standard deviation of the age, weight, height, BMI and BSA of the different age groups of the participants. For 18-20 it was found to be 19.17±0.86, 51.05±7.68, 145.30±5.74, 24.43±4.40 and 1.43±1.12. For 21-30 it was found to be 25.91±3.01, 56.74±7.86, 146.05±5.10, 26.59±3.76 and 1.51±0.11. For 31-40 it was found to be 36.32±3.19, 59.88±8.26,

146.62±5.48, 27.87±3.73 and 1.55±0.12. For 41-50 it was 45.39±2.88, 59.24±9.35, 145.85±5.15, 27.96±4.91 and 1.54±0.12. For 51-60 it was found to be 57.40±3.04, 58.20±8.55, 146.53±5.17, 27.17±4.13 and 1.53±0.12. For 61-65 it was found to be 63.29±1.64, 62.79±6.60, 145.21±3.04, 9.76±2.78 and 1.59±0.92.

**Table 2: Demographic characteristics of the participants based on age groups**

Age Groups	Demographic variables				
	Age	Weight	Height	BMI	BSA
<b>18-20</b>	19.17±0.86 (18-20)	51.05±7.68 (37-70)	145.30±5.74 (140-165)	24.43±4.40 (17.78-46.88)	1.43±1.12 (1.20-1.70)
<b>21-30</b>	25.91±3.01 (21-30)	56.74±7.86 (40-75)	146.05±5.10 (135-165)	26.59±3.76 (18.37)	1.51±0.11 (37.86)
<b>31-40</b>	36.32±3.19 (31-40)	59.88±8.26 (41-75)	146.62±5.48 (140-167)	27.87±3.73 (19.50-35.67)	1.55±0.12 (1.29-1.79)
<b>41-50</b>	45.39±2.88 (41-50)	59.24±9.35 (45-80)	145.85±5.15 (135-160)	27.96±4.91 (20.70-40.82)	1.54±0.12 (1.32-1.76)
<b>51-60</b>	57.40±3.04 (51-60)	58.20±8.55 (49-74)	146.53±5.17 (140-160)	27.17±4.13 (19.53-34.24)	1.53±0.12 (1.40-1.76)
<b>61-65</b>	63.29±1.64 (61-65)	62.79±6.60 (50-73)	145.21±3.04 (140-150)	29.76±2.78 (23.78-32.82)	1.59±0.92 (1.42-1.74)

Table 3 shows the anterior wall, posterior wall, left lateral wall and right lateral wall of urinary bladder of the male selected participants to be 2.86±0.26mm, 2.90±0.23 mm, 2.75±0.27 mm and 2.75±0.25. For females it was found to be 2.75±0.29 mm, 2.81±0.26 mm, 2.67±0.31 mm and 2.68±0.30.

**Table 3: Bladder wall thickness for both male and female participants**

Bladder Dimensions	Male (n=192)	Female (n=192)	Total (n=384)
Anterior wall (mm)	2.86±0.26 (2.04-3.96)	2.75±0.29 (1.93-3.15)	2.80±0.28 (1.93-3.96)
Posterior wall (mm)	2.90±0.23 (2.07-3.92)	2.81±0.26 (1.98-3.28)	2.85±0.25 (1.98-3.92)
Left-Lateral wall (mm)	2.75±0.27 (1.85-3.38)	2.67±0.31 (1.55-3.17)	2.71±0.29 (1.55-3.38)
Right-Lateral wall (mm)	2.75±0.25 (1.99-3.20)	2.68±0.30 (1.45-3.17)	2.71±0.28 (1.45-3.20)

**Table 4: Bladder wall thickness for the different age groups in male and female participants**

Age Groups	Bladder wall thickness						
	Male				Female		
	AW	PW	LLW	RLW	AW	PW	LLW
<b>RLW</b>							
<b>18-20</b>	2.77±0.30 2.60±0.31 (2.04-3.10) (1.45-2.97)	2.76±0.33 (2.07-3.12)	2.67±0.31 (2.13-3.01)	2.74±0.30 (2.13-3.04)	2.67±0.34 (1.99-3.05)	2.71±0.31 (1.98-3.21)	2.62±0.32 (1.55-2.99)
<b>21-30</b>	2.87±0.27 2.68±0.29 (2.05-3.96) (2.06-3.17)	2.92±0.22 (2.17-3.92)	2.77±0.25 (2.09-3.38)	2.75±0.24 (2.09-3.20)	2.75±0.29 (1.99-3.15)	2.82±0.25 (1.99-3.28)	2.64±0.31 (1.94-3.01)
<b>31-40</b>	2.85±0.25 2.71±0.33 (2.04-3.15) (2.02-3.02)	2.91±0.20 (2.25-3.21)	2.73±0.28 (1.85-3.10)	2.74±0.25 (1.99-3.09)	2.83±0.25 (1.93-3.04)	2.82±0.28 (1.99-3.10)	2.69±0.32 (2.06-3.02)
<b>41-50</b>	2.88±0.18 2.75±0.27 (2.30-3.06) (2.06-3.04)	2.93±0.16 (2.45-3.12)	2.70±0.32 (2.07-3.0)	2.68±0.28 (2.25-2.97)	2.78±0.28 (2.14-3.02)	2.91±0.18 (2.47-3.10)	2.80±0.24 (2.16-3.01)
<b>51-60</b>	2.97±0.04 2.84±0.18 (2.94-3.04) (2.50-3.0)	2.92±0.15 (2.67-3.06)	2.97±0.02 (2.95-3.0)	2.95±0.05 (2.86-3.0)	2.89±0.16 (2.54-3.05)	2.95±0.07 (2.79-3.04)	2.85±0.19 (2.45-3.0)
<b>61-65</b>	2.97±0.02 2.77±0.33 (2.94-2.99) (2.04-3.01)	3.01±0.05 (2.97-3.11)	2.92±0.10 (2.77-3.01)	2.92±0.09 (2.76-3.02)	2.96±0.03 (2.93-3.0)	2.95±0.10 (2.77-3.05)	2.83±0.32 (2.16-3.17)



Table 5 shows statistical significant difference between male and female bladder wall thickness ( $p < 0.05$ )

**Table 5: Comparison between male and female bladder walls thickness**

<b>Bladder Dimensions</b>	<b>Male (mean±SD)</b>	<b>Female (mean±SD)</b>	<b>Mean difference</b>	<b>P.value</b>
<b>Anterior wall (mm)</b>	2.86±0.26	2.75±0.29	0.11	0.000
<b>Posterior wall (mm)</b>	2.90±0.23	2.81±0.26	0.09	0.001
<b>Left lateral wall (mm)</b>	2.75±0.27	2.67±0.31	0.08	0.009
<b>Right lateral wall (mm)</b>	2.75±0.25	2.68±0.30	0.08	0.007

Table 6 shows a statistical significant difference in bladder walls thickness between different age group in both male and female participants ( $p < 0.05$ ).

**Table 6: One way ANOVA for male and female participants**

<b>Bladder Dimension</b>	<b>Males</b>				<b>Females</b>		
	<b>Mean ± SD</b>	<b>F value</b>	<b>P value</b>	<b>Mean ± SD</b>	<b>F value</b>	<b>P value</b>	
<b>Anterior Wall</b>	<b>18-20</b>	2.77±0.30		2.67±0.34			
	<b>21-30</b>	2.87±0.27		2.75±0.29			
	<b>31-40</b>	2.85±0.25	2.48	0.04	2.83±0.25	2.27	0.03
	<b>41-50</b>	2.88±0.18		2.78±0.28			
	<b>51-60</b>	2.97±0.04		2.89±0.16			
	<b>61-65</b>	2.97±0.02		2.96±0.03			
<b>Posterior Wall</b>	<b>18-20</b>	2.76±0.33		2.71±0.31			
	<b>21-30</b>	2.92±0.22		2.82±0.25			
	<b>31-40</b>	2.91±0.20	2.70	0.02	2.82±0.28	2.91	0.01
	<b>41-50</b>	2.93±0.16		2.91±0.18			
	<b>51-60</b>	2.92±0.15		2.95±0.07			
	<b>61-65</b>	3.01±0.05		2.95±0.10			
<b>Left lat. Wall</b>	<b>18-20</b>	2.67±0.31		2.62±0.32			
	<b>21-30</b>	2.77±0.25		2.64±0.31			
	<b>31-40</b>	2.73±0.28	2.07	0.03	2.69±0.32	1.91	0.04
	<b>41-50</b>	2.70±0.32		2.80±0.24			
	<b>51-60</b>	2.97±0.02		2.85±0.19			
	<b>61-65</b>	2.92±0.10		2.83±0.32			
<b>Right lat. Wall</b>	<b>18-20</b>	2.74±0.30		2.60±0.31			
	<b>21-30</b>	2.75±0.24		2.68±0.29			
	<b>31-40</b>	2.74±0.25	1.68	0.03	2.71±0.33	1.72	0.02
	<b>41-50</b>	2.68±0.28		2.75±0.27			
	<b>51-60</b>	2.95±0.05		2.84±0.18			
	<b>61-65</b>	2.92±0.09		2.77±0.33			

Table 7 shows no significant correlation between the bladder wall thickness and age, weight, height, BMI and BSA of the participants. P-value>0.05

**Table 7: Correlation of bladder walls thickness with anthropometric variables**

Bladder Dimensions	Demographic Variables									
	Age		Weight		Height		BMI		BSA	
	r	p	r	p	r	p	r	p	r	p
Anterior wall (mm)	0.18	0.00	0.18	0.00	-0.00	0.99	0.14	0.01	0.15	0.00
Posterior wall (mm)	0.23	0.00	0.19	0.00	-0.04	0.38	0.17	0.00	0.16	0.00
Left lateral wall (mm)	0.18	0.00	0.16	0.02	-0.01	0.80	0.14	0.03	0.14	0.02
Right lateral wall (mm)	0.17	0.00	0.17	0.01	0.05	0.36	0.13	0.01	0.17	0.01

**Discussions**

The findings of this study as shown in Table 1 are similar to the studies conducted by Ali *et al.*<sup>5</sup>, Idigo *et al.*<sup>4</sup> and Patil *et al.*<sup>6</sup> that reported 31.87±10.4 years, 35.16±12.37 years and 34.02±7.11 years respectively as the mean ± SD age of the participants. The possible reasons of the similarity between the current study and previous published articles might be because both studies were conducted in developing countries. However, the findings of the current study are contrary to the findings of the studies conducted by Selcen *et al.*<sup>7</sup>, Ugwu *et al.*<sup>8</sup> (2019) and Hakenberg *et al.*<sup>9</sup> (2000) that reported 37.5±10.2 years, 40.1±1.29 years and 75.96±16.23 years respectively as the mean ± SD age of the participants. Furthermore, as indicated in table 1, this study is in agreement with Idigo *et al.*<sup>4</sup> that reported 64.54±13.32 kg as the mean ± SD weight of the participants. The possible reasons of the agreement might be because of the two studies were conducted in the same country but, different regions. However, this is contrary to the findings of the study conducted by Ugwu *et al.*<sup>8</sup> that reported 75.9±10.1 Kg as the mean ± SD weight of the participants. As also shown in Table 1, the findings of this study are in accordance Idigo *et al.*<sup>5</sup> that reported 1.631±0.8.03 m as the mean ± SD height of the participants. However, this study is not in keeping with Bright *et al.*<sup>10</sup> and Ugwu *et al.*<sup>8</sup> that reported a mean height and standard deviation of 1.78 m and 172±5.3 cm as the mean ± SD height of the participants. The mean BMI, standard deviation

and range of the male participants was found to be 27.78±4.22 (18.37-46.88) kg/m<sup>2</sup> while that of female was found to be 25.40±3.81 (17.78-37.86) kg/m<sup>2</sup>. This study is also similar findings to the studies conducted by Ugwu *et al.*<sup>8</sup>, Selcen *et al.*<sup>7</sup>, Idigo *et al.*<sup>4</sup>, and Bright *et al.*<sup>10</sup> that reported a mean BMI and standard deviation of 27.0±8.0 kg/m<sup>2</sup>, 24.9±4.1 kg/m<sup>2</sup>, 24.36±4.50 kg/m<sup>2</sup> and 26.9 kg/m<sup>2</sup>.

The findings of this study as indicated in Table 3 are similar to the findings of the study conducted by Patil *et al.*<sup>6</sup> that reported a mean ± SD of the anterior and posterior bladder walls to be 2.85±0.71mm and 3.03±0.72mm respectively. The possible reasons of the similarity between the current study and previous published article might be because of the agreement of the mean age and both studies were conducted in the developing countries. The mean and standard deviation of the Left lateral bladder wall thickness for male participants was found to be 2.75±0.27 mm while that of female was found to be 2.75±0.27 mm. However, the findings of this study as shown in Table 2 are not in agreement to the findings of the study conducted by Patil *et al.*<sup>6</sup> that reported a mean left and right lateral bladder walls thickness mean ± SD of 3.24±0.74mm and 3.21±0.79mm respectively. Majority of the previous published articles did not report the mean value of anterior, posterior, right lateral and left lateral separately, rather reported a single mean value. Therefore, the findings of the study cannot be compared with the previous published articles.

A statistical significant difference was observed between male and female anterior, posterior, left and right lateral bladder walls thickness ( $p < 0.05$ ) in all instances as indicated in Table 5. This is similar to Hakenberg *et al.*<sup>9</sup> that reported statistical significant difference between male and female mean bladder wall thickness ( $p < 0.003$ ). However, this is contrary to the findings of the studies conducted by Selcen *et al.*<sup>7</sup>; Ugwu *et al.*<sup>8</sup> and Patil *et al.*<sup>6</sup> that reported no statistical significant difference between male and female bladder wall thickness ( $p = .16$ ;  $p = .462$ ; and  $p = .105$ ) respectively. This study shows statistical significant difference in bladder walls thickness between the different age groups in both male and female participants ( $p < 0.05$ ) as shown in Table 6.

Furthermore, the findings of this study shows a weak positive correlation between anterior, posterior, left lateral and right lateral walls with age, weight, BMI and BSA as shown in Table 7. This is similar to the findings of the study conducted by Patil *et al.*<sup>6</sup> that reported significant weak positive correlation between anterior, left lateral and right lateral walls with age; ( $r = 0.148$ ,  $p = 0.036$ ); ( $r = 0.139$ ,  $p = 0.049$ ) and ( $r = 0.14$ ,  $p = 0.048$ ). This is also similar to the study conducted by Ugwu *et al.*<sup>9</sup> that reported weak correlation between BWT and age ( $r = 0.10$ ,  $p < 0.05$ ). However, this is contrary to the findings of the study conducted by Patil *et al.*<sup>6</sup> that reported no correlation between posterior wall and age ( $r = 0.079$ ,  $p = 0.266$ ). This is also similar to the findings of the study conducted by Idigo *et al.*<sup>4</sup> that reported weak significant correlation between BWT and weight ( $r = 0.023$ ,  $p = 0.029$ ). However, this is contrary to the findings of the study conducted by Idigo *et al.*<sup>4</sup> that reported no correlation between BWT and BMI ( $r = 0.020$ ,  $P = 0.876$ ).

### Conclusion

This study has established the normal values of bladder wall thickness for apparently healthy adults in Kano metropolis, Nigeria. There was statistical significance difference in bladder wall thickness between males and females. A significant weak positive correlation was observed between bladder wall thickness with age, weight, BMI and BSA.

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