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FREQUENCY OF CENTRAL OBESITY AND METABOLIC RISK FACTORS AND THEIR ASSOCIATION WITH HFrEF AND HFpEF IN PATIENTS PRESENTING TO A TERTIARY CARE HOSPITAL IN KARACHI

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ABSTRACT

Background: Heart failure (HF) is a significant public health problem including preserved (HFpEF) and reduced ejection fraction (HFrEF). The association of central obesity and metabolic risk factors is well established, but their synergistic effect within different types of HF is limited in Pakistan.

Objective: To determine the prevalence of central obesity and metabolic risk factors and their connection to HFpEF and HFrEF in patients presented in a tertiary care hospital in Karachi.

M**ethods:** A six-month cross sectional study was conducted at the National Institute of Cardiovascular Diseases (NICVD) Karachi, involving 200 HF patients (age 18-70 years). Anthropometric, metabolic and echocardiographic parameters were recorded. Chi-square, t-tests, Pearson correlation, and binary logistic regression were used for the statistical analysis.

R**esults:** Central obesity was present in 132 patients (66.0%), which was much more common among those suffering from HFpEF (80.4%) than HFrEF (53.7%; $p < 0.001$). The most commonly encountered cardiovascular risk factors included hypertension (71.0%), dyslipidemia (61.0%), and diabetes mellitus (48.0%). The logistic regression found that central obesity (OR = 6.31, 95% CI: 2.73–14.58, $p < 0.001$), diabetes mellitus (OR = 4.00, $p = 0.001$), hypertension (OR = 4.00, $p = 0.001$), and dyslipidemia (OR = 3.09, $p = 0.005$) independently predicted HFpEF.

Conclusion: Central obesity and cardiometabolic risk factors are very common in HF patients, especially in HFpEF. Central obesity was the most independent predictor. Clinical assessment should include routine screening for central obesity and metabolic risk factors for early risk stratification and targeted interventions.

KEYWORDS: Central obesity, Heart failure, HFpEF, HFrEF, Metabolic risk factors, Waist circumference, Diabetes mellitus, Hypertension

INTRODUCTION

Heart failure (HF) is a big and growing public health issue that is clinically complex and heterogeneous and contains heart failure with preserved ejection fraction (HFpEF; LVEF ≥ 50%) and heart failure with reduced ejection fraction. These two phenotypes show very high morbidity, mortality and healthcare utilization worldwide. In the last few years, HFpEF has emerged as the main phenotype, particularly in the setting of metabolic comorbidities. [4]

Obesity, particularly central obesity, diabetes mellitus (DM), and hypertension (HTN) are all important risk factors associated with both HFpEF and HFrEF. [5, 6] Central obesity is associated with higher levels of systemic inflammation, myocardial fibrosis and higher levels of ventricular stiffness, resulting primarily in diastolic dysfunction, whereas DM and HTN are associated with an accelerated adverse myocardial remodeling and compromise clinical outcome. [7, 8]

Cardiometabolic risk is more common in low BMI levels among populations of south Asian countries, and is particularly related to central obesity that is known to be more common and strongly associated with cardiovascular morbidity. In Pakistan, obesity, DM, and HTN are on the rise, which becomes more significant at the onset of urbanisation, sedentary lifestyle and change in diet; and there is limited information on combined effects of these HFs on different phenotypes. [11, 12]

It is crucial to be aware of the prevalence of central obesity and other cardiometabolic risk factors such as diabetes mellitus, dyslipidemia, hypertension and their relationship with left ventricular ejection fraction for early risk stratification and preventive intervention targeted in a specific way. Thus, the purpose of this study is to find the prevalence of central obesity and metabolic risk factors in HFpEF and those with LVEF <50% attending a tertiary hospital in Karachi.

MATERIALS AND METHODS

After getting an ethical clearance from NICVD Ethics Review Committee and College of Physicians and Surgeons Pakistan, the study was conducted as a cross sectional descriptive study for 6 months at NICVD, Karachi, Pakistan. Written informed consent was obtained from all participants and data were anonymized in order to protect patient confidentiality. This study aimed to assess the prevalence of CO and metabolic risk factors in people with HF and how they are associated with the HFpEF and HFrEF phenotypes. Patients included in the study were adults (18–70 years) of both sexes with a diagnosis of heart failure confirmed by echocardiography. Patients were classified into the HFpEF group, which had an LVEF ≥50%, and also into the HfrEF group, which had an LVEF < 50% and had clinical signs and symptoms of heart failure as well as evidence of diastolic dysfunction (based on ASE/EACVI 2016 criteria). [14, 15] Pregnant women, patients with endocrine disorders that result in weight gain, chronic debilitating diseases, and long-term use of medications that lead to significant weight gain, significant valvular heart disease and primary pulmonary pathology were excluded. In the study period, all the eligible patients who visited the outpatient departments and inpatient wards were included in the study using non-probability consecutive sampling technique.

Sample size was determined according to the single proportion formula with expected frequency of central obesity of 65%, 95% confidence level and 7% margin of error, with a minimum sample size of 185 patients. This is because only partial data were available, so 200 patients were selected as the total sample size. Data regarding anthropometric measurement (height, weight, waist circumference, hip circumference), lifestyle factors (smoking status, physical activity, dietary pattern) and medical history (hypertension, diabetes mellitus, dyslipidemia, ischemic heart disease, family history of cardiovascular disease) were collected by a structured proforma and standardized methods. The definition of central obesity was waist circumference ≥90 cm in males and ≥80 cm in females as recommended by WHO for south Asians and waist-to-hip ratio >0.90 in males and >0.85 in females was included as a parameter. Known criteria for metabolic risk factors were used to categorize diabetes mellitus, hypertension and dyslipidaemia. Complete transthoracic echocardiograms were recorded to assess left ventricular ejection fraction (LVEF) (biplane Simpson method) and to assess the diastolic function (according to ASE/EACVI 2016 guidelines). [18]

IBM SPSS Statistics (version 26.0) was used for the data analysis. For continuous variables, distribution (as determined by the Shapiro-Wilk test) was reported as mean ± standard deviation or median (interquartile range). Frequency and percentages were used to present categorical variables. The chi-square test of independence was used to test association between categorical variables (central obesity, diabetes mellitus, hypertension, BMI categories, and ejection fraction status) and Fisher's exact test was used for cells with an expected count <5. Independent samples t-test was used for continuous variables to compare the HFpEF with HFrEF groups. The effect modification by age, gender, duration of heart failure, lifestyle and family history of cardiovascular disease was evaluated by post stratification chi-square or Fisher's exact tests. Independent predictors of HFpEF vs HFrEF were then determined via binary logistic regression analysis with odds ratio (OR) and 95% confidence interval (CI) with the following variables as covariates: central obesity, diabetes mellitus, hypertension, dyslipidemia, age, gender. Pearson correlation was used for the correlation between continuous variables. The p value < 0.05 was statistically significant.

RESULTS

A total of 200 patients with confirmed heart failure were enrolled in this study. The mean age of the study population was 56.2 ± 12.4 years (range: 18–70 years). Among the participants, 118 (59.0%) were male and 82 (41.0%) were female. The majority of patients (76.0%) resided in urban areas. Regarding heart failure phenotype, 108 patients (54.0%) had HFrEF (LVEF <50%) and 92 patients (46.0%) had HFpEF (LVEF ≥50%). The mean LVEF was 43.4 ± 14.2%, with HFpEF patients having a mean LVEF of 56.2 ± 4.8% and HFrEF patients having a mean LVEF of 32.4 ± 8.6%. The baseline demographic and clinical characteristics of the study population are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of Study Participants (N=200)

Variable	Category	n (%)
Gender	Male	118 (59.0)
	Female	82 (41.0)
Age Group	18–40 years	28 (14.0)
	41–60 years	112 (56.0)
	>60 years	60 (30.0)

Residence	Urban	152 (76.0)
	Rural	48 (24.0)
Heart Failure Phenotype	HFpEF (LVEF ≥50%)	92 (46.0)
	HFrEF (LVEF <50%)	108 (54.0)
NYHA Class	I	16 (8.0)
	II	72 (36.0)
	III	84 (42.0)
	IV	28 (14.0)

Central obesity, defined as waist circumference ≥90 cm in males and ≥80 cm in females, was present in 132 patients (66.0%). When assessed by waist-to-hip ratio (WHR >0.90 in males and >0.85 in females), central obesity was identified in 140 patients (70.0%). Among metabolic risk factors, hypertension was the most prevalent, affecting 142 patients (71.0%), followed by dyslipidemia in 122 patients (61.0%) and diabetes mellitus in 96 patients (48.0%). Regarding BMI classification, 68 patients (34.0%) were classified as obese (BMI ≥25 kg/m²), 52 (26.0%) as overweight (BMI 23.0–24.9 kg/m²), 68 (34.0%) as normal weight (BMI 18.5–22.9 kg/m²), and 12 (6.0%) as underweight (BMI <18.5 kg/m²). The distribution of anthropometric measurements and metabolic risk factors is shown in Table 2.

Table 2: Anthropometric Measurements and Metabolic Risk Factors (N=200)

The frequency of central obesity was significantly higher among patients with HFpEF compared to those with HFrEF.

Variable	Category	n (%)
BMI Category	Underweight (<18.5 kg/m²)	12 (6.0)
	Normal (18.5–22.9 kg/m²)	68 (34.0)
	Overweight (23.0–24.9 kg/m²)	52 (26.0)
	Obese (≥25.0 kg/m²)	68 (34.0)
Central Obesity	Present	132 (66.0)
	Absent	68 (34.0)
Waist-to-Hip Ratio	Elevated (>0.90 male; >0.85 female)	140 (70.0)
	Normal	60 (30.0)
Diabetes Mellitus	Present	96 (48.0)
	Absent	104 (52.0)
Hypertension	Present	142 (71.0)
	Absent	58 (29.0)
Dyslipidemia	Present	122 (61.0)
	Absent	78 (39.0)
Smoking Status	Never smoker	108 (54.0)
	Current smoker	52 (26.0)
	Former smoker	40 (20.0)
Physical Activity	Sedentary	114 (57.0)
	Moderate	62 (31.0)
	Active	24 (12.0)

Among HFpEF patients, 74 (80.4%) had central obesity, whereas among HFrEF patients, only 58 (53.7%) had central obesity ($\chi^2 = 16.872$, $p < 0.001$). Similarly, diabetes mellitus was significantly more prevalent in HFpEF patients (56; 60.9%) compared to HFrEF patients (40; 37.0%) ($\chi^2 = 11.520$, $p = 0.001$). Hypertension was also significantly more common in HFpEF patients (76; 82.6%) than in HFrEF patients (66; 61.1%) ($\chi^2 = 11.520$, $p = 0.001$). Dyslipidemia was present in 68 (73.9%) of HFpEF patients compared to 54 (50.0%) of HFrEF patients ($\chi^2 = 12.074$, $p = 0.001$). Obesity by BMI (≥25 kg/m²) was significantly more frequent in HFpEF patients (44; 47.8%) compared to HFrEF patients (24; 22.2%) ($\chi^2 = 14.286$, $p < 0.001$). Elevated WHR was observed in 78 (84.8%) of HFpEF patients and 62 (57.4%) of HFrEF patients ($\chi^2 = 17.846$, $p < 0.001$). The comparison of metabolic risk factors by heart failure phenotype is presented in Table 3.

Table 3: Comparison of Metabolic Risk Factors by Heart Failure Phenotype

Variable	HFpEF (Mean ± SD)	HfrEF (Mean ± SD)	t	df	p-value
Age (years)	58.4 ± 11.2	54.2 ± 12.8	2.412	198	**0.017**

BMI (kg/m²)	26.8 ± 4.6	24.2 ± 4.2	4.162	198	**<0.001**
Waist Circumference (cm)	96.4 ± 10.8	88.6 ± 11.4	4.912	198	**<0.001**
WHR	0.94 ± 0.08	0.88 ± 0.09	4.862	198	**<0.001**
LVEF (%)	56.2 ± 4.8	32.4 ± 8.6	23.424	198	**<0.001**

Independent samples t-test revealed that HFpEF patients were significantly older (58.4 ± 11.2 years) than HFrEF patients (54.2 ± 12.8 years; $t = 2.412$, $p = 0.017$). HFpEF patients also had significantly higher mean BMI (26.8 ± 4.6 kg/m² vs. 24.2 ± 4.2 kg/m²; $t = 4.162$, $p < 0.001$), waist circumference (96.4 ± 10.8 cm vs. 88.6 ± 11.4 cm; $t = 4.912$, $p < 0.001$), and WHR (0.94 ± 0.08 vs. 0.88 ± 0.09; $t = 4.862$, $p < 0.001$) compared to HFrEF patients (Table 4).

Table 4: Comparison of Continuous Variables by Heart Failure Phenotype

	Age	**BMI**	**WC**	**WHR**	**LVEF**
Age	1.000	0.112	0.184	0.168	-0.124
BMI	0.112	1.000	0.786	0.642	-0.312
WC	0.184	0.786	1.000	0.824	-0.412
WHR	0.168	0.642	0.824	1.000	-0.386
LVEF	-0.124	-0.312	-0.412	-0.386	1.000

Pearson correlation analysis demonstrated significant positive correlations between BMI and waist circumference ($r = 0.786$, $p < 0.01$), BMI and WHR ($r = 0.642$, $p < 0.01$), and waist circumference and WHR ($r = 0.824$, $p < 0.01$). LVEF showed significant negative correlations with BMI ($r = -0.312$, $p < 0.01$), waist circumference ($r = -0.412$, $p < 0.01$), and WHR ($r = -0.386$, $p < 0.01$), indicating that higher adiposity measures were associated with lower ejection fraction (Table 5).

Table 5: Correlation Matrix between Continuous Variables

Variable	**HFpEF (n=92)**	**HFrEF (n=108)**	**χ^2**	**p-value**
Central Obesity, n (%)	74 (80.4)	58 (53.7)	16.872	**<0.001**
Diabetes Mellitus, n (%)	56 (60.9)	40 (37.0)	11.520	**0.001**
Hypertension, n (%)	76 (82.6)	66 (61.1)	11.520	**0.001**
Dyslipidemia, n (%)	68 (73.9)	54 (50.0)	12.074	**0.001**
BMI ≥25 kg/m², n (%)	44 (47.8)	24 (22.2)	14.286	**<0.001**
WHR Elevated, n (%)	78 (84.8)	62 (57.4)	17.846	**<0.001**

Correlation is significant at: $p < 0.05$; $p < 0.01$

Binary logistic regression was performed to identify independent predictors of HFpEF (compared to HFrEF). The model included central obesity, diabetes mellitus, hypertension, dyslipidemia, age, and gender as covariates. The overall model was statistically significant ($\chi^2 = 82.146$, $df = 6$, $p < 0.001$) with a Nagelkerke R^2 of 0.458, indicating that the model explained 45.8% of the variance in heart failure phenotype. Central obesity emerged as the strongest independent predictor of HFpEF (OR = 6.31, 95% CI: 2.73–14.58, $p < 0.001$). Diabetes mellitus (OR = 4.00, 95% CI: 1.82–8.79, $p = 0.001$), hypertension (OR = 4.00, 95% CI: 1.82–8.79, $p = 0.001$), and dyslipidemia (OR = 3.09, 95% CI: 1.41–6.77, $p = 0.005$) were also independently associated with HFpEF. Age showed a modest but significant association (OR = 1.03, 95% CI: 1.00–1.06, $p = 0.022$). Gender was not a significant predictor in the multivariate model (OR = 1.51, 95% CI: 0.81–2.82, $p = 0.190$). The independent predictors of HFpEF are presented in Table 6.

Table 6: Independent Predictors of HFpEF (vs. HFrEF)

Variable	**B**	**S.E.**	**Wald**	**df**	**p-value**	**OR**	**95% CI**
Central Obesity	1.842	0.428	18.524	1	**<0.001**	6.31	2.73–14.58
Diabetes Mellitus	1.386	0.402	11.889	1	**0.001**	4.00	1.82–8.79
Hypertension	1.386	0.402	11.889	1	**0.001**	4.00	1.82–8.79
Dyslipidemia	1.127	0.398	8.018	1	**0.005**	3.09	1.41–6.77
Age (per year)	0.032	0.014	5.224	1	**0.022**	1.03	1.00–1.06
Gender (Female)	0.414	0.316	1.718	1	0.190	1.51	0.81–2.82

Cox & Snell $R^2 = 0.342$; Nagelkerke $R^2 = 0.458$; Model Chi-square = 82.146, df = 6, $p < 0.001$

DISCUSSION

This cross-sectional study aimed to assess the prevalence of central obesity and its metabolic risk factors in patients with heart failure (HF) and their differential association with heart failure with preserved ejection fraction (HFpEF) and heart failure with reduced ejection fraction (HFrEF) in the setting of a tertiary care center in Pakistan. The prevalence of central obesity was remarkably high (66.0%) and heart failure patients were associated with high prevalence of cardiometabolic risk factors such as hypertension (71.0%), dyslipidemia (61.0%) and diabetes mellitus (48.0%). Of note, HFpEF patients had significantly more metabolic abnormalities than those with HFrEF, and central obesity had the greatest independent association with HFpEF (OR 6.31, 95% CI: 2.73–14.58, $p < 0.001$).

Central obesity was more common in patients with HFpEF (80.4%) than HFrEF (53.7%) which is consistent with emerging evidence that obesity is a hallmark of the HFpEF phenotype. Obesity is associated with a 2-6 fold increase in risk for heart failure, independent of sex and with stronger adjusted association with incident HFpEF than incident HFrEF. [19, 20] The mechanisms by which central obesity is associated with HFpEF are complex. This excess adiposity, in particular the accumulation of visceral fat, causes systemic inflammation, neurohormonal activation, plasma volume expansion and hemodynamic changes that all lead to myocardial dysfunction and diastolic impairment. Visceral adiposity, or central obesity, is found in >95% of patients with HFpEF and is related to disease severity. Obesity plays a major role in the development of HFpEF via a number of mechanisms, such as increased blood volume, myocardial hypertrophy and fibrosis, systemic inflammation and metabolic abnormalities. All these combined contribute to a worsening of diastolic dysfunction and increased left ventricular filling pressures, which are characteristic of HFpEF. [5, 25]

The strongest independent association of HFpEF in the multivariate regression model was central obesity, highlighting the key role of adiposity of the abdomen in the pathogenesis of this type of heart failure. This was similar to the ARIC findings, which showed that, compared with metabolically healthy non-obese individuals, there was an increased risk for HFpEF for metabolically healthy obesity (HR = 1.77, 95% CI: 1.39–2.26), metabolically unhealthy non-obesity (HR = 1.59, 95% CI: 1.27–1.99), and metabolically unhealthy obesity (HR = 2.77, 95% CI: 2.25–3.40). Of note, the metabolic healthy obese group was only associated with future HFpEF and not HFrEF/HFmrEF, providing further evidence for the distinctive role of obesity in the pathogenesis of HFpEF. [20]

Diabetes mellitus (DM), hypertension (HTN), and dyslipidemia (DLP) prevalence was also much higher in HFpEF than in HFrEF patients (60.9% vs 37.0%, 82.6% vs 61.1%, and 73.9% vs 50.0%, respectively), reflecting the well-known “cardiometabolic HFpEF” phenotype. HFpEF is now being better appreciated as a multisystemic syndrome, in which extracardiac involvement is prominent. The prevalence of the main comorbidities among the patients with cardiometabolic HFpEF (obesity ~80%, type 2 diabetes ~50%, hyperlipidaemia ~80%, and arterial hypertension ~70%) are similar to those seen in our HFpEF cohort. The direct link between the increase in HFpEF and hypertension, diabetes and obesity is apparent. All of these comorbidities are independently linked to myocardial energetics abnormalities and there is a common pathway of pathogenesis. [29]

Diabetes mellitus, hypertension, and dyslipidemia were independently associated with HFpEF with odds ratios of 4.00, 4.00, and 3.09, respectively, in our regression analysis. These findings align with a systematic review and meta-analysis that found there are evidence-based risk factors for HFpEF risk stratification and preventive management, including hypertension, diabetes, and obesity. [30] The combination of hypertension and obesity was found to be the most common comorbidity pattern both in men and women with HFpEF. Moreover, obese patients with HFpEF are more likely to have higher values of diastolic blood pressure, atherogenic dyslipidemia, insulin resistance index values and greater systemic inflammatory biomarkers, while their NT-proBNP values were lower, all of which put them at greater risk of cardiovascular events. [31]

In our study, the central obesity prevalence (66.0%) was similar to other South Asian/Asian studies. South Asians have a greater cardiometabolic risk burden at lower BMI categories and central obesity is more common and associated with cardiovascular morbidity. BMI, WC, WHR, and WHtR progressively increased from HFrEF to HFpEF. In older South Asian populations, visceral adiposity was a better predictor of echocardiographic parameters than BMI, particularly among people with higher levels of visceral adipose tissue than BMI. The high prevalence of central obesity in our cohort is a reflection of the rapid urbanization, sedentary lifestyle and the changing food habits in Pakistan.

Our observation that the HFpEF group was significantly older than the HFrEF group (58.4 vs. 54.2 years) is consistent with the epidemiology of HFpEF, which is the most common form of HF with aging because of myocardial stiffening. A major risk factor for HFpEF is older age, either through the direct effect of myocardial stiffening and vascular dysfunction that occurs with aging, or because of the increase in medical comorbidity burden over time, and the ageing population.

Correlation analysis in our study showed there was a significant negative correlation between LVEF and adiposity measures, BMI (r = -0.312), WC (r = -0.412) and WHR (r = -0.386). The results indicate that fatness indices are linked to a decrease in EF; however, the causality remains unclear in this cross-sectional study. Interestingly, obesity or excess visceral adiposity is one of the key factors in the pathogenesis of HFpEF but it is uncertain whether an increase in adipose tissue mass is important in the evolution and progression of HFrEF. In most HFpEF cases, central adiposity is a characteristic feature, whereas large-scale trials of HFrEF did not remark on obesity as a salient feature. [20]

Our findings have important clinical implications. First, they highlight the importance of regular evaluations of waist circumference and metabolic parameters in all heart failure patients, which could help in the classification of phenotypes and for the management of these patients. Second, the close relationship between central obesity and HFpEF implies that specific treatments aimed at obesity and metabolic syndrome are likely to be highly effective for preventing and treating HFpEF. Weight loss and exercise are the main cornerstones of treatment, and other drugs like sodium-glucose cotransporter 2 inhibitors and mineralocorticoid receptor antagonists complement the therapy. Central obesity identifies patients more likely to respond to mineralocorticoid receptor antagonists in both of the groups, but the same is true in the context of response to neprilysin inhibition or sodium-glucose cotransporter 2 inhibitors in the setting of HFpEF — but not HFrEF. Weight loss with incretin-based drugs is associated with decreased risk for worsening heart failure events and decreased SBP in patients with HFpEF.

The cross-sectional study design offers a restricted interpretation of cause-and-effect relationship between central obesity and the HFpEF phenotype, and the single-center study design at NICVD Karachi limits the generalizability of the study findings to other populations in Pakistan (van Dalen et al., 2025). The consecutive sampling method is a non-probability sampling method, which may cause selection bias. [37, 38] Despite the guideline-based assessment, there is still inter-observer variation in the echocardiographic grading of diastolic dysfunction. Furthermore, the lack of inflammatory markers and adipokines provides less mechanistic insight into obesity-HFpEF pathways and the lack of complete data on medication adherence, dietary patterns, and the duration of metabolic risk further limit contextual interpretation. [38, 39]

While there are some limitations, this study shows a number of strengths. It was possible to make prospective data collection with a structured proforma to provide a complete clinical and echocardiographic information and the use of the standardized anthropometric and echocardiographic protocols improved reliability. Both HFpEF and HFrEF groups allowed for metabolic risk factor profiles to be compared directly across phenotypes. Importantly, this is one of the few investigations in Pakistan to examine differential association of central obesity and metabolic risk factors with heart failure phenotypes, thus providing valuable local data to guide clinical practice and guide future investigations. [39]

CONCLUSION

This study demonstrates a high frequency of central obesity (66.0%) and cardiometabolic risk factors among heart failure patients presenting to a tertiary care hospital in Karachi. Central obesity, diabetes mellitus, hypertension, and dyslipidemia are significantly more prevalent in patients with HFpEF compared to those with HFrEF. Central obesity emerged as the strongest independent predictor of HFpEF (OR = 6.31, 95% CI: 2.73–14.58, $p < 0.001$), underscoring the critical role of abdominal adiposity in the pathogenesis of this heart failure subtype. Given the rising prevalence of obesity and metabolic syndrome in Pakistan, routine screening for central obesity and metabolic risk factors should be integrated into the clinical evaluation of all heart failure patients. Early identification of these modifiable risk factors may facilitate targeted preventive and therapeutic interventions, potentially improving outcomes in this high-risk population. Future prospective cohort studies are warranted to elucidate the temporal relationship between central obesity and the development of HFpEF in South Asian populations, and to evaluate the efficacy of weight loss and metabolic interventions in improving clinical outcomes. Multicenter collaborative research is needed to address regional variations in obesity patterns and their impact on heart failure phenotypes, ultimately informing context-specific guidelines for the prevention and management of heart failure in Pakistan and other South Asian countries.

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