



# **Normal Values for Dimensions of the Heart by Echocardiography in Normal Egyptian Adults**

*Thesis*

Submitted for the partial fulfillment of Master Degree *in*  
***Cardiology***

*By*

Ayat Shams El-Deen Mohammed

M.B.B.Ch.,

***Supervised by***

**Professor Doctor**  
**Khaled Abdel-Latif Miniawy**

*Professor of Cardiology*  
*Faculty of Medicine, Ain Shams University*

**Doctor**

**Sherif Abd El-Salam Sakr**  
*Ass. Professor of Cardiology*  
*Faculty of Medicine, Mansoura University*

**Doctor**

**Ahmed Mohamed Abou Bakr El Missiri**

*Lecturer of Cardiology*  
*Faculty of Medicine, Ain Shams University*

**Faculty of Medicine**  
**Ain Shams University**

**2015**



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا بِمَا عَلَّمْتَنَا إِنَّكَ  
أَنْتَ الْعَلِيمُ الْحَكِيمُ (٣٢)

صدق الله العظيم

سورة البقرة آية (٣٢)



## **Acknowledgment**

First and foremost, my deep gratefulness and indebtedness is to Allah.

I wish to express my deep obligation and profound gratitude to ***Dr. Khaled Abdel-Latif Miniawy***. Professor of Cardiology Faculty of Medicine, Ain Shams University, for his profound suggestion, valuable advice, continuous encouragement and judicious guidance during the conduction of this study.

I would like to express my great thanks and deep appreciation to ***Dr. Sherif Abd El-Salam Ali Sakr***. Ass. Professor of Cardiology Faculty of Medicine, Mansoura University, for his patience, faithful efforts, continuous valuable help and cooperation.

My sincere appreciation is to ***Dr. Ahmed Mohamed Abou Bakr El Missiri*** Lecturer of Cardiology Faculty of Medicine, Ain Shams University, for his invaluable support and advice on the physical properties evaluation.

I would also like to extend my deepest gratitude to my family, specially my mother, father and husband. Without their encouragement, I would not have the chance to complete my study.

**Ayat Shams El-Deen**  
2015



# List of contents

List of Abbreviations .....	i
List of Tables .....	iv
List of Figures.....	vi
Introduction .....	1
Aim of the work .....	2
Review of Literature .....	3
* Echocardiography .....	3
* Quantification of LV, LA and RV .....	23
* Quantification of LV Ejection Function.....	42
<b>Subjects and Methods .....</b>	<b>48</b>
<b>Results.....</b>	<b>57</b>
<b>Discussion .....</b>	<b>69</b>
<b>Conclusion .....</b>	<b>75</b>
<b>Recommendations.....</b>	<b>77</b>
<b>Summary .....</b>	<b>78</b>
<b>References .....</b>	<b>80</b>
<b>Arabic Summary .....</b>	<b>١</b>





---

## List of Abbreviations

---

2D	:	Two-dimensional
3D	:	Three-dimensional
A	:	Late diastolic filling due to atrial contraction
A'	:	Late diastolic velocity of the mitral annulus
ACS	:	Aortic cusps separation
AFV	:	Aortic flow velocity
AO Root	:	Aortic root diameter in diastole.
Ao	:	Aorta
Aort Annul	:	Aortic valve annulus
ASE	:	American Society of Echocardiography
AT	:	Acceleration time
BMI	:	Body mass index.
BSA	:	Body surface area.
CI	:	Cardiac index
CO	:	cardiac output
D	:	diastolic forward flow velocity
DT	:	Deceleration time
E	:	Peak velocity of early diastolic filling of mitral inflow
E/ A	:	Ratio of E and A velocities
E=' Ea	:	Peak early diastolic velocity of the mitral anulus
ECG	:	Electrocardiogram
EF	:	Ejection fraction
EF	:	Ejection fraction.
ERO	:	effective regurgitant orifice
ET	:	Ejection time
FAC	:	Fractional area change
FS	:	Fractional Shortening
IVA	:	Isovolumic acceleration
IVC	:	Inferior vena cava
IVCT	:	Isovolumic contraction time
IVRT	:	Isovolumic relaxation time

---

## List of Abbreviations (Cont.)

---

IVS	: Interventricular septum
IVSd	: Interventricular septal thickness in diastole by M- mode
LA	: Left atrium
LV	: Left ventricle
LV EF	: Left ventricular Ejection Fraction
LVDd	: Left ventricular diastolic dimension
LVDd	: Left ventricular diastolic dimension by M mode
LVDs	: Left ventricular systolic dimension by M mode
LVEDS	: Left ventricular end diastolic diameter.
LVEF	: Left ventricular ejection fraction
LVOT	: Left ventricular outflow tract
LVPWd	: Left ventricular posterior wall diastolic thickness by M mode
LVPWD	: Left ventricular posterior wall thickness in diastole
LVSD	: Left ventricular systolic dimension
M Ao	: Aortic root diameter by M mode
M LA	: Left atrial dimension by M mode
M RV	: Right ventricular dimension by M mode
Mit Annul	: Mitral annulus
MPI	: Myocardial performance index
MRI	: Magnetic resonance imaging
MV	: Mitral valve
NCHS	: National center for health statistics.
PA	: Pulmonary artery
PADP	: Pulmonary artery diastolic pressure
PAT	: Pulmonary flow acceleration time
PFO	: Patent foramen ovale
PH	: Pulmonary hypertension
PHT	: Pressure half-time

---

## List of Abbreviations (Cont.)

---

PISA	:	Proximal isovelocity surface area
PLAX	:	Parasternal long-axis
PSAX	:	Parasternal short-axis
PVR	:	Pulmonary vascular resistance
PW	:	Posterior wall
PWT	:	Posterior wall thickness
PW-TDI	:	Pulsed wave- tissue Doppler imaging.
RA major	:	Major axis of the right atrium.
RA minor	:	Minor axis of the right atrium.
RA	:	Right atrium
RIMP	:	Right ventricular index of myocardial performance
RV	:	Right ventricle
RV major	:	Major axis of the right ventricle.
RV minor	:	Minor axis of the right ventricle.
RVH	:	Right ventricular hypertrophy
RVOT	:	Right ventricular outflow tract
RVSP	:	Right ventricular systolic pressure
S	:	Systolic forward flow velocity
S'	:	Systolic velocity of the mitral anulus
SD	:	Standard deviation
SPAP	:	Systolic pulmonary artery pressure
SV	:	Stroke volume
SVC	:	Superior vena cava
TAPSE	:	Tricuspid annular plane systolic excursion
TEE (TOE)	:	Transesophageal echocardiography
TR	:	Tricuspid regurgitation
Tric Annul	:	Tricuspid annulus
TTE	:	Transthoracic echocardiography
TVI	:	Time velocity integral



## **List of tables**

<b><i>Table</i></b>	<b><i>Description</i></b>	<b><i>Page</i></b>
1	Reference ranges for men and women	35
2	RV, RVOT and PA dimensions-reference ranges	38
3	Normal Values by M-Mode	47
4	Mean and standard deviation of baseline clinical characteristics of the cases.	57
5	Mean and standard deviation of left ventricular measurements of the cases.	58
6	Mean and standard deviation of left atrium and aortic root measurements of the cases.	59
7	Mean and standard deviation of right ventricular area measurements of the cases.	59
8	P and r values of LV measurements of all cases.	60
9	P and r values of LA and aortic root measurements of all cases.	60
10	P and r values of RVA measurements of all cases.	61
11	mean and standard deviation of baseline clinical characteristics of the male cases	61
12	Mean and standard deviation of left ventricular measurements of the male cases.	62
13	Mean and standard deviation of left atrium and aortic root measurements of the male cases.	62
14	mean and standard deviation of right ventricular area measurements of the male cases	62
15	Mean and standard deviation of baseline clinical characteristics of the female cases.	63

List of tables (Cont.)

<i>Table</i>	<i>Description</i>	<i>page</i>
16	mean and standard deviation of left ventricular measurements of the female cases	64
17	mean and standard deviation of left atrium and aortic root measurements of the female cases	64
18	mean and standard deviation of right ventricular area measurements of the female cases	64
19	mean and standard deviation of baseline clinical characteristics of the male versus female cases	66
20	mean and standard deviation of left ventricular measurements of the male versus female cases	66
21	mean and standard deviation of left atrium and aortic root measurements of the male versus female cases	67
22	mean and standard deviation of right ventricular area measurements of the male versus female cases	67
23	mean and standard deviation of left ventricular mean indexed values measurements of the male versus female cases	67
24	mean and standard deviation of left atrium and aortic root mean indexed values measurements of the male versus female cases	68
25	mean and standard deviation of right ventricular area mean indexed values measurements of the male versus female cases	68
26	comparing results of current study to these of ASE and EACVI guidelines 2015	73

## **List of figures**

<b>Fig</b>	<b>Description</b>	<b>Page</b>
1	Echocardiographic views	8
2	M-mode in a normal heart (parasternal view	9
3	Standard M-mode image through the left ventricle at the level of the mitral valve from	10
4	Short-axis sector in the parasternal position through the at the level of the mitral valve aMVL, anterior mitral valve leaflet; PMVL, posterior mitral valve leaflet	12
5	2D image of the apical three-chamber view	15
6	Subcostal 2D image demonstrating the right atrium (RA), inferior vena cava (IVC) and hepatic vein (arrow)	17
7	2D image of the suprasternal long-axis view of the thoracic aorta. I, innominate artery; LCCA, left common carotid artery; LSC, left subclavian artery; PA, right pulmonary artery	19
8	Pulsed-wave Doppler imaging in the left ventricular outflow tract (apical 5-chamber	21
9	An Anterior view of the heart in its usual anatomic position with its apex directed from right to left. Arrows point to the anterior interventricular groove. B. Nonanatomic positioning of the normal heart with its apex directed downward	23
10	A schematic diagram of the fibrous cardiac skeleton. The centrally located aortic valve forms the cornerstone of the cardiac skeleton	24
11	Measurement of aortic root diameter at sinuses of Valsava from 2-dimensional parasternal long-axis image (inner edge to inner edge method	26
12	Measurement of left ventricular end-diastolic diameter (EDD) and end-systolic diameter (ESD)	31