DOI: http://dx.doi.org/10.48305/arya.2023.24266

Average values for real-time two and three-dimensional echocardiographic parameters of mitral and tricuspid valves in a healthy Iranian population

Hoorak Poorzand[1], Tahereh Mohtaj[2], Hedieh Alimi[1], Ghassem Sazegar[3], Negar Morovatdar[4]

Original Article

Abstract

BACKGROUND: The reliability and validity of echocardiography are critical issues. Day and age, defining normal cases necessitates expressing natural physiological differences, including ethnicity.

OBJECTIVE: We are persuaded to evaluate average values in mitral and tricuspid valves in the Iranian population because only a few studies have been conducted to obtain average measures in echocardiography.

METHOD: This six-month study was conducted in a tertiary center's echocardiography lab. This study included 87 healthy Iranian volunteers who had no health issues. The tricuspid and mitral valves were examined using three and two-dimensional echocardiography. The investigated indicators produced normal data. The cases were divided into six age groups with a 12-year age gap.

RESULTS: The participants ranged in age from 18 to 90, with 35 males (40/2 %) and 52 females (59/8%). By comparing tricuspid and mitral valve indices, this study found a difference between men and women (P<0.05). Furthermore, a difference in MV3D1, MV2CH1, MVPLAX1, MV3D2, MV4CH1, MV2CH1, MV ALAX2, MV2CH2, MV TENTING AREA, MV AREA indices at the mitral valve, and SAX2 TV4CH1, TV4CH2, TVSAX1, TVRVIF2 indices at the tricuspid valve was observed in various age groups (P-value<0.05).

CONCLUSIONS: Our findings confirmed that gender and age impacted echocardiographic parameters, with a trend of decreasing measurements after 65 years of age and the most significant dimensions obtained after 42 years of age.

Keywords: Echocardiography, Mitral Valve, Reference Values, Tricuspid Valves, Healthy subjects

Date of submission: *2021-Aug-12,* ***Date of acceptance:****2022-Aug-29*

Introduction

The ability of a test to diagnose disorders accurately determines its effectiveness. Test reliability and validity are unquestionably significant issues in all medical tests, including echocardiography[1]. Diagnosing abnormalities is directly pertinent to the definition of normal cases and necessitates the expression of natural physiological differences such as age, body size, gender, and ethnicity. Several studies have been conducted to obtain normal echocardiography measures associated with age, sex, height, weight, and body surface parameters.

In contrast, only a few studies have taken ethnicities into account.

Reference values from the crowds of Western Europe, the United States, and the Caucasus were obtained to evaluate the size of cavities and structures by echocardiography per standard guidelines[2]. Because ethnicity is an essential factor in this matter, different sizes were obtained in various studies, such as

1- Division of cardiovascular medicine; Vascular and endovascular surgery research center; Mashhad University of Medical Sciences, Mashhad, Iran
2- Quem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran
3-Macroanatomy Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
4-Clinical Research Development Unit, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
Address for correspondence: Tahereh Mohtaj; Quem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran. Email: mohtajrayka@yahoo.com

those conducted in Japan[3].

Another example is the Iranian population, where studies for determining normal values are scarce. A study was recently conducted on 368 normal individuals aged 30 to 70, the first and most extensive research performed in Iran. The left ventricular ejection fraction and cavity size were investigated; as a result, the average values were lower than those reported in conventional guidelines[4].

As a result, using general scales from other ethnicities for a specific ethnicity to determine the difference between normal or abnormal heart cavity size and function could lead to inappropriate clinical decisions. This study was conducted on a group of Iranians to focus on the morphological evaluation of two valves. Three-dimensional echocardiography is becoming increasingly important in the diagnosis of valvular heart disease. The mitral and tricuspid annuli were studied quantitatively. Because, unlike the mitral and aortic valves, the tricuspid valve cannot be completely viewed and studied using 2D echocardiography, three-dimensional echocardiography plays an important role in determining the status of this valve. The tricuspid valve must also be evaluated to diagnose mitral valve diseases[5].

Materials and Methods

This six-month cross-sectional study was conducted in a tertiary center's echocardiography lab. It included 87 healthy Iranians with no health issues such as heart disease, history of hypertension, diabetes mellitus, or dyslipidemia. The IE33 scanner (Philips Ultrasound, Bottell, WA, USA) and the X5S matrix probe were used to perform three-dimensional echocardiography.The images of the tricuspid and mitral valves were taken from the apical four-chamber view in 3d-zoomed and full volume modes over four consecutive beats while the patients were asked to hold their breath. The captured images were then cropped and rotated (using Qlab 9.1 software) to provide an en-face view of the valve from the atrial side. Subsequently, the images of the mitral and tricuspid annulus were reconstructed using MPR (Multiplanar Reconstruction), and measuring processes (maximum and minimum diameter and surface determination) were implemented.

Each echocardiography test measured and recorded the following parameters:

Tricuspid valve

The longitudinal and transverse diameters (RAD1, RAD2), RA area, and volume (RAV) of the right atrium were measured in an apical four-chamber view.

The dimensions of the tricuspid annulus were measured using two-dimensional echo at end-diastole and end-systole in the apical four-chamber view (TV4CH1, TV4CH2), right ventricular (RV) inflow view (TVRVIF1, TVRVIF2), and short axis view (TV SAX1, TV SAX2) at aortic valve level, from one annulus corner to the opposite side (at the hinge point of the leaflets). Each viewpoint yielded two measurements (a minor and major dimension). Anterior-posterior and lateral-medial diameters and cross-sections of the tricuspid annulus (in en-face views) were measured using 3D echocardiography (TV3D1, TV3D2, TV; TV; Figure 1).

Mitral valve

The mitral annulus diameters were measured at the hinge points of the leaflets at end-diastole and end-systole using two-dimensional echo in the apical four-chamber view (MV4CH1, MV4CH2), apical two-chamber view (MV2CH1, MV2CH2) and parasternal long axis view (MVPLAX1, MVPLAX2). In each viewpoint, two measurements were obtained as minor and major dimensions.

The anterior-posterior and lateral-medial diameters and the cross-section of the mitral annulus (in en-face views) were measured using 3D echocardiography (MV3D1, MV3D2, and MV Area; See Figure 2).

The tenting diameter and area were also measured in the parasternal long-axis view.

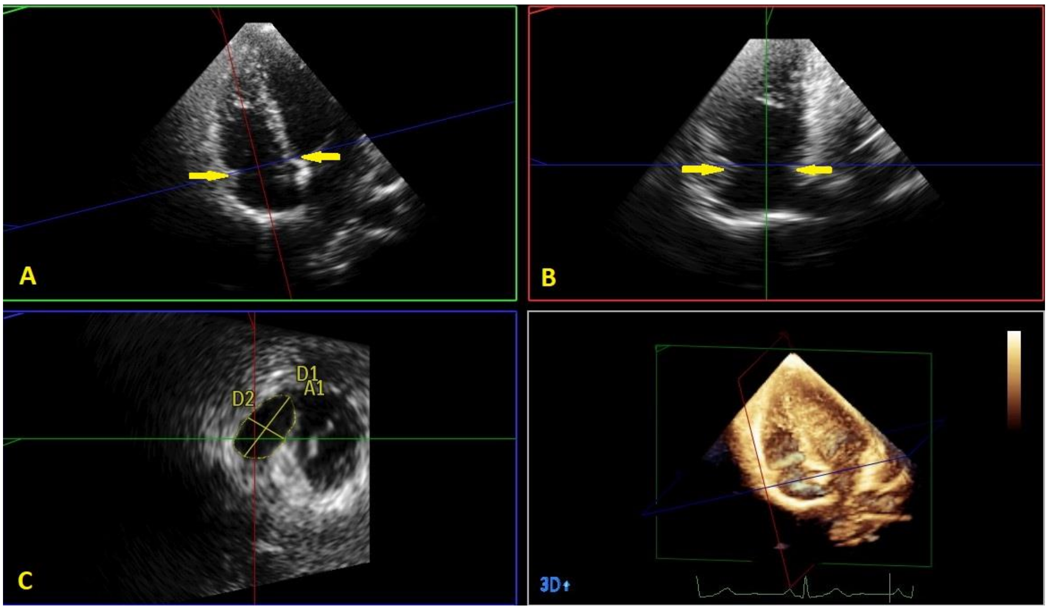

Figure 1. Medial-lateral (TV3D2) and anterior-posterior (TV3D1) diameters (white arrows in figures A and B) and cross-section area (figure C) of the tricuspid valve annulus (in en-face view, using 3D echocardiography are assessed

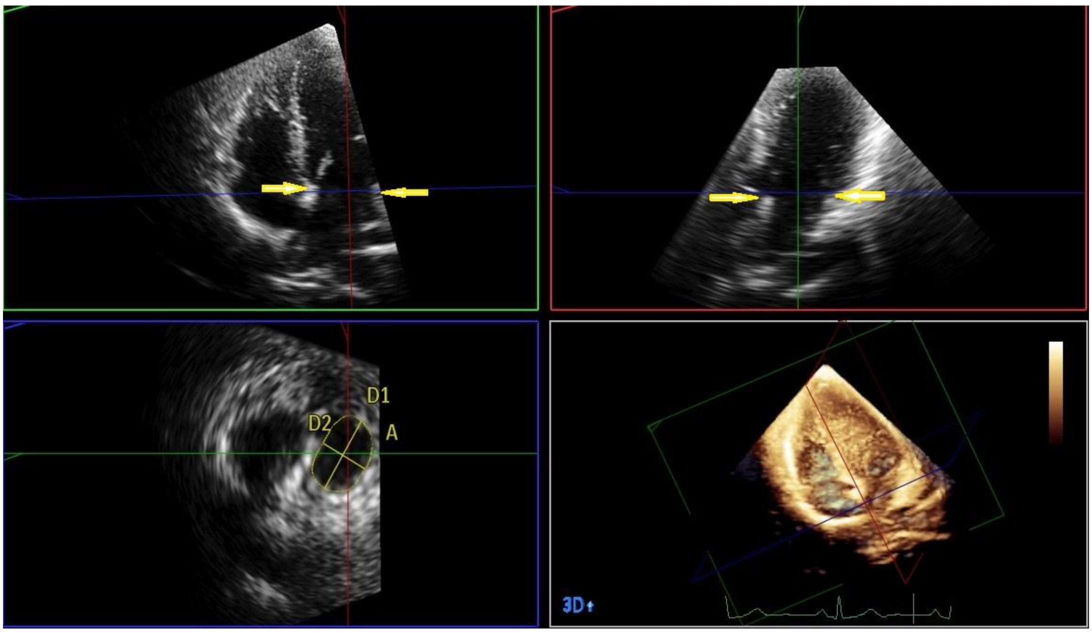

Figure 2. Anterior-posterior (MV3D1) and medial-lateral (MV3D2) diameters and cross-section area of the mitral valve annulus (in en-face views, applying 3D echocardiography and MV AREA are evaluated

Statistical Analysis

SPSS 16 software was used to analyze statistical data. The numbers and frequencies were evaluated using descriptive statistics. Furthermore, the Kolmogorov-Smirnov test was used to determine the normal distribution of data. The Chi-square or Fisher's exact test was used for comparing qualitative variables, and for comparing quantitative variables, the independent t-test or non-parametric equivalent was used. In addition, we used ANOVA or the Kruskal-Wallis test to compare quantitative variables between three or more groups. A P-value of 0.05 or less was considered statistically significant.

Results

The 87 participants ranged in age from 18 to 90 and were divided into six age groups with a 12-year age gap. There were 35 males (40.2%) and 52 females (59.8%), and the average weight and height were 82.5 kg and 169.5 cm, respectively. Tables 1 and 2 show demographic data and distribution patterns based on age and gender. Only in Height and BSA were significant differences in demographic data between the two sexes (P-value <05, P-value <0/0001).

Tables 3 and 4 show all tricuspid and mitral annulus measurements, regardless of age and sex.

The indexed area of the tricuspid and mitral annulus did not differ significantly between male and female cases.

Table 5 displays all other indexed data. The absolute values (no indexing) are shown in Supplementary Table 1. Males and females had significantly different absolute and indexed end-diastolic diameters of the mitral annulus (MV4CH1). Males had significantly higher absolute values of MV3D1, MV4CH1, MV4CH2, MVPLAX1, MV2CH2, and MVALAX2 were substantially higher in males (Supplementary Table 1).

Table 1. Distribution of samples by age group and sex

Group		Number (F/M)	N (%)
1	18-29	10/8	18 (20.7)
2	30-41	13/10	23 (26.4)
3	42-53	7/8	15 (17.2)
4	54-65	15/3	18 (20.7)
5	66-77	3/2	5 (5.70)
6	78-89	4/4	8 (9.20)

Table 2. Different demographic data of samples by sex

Data	Male	Female	P value
Age (y)	44.5 ± 19.2	47.3 ± 17.5	0.85
Height(cm)	173.4 ± 10.9	161.6 ± 7.4	0.05
Weight (Kg)	78.7 ± 15.1	67.4 ± 11.6	0.07
BSA(m2)	1.73 ± 0.11	1.61 ± 0.07	<0.0005

All data presented in mean ± SD

Male cases had higher absolute values for TV3D1, TV3D2, RAD2, RA AREA, RAV, TV SAX1, TV SAX2, TV4CH2, TV4CH1, and TVRVIF1 were more considerable in male cases (Supplementary Table 1). However, only the indexed TV3D1 showed significant differences regarding sex groups (Table 5).

Table 6 displays the measurements in various age groups (with the not-indexed values in Supplementary Table 2). Data analysis revealed a downward trend in size after 65 years of age. Also, it is revealed that the most significant dimensions were obtained after 42.

Table 3. Measures of Central Tendency and variability of the investigated indicators in Tricuspid Valve

Parameter	Range	Mean ± SD
TV3D1(cm)	2.60-4.20	3.40 ± 0.3
TV3D2(cm)	1.70-3.4	2.50 ± 0.3
RAD1(cm)	3.00-5.20	4.10 ± 0.5
RAD2(cm)	2.60-5.30	3.70 ± 0.5
RA AREA (cm^2)	9.00-21.00	14.2 ± 2.7
RAV (cm^3)	15.0-70.0	36.4 ± 11.9
TV annulus AREA (cm^2)	3.80-9.20	6.90 ± 1.0
TV4CH1(cm)	2.50-3.90	3.08 ± 0.3
TV4CH2(cm)	1.80-3.20	2.40 ± 0.3
TVRVIF1(cm)	2.50-4.20	3.30 ± 0.4
TVRVIF2(cm)	1.70-3.70	2.70 ± 0.4
TV SAX1(cm)	2.70-3.80	3.30 ± 0.3
TV SAX2(cm)	1.90-3.50	2.80 ± 0.4

TV3D1: TV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, TV3D2: TV annulus diameter in lateral-medial diameters, in en-face view, using 3D echocardiography, RAD1: Right atrium diameter (longitudinal diameter), RAD2: Right atrium diameter (transverse diameter), RAV: Right atrial volume, TV4CH1: Tricuspid annulus dimension in apical four-chamber view (end-diastole), TV4CH2: Tricuspid annulus dimension in apical four-chamber view (end-systole), TVRVIF1: Tricuspid annulus dimension in RV inflow view (end-diastole), TVRVIF2: Tricuspid annulus dimension in RV inflow view (end-systole), TV SAX1: Tricuspid annulus dimension in short axis view, at aortic valve level (end-diastole), TV SAX2: Tricuspid annulus dimension in short axis view, at aortic valve level (end-systole)

Table 4. Measures of Central Tendency and variability of the investigated indicators in the Mitral valve

Parameter	Range	Mean ± SD
MV3D1 (cm)	2.5-3.0	3.1 ± 0.2
MV3D2 (cm)	1.72-3.2	2.20 ± 0.3
MV tenting D(cm)	0.10-0.6	0.30 ± 0.09
MV tenting Area (cm^2)	0.20-0.7	0.40 ± 0.1
MV annulus AREA (cm^2)	3.70-8.0	5.40 ± 0.8
MV4CH1 (cm)	2.50-3.7	3.07 ± 0.2
MV4CH2(cm)	2.00-3.4	2.70 ± 0.3
MV PLAX1(cm)	2.10-3.4	2.80 ± 0.3
MV PLAX2(cm)	1.80-3.1	2.50 ± 0.3
MV2CH1(cm)	2.50-3.7	3.01 ± 0.3
MV2CH2(cm)	1.70-3.4	2.70 ± 0.3
MV ALAX1(cm)	2.10-2.9	2.50 ± 0.3
MV ALAX2(cm)	1.90-2.6	2.20 ± 0.2

MV3 D1: MV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, MV3 D2: MV annulus diameter in medial-lateral dimension, in en-face view, using 3D echocardiography, MV area: cross-section of the tricuspid annulus (in en-face views, using 3D echocardiography, MV4CH1: Mitral annulus dimension in apical four-chamber view (end-diastole), MV4CH2: Mitral annulus dimension in apical four-chamber view (end-systole), MV2CH1: Mitral annulus dimension in apical two-chamber view (end-diastole), MV2CH2: Mitral annulus dimension in apical two-chamber view (end-systole), MVPLAX1: Mitral annulus dimension in parasternal long axis view(end-diastole), MVPLAX2: Mitral annulus dimension in parasternal long axis view(end-systole), MVALAX1: Mitral annulus dimension in apical long axis view(end-diastole), MVALAX1: Mitral annulus dimension in apical long axis view(end-diastole)

Table 5. Difference between men and female in tricuspid and mitral valves annulus dimension (all indexed to body surface area)

Parameters N=87	Male N=35	Female N=52	p-value*
MV3D1	1.71 ± 0.1	1.78 ± 0.1	0.08
MV3D2	1.16 ± 0.1	1.31 ± 0.1	<0.001
MV tenting D	0.20 ± 0.04	0.22 ± 0.05	0.14
MV tenting Area	0.24 ± 0.06	0.27 ± 0.06	0.07
MV annulus Area	2.94 ± 0.3	3.10 ± 0.4	0.10
MV4CH1	1.70 ± 0.1	1.80 ± 0.1	0.10
MV4CH2	1.56 ± 0.1	1.58 ± 0.1	0.50
MVPLAX1	1.55 ± 0.2	1.64 ± 0.1	0.08
MVPLAX2	1.39 ± 0.1	1.49 ± 0.2	0.04
MV2CH1	1.60 ± 0.2	1.74 ± 0.1	0.009
MV2CH2	1.48 ± 0.1	1.56 ± 0.1	0.10
MVALAX1	1.51 ± 0.1	2.18 ± 0.2	0.40
MVALAX2	1.34 ± 0.1	1.33 ± 0.1	0.90
TV3D1	1.88 ± 0.2	2.00 ± 0.2	0.041
TV3D2	1.42 ± 0.2	1.46 ± 0.1	0.74
RAD1	2.21 ± 0.2	2.44 ± 0.2	0.008
RAD2	2.21 ± 0.4	2.03 ± 0.2	0.83
RA Area	8.23 ± 1.52	7.76 ± 1.27	0.20¥
RAV	22.8 ± 6.49	18.5 ± 4.95	0.001¥
TV annulus Area	3.84 ± 0.4	3.92 ± 0.5	0.30
TV4CH1	1.72 ± 0.2	1.75 ± 0.2	0.50¥
TV4CH2	1.44 ± 0.1	1.42 ± 0.2	0.61
TVRVIF1	1.84 ± 0.3	1.90 ± 0.2	0.41
TVRVIF2	1.55 ± 0.2	1.60 ± 0.2	0.42
TVSAX1	1.86 ± 0.2	1.89 ± 0.2	0.61
TVSAX2	1.59 ± 0.2	1.61 ± 0.2	0.70

TV3D1: TV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, TV3D2: TV annulus diameter in lateral-medial diameters, in en-face view, using 3D echocardiography, RAD1: Right atrium diameter (longitudinal diameter), RAD2: Right atrium diameter (transverse diameter), RAV: Right atrial volume, MV3D1: MV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, MV3D2: MV annulus diameter in medial-lateral dimension, in en-face view, using 3D echocardiography, MV area: cross-section of the tricuspid annulus (in en-face views, using 3D echocardiography.
*Independent sample T test
¥ Mann-Whitney U test

Discussion

Measuring the dimensions of valves, and obtaining optimal results and methods, is a broad field of study. Cardiologists have embarked on a new path of diagnosing and treating valvular heart disorders, particularly those affecting the mitral and tricuspid valves. This new path necessitates recording the normal data to define the cut-off points for abnormal values and dimensions at the time of therapeutic intervention. However, due to the complex and uneven structure of the valves, even using echocardiography to evaluate them would be difficult [6].

Table 6. Difference between men and female at mitral and tricuspid valves (all indexed to body surface area)

	Different Age Groups						
Parameters N=87	18-29 N=18	30-41 N=23	42-53 N=15	54-65 N=18	66-77 N=5	78-89 N=8	P value*
MV3D1	1.66 ± 0.1	1.68 ± 0.1	1.93 ± 0.1	1.86 ± 0.1	1.86 ± 0.1	1.76 ± 0.1	<0.001
MV3D2	1.21 ± 0.1	1.19 ± 0.1	1.38 ± 0.1	1.36 ± 0.1	1.31 ± 0.1	1.28 ± 0.1	0.05
MV tenting D	0.18 ± 0.03	0.19 ± 0.05	0.29 ± 0.06	0.22 ± 0.06	0.20 ± 0.03	0.20 ± 0.04	<0.001
MV tenting area	0.26 ± 0.05	0.24 ± 0.07	0.31 ± 0.02	0.29 ± 0.02	0.25 ± 0.03	0.26 ± 0.06	0.22
MV annulus area	2.88 ± 0.2	2.81 ± 0.3	3.20 ± 0.4	3.23 ± 0.2	3.26 ± 0.5	3.23 ± 0.4	0.002
MV4CH1	1.615 ± 0.1	1.686 ± 0.1	1.949 ± 0.1	1.909 ± 0.1	1.836 ± 0.1	1.708 ± 0.1	<0.001
MV4CH2	1.57 ± 0.1	1.53 ± 0.1	1.66 ± 0.2	1.59 ± 0.1	1.60 ± 0.1	1.55 ± 0.1	0.30
MVPLAX1	1.50 ± 0.1	1.53 ± 0.2	1.84 ± 0.1	1.74 ± 0.3	1.60 ± 0.1	1.58 ± 0.1	0.022
MV2CH1	1.74 ± 0.1	1.60 ± 0.1	1.81 ± 0.2	1.92 ± 0.1	1.70 ± 0.1	1.59 ± 0.1	0.036
MVALAX1	1.46 ± 0.05	1.69 ± 0.1	1.54 ± 0.1	1.56 ± 0.1	2.72 ± 0.2	1.43 ± 0.1	0.91
MVALAX2	1.36 ± 0.03	1.36 ± 0.1	1.37 ± 0.02	1.36 ± 0.1	1.30 ± 0.1	1.33 ± 0.1	0.93
MVPLAX2	1.44 ± 0.1	1.38 ± 0.2	1.64 ± 0.1	1.51 ± 0.3	1.45 ± 0.2	1.45 ± 0.1	0.19
MV2CH2	1.61 ± 0.1	1.48 ± 0.1	1.53 ± 0.3	1.69 ± 0.1	1.55 ± 0.1	1.480 ± 0.2	0.45
TV3D1	1.86 ± 0.2	1.86 ± 0.2	2.17 ± 0.2	2.09 ± 0.2	1.97 ± 0.2	1.89 ± 0.2	0.036
TV3D2	1.36 ± 0.1	1.38 ± 0.1	1.47 ± 0.1	1.47 ± 0.1	1.52 ± 0.1	1.52 ± 0.1	0.06
RAD1	2.22 ± 0.3	2.16 ± 0.3	2.72 ± 0.4	2.64 ± 0.3	2.52 ± 0.2	2.31 ± 0.2	<0.001
RAD2	2.03 ± 0.2	2.08 ± 0.3	2.13 ± 0.3	2.18 ± 0.3	2.04 ± 0.2	2.06 ± 0.3	0.91
RA AREA	7.37 ± 1.2	7.76 ± 1.2	8.26 ± 1.9	8.95 ± 2.1	8.21 ± 1	8.21 ± 1.4	0.22¥
RAV	18.7 ± 4.9	20.3 ± 5.7	19.6 ± 7.2	22.0 ± 6.8	20.7 ± 5.4	22.0 ± 7.1	0.56¥
TV annulus AREA	3.87 ± 0.6	3.81 ± 0.5	3.86 ± 0.4	3.90 ± 0.8	3.97 ± 0.5	3.94 ± 0.4	0.96
TV4CH1	1.63 ± 0.1	1.63 ± 0.2	1.99 ± 0.3	1.99 ± 0.1	1.85 ± 0.2	1.69 ± 0.1	<0.001¥
TV4CH2	1.40 ± 0.1	1.36 ± 0.2	1.57 ± 0.2	1.72 ± 0.5	1.41 ± 0.2	1.44 ± 0.1	0.020
TVRVIF1	1.74 ± 0.1	1.81 ± 0.3	2.01 ± 0.3	2.04 ± 0.3	1.93 ± 0.2	1.92 ± 0.3	0.22
TVRVIF2	1.46 ± 0.2	1.61 ± 0.3	1.62 ± 0.3	1.52 ± 0.3	1.60 ± 0.2	1.67 ± 0.2	0.034
TVSAX1	2.03 ± 0.2	1.82 ± 0.3	1.74 ± 0.002	2.03 ± 0.2	1.76 ± 0.2	1.90 ± 0.1	0.001
TVSAX2	1.80 ± 0.2	1.59 ± 0.2	1.61 ± 0.008	1.44 ± 0.1	1.50 ± 0.2	1.59 ± 0.1	0.000

TV3D1: TV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, TV3D2: TV annulus diameter in lateral-medial diameters, in en-face view, using 3D echocardiography, RAD1: Right atrium diameter (longitudinal diameter), RAD2: Right atrium diameter (transverse diameter), RAV: Right atrial volume, MV3D1: MV annulus diameter in anterior-posterior aspect, in en-face view, using 3D echocardiography, MV3D2: MV annulus diameter in medial-lateral dimension, in en-face view, using 3D echocardiography, MV area: cross-section of the tricuspid annulus (in en-face views, using 3D echocardiography.

*ANOVA test

¥ Kruskal-Wallis test

Because this study focuses on morphometric measurements of heart valves in the general population, we have worked hard to eliminate previous flaws. As a result, both the tricuspid and mitral valves' underneath the structure have been considered in the measurement processes using echocardiography. Finally, unlike previous studies, the effect of age, gender, height, and weight on Iranian ethnicity was investigated. As previously stated, only a few studies on heart valves have taken height, weight, age, gender, and ethnicity into account. Sadeghpour et al. studied 368 normal cases between the ages of 30 and 70, and this was the first relevant study in Iran. However, this study concentrated on LVEF (left ventricular ejection fraction) and other heart cavities. The mean values obtained were lower than those reported in the guidelines [4].

Moreover, Peterson et al. studied the effect of BMI on the left ventricle in 20 obese and 31 lean women. They concluded that obese women have thicker heart walls and lower systolic and diastolic function than thin women [7]. Given the findings, it is unsurprising that these parameters could influence mitral and tricuspid ring size.

Moreover, Diamon et al. researched a population of 700 people in Japan, including males and females aged 20-79, by applying an echocardiography study to record normal data. They concluded that age impacts parameter changes [8]. Camacho et al. also collected and registered normal data by performing the echocardiography on 274 healthy individuals aged from 1 to 73 years in the Mexican population. They declared that age and BMI parameters affect heart size [9].

The effect of gender on measured parameters was demonstrated in the current study's morphometric analysis of the tricuspid valve by echocardiography. In this regard, absolute values of TV3D1, TV3D2, RA Area and volume, TV annulus AREA, TV4CH1, TV4CH2, TV SAX1, TV SAX2, and TV RVIF1 were higher in males. However, after normalization for BSA, only TV3D1, RAD1, and RAV were significantly higher in females. Similarly, Ekkehard et al. discovered that gender influences RA Area size and concluded that it is more significant in men than in women [10]. Foppa and colleagues also confirmed that males have higher RAV and RAV indices than females [11]. Like the previous study, Alicia and colleagues concluded that age did not affect RAV and RAV indexes [12].

Furthermore, Neda Rastegar et al. demonstrated that gender affects TV4CH1 and TV4CH2 parameters, which were higher in men than women [13]. Accordingly, Miglioranza M.H. et al. discovered that TV SAX is more prominent in men. Markedly, they stated that the effect of gender on RVIF TV is higher in men than in women [14].

Relatedly, Ancona and colleagues distinguished that RAD2 is higher in men than women. However, gender did not affect the measurement after adjusting for BSA. Furthermore, they demonstrated that males have a larger TV Area than females [15]. Furthermore, when the effect of age on the tricuspid valve indices was examined, it was discovered that age affected the dimensions, which peaked in the third age group of 42 years and older, with a trend to decline after 65 years of age.

In this regard, Ancona et al. confirmed that age affects TV SAX [15]. Similarly, Miglioranza et al. reaffirmed the effect of age on RVIF TV [14].

The findings in the age distribution were similar regarding the mitral annulus measurement. Furthermore, this study found that gender affects MV3D1, MV4CH1, MV4CH2, MVPALAX1, MV2CH2, and MVALAX2 parameters, with men having high values and women having high values after adjusting for BSA. It is worth noting that all indices were higher in men. However, after normalization for BSA, the results reverse, except for RAV, which is consistent with the findings of Willis et al.[16].

Conclusion

Our findings confirmed that both gender and age impacted echocardiographic parameters, with a trend of decreasing measurements after 65 years of age and the most significant dimensions obtained after 42 years of age (ages between 42-65). Normalization for BSA may impact the data, with higher values detected in females than in their male counterparts.

Acknowledgment

The authors would like to thank the Imam Reza Hospital echocardiography laboratory staff, particularly Mrs. Fatemeh Iravani, for their cooperation and support. Mashhad University of Medical Sciences' vice-chancellory for research funded this study (Research Project Number: 940558).

Authors' Contribution

Dr. Poorzand and Mohtaj researched and developed the manuscript's main design. All co-authors contributed and participated in the final revision of the manuscript.

Ethical statements

The local research ethics committee (IR. MUMS.fm.REC.1394.370) granted permission to access the health records, and all cases provided informed consent.

Conflict of Interest

The authors state that they do not have any conflicts of interest.

Role of Funding Source

None.

References

1. Badano LP. Ethnicity: A Missing Variable When Defining Normative Values for Reporting Echocardiographic Studies. Arch Cardiovas Imag 2014; 2(1): e16315.
2. Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA, et al. Recommendations for chamber quantification. Eur J Echocardiogr 2006; 7(2): 79–108.
3. Fukuda S, Watanabe H, Daimon M, Abe Y, Hirashiki A, Hirata K, et al. Normal values of real-time 3-dimensional echocardiographic parameters in a healthy Japanese population: the JAMP-3D Study. Circ J 2012; 76(5): 1177–81.
4. Sadeghpour A, Shahrabi MR, Bakhshandeh H, Naderi N. Normal Echocardiographic Values of 368 Iranian Healthy Subjects. Arch Cardiovasc Image 2013; 1(2): 72-9.
5. Bigdelu L, Poorzand H, Azari A, Jarahi L, Ghaderi F, Fazlinejad A, et al. Mitral leaflet separation to evaluate the severity of mitral stenosis: Validation of the index by transesophageal three-dimensional echocardiography. Echocardiography 2018; 35(3): 361-367.
6. Kalyani R, Thej MJ, Prabhakar K, Venkatesh TK, Thomas AK, kiran J. Morphometric analysis of tricuspid valve: An Indian perspective. J Nat Sci Biol Med 2012; 3(2): 147-51.
7. Peterson LR, Waqqoner AD, Schechtman KB, Meyer T, Gropler RJ, Barzilia B. Alterations in left ventricular structure and function in young healthy obese women: assessment by echocardiography and tissue Doppler imaging. J Am Coll Cardiol 2004; 43(8): 1399-404.
8. Diamon M, Watanabe H, Abe Y, Hirata K, Hozium T, Ishii K. Normal values of echocardiographic parameters in relation to age in a healthy Japanese population: the JAMP study. Circ J 2008; 72(11): 1859-66.
9. JG EA, Arenas JL, Hernández JG, HG VO. Normal values in Mexico of the echocardiographic measurements of the left heart. Arch Inst Cardiol Mex 1988; 58(2): 127-35.
10. Ekkehard G, Henn P, Antonello D, Ehlken N. Reference Values for and Determinants of Right Atrial Area in Healthy Adults by 2-Dimensional Echocardiography. Circ Cardiovasc Imaging 2013; 6(1): 117-124.
11. Foppa M, Arora G, Gona P, Ashrafi A, Salton CJ, Yeon SB, et al. Right Ventricular Volumes and Systolic Function by Cardiac Magnetic Resonance and the Impact of Sex, Age, and Obesity in a Longitudinally Followed Cohort Free of Pulmonary and Cardiovascular Disease: The Framingham Heart Study. Circ Cardiovasc Imaging 2016; 9(3): e003810.
12. Alicia M, Roughton M, Sanjay K, Dudley J.

Reference right atrial dimensions and volume estimation by steady state free precession cardiovascular magnetic resonance. J Cardiovasc Magn Reson 2013; 15(1):29.
13. Rastegar N, Stephan L, James C, Murry B, Judge D, Tichnell C, et al. Fibrofatty Changes: Incidence at Cardiac MR Imaging in Patients with Arrhythmogenic Right Ventricular Dysplasia/ Cardiomyopathy. Radiology 2016; 280(2): 405-12.
14. Miglioranza MH, Mihaila S, Muraru D, Cucchini U, Iliceto S, Badano LP. Dynamic changes in tricuspid annular diameter measurement in relation to the echocardiographic view and timing during the cardiac cycle. J Am Soc Echocardiog 2015; 28(2): 226-35.
15. Ancona F, Marini C, Stella S, Rosa I, Margonato A, Agricola E. P1246 Age-, body size-, and sex-specific reference values for tricuspid valve apparatus parameters by real-time three-dimensional transthoracic echocardiography. Eur Heart J Cardiovasc Imaging 2016; 17(2): ii263-ii270.
16. Willis J, Augustine D, Shah R, Stevens C, Easaw J. Right ventricular normal measurements: time to index. J Am Soc Echocardiogr 2012; 25(12): 1259-67.

How to cite this article: Poorzand H, Mohtaj T, Alimi H, Sazegar G, Morovatdar N. **Average values for real-time two and three-dimensional echocardiographic parameters of mitral and tricuspid valves in a healthy Iranian population.** ARYA Atheroscler 2023; 19(1): 34-43.