Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2020 17(4): 4056-4060. **OPEN ACCESS**

Sonographic Assessment of Normal Abdominal Aortic Diameter and its Correlations to the Body Mass Index, Waist and Wrist Circumferences among Young Saudi Females

Mahasin Gamalalddin Yaqob, Futun Ahmed Almohsen, Abeer Khalid Alhudathi, Areej Abdullah Aldabbagh, Razan Mohammed Nizar Labbad and Nouf Mohammed Almohsen

Department of Radiological Sciences, Faculty of Health and Rehabilitation Sciences, Princess Nourah Bint Abdulrahman University**, Kingdom of Saudi Arabia**

***Correspondence:** mghassan@pnu.edu.sa **Received 23-09-2020, Revised: 10-12-2020, Accepted: 20-12-2020 e-Published: 24-12-2020**

The study aimed to establish the normal diameters of the abdominal aorta at the different three levels using ultrasound among young Saudi females, to assess the correlation between the diameters and correlate the diameters with body mass index (BMI), waist, and wrist circumferences. This will facilitate the assessment of patients with suspected abdominal aortic aneurysm (AAA). This descriptive and prospective study was conducted from December 2018 to April 2019 at Princess Nourah Bint Abdulrahman University (PNU). One hundred participants of females between 18 and 25 years old were scanned. BMI, wrist, and waist circumferences were measured. Three aortic diameters were measured at three levels upper, middle, and lower. Mean ± Standard deviation (Std.) and personal correlation in the Statically package for the social sciences (SPSS) program were used for data analysis. The mean aortic diameters ± Std. are 1.3 ± 0.2 cm, 1.1 ± 0.2 cm, and 0.9 ± 0.2 cm at the upper, middle, and lower levels, respectively. The differences between middle and lower, middle and upper, upper, and lower aortic diameters are significant (P-value < 0.05). There are no correlations between the diameters at different levels and BMI, and body circumferences (waist and wrist) (P-value > 0.05).The normal aortic diameters among young Saudi females were established. The aortic diameters can be calculated using different equations. Other studies with larger sample sizes are recommended because no significant correlations were found between the measurements and BMI, waist, and wrist circumferences.

Keywords: Abdominal Aorta, Females, Circumference, Diameter, Ultrasound.

INTRODUCTION

The abdominal aortic diameter is less than 3 cm, and it varies with age, gender (larger in males than females), race, and patient build. The presence of a certain disease can affect the aortic diameter. An abdominal aortic aneurysm (AAA), which is defined as an enlargement of 3 cm or more, can result in a fatal rupture if an aneurysm continues to enlarge. Usually, AAAs are asymptomatic and can remain untreated or detected for years, except when it expands enough to press on local organs or rupture (Deen 2005, Wang et al. 2005, Hartshorne et al. 2011).

Penny mentioned that the aorta has three levels with different diameters. The upper level is located below the diaphragm, and the normal limit

of it is 2.5 cm. The level which is located at the midabdomen measures 2 cm or less and the distal level which should not exceed 1.8 cm (Penny, 2011). Goldberg et al. found that the normal diameter above the renal arteries is about 22 mm, 18 mm just below the renal arteries, and 15 mm above the bifurcation (Deen, 2005).

Jasper et al. found a significant positive correlation between the suprarenal and infrarenal aortic diameters and BMI in men. In women, the positive correlation was significant between the infrarenal aorta (not the suprarenal) and BMI (Jasper et al. 2014). Waist circumference is often used as a surrogate marker for abdominal fat mass because it correlates with it (Pouliot et al. 1994). Stackelberg found the correlation between waist circumference and AAA (Stackelberg et al., 2012). Sconfienza et al. in 2013 introduced an ultrasonographic index using the wrist circumference as a body build reference. They found that the intermediate aortic level /wrist circumference ratio of 15% may be regarded as a threshold to differentiate AAA from non-AAA patients (Sconfienza, 2013).

Because each race has its own organs measurements, the purposes of the study were to establish the normal aortic diameters in the young Saudi females at the three levels of it: upper abdomen (suprarenal), middle abdomen (infrarenal), and lower abdomen (before bifurcation) using ultrasound, to assess the difference between the aortic diameters and the correlations between the diameters and body mass index (BMI), waist and wrist circumferences. This will facilitate the assessment of patients with suspected abdominal aortic aneurysm.

MATERIALS AND METHODS

2.1 volunteer selection, place and equipment

The population of the study included asymptomatic young females above 18 years old. Any female with cardiovascular disease, aneurysm, or irritable bowel syndrome (IBS) was excluded.

This study was conducted at Princess Nourah Bint Abdulrahman University (PNU), Department of Radiological Sciences (Ultrasound Lab), from December 2018 to April 2019. One hundred females were scanned using a convenience sampling technique.

The abdominal aortic diameters were measured using the Philips IU22 ultrasound machine, B-mode, and curved array ultrasound transducer with frequency 1-5 MHz. Electronic body scale TCS-200-RT was used to measure the height, Seca mBCA 515 (medical Body Composition Analyzer) for calculating BMI, and a tape measure for wrist and waist circumferences.

2.2 Study design

This is a descriptive and proscriptive study using an ultrasound investigation to scan the abdominal aorta at the three levels. The study was approved by the local institutional review board (IRB number: 18-0380).

The procedure was explained to the participant, she was instructed to fast 8 hours before the exam, and she signed the consent form before the procedure. The participant's data were obtained in the data collection sheet, which includes BMI, waist and wrist circumferences, and the aortic measurements. An ultrasound exam was performed with the patient in the supine position. A transverse section was taken at the three levels of the aorta, and the anteroposterior luminal diameter (AP) was measured (inner to inner). Mean ± standard deviation (Std.) and personal correlation were used for analysis in SPSS (statical package for the social sciences) version 23 program.

RESULTS

The participants were between 18 and 25 years old and with BMI ± Std. (standard deviation) = 23.0 ± 5.2, a wide range of waist circumference [49-94] cm, and a limited range of wrist circumference [14-18] cm. The mean diameters of the abdominal aortic lumen at the three levels ± Std. are given in (Table 1).

Table 1: Mean abdominal aortic diameters and Std.

Parameters	Mean± Std.
Upper	1.3±0.2
Middle	1.1±0.2
Lower	0.9±0.2

The differences between the diameters, middle and lower, middle and upper, upper, and lower are significant ($P<0.05$), (Table 2). There are no personal correlations between the diameters at different levels and BMI, waist, and wrist circumferences ($P>0.05$) (Table 2).

The mid-aortic diameter (MAD) increases by 0.8094 cm when the distal aortic diameter increases by 1 cm. The mid-aortic diameter can be predicted using the following equation: $MAD = 0.8094x + 0.0241$.

Table 2: Pearson correlation between the variables of the study

.

Correlations		Upper	Middle	Lower
BMI	Pearson Correlation	-0.042	0.062	-0.082
	P-value	0.676	0.542	0.419
Wrist	Pearson Correlation	0.126	0.125	0.145
	P-value	0.21	0.216	0.15
Waist	Pearson Correlation	-0.023	0.125	0.005
	P-value	0.821	0.216	0.964
Upper	Pearson Correlation		0.722*	0.600*
	P-value		0.000	0.000
Middle	Pearson Correlation			0.746*
	P-value			0.000

* Correlation is significant at the 0.01 level

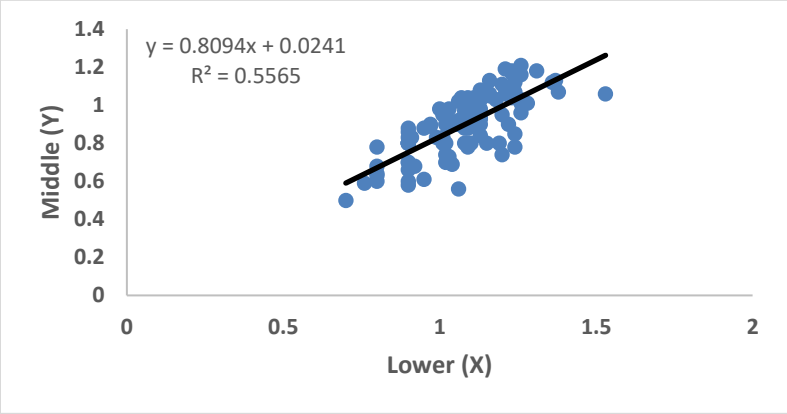

Figure 1: Scatter plot to describe the correlation between middle & lower aortic diameters.

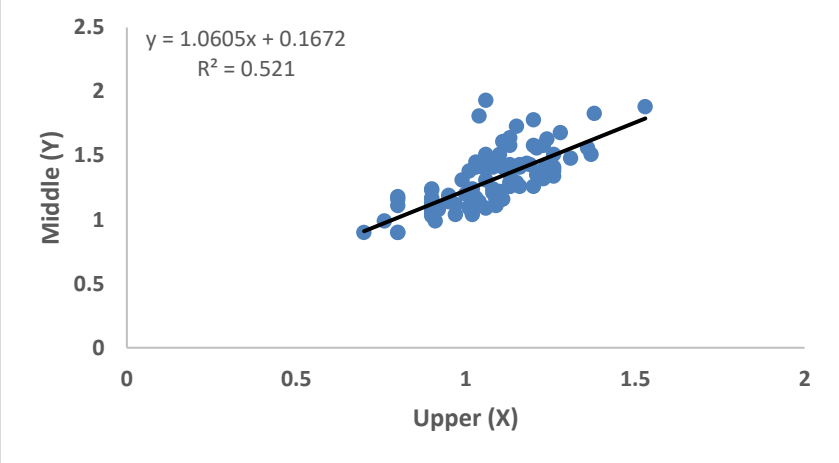

Figure 2: Scatter plot to describe the correlation between middle & upper aortic diameters.

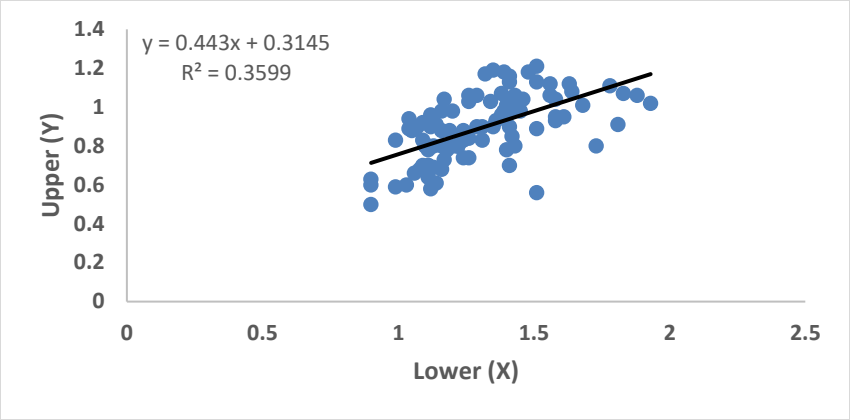

Figure 3: Scatter plot to describe the correlation between upper & lower aortic diameters.

The mid-aortic diameter (MAD) increases by 1.0605 cm when the upper aortic diameter increases by 1 cm. The mid-aortic diameter can be predicted using the following equation: MAD = 1.0605x + 0.1672, (Figure 2).

The Upper aortic diameter (UAD) increases by 0.443 cm when the distal aortic diameter increases 1 cm, where the upper aortic diameter can be predicted using the following equation: UAD = 0.443x + 0.3145.

DISCUSSION

The results indicate that as we go inferiorly, the aortic lumen diameter significantly decreases, as it is shown in (Table 1- Table 2). Different studies were conducted regarding this topic in different races, but most of them were conducted among older adults. For example, a study was conducted in the Turkish population (Sariosmanoglu et al. 2002) shows that the diameters are larger in old Turkish females than the diameters in this study.

This study shows a positive correlation between the upper and middle, the upper and lower, the middle and lower aortic diameters (P-value < 0.05) (Table 2). The study shows that there are a linear regression between the upper and middle (r=0.722), middle and lower (r=0.746), upper and lower aortic diameters (r= 0.600). The coefficients of these associations can be used in regression equations to predict the aortic diameter at a certain level. Regarding (Figure 1), the mid-aortic diameter (MAD) can be predicted using the lower aortic diameter (LAD) through the following equation: *MAD = 0.8094(LAD) + 0.0241*, and using the upper aortic diameter (UAD) through the equation: *MAD = 1.0605(UAD) + 0.1672*, as shown in (Figure 2). The upper aortic diameter can be predicted using the following equation: *UAD = 0.443(LAD) + 0.3145,* as it is shown in (Figure 3). These equations can help us to assess the aneurysm at different levels of the abdominal aorta.

According to (Table 2), there is no correlation (P-value > 0.05) between BMI and the aortic diameters at the three different levels (upper, middle, and lower diameters). This result is contrary to the result of different previous articles; done by Lederle et al. (Lederle et al. 1997) and Jasper et al. (Jasper et al. 2014); show that BMI has a significant relationship with the aortic diameter. This study's unexpected result can be due to the limited range of age and BMI of participants.

Women who have a waist circumference greater than 102 cm are considered to be at increased risk for cardiometabolic disease (Wang et al. 2005). Different studies reported that waist and wrist circumferences are positively associated with the presence of an abdominal aortic aneurysm (AAA) (Stackelberg et al. 2012, Sconfienza et al., 2013). Regarding (Table 2), there is no correlation between the aortic measurements and body circumferences (waist and wrist) (P-value > 0.05). These results are contrary to previous articles that confirm the correlation. The small sample size may not be enough to show significant differences.

There were several limitations to this study, including the shortage of time allowed for this study; the range of BMI was also limited because a large number of obese and overweight females refused to participate. In the end, ultrasound is an operator-dependent procedure, and five different readers measured the aortic diameters.

CONCLUSION

The normal aortic measurements among the young Saudi females were established: 1.3 ±0.2

cm, 1.1 ±0.2 cm, and 0.9 ± 0.2 cm at the upper, middle, and lower levels, respectively. The measurements are correlated positively with each other (P-value < 0.05) and can be calculated using different equations. There are no correlations between the measurements at different levels and BMI and body circumferences (waist and wrist).

Other studies with larger sample sizes are recommended, including different age groups, BMI groups, and various body circumferences. This will give precise results.

CONFLICT OF INTEREST

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

ACKNOWLEDGMENT

This research was funded by the Deanship of Scientific Research at Princess Nourah Bint Abdulrahman University through the Fast-track Research Funding Program.

AUTHOR CONTRIBUTIONS

FA, AK, AA, RM, and NM performed ultrasound scanning, did data collection, and wrote introduction and references. MG did data analysis, wrote and reviewed the manuscript.

REFERENCES

Dean D, 2005, Abdominal Ultrasound and instrumentation.Part1. Module1. 1st ed. The Burwin institute of diagnostic medical ultrasound. Luneburg; Canada, pp10.

Hartshorne TC, McCollum CN, Earnshaw JJ, et al.,2011, Ultrasound measurement of aortic diameter in a national screening program. Eur J Vasc Endovasc Surg, 42(2): 195-9. https://doi.org/10.1016/j.ejvs.2011.02.030.

Jasper A, Harshe G., Keshava SN., et al.,2014, Evaluation of normal abdominal aortic diameters in the Indian population using computed tomography. J Postgrad Med, 60(1): 57-60. http://www.jpgmonline.com/text.asp?2014/60/1/57/128813.

Lederle FA., Johnson GR, Wilson SE, et al., Relationship of age, gender, race, and body size to infrarenal aortic diameter. Journal of vascular surgery, 1997; 26(4): 595-601. https://doi.org/10.1016/S0741-5214(97)70057-0.

Penny S, 2011, Examination review for ultrasound: abdomen, obstetrics, and gynecology, Lippincott Williams & Wilkins, pp 102.

Pouliot MC, Despres JP, Lemieux S, et al., 1994Waist circumference and abdominal sagittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. Am J Cardiol, 73(7): 460-8. https://doi.org/10.1016/0002-9149(94)90676-9.

Pouliot MC, Despres JP, Lemieux S, et al.,1994, Waist circumference and abdominal sagittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. Am J Cardiol, 73(7): 460-8. https://doi.org/10.1016/0002-9149(94)90676-9.

Sariosmanoglu N, Ugurlu B, Karacelik M, et al., 2002, A multicentre study of abdominal aorta diameters in a Turkish population. J Int Med Res, 30(1): 1-8. https://doi.org/10.1177/147323000203000101.

Sconfienza L, Santagostino I, Di Leo G, et al., 2013, When the diameter of the abdominal aorta should be considered as abnormal? A new ultrasonographic index using the wrist circumference as a body build reference, Eur J Radiol., 82(10): e532-e536. https://doi.org/10.1016/j.ejrad.2013.06.008.

Stackelberg O, Björck M, Sadr-Azodi O, et al.,2012, Obesity and abdominal aortic aneurysm, BJS, 100(3): 360-366. https://doi.org/10.1002/bjs.8983.

Wang Y, Rimm EB, Stampfer MJ, et al., 2005, Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. Am J Clin Nutr, 81(3): 555-563. https://doi.org/10.1093/ajcn/81.3.555.