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BRIDGING THE GAP: A SYSTEMATIC REVIEW OF BARIATRIC SURGERY'S EFFECTS ON CARDIAC HEALTH

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Abstract

Objective: This study compares preoperative and post-operative cardiac imaging measures to examine the effects of bariatric surgery on heart shape and function in obese patients.

Methodology: Using PubMed, MedLine, Ovid, and Cinhal, this work searched the literature for bariatric, metabolic, weight loss, and obesity surgery as well as echocardiography, MRI, cardiac imaging, cardiac dimensions, & ventricular dimensions. Studies included had an initial follow-up of three months and reported on heart structural and function parameters obtained by MRI or echocardiography. Study excluded had conflicting or no preoperative or postoperative data. The Newcastle-Ottawa scale was used for quality assessment; PRISMA guidelines were followed for statistical analysis, which computed and pooled results using a model of random effects with 95% confidence intervals, weighted mean differences, and DerSimonian & Laird modelling. We looked at inter-study heterogeneity with the I2 statistic.

Results: Bariatric surgery greatly improves a number of cardiac indices, including left atrium diameter (1.967 mm, 95% CI 0.980-2.954), left ventricular end-diastolic volume (13.28 ml, 95% CI 5.22-21.34 ml), as well as left ventricular mass index (11.2, 95% confidence intervals (CI) 8.2-14.1%). Positive increases were noted for the left ventricular ejection fraction (1.198, 95% CI 0.050-2.347) and the E/A ratio (0.189, 95% CI 0.113–0.265).

Conclusion: In obese patients, bariatric surgery has been shown to have beneficial impacts on diastolic function, systolic function, and cardiac structure. The alteration of the enteric cardiac axis may be a contributing factor to these outcomes. However, future research endeavours should prioritize the acquisition of more robust evidence to precisely determine the most effective bariatric procedures for preventing and treating a diverse spectrum of obesity-related cardiac pathologies, in addition to further developing strategies for managing obesity cardiomyopathy.

Keywords: bariatric surgery, metabolic surgery, imaging, cardiac activity, cardiac structure, obesity cardiomyopathy.

Introduction:

Worldwide prevalence of obesity and cardiovascular illnesses (CVDs) is rising. Since 1980, the prevalence of obesity has almost quadrupled; estimates put the number of obese and overweight adults globally at 13% and 39%, respectively [1]. The overall number of CVD cases almost doubled from 271 million cases in 1990 to 523 million cases in 2019, and the number of CVD-related deaths progressively increased from 12.1 million in 1990 to 18.6 million in 2019[2]. Long associated with a higher risk of heart failure, atherosclerosis, and CVDs, is obesity. 2. We call this combination of obesity and other risk factors, such diabetes mellitus, dyslipidaemia, and hypertension, "metabolic syndrome" (MetS). MetS is a standalone predictor of cardiovascular disease and cardiac failure. Chapters[4,5].

Epidemiological and cardiovascular imaging studies indicate that long-term obesity may result in left ventricular hypertrophy and dilatation, which can induce heart failure. Among these are the National Health and Nutrition Examination Survey 5 and the Framingham Heart Study. Through their distortion of the form and cavity and impairment of ventricular contractile function, these structural alterations result in maladaptive LV remodelling, which can induce non-ischaemic dilated cardiomyopathy [5, 6].

The data indicates that, by reverse remodelling, weight loss in any form may reduce cardiovascular risk and enhance heart structure and performance[7]. Nonetheless, most patients have not yet shown that combining drugs with lifestyle modifications (diet and exercise) leads to long-term, sustainable weight loss [8]. For those who are extremely obese, bariatric surgery offers the most successful and long-term weight loss, which can then enhance heart function and other cardiovascular risk factors [3]. Many studies have demonstrated that functional heart imaging endpoints (like echocardiography & magnetic resonance imaging (MRI)) are improved by bariatric surgery. While past systematic reviews in this area have been carried out, our objective was to gather all available data and considerably expand the number of studies examined in comparison to other literature reviews [9]. To assess how bariatric surgery affects obese patients' heart shape and function, we set out to finish the largest and most comprehensive systematic analysis of data from cardiac imaging studies.

Methodology:

Literature Search:

The research methodology involved conducting a comprehensive literature search on bariatric surgery, metabolic surgery, weight loss surgery, and obesity surgery, along with echocardiography, magnetic resonance imaging, cardiac imaging, cardiac dimensions, and ventricular dimensions. The search was conducted using the databases PubMed, MedLine, Ovid, and Cinhal. The search occurred on December 9, 2022. (see Table. 1 for details)

Table 1. Detailed Search Strategy for Pubmed/Medline, Ovid, and Cinhal.

Database	Search Strategy	Filter
Pubmed/Medline	((Bariatric Surgery[mesh] OR Metabolic Surgery[mesh] OR Weight Loss Surgery[mesh] OR Obesity Surgery[mesh]) AND (Echocardiography[mesh] OR Magnetic Resonance Imaging[mesh] OR Diagnostic Imaging[mesh] OR Cardiac Imaging Techniques[mesh]))	2000-2022
Ovid	Bariatric Surgery/ OR Metabolic Surgery/ OR Weight Loss Surgery/ OR Obesity Surgery/ AND Echocardiography/ OR Magnetic Resonance Imaging/ OR Cardiac Imaging Techniques/ OR Diagnostic Imaging/	2000-2022

Cinhal	(MH "Bariatric Surgery+") OR (MH "Metabolic Surgery+") OR (MH "Weight Loss Surgery+") OR (MH "Obesity Surgery+") (MH "Echocardiography+") OR (MH "Magnetic Resonance Imaging+") OR (MH "Diagnostic Imaging+") OR (MH "Cardiac Imaging Techniques+")	2000-2022

Inclusion Criteria:
To ensure their validity and reliability, all studies chosen for this review had to meet specific criteria. The analysis included only randomized controlled trials (RCTs) and double-arm observational studies (cohort and case-control). Furthermore, these studies were required to report on either MRI or echocardiographic cardiac structure and function parameters. In addition, they had to have a minimum three-month follow-up period after the surgical procedure. We aim to improve the quality and rigor of the findings by imposing these stringent selection criteria.

Exclusion Criteria:
Studies excluded from review after screening were excluded for three reasons (see Table 2):
1. studies that did not report preoperative data.
2. studies that did not report post-operative data.
3. whose data were inconsistent with one another were omitted from the review.
4. Animal Studies
5. Single-arm observational studies
6. Reviews, viewpoints, commentaries, etc. were also excluded.
7. Studies not reported in English

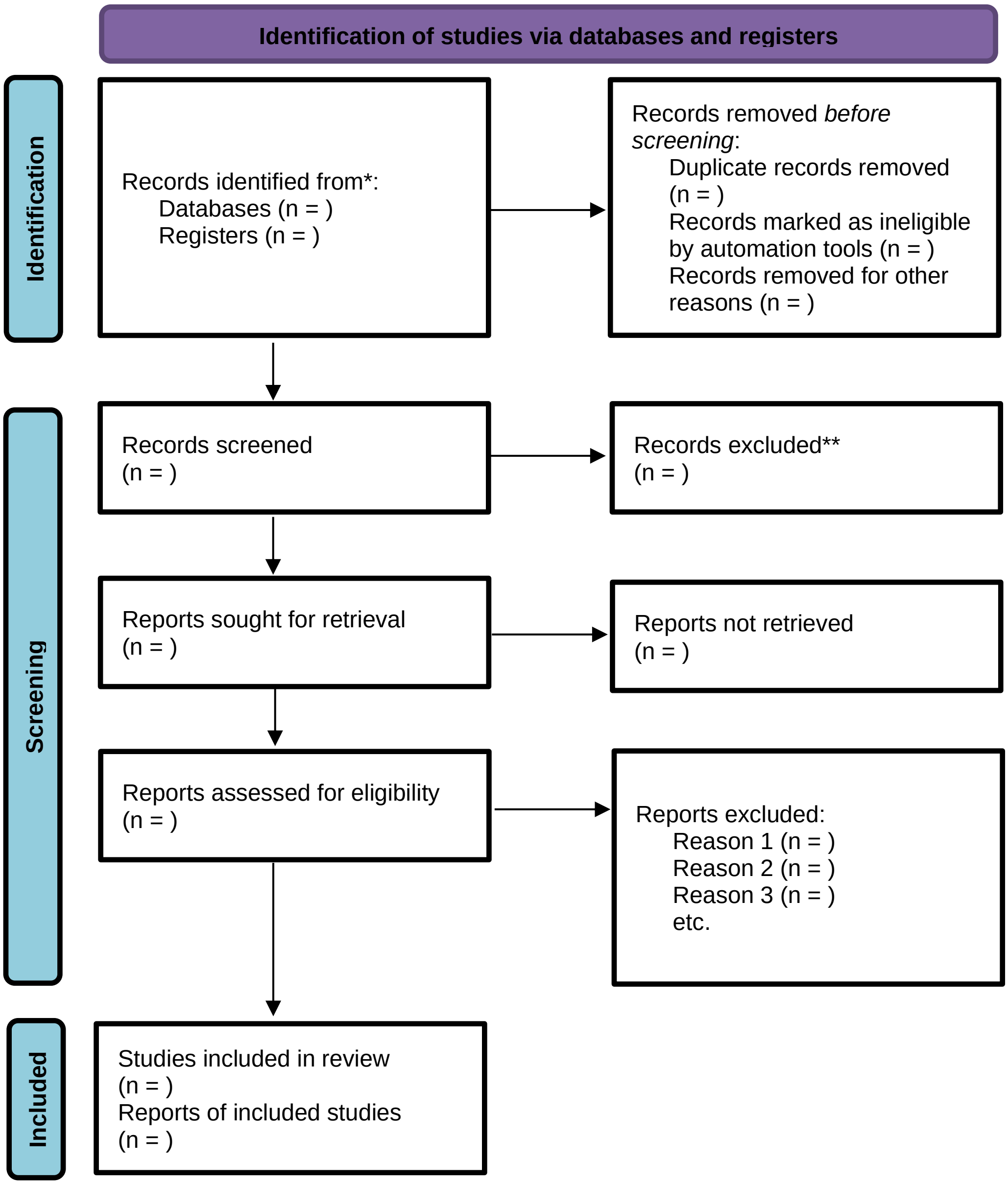
Table 2. Characteristics and Inclusion/Exclusion Criteria for the patient/population, intervention, comparison and outcomes.

PICO	Inclusion	Exclusion
Population	Obese adults (aged 18 and above) with a body mass index (BMI) of 30 kg/m² or higher.	Studies with participants who have had previous bariatric surgery, have a history of cardiac disease, or have undergone other surgical procedures within six months prior to bariatric surgery will also be excluded.
Intervention	Bariatric surgery (including Roux-en-Y gastric bypass, sleeve gastrectomy, adjustable gastric banding, and biliopancreatic diversion) for weight loss	
Comparison	Pre-operative and post-operative measurements of cardiac imaging parameters (including echocardiography and magnetic resonance imaging) for cardiac structure and function	Studies that lack preoperative or postoperative data or have inconsistent data will be excluded.
Outcomes	Changes in cardiac structure and function parameters, including left ventricular mass index, left ventricular end-diastolic volume, left atrium diameter, E/A ratio, and left ventricular ejection fraction	
Study Characteristics	Studies that are randomized controlled trials and double-arm observational studies (cohort and case-control) that report on MRI or echocardiographic cardiac structure and function parameters, and have a minimum follow-up period of no less than three months after the surgical procedure	Studies with non-human subjects or that are not written in English will also be excluded.

Quality Assessment:
The Newcastle-Ottawa scale was used to score the quality of the included studies.

Statistical Analysis:
In accordance with the **PRISMA** standards, a systematic review was conducted. (See Figure 1)
We used a random effects model to evaluate the data. 95% confidence intervals and weighted mean differences (WMD) were used to analyse continuous data (CI).
DerSimonian and Laird random effects modelling was used to compute and pool the proportion of the difference between outcomes.
Using the I2 statistic, inter-study heterogeneity was investigated; 30% was regarded as low, 30–60% as moderate, and >60% as excessive. The Newcastle-Ottawa scale was used to evaluate the quality.

Fig. 1 Schematic representation of study selection



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Results:

Forty studies met the inclusion criteria, yielding a pooled data set of 1486 patients. There were 26 retrospective cohort studies and 14 non-randomized prospective observational studies among these studies. Two studies (10 and 11) had two distinct cohorts, which were examined separately. 37 studies used echocardiography, while 5 used MRI (CMR) to visualize heart characteristics. (see Table 3)

Table 3. Bariatric surgical studies reporting on changes in cardiac structure and function

Study author with reference	Procedure name	Imaging technique	Cardiac indices
Alpert, et al [10]	VBG	Transthoracic echocardiogram and cardiac Doppler	LA, LVDD, LVMI, E/A ratio
Cunha et al [11]	RYGB	Echo	LA diameter, E/A, IVRT, LVEF, LVM, LVMI (g/m2)
Ikonomidis et al [12]	RYGB or BDP	Echo	LA diameter, E/A, IVRT, LVM, LVMI (g/m2).
Algahim et al [13]	RYGB or LAGB	Echo	LVMI (g/m2)
Owan et al [14]	RYGB	Echo	LVEF, LVMI (g/m2),
Mukerji et al [15]	VBG	Echo	LVMI(g/m2)
Iancu et al [16]	SG	Echo	LVM, LVMI (g/m2), IVST
Alpert et al [17]	VBG	Echo	E/A, LVMI (g/m2)
Di Bello et al [18]	NA	Echo	LA diameter, E/A, DT, IVRT, LVEF, LVMI (g/m2), IVST
Leichman et al [19]	RYGB or LAGB	Echo	LVMI (g/m2)
Graziani et al [20]	NA	Echo	LA diameter, E/A ratio, LVEF, LVM, LVMI (g/m2), IVST

NA: not available, LAG: laparoscopic adjustable gastric band, SG: sleeve gastrectomy, BPD: biliopancreatic diversion, VBG: vertical banded gastroplasty, RYGB: Roux-en-Y gastric bypass, LA: Left atrium, LVdd: Left Ventricular Diastolic Dimension, LVEF: Left Ventricular Ejection Fraction, LVM: Left Ventricular Mass, LVMI: Left Ventricular Mass Index, IVST: Inter-Ventricular Septal Thickness, IVRT: Iso-Volumetric Relaxation Time, g/m2: gram per meter square, E/A: early to late mitral flow velocity

The parameters provided and the types of operations described in the forty publications varied significantly. We only used the most recent study on these cohorts for these outcomes because some publications used the same cohort of patients with the same results. The overall weighted mean follow-up for patients with a BMI was 18.2 months. (See Table 4)

Table 4. Summary of the 10 studies' characteristics reporting data on cardiac changes after bariatric surgery

Study	Publication year	Reporting imaging subjects	Mean Age in years	BMI (kg/m2)	Mean follow-up (months)	Gender F/M (%)	Procedure
Alpert, et al [10]	1997	39	38	50.4	4.5	80/20	VBG
Cunha et al [11]	2006	23	37.9	48.8	36	6/17	RYGB
Ikonomidis et al [12]	2007	60	35	48.7	36	35/25	RYGB or BDP
Algahim et al [13]	2010	15	49.2	46.7	24	0/15	RYGB or LAGB
Owan et al [14]	2011	259	42.1	48.8	24	NA	RYGB
Mukerji et al [15]	2012	39	37.8	42.8	NA	18/21	VBG
Iancu et al [16]	2013	34	38	43.6	12	17/17	SG
Alpert et al [17]	2015	67	38	46.2	5	37/30	VBG
Di Bello et al [18]	2008	13	40	47	6-24	3/10	NS
Leichman et al [19]	2006	22	44	46.8	4	0/22	RYGB or LAGB
Graziani et al [20]	2013	51	NA	47.9	24	NA	NA

NA: not available, **LAG**: laparoscopic adjustable gastric band, **SG:** sleeve gastrectomy, **BPD:** biliopancreatic diversion, **VBG:** vertical banded gastroplasty, **Kg/m^2:** kilograms per meter square, **F/M:** Female/Male, **RYGB:** Roux-en-Y gastric bypass.

Heart Geometry:

Left Ventricular Mass (LVM):

Absolute left ventricular mass (LVM) was referenced in 24 research articles. Following the surgical procedure, the analysis using weights revealed a decrease in the left ventricular mass (LVM) by an average of 29.80 g (95% confidence interval 24.06-35.54, p = 0.001). The study exhibited considerable heterogeneity (I2 55%). (Table 5)

Left Ventricular Mass Index (LVMI):

Thirteen studies reported LVM indexed to height (m2.7), six to body surface area (m2), and three to LVM indexed to height (m).

The analysis of cardiac imaging findings in all 22 trials revealed a weighted mean drop in LVMI of 11.2% (95% CI 0.082-0.141, p = 0.001) after surgery. There was moderate heterogeneity observed between the studies. (I^2 32.8%). (Table 5)

End-diastolic volume of the left ventricular septum (EDVLVS):

Thirteen study papers presented data on the EDVLVS, demonstrating a volume of 13.28 ml (95% CI 5.22-0.001). The studies showed considerable variation. (I^2 85.9%). (Table 5)

End-systolic volume of the left ventricular septum (ESVLVS):

There was significant heterogeneity between trials (I^2 87.3%), with ten studies reporting on the end-systolic volume of the left ventricular septum (ESVLV) and revealing a decrease of 4.99 ml (95% CI 0.35-9.62 ml, p = 0.035). (Table 5)

Diastolic Activity:

E/A Ratio:

The analysis of 21 trials comparing the E/A ratio before and after surgery revealed a weighted mean increase of 0.189 (95% CI 0.113-0.265, p 0.001) from a baseline value of 1.16. Significant heterogeneity (I2 82.0%) was detected among the trials. (Table 5)

Left Atrium Diameter:

Fifteen studies studied the pre- and post-surgical diameter of the left atrium (LA). A pooled analysis of cardiac imaging results revealed a weighted mean decrease in left atrium (LA) diameter of 1.967 mm (95% CI 0.980-2.954, p = 0.001) following surgery. However, there was significant heterogeneity among the studies. (I^2 79.7%). (Table 5)

Systolic Activity:

Left Ventricular Ejection Fraction:

The LV ejection fraction (LVEF) was assessed in 22 studies both before and after operation. The pooled analysis of cardiac imaging results revealed a weighted mean rise in LVEF of 1.198% (95% CI 0.050-2.347, p = 0.041) after surgery. However, there was a notable variation in the studies included, indicating significant study heterogeneity. (I^2 74.2%).(Table 5)

BMI:

When the data from all trials providing pre- and post-operative BMI statistics combined, a weighted mean decrease in BMI of 13.51 BMI points (95% CI 12.36-14.66, p = 0.001) was seen. The baseline BMI was 47.2. (I^2 83.9%). (Table 5)

Table 5. Results of cardiac structure and function studies

Study Authors	BMI		LVEF		LVM		LA		RWT ratio		E/A Ratio		IVRT mm		LVMI, g/m2 or g/h2.7		LVDD mm	
	pre kg/m2	post kg/m2	pre%	post %	Pre g/m	Post g/m	pre mmL	post mmL	pre mm	post mm	pre	post	Pre mm	Post mm	Pre	Post	Pre	Post
Alpert, et al (10)	50.4	NA	NA	NA	NA	NA	33	33	NA	NA	1.2	1.42	NA	NA	NA	NA	57	52
Cunha et al (11)	48.8	31.8	71.3	74.7	195.4	177.5	38.9	38.1	NA	NA	1.29	1.6	99.9	74.9	NA	NA	44.9	48.8
Ikonomidis et al (12)	48.7	32	NA	NA	348	285	NA	NA	NA	NA	1.17	1.24	91	82	85	73	50	48
Algahim et al (13)	46.7	40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	49	37	NA	NA
Owan et al (14)	47.9	32.2	63	65	NA	NA	NA	NA	0.49±0.15	0.46±0.12	NA	NA	NA	NA	44	38	45.8	44.4
Mukerji et al (15)	42.8	31.9	NA	NA	73.1	52.2	NA	NA	0.39±0.03	0.42±0.03	NA	NA	NA	NA	73	52	56	51
Iancu et al (16)	43.6	28.9	62.5	64	217	177	42	34	NA	NA	1.1	1.2	NA	NA	51.3	42.2	NA	NA
Alpert et al (17)	46.2	34.5	NA	NA	80.6	62	NA	NA	NA	NA	0.99	1.18	NA	NA	119.8	95.2	59	56
Di Bello et al (18)	47	36	72.5	70.6	NA	NA	37.9	33.5	NA	NA	1.18	1.3	80.2	71.8	NA	NA	53	47.7
Leichman et al (19)	46.8	40.1	61	57	NA	NA	NA	NA	0.42±0.01	0.43±0.02	1.26	1.22	NA	NA	50	46.1	NA	NA

Body mass index (BMI), Left ventricular mass (LVM), Left ventricular ejection fraction (LVEF), left atrium volume (LA), relative wall thickness (RWT), Not available (NA),IVRT: isovolumic relaxation time; LVDD: left ventricular diastolic dimension; LVMI: left ventricular mass index, E/A: early to late mitral flow velocity.

Discussion:
Our data indicates that, in general, patients who underwent bariatric surgery consistently exhibited improved heart shape and function. Statistically substantial improvements were observed in the geometry of the heart, diastolic function, or systolic function. The beneficial impacts are observed in many methods of cardiac imaging, such as echocardiography and MRI, following substantial weight loss (with an average decrease in BMI of 13.51 kg/m2). Our systematic review, which includes 40 research studies, provides the most comprehensive data available. Although the majority of research in this field has been conducted in small-scale investigations, the results have enhanced our understanding of heart geometry or diastolic function, thereby confirming and expanding upon previous information. The discovery of a small yet statistically significant increase in systolic function, as measured by LV ejection fraction, is a noteworthy and original finding. Three studies that utilized CMR instead of echocardiography, that has been demonstrated to be more exact and accurate in assessing LV mass, was included.

Heart Geometry:
Obesity has been identified as a contributing cause to the increase in left ventricular mass. In obese women, both eccentric & concentric hypertrophy have been observed, while obese men mostly show concentric hypertrophy. The results of our study indicate a considerable reduction in 11.2% in left ventricular mass index (LVMI) after surgery, demonstrating a proportionate decrease. This conclusion supports the notion that bariatric surgery leads to reverse remodeling. The reduction in hypertrophy of the left ventricle, shown by a substantial drop in left ventricular mass, may be the cause of the long-term decrease in cardiovascular mortality observed in bariatric patients [3]. This condition can be caused by pathological diastolic dysfunction, which leads to lower ventricular filling, lower ventricular contractility, a smaller coronary reserve, & arrhythmogenic electrical dysfunction. Our data provide additional evidence for the beneficial reversal of left ventricular hypertrophy in bariatric subjects, as indicated by improvements in posterior thickness of the wall, interventricular septal thickness, as well as relative wall thickness. After bariatric surgery, there were observed enhancements in the end-systolic & end-diastolic volume & diameter evaluations, indicating that the left ventricle is experiencing increased filling and relaxation.

Diastolic Dysfunction:
Our extensive research demonstrates that bariatric surgery alters the echocardiographic markers of diastolic dysfunction to a beneficial manner. All studies, save for one, demonstrate a rise of the post-operative E/A ratio. This likely represents an enhancement in the diastolic dysfunction associated with obesity, namely in the pseudonormal (grade II) category. Furthermore, we have seen a significant enlargement in the diameter of the left atrium ($p = 0.001$). Left atrial enlargement is an important measure of diastolic function as it reflects prolonged exposure to elevated left ventricular filling pressure. Furthermore, LVMI independently predicts left atrial enlargement, which is associated with unfavorable cardiovascular outcomes [17]. The normalization of this chamber indicates the beneficial impact of bariatric surgery overall diastolic function and the reduced likelihood of arrhythmogenesis. This is because larger left atrium dimensions are associated with a higher risk for developing atrial fibrillation. Furthermore, there is a well-established correlation between the size in the left atrium and obstructive sleep apnoea. It has been demonstrated that bariatric surgery leads to significant improvement in obstructive sleep apnoea. [17,18].

Left Ventricular Systolic Function:
It is widely recognized that morbid obesity negatively affects the pumping performance of the left ventricle, however this is often an asymptomatic condition which can only be detected using echocardiography. Our meta-analysis revealed significant variability among trials including a moderate yet noteworthy enhancement in left ventricular ejection fraction (LVEF). The surprising discovery could be attributed to the extensive dataset employed in this investigation, which may have compensated for the potential lack of statistical power in each report and previous analyses. Alpert et

al. [19] demonstrated that enhancements in systolic function are observed exclusively in obese individuals with pre-existing low systolic function prior to surgery. Furthermore, those who were morbidly obese for extended durations exhibit the most significant changes in systolic parameters [20]. Nevertheless, bariatric surgery has the potential to enhance systolic function in those suffering from severe heart failure that are awaiting a heart transplant, and it may also lead to symptomatic improvement in all stages of obesity-related cardiomyopathy [21]. The mean weighted baseline left ventricular ejection fraction (LVEF) across all trials was 62%. This typical value may suggest that a significant number of patients in the mentioned studies had uncomplicated obesity (without heart-related complications), or it might also suggest a preference for those with cardiac dysfunction for the choice to have surgery. The observation of a significant enhancement in this parameter remains evident, suggesting the presence of metabolic processes that exceed normal physiological levels. These include the possibility of enterocardiac axis-mediated immediate gut hormone inotropic action upon the heart [3]. The models that explain how these operations result in beneficial reverse remodeling serve as the foundation for understanding the remarkable enhancements in cardiac imaging after bariatric surgery. The positive outcomes of surgery can occasionally occur regardless of fluctuations in blood pressure. The conventional hemodynamic as well as mechanical weight-dependent impact of bariatric surgery, which involves a decrease in circulating volume, is no longer believed to be the sole cause of the observed reverse remodeling following surgery [22, 23]. Consequently, it is hypothesized that the significant metabolic effects of bariatric surgery, which are not dependent on weight loss, also play a role in the cardiac impacts of the surgery. The combined impact of weight loss as well as metabolic improvement can potentially lead to the reversal of heart geometry & function. [24]. The latest integrated metabolic and hemodynamic theory, proposed on the 24th, offers a more thorough explanation for the positive surgical outcomes. According to this article, metabolites such as leptin and other adipokines contribute to the development of ventricular hypertrophy during early obesity. In morbid obesity, these metabolites further increase circulation volume, leading to ventricular dilatation and hypertrophy. Bariatric surgery can improve heart form and function by reversing metabolic abnormalities. The metabolic consequences of bariatric surgery, including changes in bile flow, a decrease in stomach size, rearrangement of the gut structure, manipulation of the vagus nerve, and manipulation of gut hormones, contribute to the reversal of cardiac remodeling. [25, 26]. The operations mentioned in the study result in enhancements in glucose metabolism, insulin resistance, gut hormonal release, microbiota, as well as adipokine modulation. These improvements can be seen as a model to identify the significant mechanisms that lead to a high level of resolution in obesity-related cardiac dysfunction, similar to a "bionic" level. Manipulating enteric gut hormones via the enterocardiac axis has been demonstrated to have beneficial impacts on cardiac function, [3, 24, 30]. Adenylate cyclase, an essential enzyme involved in communication between cardiac cells, is stimulated by hormones such as secretin, glucagon (produced in the pancreas), & vasoactive intestinal peptide (produced in the pancreas, gut, & brain) to function as inotropes [31]. While the precise processes remain unclear, it is hypothesized that TCA cycle intermediates, cardiorenal protective action, including biochemical caloric restriction likely play a role in enhancing cardiac energy metabolism [32]. Moreover, the hormones glucagon-like peptide-1 (GLP-1) and ghrelin exert a significant influence on cardiac performance. GLP-1 levels are widely recognized to rise following bariatric surgery, leading to increased feelings of fullness and enhanced insulin production. Studies have shown that it can enhance the functional status of individuals with chronic heart failure and alleviate left ventricular systolic dysfunction after a heart attack in humans [33, 34]. Research indicates that the administration of this treatment to individuals with heart failure leads to improvements in stroke volume index, ejection fraction, as well as cardiac index, while also reducing LV wall stress. However, there are conflicting findings about the effects of the appetite-stimulating hormone ghrelin following bariatric surgery. After bariatric surgery, there is a significant decrease in the levels of cardiovascular-related adipokines, including leptin, TNF, & adiponectin, over a period of up to 2 years [35,36]. Leptin levels in the blood are directly related to left ventricular (LV) mass in individuals with extreme obesity, both prior to and following bariatric surgery [37]. This suggests that leptin may contribute to the favorable effects of weight loss treatment on the heart. [38]

Limitations:

There are other limitations in the study that should be taken into account. Initially, the studies that were included exhibited differences in terms of patient groups, follow-up intervals, cardiovascular imaging modalities, and bariatric surgeries. These variations could potentially introduce heterogeneity and impact the generalization of the results. Furthermore, a mere fraction of the studies that were included in the analysis managed to attain a quality score of 7 or higher on the Newcastle-Ottawa Scale, suggesting that the methodological quality of the literature was less than optimal. Furthermore, the utilization of echocardiography in certain research investigations may be prone to subjective assessment and reporting biases, especially in overweight individuals with restricted acoustic windows and inadequate data quality. Finally, the prevalence of retrospectively and prospective observational research without randomized controlled experiments restricts the robustness of the evidence. It could impact the ability to make causal inferences based on the results. Although there are limitations, the current study offers vital insights into how bariatric surgery affects the shape and function of the heart in obese patients.

Conclusion:

Overall, our thorough examination of the effects of bariatric surgery of the structure and function of the heart, utilizing advanced imaging techniques, demonstrates a significant enhancement in both the physical characteristics and performance of the heart after these surgical interventions. Nevertheless, the substantial variation across the studies included restricts the robustness of the conclusions which can be made, highlighting the necessity for additional research to elucidate the impact of bariatric surgery for treating cardiac dysfunction associated with obesity. It is essential to identify the most suitable populations of patients and surgical methods to effectively address the significant morbidity and death caused by obesity-related heart disease. We recommend performing further randomized controlled trials accompanied by mechanistic research to further our comprehension of the possible advantages and constraints of bariatric surgery in enhancing cardiac outcomes in obese individuals.

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