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Anatomy

Study on Coronary Artery Dimensions in Normal Adult Bangladeshis

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Abstract	Original Research Article

Background: The heart is supplied by the two coronary arteries and their branches. Coronary computed tomography angiography is a cardiac imaging test that helps to determine coronary artery disease. The detailed anatomical knowledge of coronary arteries is essential for proper diagnosis and management of heart diseases. There is no published article available on morphometric analysis of normal coronary arteries by computed tomography angiogram in adult Bangladeshi people. Morphometry of the coronary arteries will provide useful baseline data to almost all the sectors of the medical science. **Methods**: A Cross-sectional, analytical study was conducted on 35 adult male and 35 adult female Bangladeshi people in Department of Anatomy, Dhaka Medical College, Dhaka, from January, 2017 to December, 2017. After obtaining the images of coronary CT angiogram, different dimensions of coronary arteries were measured by using a computer software program followed by statistical analysis. **Results**: The mean diameter of the left main coronary artery (LMCA) and left anterior descending artery (LAD), and the mean length of the right coronary artery (RCA), LMCA, and LAD were significantly higher in men than women (p < 0.05). However, there was no significant difference (p > 0.05) between men and women in the mean diameter of the RCA, or the mean diameter and mean length of the left circumflex artery (LCX). **Conclusion**: The study findings suggest that morphometric measurements of coronary arteries show variations among adult Bangladeshi male and female.
Keywords: Coronary artery, Coronary computed tomography angiography, morphometric analysis.

INTRODUCTION

The heart, a muscular organ, relies on the intricate network of two coronary arteries and their branches for its blood supply, making coronary artery disease a prominent global cause of mortality. Precise characterization of coronary atherosclerosis extent hinges upon a comprehensive grasp of normal coronary anatomy. Amongst the pivotal determinants influencing percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) techniques and outcomes, coronary artery diameters stand paramount. In contemporary times, the widespread adoption of advanced imaging diagnostic modalities has facilitated an in-depth comprehension of normal coronary anatomy, its variants, and potential anomalies. Past investigations have delved into the lumen diameter of normal human coronary arteries and elucidated factors impacting these diameters [1, 2]. The measurement of absolute coronary dimensions, reliant on arterial lumen assessment, constitutes a validated and widely embraced approach to scrutinize longitudinal alterations in arterial dimensions, traditionally conducted via catheter-based techniques [3]. Coronary computed tomography angiography (CCTA) emerges as a transformative cardiac imaging method, illuminating the landscape of coronary artery disease. In a CCTA procedure, patients receive intravenous administration of iodine-based contrast material, enhancing the visualization of cardiac blood vessels. The resulting cross-sectional images can be reconfigured into diverse planes and even construct three-dimensional representations, aiding diagnosis and assessment. These images are easily accessible for review on computer monitors, film prints, or storage on compact discs (CDs) or digital video discs (DVDs) [4]. CCTA proves instrumental in discerning the presence and extent of coronary artery plaque [5]. While previous studies have ventured into the dimensions of postmortem

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coronary arteries [6-8], only a limited number have employed quantitative coronary arteriographic (QCA) techniques to gauge the normal dimensions of living patients' coronary arteries, presumptively healthy [4, 5, 9]. Strikingly, within our nation, there exists a conspicuous absence of investigations dedicated to morphometric evaluations of coronary arteries through CT coronary angiography. This study endeavors to bridge this gap and provide essential insights into the coronary anatomy of our population.

METHODS

In this study, a cross-sectional analytical investigation was carried out on a cohort comprising 35 adult male and 35 adult female participants from Bangladesh, conducted at the Department of Anatomy, Dhaka Medical College, Dhaka, spanning from January 2017 to December 2017. Coronary CT angiograms were obtained from these individuals, and various dimensions of their coronary arteries were measured using computer software, specifically the RadiAnt DICOM Viewer software. The study participants were adult Bangladeshi males and females aged between 20 and 70 years, recruited from the Radiology & Imaging department of the National Heart Foundation Hospital and Research Institute, Mirpur, Dhaka, who had undergone CT angiography for ischemic heart disease evaluation, with normal CT angiogram findings. Informed written consent was obtained from all subjects, ensuring their right to withdraw from the study at any time, and confidentiality was rigorously maintained. All CT angiograms were conducted using a 64-slice multidetector computed tomography (MDCT) angiogram machine (Philips Brilliance 64 CT Scanner System), following thorough clinical evaluations, routine blood chemistry, standard 12-lead ECG (Electrocardiogram), 2D ECHO (2-dimensional echocardiogram), and CXR-PA (chest X-ray postero-anterior) views. Measurements of epicardial coronary arteries were taken at end-diastole using the RadiAnt DICOM Viewer software at a magnification of 100%, followed by transferring the image to a CD. The dimensions of coronary arteries were then measured from the CT image [9, 10]. Ethical clearance for this research was granted by the Ethical Review Committee (ERC) of Dhaka Medical College, Dhaka. Subsequently, data collected were meticulously checked, edited, and subjected to statistical analysis using SPSS for Windows (Version 22.0) software. Various statistical tests, including Unpaired Student's 't' tests and proportion tests, were performed, and the data were presented as Mean±Standard Deviation ($\pm$ SD) for descriptive statistics in both male and female groups. Statistical significance was established at a p-value of less than or equal to 0.05 ($p \leq 0.05$).

Figure 1: Photograph of coronary CT angiogram (Curved multiplanar view) showing diameter of A) Right coronary artery. (RCA: Right coronary artery); B) Left main coronary artery. (LMCA: Left main coronary artery); C) Left anterior descending artery. (LAD: Left anterior descending artery); D) Left circumflex artery. (LCX: Left circumflex artery)
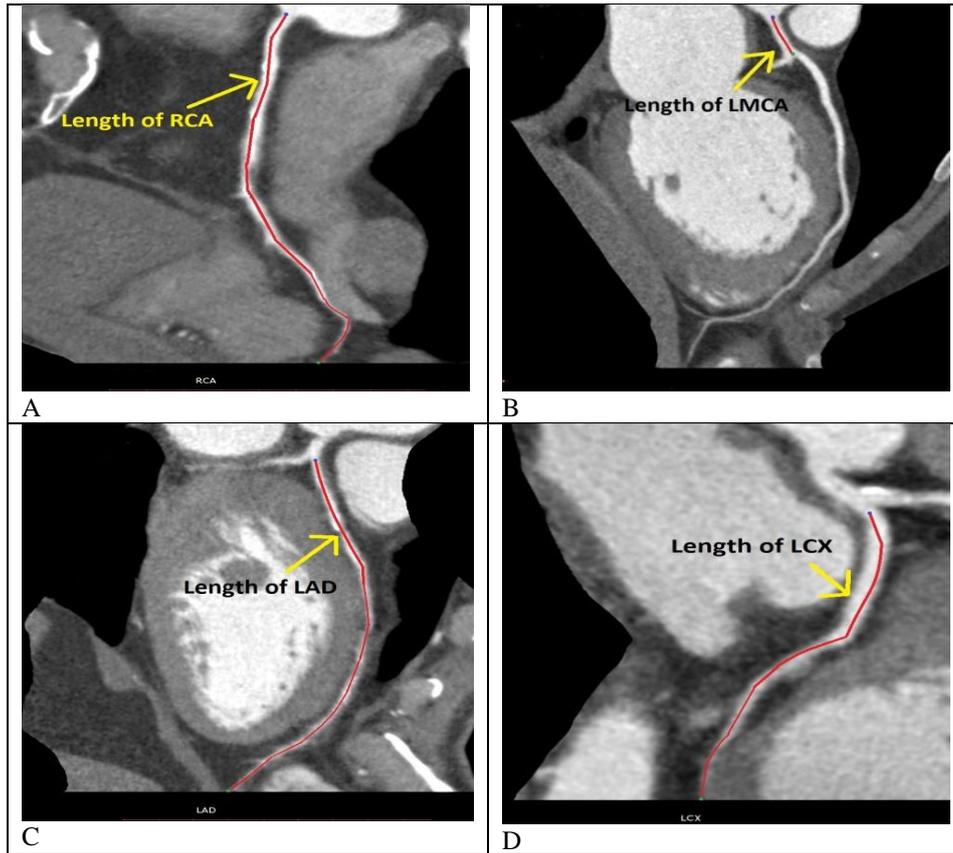
Figure 2: Photograph of coronary CT angiogram (Curved multiplanar view) showing length of A) Right coronary artery. (RCA: Right coronary artery); B) Left main coronary artery. (LMCA: Left main coronary artery); C) Left anterior descending artery. (LAD: Left anterior descending artery); D) Left circumflex artery. (LCX: Left circumflex artery)

RESULTS

The present study was carried out on seventy (70) coronary artery CT angiograms of adult Bangladeshi male and female. Out of 70 CT angiograms, 35 were males of 24 to 69 (46.74±11.52) years of age and 35 were females of 20 to 66 (45.77±12.30) years of age. After collection of data, statistical analyses were done by the software, SPSS (Statistical Package for Social Sciences) for Windows, Version 22.0. Results and observations of this study are described below with suitable tables and graphs.
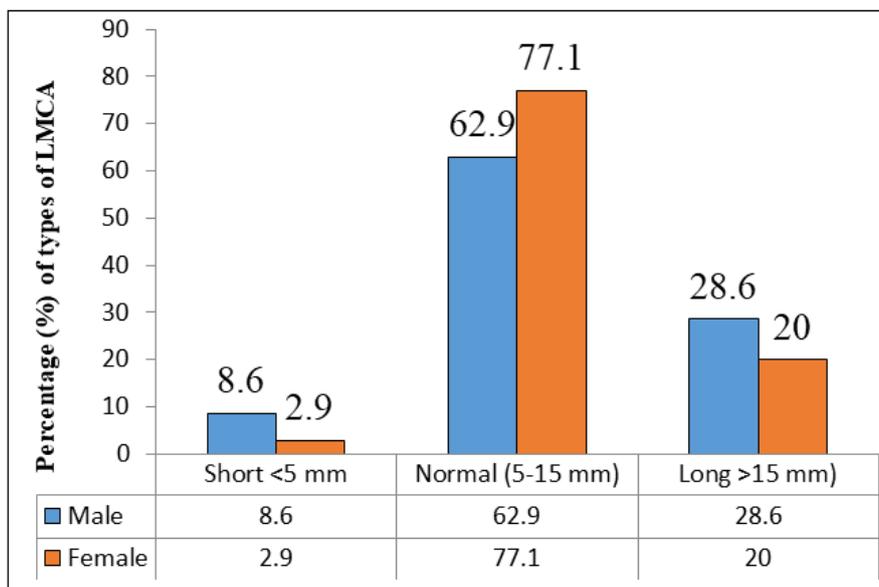

	Short <5 mm	Normal (5-15 mm)	Long >15 mm)
Male	8.6	62.9	28.6
Female	2.9	77.1	20

Figure 3: Comparison of types of left main coronary artery (LMCA) between male and female

Table 1: Comparison of diameter (close to the origin) of right coronary artery (RCA) and left main Coronary artery (LMCA) between male and female

Diameter(mm)	Male (n=35)	Female (n=35)	p value
RCA (Mean±SD)	3.79± 0.77 (3.02-4.56)	3.58±0.72 (2.86-4.30)	0.242 ns
LMCA (Mean±SD)	4.83 ± 0.74 (4.09-5.57)	4.42 ± 0.77 (3.65-5.19)	0.026*

Figures in parentheses indicate range. SD = Standard Deviation. Comparison of values between male and female was done by Unpaired Student's test, * = Significant at $p < 0.05$, ns = not significant.

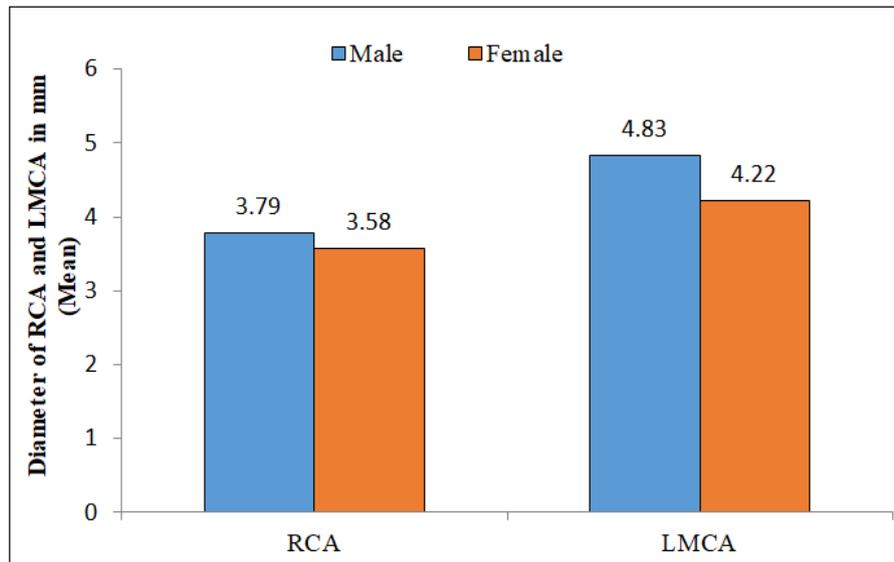**Figure 4: Comparison of diameter (close to the origin) of right coronary artery (RCA) and left main coronary artery (LMCA) between male and female**

Table 2: Comparison of diameter (close to the origin) of left anterior descending artery (LAD) and left circumflex artery (LCX) between male and female

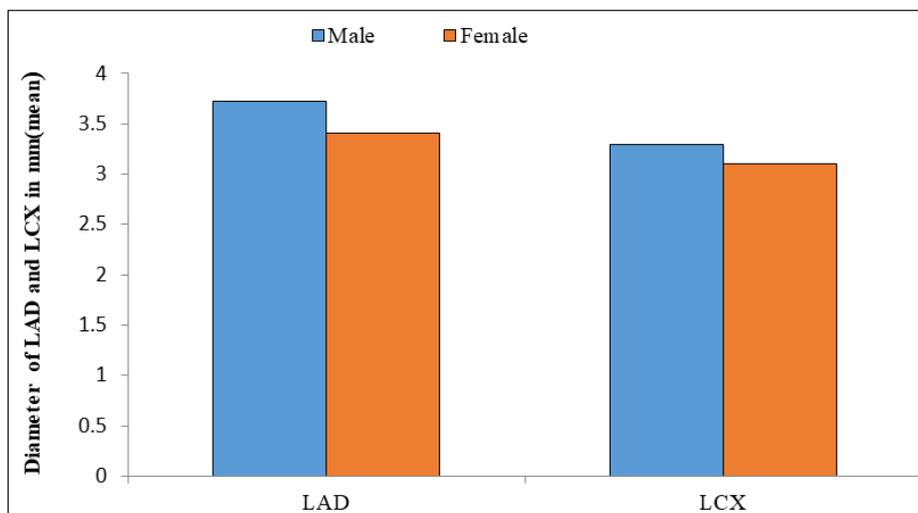| Diameter(mm)	Male (n=35)	Female (n=35)	p value
LAD (Mean±SD)	3.72 ± 0.57 (3.15-4.29)	3.45 ± 0.52 (2.93-3.97)	0.042*
LCX (Mean±SD)	3.29 ± 0.54 (2.75-3.83)	3.10 ± 0.59 (2.51-3.69)	0.164 ns

Figure 5: Comparison of diameter (close to the origin) of left anterior descending artery (LAD) and left circumflex artery (LCX) between male and female.

Table 3: Comparison of length of rightcoronary artery (RCA) and left main coronary artery (LMCA) between male and female

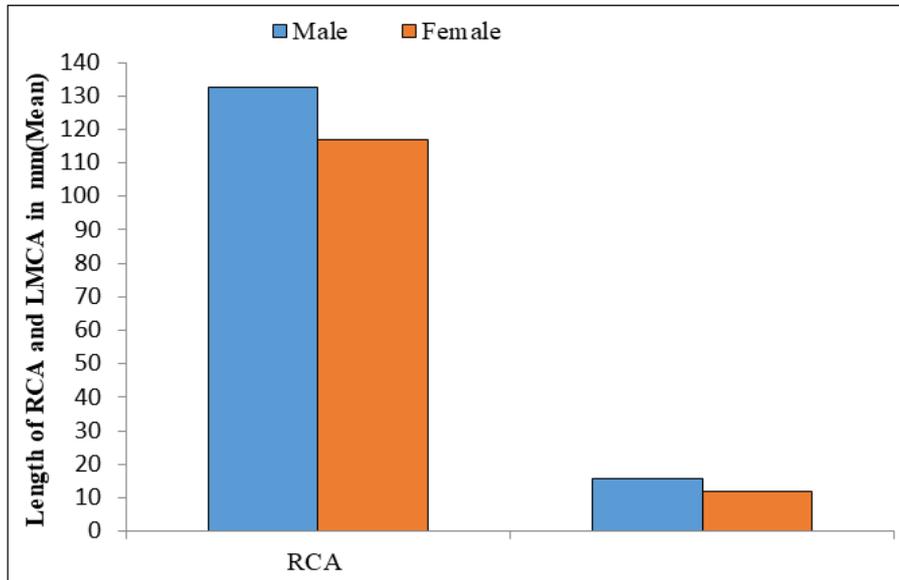| Length(mm)	Male (n=35)	Female (n=35)	p value
RCA (Mean±SD)	132.51 ±31.35 (101.16-163.86)	116.73 ± 34.52 (82.21-151.25)	0.049*
LMCA (Mean±SD)	15.65 ± 8.55 (7.10-24.20)	10.84 ± 6.76 (4.09-17.60)	0.011*

Figure 6: Comparison of length of right coronary artery (RCA) and left main coronary artery (LMCA) between male and female

Table 4: Comparison of length of left anterior descending artery (LAD) and left circumflex artery (LCX) between male and female

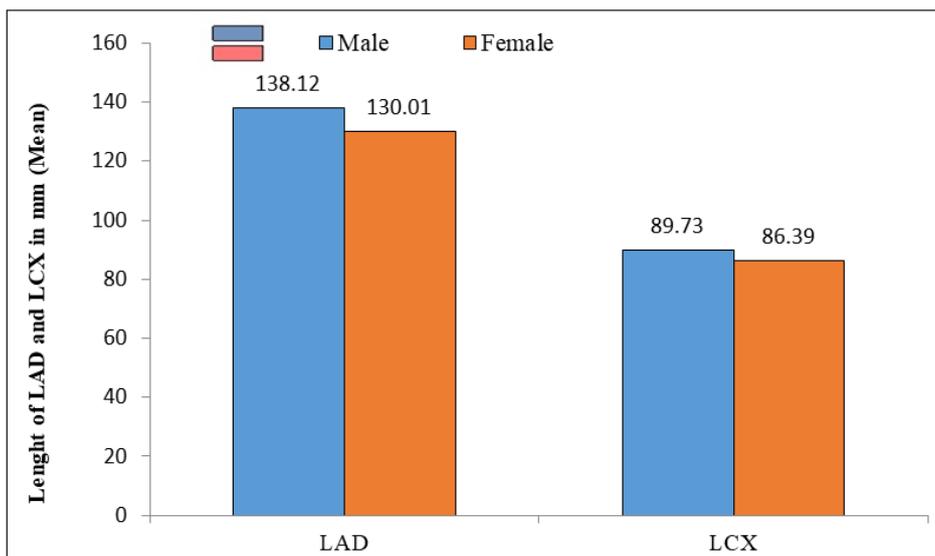| Length (mm)	Male (n=35)	Female (n=35)	p value
LAD (Mean±SD)	138.12 ± 13.95 (124.17-152.07)	130.01 ± 18.22 (111.79-148.23)	0.040*
LCX (Mean±SD)	89.73 ± 25.92 (63.81-115.65)	86.39 ± 25.49 (60.90-111.88)	0.588ns

Figure 7: Comparison of length of left anterior descending artery (LAD) and left circumflex artery (LCX) between male and female

DISCUSSION

The normative baseline data concerning the morphology of coronary arteries, considering factors such as age, gender, and racial variations, plays a pivotal role in serving as a reference point for assessing the presence and progression of various cardiovascular diseases that affect these arteries and the heart itself. Comprehensive knowledge of coronary artery anatomy is paramount for accurate diagnosis and effective management of heart conditions. This study encompassed a cohort of 70 adult Bangladeshi individuals, with 35 being male and 35 female, ranging in age from 20 to 69 years. The research was conducted at the Department of Anatomy, Dhaka Medical College, Dhaka, utilizing coronary CT angiography to quantify various morphometric parameters of the coronary arteries. Notably, previous investigations on the morphology of coronary arteries in the Bangladeshi population primarily focused on postmortem assessments, with no prior studies utilizing CT angiograms. Therefore, this study's findings were juxtaposed with those of both local and international researchers. In terms of the length of the left main coronary artery, our study revealed categories of short (less than 5 mm), normal (between 5-15 mm), and long (more than 15 mm) segments, with no statistically significant difference (p > 0.05) between genders. This observation aligns with Sinha *et al*.,'s study, which similarly reported no statistically significant gender-based differences in the length of the left main coronary artery [11]. However, distinctions emerged in terms of the mean diameter of the left main coronary artery and the left anterior descending artery, which were significantly higher in males compared to females (p < 0.05). Conversely, no significant differences (p > 0.05) were observed between male and female participants in the mean diameter of the right coronary artery and the left circumflex artery. These findings echo the results of two other studies, which reported no statistically significant gender disparities in the mean diameters of various coronary arteries [4, 12]. In contrast, Shukri et al.'s angiographic study in Iraq found statistically significant differences (p < 0.05) between males and females in the coronary artery diameter for the left main coronary artery, proximal left anterior descending artery, and proximal left circumflex artery, but not for the proximal right coronary artery [9]. Similarly, Turamanlar *et al*.,'s angiographic analysis in a Turkish population reported only a statistically significant difference (p < 0.05) in the mean value of the left anterior descending artery between genders, with no significant differences in the mean values of the right coronary artery, left main coronary artery, and left circumflex artery [13]. Ajayi *et al*.,'s study on coronary angiograms involving 151 participants found no statistically significant gender-based differences in the diameter of the left main coronary artery [14]. Additionally, a study examining 221 cadaveric hearts in Colombia revealed no significant gender differences in the caliber of the proximal segments of the right coronary artery and the left coronary artery [15]. Regarding coronary artery length, our study found that the mean lengths of the right coronary artery, left main coronary artery, and left anterior descending artery were significantly greater in males than females (p < 0.05). Conversely, no significant differences (p > 0.05) in mean length were observed between male and female participants for the left circumflex artery. These results are consistent with previous research, which reported no statistically significant gender disparities in the length of the left main coronary artery [5, 14, 16]. In conclusion, our study contributes valuable morphometric data on coronary arteries in the Bangladeshi population using CT angiograms, demonstrating variations in diameter and length between genders, while aligning with previous literature on the subject.

CONCLUSION

The morphometric measurements of the coronary arteries showed thatshort and long types of left main coronary artery were non-significantly higher in male than in female. The mean diameter of left main coronary artery and left anterior descending artery, mean length of right coronary artery, left main coronary artery and left anterior descending artery were significantly higher (p<0.05) in male than in female. There was no significant difference (p>0.05) observed between male and female in mean diameter of right coronary artery, mean diameter and mean length of left circumflex artery. The study findings suggest that morphometric measurements of coronary arteries show variations among adult Bangladeshi male and female.

LIMITATIONS:

It was a single centered non randomized study with small study population.

RECOMMENDATIONS:

Multi-center study with a larger population is required in Bangladesh for more information of coronary artery dimensions.

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