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Echocardiographic Assessment of Left Ventricular Remodeling in Hypertensive Patients: Systematic Review and Meta-Analysis

Alsrur, Hamad Hamoud H[1], Zarihah binti Mohd Zain[2]

Abstract

Left ventricular remodeling is typically observed in coronary artery disease (CAD) and hypertensive heart disease (HHD). Consequently, it is of paramount significance to evaluate the left ventricular remodeling of CAD and HHD, as it may significantly impact the therapeutic choices, prognosis, and diagnosis.This meta-analysis assessed left ventricular remodeling in hypertensive cases using echocardiography.The systematic review and meta-analysis have been carried out in line with the PRISMA guidelines. The research involved published non-randomized investigations and randomized controlled trials (RCT) that assessed left ventricular remodeling in hypertensive patients using echocardiography. A thorough search has been carried out in electronic databases, including Scopus, PubMed, Cochrane Library, MEDLINE, and Web of Science, utilizing MeSH and text keywords such as "Hypertension," "Hypertensive Patients," "cardiac remodeling," "Left Ventricular Remodeling," "speckle tracking echocardiography," and "3D echocardiography."A total of 7 studies have been selected for the present analysis, including a total of 2174 cases. The combined outcome demonstrates highly statistically significant variance among groups according to SBP (Z = 3.29, P <0.001). The combined outcome demonstrates statistically significant variance among groups according to DBP (Z-value = 2.87, P-value =0.004). Result demonstrates statistically insignificant variance among groups according to HR (Z-value = 1.66, P-value =0.10). The combined outcome demonstrates statistically insignificant variance among groups according to aortic Dimensions (Z-value = 1.04, P-value =0.30). The combined outcome demonstrates highly statistically significant variance among groups according to Left atrial diameter (Z = 9.37, P<0.001). The combined outcome demonstrates statistically significant variance among groups according to interventricular septum dimension (Z = 4.34, P <0.001). The combined outcome demonstrates statistically insignificant variance among groups according to posterior wall dimension (Z = 1.61, P =0.11). The combined outcome demonstrates highly statistically significant variance among groups according to left ventricle mass (Z-value = 3.93, P-value <0.001).This research concluded that in hypertensive cases with essentially preserved left ventricle systolic function, significant impairment of left ventricle diastolic and systolic functions was observed, particularly when correlated with LVH, as demonstrated by 2D and 3D speckle tracking echocardiography.

Keywords: *Hypertensive Patients, Left Ventricular Remodeling, Echocardiographic Assessment.*

Introduction

Chronic renal failure (CRF), coronary heart disease (CHD), myocardial infarction (MI), congestive heart failure (CHF) and cerebrovascular accidents (CVA), are all significantly influenced by hypertension. A rise in blood pressure ([BP] >140/90 millimeter mercury) of unidentified reason that elevates the probability of cardiovascular (CV) illnesses, including cerebral, cardiac, large artery, and kidney condition, is recognized to be necessary hypertension (1).

Nevertheless, subclinical vascular target organ damage (TOD) is a condition that manifests in the early stages of hypertension and may be detected through noninvasive testing. Microalbuminuria, diastolic dysfunction, abnormal vascular dementia or cognitive dysfunction, and left ventricular hypertrophy (LVH) are among the subtle cardiovascular outcomes (2). left ventricular hypertrophy is a significant risk factor in cases with hypertension and a significant maladaptive response to persistent pressure excess. In the Framingham Heart Research, even borderline isolated systolic hypertension at an elderly age has been correlated with impaired diastolic filling and elevated left ventricular wall thickness (3). The early identification of LV dysfunction prior to the development of left ventricular hypertrophy could be a clinical observation which could necessitate aggressive management to reduce cardiovascular morbidity and death. Consequently, it must be taken into account in the evaluation of global cardiovascular risk (4).

[1] MSc of Medical Science, Medical Faculty, Lincoln University College, Email: ihamad888@gmail.com

[2] Lecturer, Community Medicine Department, Medical Faculty,Lincoln University College, Email: Zarihah@lincoln.edu.my

The general progress of left ventricular remodeling is a recognized characteristic of hypertensive heart disease. Consequently, it is of crucial importance to evaluate the left ventricular remodeling of hypertensive heart illness, as it may significantly impact the therapeutic choices, prognosis and diagnosis (5) .

Echocardiography, a method for evaluating LV remodeling, offers safe, noninvasive, convenient, and repeatable benefits in comparison to other techniques (6) . New developments in the ability of a new combination of ultrasound system, commercial software, and computer processing, real-time 3D echocardiography, have resolved numerous limitations correlated with assessing of LV volume from 2D echocardiography images. This has significantly enhanced the precision of these measures and offered a fast, precise, and accessible evaluation volume of LV and mass without geometric assumptions. Consequently, agreement levels & reproducibility with the cardiovascular magnetic resonance reference values have increased (7). Consequently, this meta-analysis evaluated the remodeling of the left ventricle in hypertensive cases through the use of echocardiography.

Methods

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were adhered to during meta-analysis and systematic review (8). Investigation encompassed published non-randomized investigations and randomized controlled trials (RCT) that assessed left ventricular remodeling in hypertensive patients using echocardiography.

Search Strategy: A thorough search was performed in electronic databases, including Scopus, PubMed, Cochrane Library, MEDLINE, and Web of Science, utilizing MeSH and text keywords such as “Hypertension,” “Hypertensive Patients,” “cardiac remodeling,” “Left Ventricular Remodeling,” “speckle tracking echocardiography,” and “3D echocardiography.”

The electronic inquiries were limited to controlled randomized studies that were published in English and conducted in people. Furthermore, we carried out a manual assessment of the reference lists of the clinical investigations and previous reviews which participated in to detect any extra researches.

Inclusion criteria: This meta-analysis selected studies for inclusion based on the following criteria: Cases diagnosed with hypertension and left ventricular thickening [interventricular septal thickness over eleven millimeters] regarding the hypertension diagnostic standard as determined by 2D echocardiography. Non-randomized investigations and randomized controlled trials. Research published in the English language.

Exclusion criteria: Investigations involving reviews, books, or comments. Poor echocardiographic images, serious arrhythmia, cases with conduction abnormalities, pacemaker, cardiac intervention (CABG or PCI), bundle branch block, congestive heart failure, congenital heart illness, valvular illness, ischemic heart illness, EF less than fifty percent, and diabetes mellitus.

Data extraction: The following data was extracted: the author's name, year of publication, research location, sample age, size, sex, aortic dimensions, left atrial diameter, interventricular septum dimension, DBP, SBP, heart rate, the left ventricle ejection fraction, posterior wall dimension, left ventricle mass, and mass of the left ventricles.

Statistical analysis: All data analysis has been carried out applying Review Manager version 5.4.1. Cochrane Collaboration, 2014, Copenhagen: Nordic Cochrane Centre. The odds ratio for binary outcomes has been calculated applying a 95% CI. We calculated mean variance with a 95% CL for continuous outcomes. A fixed-effect model applying the Mantel-Haenszel method has been applied to calculate the overall impact, calculated with a 95% CI, assuming no heterogeneity among trials. The random-effects model applying the Laird and DerSimonian method has been chosen. The Q statistic and I^2 test have been applied to assess the heterogeneity among investigations, indicating variability degree in the impact estimations. A p-value below 0.05 indicated that it was statistically significant.

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Results

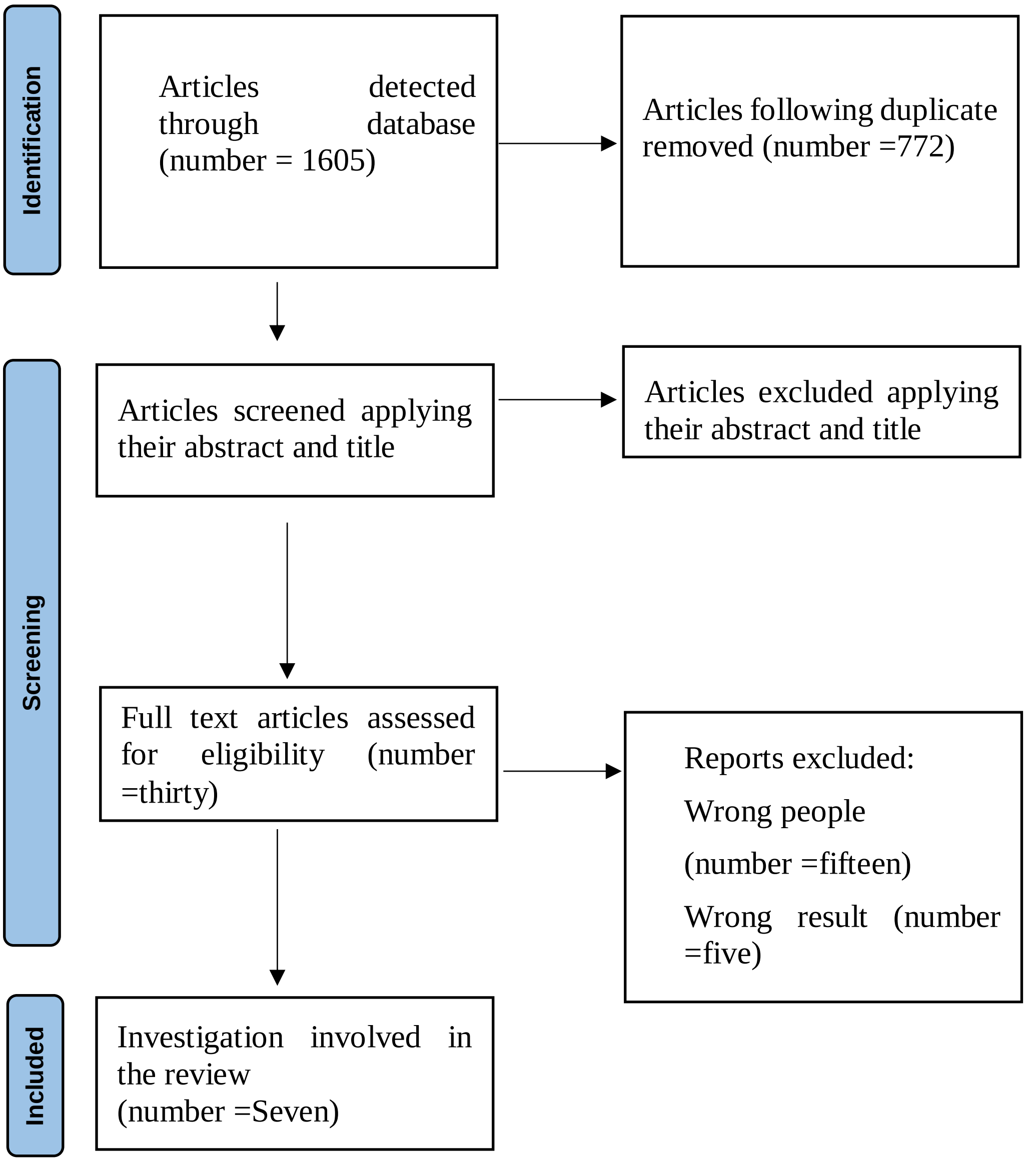

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses Flow Chart for Research Selection Process.

A total of 7 investigations have been selected for the current analysis, including a total of 2174cases. The publication year ranged from 2005 to 2023. Two studies were conducted in Egypt, one study was conducted in each of the following: Nigeria, Australia, Italy, Japan and China. Demographic data of involved investigations are showed within Table 1.

Study ID	Year	Country	Study duration	Sample Size

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			from	to	Case	Control	total
Ezzat et al., (9)	2019	Egypt	2018	2019	100	20	120
Hamed et al., (10)	2014	Egypt			40	20	60
Adebayo et al., (11)	2013	Nigeria			488	186	674
Lange et al., (12)	2023	Australia			96	82	178
Cameli et al., (13)	2012	Italy	2010	2012	70	60	130
Yoshiyama et a., (14)	2005	Japan			46	48	94
Sheng et al., (15)	2021	China			306	612	918

Table2. Patient's Features

According to Table 2, the mean age of subjects in examined groups was 50.82 years, with a vary of 25 to 80 years. Gender has been recorded in all six investigations, with 835 men and 665-woman subjects.

Study ID	Age (year)						Sex					
	Case			Control			Case			Control		
	mean	standard deviation	total	mean	standard deviation	total	male	female	total	male	female	total
Ezzat et al., (9)	38.08	7.16	100	36.35	9.37	20	54	46	100	8	12	20
Hamed et al., (10)	52.2	6	40	50.5	6	20	21	19	40	8	12	20
Adebayo et al., (11)	57.14	12.38	488	55.48	12.68	186						
Lange et al., (12)	61	7	96	59	10	82	52	44	96	42	40	82
Cameli et al., (13)	64.8	8.8	70	65	15.5	60	36	34	70	31	29	60
Yoshiyama et a., (14)	64.2	9.2	46	60.8	9.3	48	40	6	46	30	18	48
Sheng et al., (15)	56.95	10.19	306	57.07	10.8	612	181	125	306	332	280	612

Systolic Blood Pressure (SBP)

SBP was stated in five investigations, and all of them are applicable. A significant degree of heterogeneity was identified. Consequently, a random-effect model has been applied for the analysis (I^2-value = 97%, P <0.001). The combined mean variance and 95% confidence intervals were 15.21 (6.14 to 24.28). The combined result indicates a highly statistically significant variance among the groups according to SBP (P-value <0.001, Z-value = 3.29).

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Study or Subgroup	Case Mean	Case SD	Case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Aleksandra Lange 2023	142.76	21.89	488	140.58	21.38	186	20.1%	2.18 [-1.45, 5.81]
Asaaq A. Adebayo 2013	139	15	96	123	9	82	20.2%	16.00 [12.42, 19.58]
Matteo Cameli 2012	135.5	11.9	70	121	10.1	60	20.1%	14.50 [10.72, 18.28]
Minoru YOSHIYAMA 2005	139	15	46	122	15	48	19.0%	17.00 [10.93, 23.07]
Yuanyuan sheng 2021	146.87	17.43	306	120.65	9.82	612	20.6%	26.22 [24.12, 28.32]
Total (95% CI)			**1006**			**988**	**100.0%**	**15.21 [6.14, 24.28]**

Heterogeneity: Tau² = 102.82; Chi² = 135.65, df = 4 (P < 0.00001); I² = 97%
Test for overall effect: Z = 3.29 (P = 0.001)

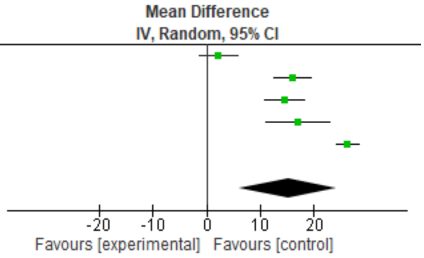

Fig. 2. Forest Plot of SBP Reveals Statistically Significant Variance Among Case and Control Groups

Diastolic Blood Pressure (DBP)

DBP was stated in five investigations, and all of them are applicable. A significant degree of heterogeneity was identified. Consequently, a random-effect model has been applied for the analysis (I² = 94%, P-value <0.001). The combined mean variance and ninety-five percent confidence intervals were 5.99 (1.90 to 10.09). Combined outcome indicates a statistically significant variance among the groups according to DBP (P-value = 0.004, Z-value = 2.87).

Study or Subgroup	Case Mean	Case SD	Case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Aleksandra Lange 2023	87.79	12.71	488	86.33	12.02	186	20.6%	1.46 [-0.60, 3.52]
Asaaq A. Adebayo 2013	80	8	96	74	7	82	20.4%	6.00 [3.80, 8.20]
Matteo Cameli 2012	79.6	6	70	77.3	5.5	60	20.7%	2.30 [0.32, 4.28]
Minoru YOSHIYAMA 2005	81	11	46	71	11	48	17.3%	10.00 [5.55, 14.45]
Yuanyuan sheng 2021	87.18	12.82	306	76.43	7.1	612	21.1%	10.75 [9.21, 12.29]
Total (95% CI)			**1006**			**988**	**100.0%**	**5.99 [1.90, 10.09]**

Heterogeneity: Tau² = 20.09; Chi² = 71.46, df = 4 (P < 0.00001); I² = 94%
Test for overall effect: Z = 2.87 (P = 0.004)

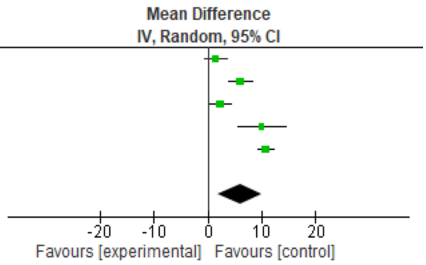

Figure 3. Forest Plot of DBP Reveals Statistically Significant Variance Among Case and Control Groups.

Heart Rate (HR)

Four studies reported heart rate and all may be utilized. There was an insignificant heterogeneity evident. Due to this, a fixed-effect model has been utilized for the analysis (I²-value = 0%, P-value=0.97). -0.01 (-0.05 to 0.04) was the combined mean variance and ninety-five percent confidence interval. According to combined outcome, statistically insignificant variance was discovered among the groups according to HR (Z-value = 1.66, P-value = 0.10).

Study or Subgroup	Case Mean	Case SD	Case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
Aleksandra Lange 2023	67	11	96	65	13	82	45.9%	2.00 [-1.57, 5.57]
Matteo Cameli 2012	76.1	9.8	70	74	9.3	60	54.1%	2.10 [-1.19, 5.39]
Yuanyuan sheng 2021	71.72	11.34	306	71.98	0	612		Not estimable
Total (95% CI)			**472**			**754**	**100.0%**	**2.05 [-0.36, 4.47]**

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.97); I² = 0%
Test for overall effect: Z = 1.66 (P = 0.10)

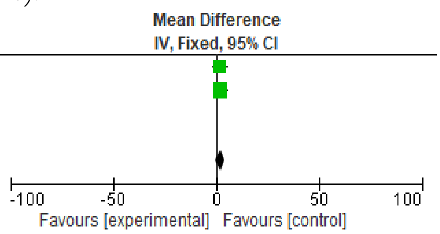

Fig. 4. Forest Plot of HR Reveals Insignificant Variance Was Discovered Among Case and Control Groups.

Aortic Dimensions

Three studies reported aortic Dimensions, and all may be utilized. An insignificant heterogeneity has been identified. Consequently, a fixed-effect model has been applied for analysis (I²-value = 58%, P-value =0.09). Combined mean variance and ninety-five percent confidence intervals was 0.05 (-0.04 to 0.13). The combined outcome reveals statistically insignificant variance among groups according to aortic Dimensions (Z-value = 1.04, P-value =0.30).

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Study or Subgroup	Case Mean	Case SD	Case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
Asaaq A. Adebayo, 2013	2.56	1.1	488	2.45	1.09	186	21.7%	0.11 [-0.07, 0.29]
Mohammad H. Ezzat, 2019	3.1	0.23	100	3.15	0.26	20	49.3%	-0.05 [-0.17, 0.07]
Waleed Abdou Ibrahim Hamed, 2014	3.11	0.33	40	2.95	0.28	20	29.0%	0.16 [0.00, 0.32]
Total (95% CI)			**628**			**226**	**100.0%**	**0.05 [-0.04, 0.13]**

Heterogeneity: Chi² = 4.78, df = 2 (P = 0.09); I² = 58%
Test for overall effect: Z = 1.04 (P = 0.30)

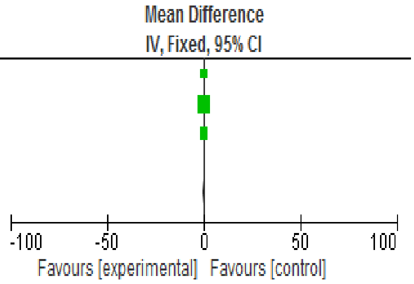

Fig.5. Forest Plot of Aortic Dimensions Reveals Statistically Insignificant Variance Among Case and Control Groups

Left Atrial Diameter

Three studies reported Left atrial diameter, and all may be utilized. Highly significant heterogeneity has been identified. Consequently, a random-effect model was applied for analysis (I²-value = 97%, P-value <0.001). The combined mean variance and ninety-five percent confidence intervals was -0.54 0.43 to 0.66). The combined outcome reveals highly statistically significant variance among groups according to Left atrial diameter (Z-value = 9.37, P-value <0.001).

Study or Subgroup	case Mean	case SD	case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
Asaaq A. Adebayo 2013	3.54	1.72	488	3.48	0.57	186	43.2%	0.06 [-0.11, 0.23]
Mohammad H. Ezzat 2019	3.72	2.7	100	3.48	0.24	20	4.5%	0.24 [-0.30, 0.78]
Waleed Abdou Ibrahim Hamed 2014	4.03	0.359	40	3.06	0.254	20	52.3%	0.97 [0.81, 1.13]
Total (95% CI)			**628**			**226**	**100.0%**	**0.54 [0.43, 0.66]**

Heterogeneity: Chi² = 59.36, df = 2 (P < 0.00001); I² = 97%
Test for overall effect: Z = 9.37 (P < 0.00001)

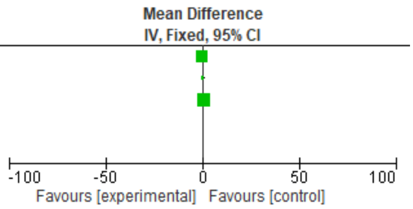

Fig. 6. Forest Plot of Left Atrial Diameter Shows Statistically Significant Variance Among Case and Control Groups

Interventricular Septum Dimension

Four studies reported interventricular septum dimension, and all may be utilized. A significant heterogeneity has been identified. Consequently, a random-effect model has been utilized for analysis (I² = 98%, P<0.001). The combined mean variance and 95% confidence intervals was 0.27 (0.15 to 0.39). The combined outcome reveals statistically significant variance among groups according to interventricular septum dimension (Z-value = 4.34, P-value <0.001).

Study or Subgroup	Case Mean	Case SD	Case Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Asaaq A. Adebayo, 2013	1.2	0.2	488	1.11	0.2	186	25.4%	0.09 [0.06, 0.12]
Mohammad H. Ezzat, 2019	1.26	0.07	100	0.88	0.07	20	25.4%	0.38 [0.35, 0.41]
Waleed Abdou Ibrahim Hamed, 2014	1.25	0.08	40	0.9	0.17	20	23.4%	0.35 [0.27, 0.43]
Yuanyuan sheng, 2021	1.14	0.16	306	0.88	0.13	612	25.7%	0.26 [0.24, 0.28]
Total (95% CI)			**934**			**838**	**100.0%**	**0.27 [0.15, 0.39]**

Heterogeneity: Tau² = 0.01; Chi² = 150.61, df = 3 (P < 0.00001); I² = 98%
Test for overall effect: Z = 4.34 (P < 0.0001)

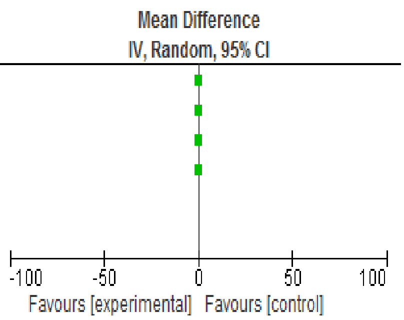

Fig.7. Forest Plot of Interventricular Septum Dimension Shows Statistically Significant Variance Among Case and Control Groups.

Posterior Wall Dimension

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Five studies reported posterior wall dimension, and all may be utilized. A significant heterogeneity has been identified. Consequently, a random-effect model has been utilized for analysis (I^2 = 99%, P<0.001). The combined mean variance and 95% confidence intervals was 0.16 (-0.03 to 0.36). The combined outcome shows statistically insignificant variance among groups regarding posterior wall dimension (Z = 1.61, P =0.11).

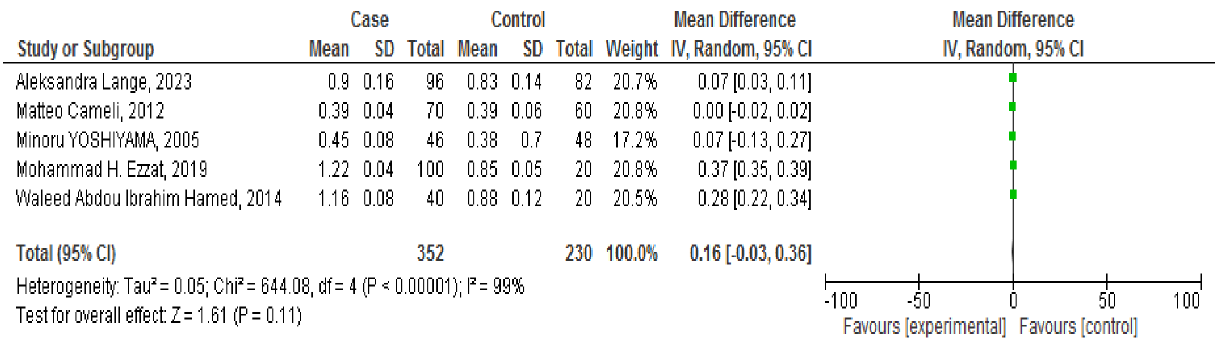

Figure 8. Forest Plot of Posterior Wall Dimension Shows Statistically Insignificant Variance Among Case and Control Groups

LV Ejection Fraction

Five investigations stated LV ejection fraction, and all may be utilized. An insignificant heterogeneity has been identified. Consequently, a random-effect model has been utilized for analysis (I^2 = 50%, P=0.09). The combined mean variance and 95% confidence intervals was -0.37 -0.27 to 1.01). The combined outcome demonstrates a shows statistically significant variance among groups according to LV ejection fraction (Z-value = 1.14, P-value = 0.26).

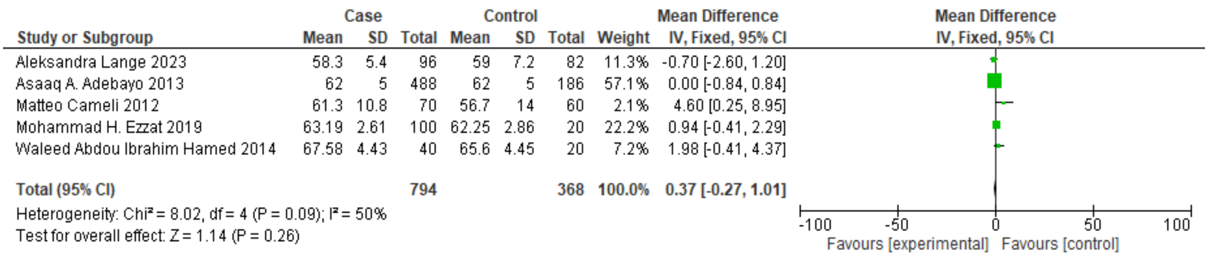

Fig. 9. Forest Plot of Left Atrial Diameter Shows Statistically Insignificant Variance Among Case and Control Groups

Left Ventricle Mass

Five studies reported left ventricle mass, and all may be utilized. A significant heterogeneity has been identified. Consequently, a random-effect model has been utilized for analysis (I^2 = 98%, P<0.001). The combined mean variance and 95% confidence intervals was 81.25 (40.76 to 121.74). The combined outcome reveals statistically significant variance among groups according to left ventricle mass (Z = 3.93, P <0.001).

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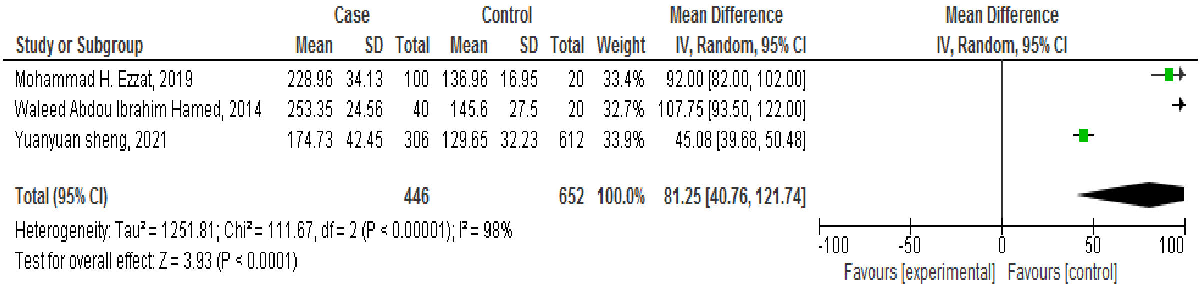

Figure 10. Forest Plot of Left Ventricle Mass Reveals Statistically Significant Variance Among Case and Control Groups.

Discussion

Hypertension causes a compensatory thickening of the ventricular wall in an effort to normalize wall stress. This leads to concentric left ventricular hypertrophy, that in turn reduces LV compliance and LV diastolic filling, thereby inducing heart failure. regardless of the absence of left ventricular hypertrophy, hypertensive cases develop diastolic dysfunction. The velocity of early diastolic filling is reduced as a result of impaired isovolumic relaxation (16). The left ventricular cardiomyocyte in hypertensive heart disease showed hyperplasia, hypertrophy, and cardiomyocyte lengthening in response to a pressure load, which resulted in an increase in cardiomyocyte thickness, and a volume load, which resulted in cardiomyocyte lengthening. Consequently, the LV underwent eccentric or concentric hypertrophy, resulting in an alteration in shape to ellipse or sphericity. This, in turn, resulted in a greater rise in left ventricular mass compared to volume of left ventricle (17). An alteration in the size, shape, and left ventricle function as a result of pathological or physiological conditions is known as left ventricular remodeling. Thus, the "athlete's heart" was a term utilized for describing and extensively report an adaptation to the elevated hemodynamic overload caused by intensive and chronic exercise. Conversely, hypertension, ischemic cardiomyopathy, hypertrophic and dilated cardiomyopathy, and valvular heart disease may all result in pathological alterations in the ventricles (18). For an extended period, 2D echocardiography was utilized to evaluate the left ventricle's volumetric and morphological characteristics. Nevertheless, this method has certain constraints, including a probe positioning bias, a high interobserver variability, and the utilization of geometric assumptions for calculating volumetric variables. The optimal imaging method for the evaluation of serial ventricular volumes must be precise, reproducible, and broadly accessible. These criteria may be met by real-time 3D echocardiography (19). Echocardiography is a safe, noninvasive, convenient, and repeatable procedure that excels over other procedures in assessment of LV remodeling. By utilizing a matrix array, the LV cubic shape, volume and mass are demonstrated in RT3DE. The possibility for nearly online quantification of LV mass and volume without needing for tedious reconstruction is particularly appealing due to the utilization of a probe and multi-directional beam steering (20).

This meta-analysis assessed left ventricular remodeling in hypertensive cases utilizing echocardiography.

The combined result demonstrated a statistically significant variance among groups regarding SBP, DBP, Left atrial diameter, Interventricular septum dimension and Left ventricle mass. While statistically insignificant variances were observed among groups according to heart rate, Aortic Dimensions, Posterior wall dimension, and LV ejection fraction.

In Egypt, Ezzat et al., (9) the left ventricular remodeling index in HTN cases was comparing with that of normal cases utilizing 2D and 3D transthoracic echocardiography. Their investigation comprised 120 participants, who were classified into two groups: Cases Group A: consisted of one hundred hypertensive cases. Control group (Group B): comprised of twenty people who appeared to be in good health, matched in terms of sex and age. They reported that statistically significant variance was discovered among cases and control regarding posterior wall dimension, interventricular septum dimension, left ventricle mass, left ventricular remodeling index and left ventricular end-diastolic volume. The left ventricular remodeling index identified by RT3DE and 2DE demonstrated significant variance between the two groups (1.72±0.04

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versus 1.94±0.07, 1.73±0.04 versus 2.17±0.05). Additionally, significant variances were discovered within the case group (1.94±0.07 versus 2.17±0.05), however insignificant variances within the control group (1.72±0.04 vs 1.73±0.04). They concluded that the left ventricular remodeling index, which is derived from RT3DE, is more effective than the left ventricular remodeling index, which is derived from 2D echocardiography, as an index for assessing LV remodeling.

Lange et al., (12) The investigation included a total of 178 cases (mean age sixty ± nine years, fifty-three percent female), with Group one consisting of cases with essential hypertension (the number = ninety-six, Group one) and Group two serving as age-matched controls (the number = eighty-two, Group two). The left heart remodeling alterations due to hypertension have been evaluated using transthoracic echocardiography (TTE) and computed tomography coronary angiography (CTCA), with underlying ischemic heart disease being excluded. All participants received both transthoracic echocardiography and computed tomography coronary angiography. Transthoracic echocardiography measurements encompassed the function and volume of left atrial and the concentricity and function of the left ventricle. transthoracic echocardiography and computed tomography coronary angiography were utilized to determine the volume of left ventricular diastasis (LV dias) and left atrial diastasis (LA dias). They determined that the transthoracic echocardiography LEDA score, which is determined by 4 variables—LVED index/mean wall thickness, E/e', LVdias/LA dias, and left atrial reservoir function—is the most efficient technique for identifying left ventricular remodeling in hypertension.

Similarly, Hamed et al., (10) assessed left ventricle function in hypertensive cases with evident preserved left ventricle systolic function was assessed utilizing 2D speckle tracking echocardiography in association with plasma brain natriuretic peptide (BNP) concentration. The researchers determined that hypertensive cases with seemingly preserved LV systolic function, particularly when correlated with left ventricular hypertrophy, demonstrated a significant impairment of LV diastolic and systolic functions, as demonstrated by 2D speckle tracking echocardiography.

As well, Adebayo et al., (11) demonstrated that Cases with concentric hypertrophy have been significantly older and demonstrated significantly greater diastolic, pulse , and systolic pressures compared to those with normal geometry. The systolic function index was significantly lesser in cases with eccentric hypertrophy compared to those with other geometric patterns. Hypertensive cases with abnormal left ventricular geometry demonstrated some diastolic dysfunction as indicated by Doppler echocardiographic variables. The most frequent LV geometric pattern noticed in their hypertensive cases was concentric remodeling, then eccentric hypertrophy and concentric hypertrophy. In comparison to cases with other geometric patterns, those with concentric hypertrophy have been older. In cases with eccentric hypertrophy, LV systolic function has been significantly decreased, and cases with abnormal LV geometry demonstrated some degree of diastolic dysfunction.

Chen et al., (21) who examined sixty subjects of their choosing. The hypertensive heart illness group contained eighteen cases of hypertension diagnosed regarding the hypertension diagnostic standard and LV thickening [interventricular septal thickness more than or equal eleven millimeters determined by 2D echocardiography; eleven men and seven women with a mean age of 52.2±12.6 years], as well as nine cases of eccentric hypertrophy and nine cases of concentric hypertrophy. In the coronary artery illness group, twenty cases of coronary artery disease were confirmed by coronary artery angiography without LV hypertrophy. These cases included thirteen men and seven women, with a mean age of 54.3±13.2 years. The mean age of the twenty-two healthy volunteers in the normal control (NC) group was 48.4±11.2 years, with fourteen males and eight females. The outcomes indicated that the left ventricular remodeling index measurements identified by RT3DE and 2DE demonstrated significant variances among the groups. Insignificant variance was discovered in the normal control group but significant variance in hypertensive heart illness and coronary artery disease intra-group. Good positive correlations were observed among the left ventricular remodeling index identified by 2D echocardiography and RT3DE in the normal control and hypertensive heart disease groups. In conclusion, the left ventricular remodeling index derived from RT3DE, a novel index for assessing left ventricular remodeling, has the potential to perform better than the left ventricular remodeling index derived from 2D echocardiography.

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Avegliano et al., (22) he discovered in an investigation involving forty-eight cases with HCM (thirty-five men and thirteen women, mean age 57.4 ± 13.7 years) he had a complete transthoracic investigation and cardiovascular magnetic resonance carried out in a period of seven days, it was also discovered that 3D echocardiography is a precise technique for the quantification of left ventricular mass in cases with different subtypes of hypertrophic cardiomyopathy. This technique is in better agreement with cardiovascular magnetic resonance reference values compared to M-mode measures. RT3DE and M-mode were utilized for calculating left ventricular mass, which was then comparing with the gold standard, cardiovascular magnetic resonance. Based on these findings: The left ventricular mass was (195 + 41 g) as determined by RT3DE and (187 +49 g) by cardiovascular magnetic resonance. The Lin index was 0.63, and the linear correlation was acceptable (r-value = 0.63, P-value < 0.0001). The association among both techniques was moderate. The correlation was significant if the image quality of RT3DE was either high or adequate. The association among left ventricular mass by M-mode and cardiovascular magnetic resonance was insufficient.

Conclusion

This study concluded that significant impairment of left ventricular diastolic and systolic functions was observed in hypertensive cases with essentially maintained left ventricular systolic function, particularly when correlated with left ventricular remodeling, as demonstrated by 3D and 2D speckle tracking echocardiography. In hypertensive cases, the accurate indexing algorithm and thresholds based on ethnic-specific normal reference values are of paramount significance, as a correct diagnosis of LV remodeling is essential for prognostic expectations and therapeutic options. Additional research is required for addressing this question.

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