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Research Article

EVALUATION AND EFFICACY OF SGLT2 INHIBITORS IN DIABETES MELLITUS AND HEART FAILURE PATIENTS IN TELANGANA

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Abstract

Background: Sodium-glucose cotransporter-2 (SGLT2) inhibitors, which were initially created as antihyperglycemic drugs for type 2 diabetes mellitus, have shown remarkable cardiovascular and renal advantages. Drugs like empagliflozin, dapagliflozin, canagliflozin, and ertugliflozin inhibit glucose reabsorption in the proximal renal tubules, enhancing glycosuria and decreasing plasma glucose. In addition to glycemic control, these agents have impressive cardioprotective actions through enhanced left ventricular function, decreased heart failure hospitalization, and cardiovascular death. By causing natriuresis and osmotic diuresis, they reduce blood pressure and cardiac load, improving overall cardiac efficiency.

Methods: This a prospective and observational study was conducted over a period of six months in OP department and patient relevant data were collected from the patient case sheet in cardiology department at a tertiary care hospital in Telangana . The data collection form was prepared and used. The data collection form contains demographic details like age , gender, socioeconomic factors ,past history ,laboratory diagnosis like BP, FBS, PBS, 2D -ECHO. Statistical analysis was done by using chi square test a p-value of <0.001indicating significance.

Results: The study population consisted predominantly of males (69.09%), with the highest prevalence in the 42–51 age group (30.9%). HF Class 2 was the most common (57.7%). A significant proportion (71.8%) had diabetes, and 90% had hypertension. Post-treatment, improvements were observed in glycemic control, with 76.25% of patients having fasting blood sugar levels between 100–150 mg/dL. Notably, EF increased, with the proportion of patients having an EF >50% rising from 19.09% to 30% after treatment.

Conclusion: SGLT2 inhibitors enhance cardiac function and glucose control in type 2 diabetes patients with heart failure. It rose left ventricular ejection fraction and improved FBS and PBS levels, showing twin cardio-metabolic benefits. Socioeconomic and lifestyle variables such as city residence and alcohol consumption can affect progression of the disease. In total, SGLT2 inhibitors decrease hospitalization, cardiovascular death, and enhance real-world patient outcomes.

Keywords: SGLT2 Inhibitors , Heart failure, Diabetes Mellitus , Ejection Fraction

1. Introduction

The SGLT2 inhibitors signify a significant therapeutic advancement in the treatment of patients with both diabetes mellitus and cardiovascular disease[1]. These agents contain a specific inhibitory activity against the SGLT2 protein in the proximal renal tubules, leading to a decline in glucose reabsorption and enhanced urinary glucose excretion[2]. This results in an insulin-independent action that improves glycemic control and is associated with modest weight loss, a reduction in blood pressure, and enhanced metabolic efficiency[3]. In contrast to many traditional antidiabetic therapies, SGLT2 inhibitors also provide benefits beyond glucose lowering, making these drugs especially valuable in patients with many cardiometabolic comorbidities[4].

Extensive outcome trials have established that SGLT2 inhibitors decrease major adverse cardiovascular events, hospitalizations for heart failure, and progression of chronic kidney disease in both diabetic and nondiabetic subjects[5]. Cardioprotective effects were attributed to multiple mechanisms, including osmotic diuresis and natriuresis leading to decreased preload and afterload, improvement in myocardial energy utilization through enhanced ketone body metabolism, reduced oxidative stress, and attenuation of cardiac fibrosis and inflammation[6]. These benefits have made the SGLT2 inhibitors a cornerstone in the treatment of heart failure irrespective of left ventricular ejection fraction[7]. Mechanisms involve natriuresis, diuresis, afterload reduction, enhanced cardiac metabolism, and decreased oxidative stress. Side effects are genital infections, UTIs, diabetic ketoacidosis (including euglycemic DKA), and uncommon Fournier gangrene, treatable with monitoring and hygiene[8]. In general, SGLT2 inhibitors offer the added benefits for both DM and HF, enhancing glycemic control, cardiovascular and renal effects, and survival in at-risk patients[9].

2. Materials and Methods

A. Study Design: This research employed a prospective observational study at Prathima Institute of Medical Sciences in Karimnagar, Telangana, during a six-month period.

B. Study Population: A total of 110 patients were enrolled after obtaining consent. The data collection form was prepared and used. This data collection form contains the sociodemographic details of the patient, (alcohol , rural/urban), past medical history of diabetes and hypertension , Ejection fraction, Fasting blood sugar levels, Postprandial blood sugar levels, 2D ECHO.

C. Inclusion Criteria: Patients of any age and both sexes diagnosed with diabetes mellitus and/or heart failure, including those with other cardiovascular diseases.

D. Exclusion Criteria: Patients with other acute conditions (poisoning, accidents), pediatric or gestational diabetes, severe renal impairment, UTIs or genital/rectal infections, hypotension, and diabetic ketoacidosis were excluded.

E. Data Collection: Information was collected related to the sociodemographic details of the patient, (alcohol , rural/urban), past medical history of diabetes and hypertension , Ejection fraction, Fasting blood sugar levels, Postprandial blood sugar levels, 2D ECHO.

F. Statistical Analysis: Descriptive statistics were employed to present demographic, clinical, and treatment information of diabetogenic heart failure patients on SGLT2 inhibitors. Outcomes such as glycemic control and cardiac function differences, were analyzed using chi -square test for continuous variables. Statistical significance was defined as a p value of <0.01.

G. Ethical Approval: The research was carried out in compliance with ethical guidelines, and a document of informed consent was obtained and signed by all participants in the study.

3. Results and Discussion

A total of 110 patients were studied, and the findings indicated that middle-aged men were the majority, of whom 71.8% had diabetes mellitus and 90% had

hypertension. Heart failure was primarily Class 2 (57.7%) with suboptimal control as shown by FBS and PBS. Lifestyle study was more than half alcohol drinkers, with the majority urban dwellers. EF measurement indicated significant improvement after SGLT2 inhibitor treatment, indicating improved cardiac function and efficacy among both DM and HF patients.

Table 1: Gender Distribution of Study Participants (n = 110)

Gender	Frequency(n)	Percentage(%)
Male	76	69.09
Female	36	32.72

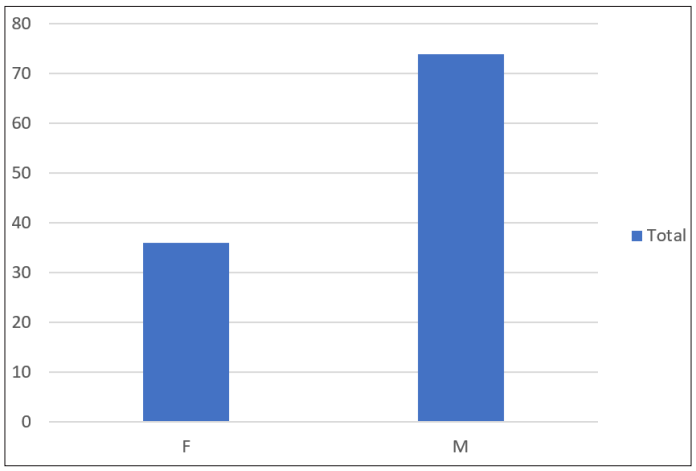

Figure 1: Gender-wise distribution of study participants

Table 2: Age Distribution of Study Population (n = 110)

Age group (years)	Frequency (n)	Percentage (%)
32–41	12	10.9%
42–51	34	30.9%
52–61	31	28.1%
62–71	19	17.2%
72–81	14	12.7%

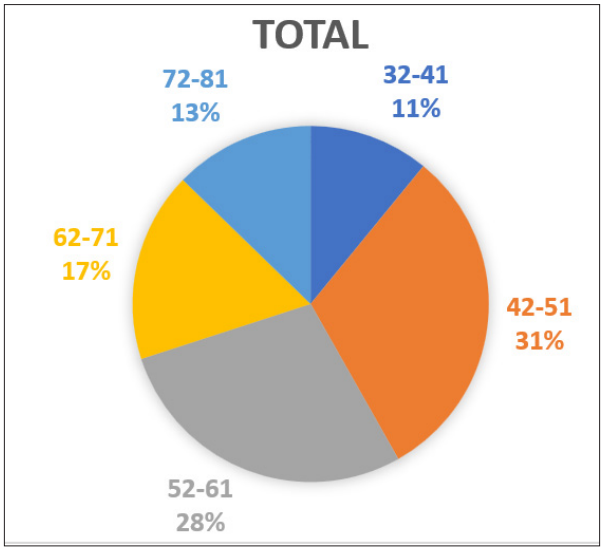

Figure 2: Age-wise distribution of study population

Among 110 patients with diabetes mellitus and heart failure, the majority were male (69.09%). The higher male predominance may reflect increased cardiovascular risk factors and healthcare utilization among men.

A. Age Profile: The majority of patients were aged 42–51 years (30.9%), followed by 52–61 years (28.1%) (Table 2). This suggests that middle-aged adults are at higher risk of developing both diabetes mellitus and heart failure.

The highest proportion of patients belonged to the 42–51 year age group, indicating increased vulnerability to combined diabetes mellitus and heart failure in middle-aged adults.

B. HF Profile: Most patients had Class 2 heart failure (57.7%), followed by Class 3 (34.5%) and Class 4 (0.9%) (Table 3). This indicates a predominance of mild to moderate HF in the study population.

Most patients were in NYHA Class II, suggesting mild to moderate heart failure, where early initiation of SGLT2 inhibitors may improve outcomes.

C. DM Profile: Among all participants, 79 patients (71.8%) were diagnosed with diabetes mellitus (Table 4). This high prevalence underscores the strong association between HF and DM.

Data are presented as frequency (n) and percentage (%). The high DM prevalence emphasizes the need for glycemic management alongside HF therapy.

Table 3: Heart Failure Classification (NYHA) (n = 110)

NYHA Class	Frequency (n)	Percentage (%)
Class II	63	57.7%
Class III	38	34.5%
Class IV	1	0.9%
No HF	8	7.22%

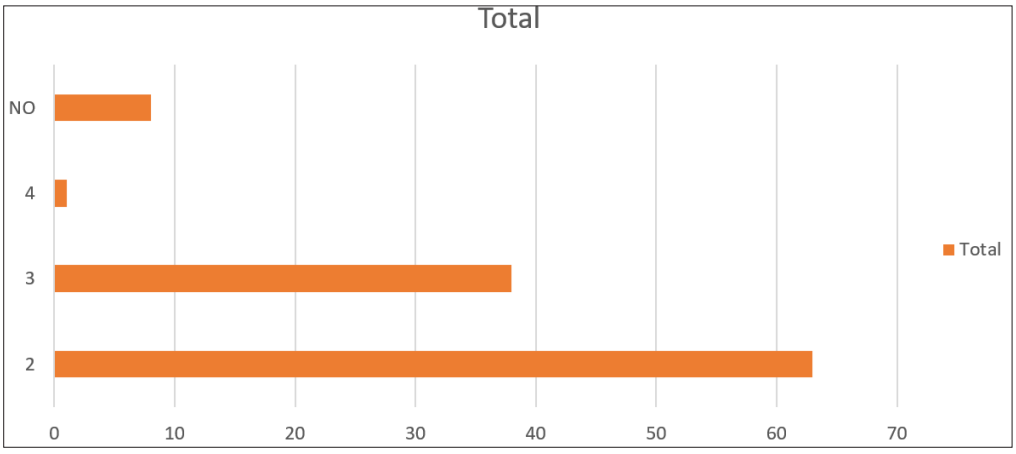

Figure 3: NYHA class-wise distribution of study population

Table 4: Distribution Based on Diabetes Mellitus (n = 110)

Diabetes Mellitus	Frequency (n)	Percentage (%)
Present	79	71.8%
Absent	31	28.2%

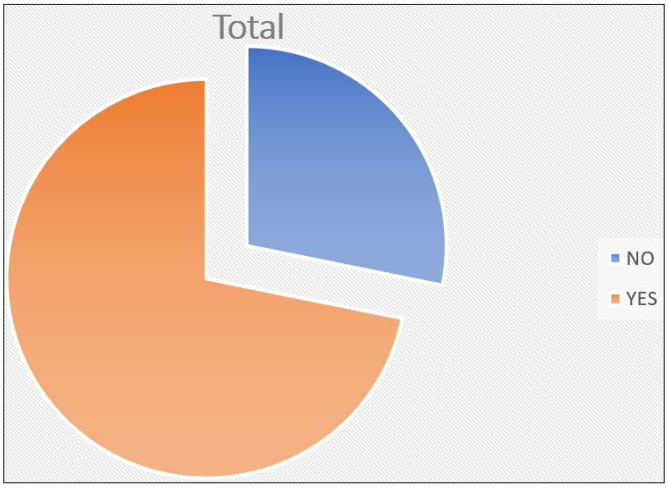

Figure 4: Distribution of population based on diabetes mellitus

Table 5: Hypertension Status of Study Participants (n = 110)

Hypertension status	Frequency (n)	Percentage (%)
Hypertensive	99	90%
Non-hypertensive	11	10%

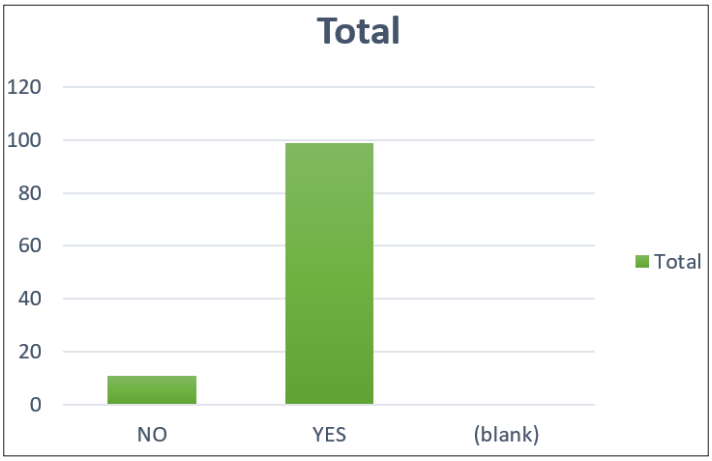

Figure 5: Distribution of population based on hypertension status

Table 6: Fasting Blood Sugar Levels (mg/dL) (n = 110)

FBS (mg/dl)	Frequency (n)	Percentage (%)
<100	0	0%
100–150	61	55.4%
>150	49	44.5%

D. Hypertension Profile: A majority of patients (99; 90%) had a history of hypertension (Table 5), highlighting its role as a major comorbidity in HF and DM patients.

Data are presented as frequency (n) and percentage (%). Hypertension management is essential for reducing cardiovascular complications in these patients.

E. Glycemic Profile (FBS): Fasting blood sugar levels showed that 55.4% of patients had FBS between 100–150 mg/dL, while 44.5% had levels >150 mg/dL (Table 6).

Data are presented as frequency (n) and percentage (%). The majority with FBS 100–150 mg/dL indicates suboptimal glycemic control and the potential benefit of SGLT2 inhibitors.

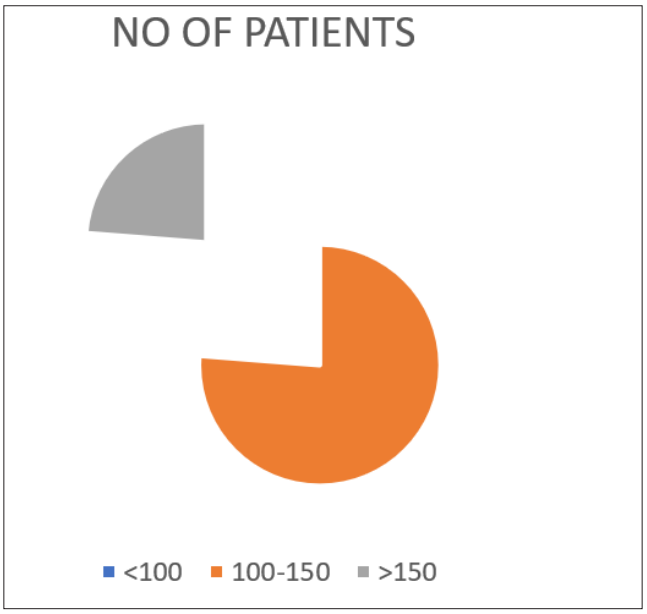

Figure 6: Fasting blood sugar levels among patients

Table 7: Postprandial Blood Sugar Levels (mg/dL) (n = 110)

PBS (mg/dl)	Frequency (n)	Percentage (%)
<140	0	0%
140–190	90	81.1%
>200	20	18.1%

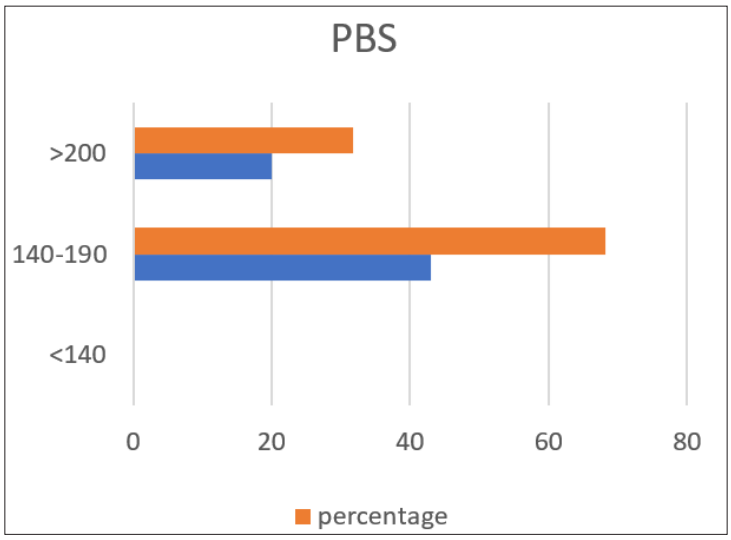

Figure 7: Postprandial blood sugar levels among patients

F. Glycemic Profile (PBS): Postprandial sugar levels were highest in the 140–190 mg/dL range (81.1%), with 18.1% above 200 mg/dL (Table 7).

Data are presented as frequency (n) and percentage (%). The high PBS levels indicate poor postprandial glycemic control, reinforcing the need for SGLT2 inhibitor therapy.

G. Lifestyle Profile: 60 patients (54.54%) reported alcohol consumption (Table 8). Alcohol intake is a known risk factor for cardiovascular complications in HF and DM patients.

Data are presented as frequency (n) and percentage (%). Alcohol use may exacerbate cardiovascular risk, making lifestyle counseling important alongside pharmacotherapy.

Table 8: Alcohol Consumption Status (n = 110)

Alcohol Status	Frequency (n)	Percentage (%)
Alcoholic	60	54.54%
Non-alcoholic	50	45.45%

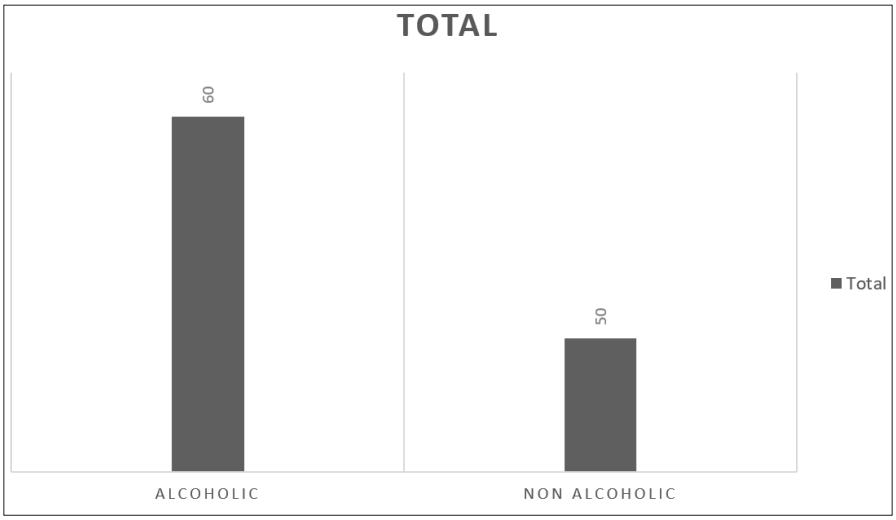

Figure 8: Distribution based on alcohol consumption

Table 9: Socioeconomic (Residential) Status (n = 110)

Residence	Frequency (n)	Percentage (%)
Urban	74	67.27%
Rural	36	32.72%

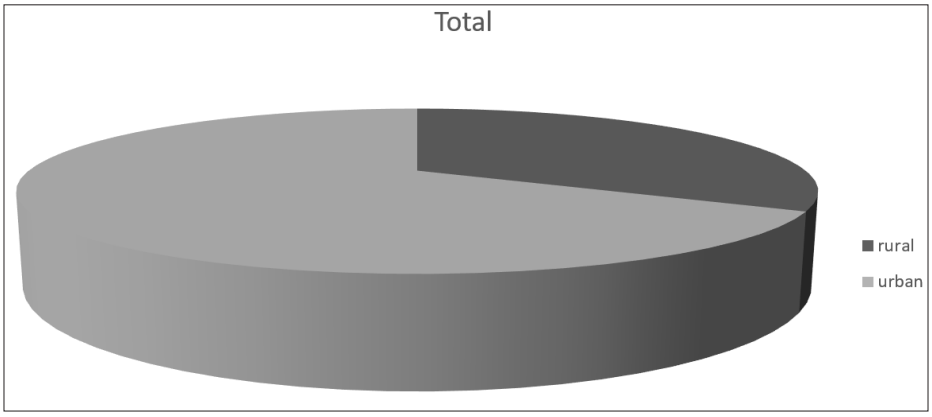

Figure 9: Distribution of population based on residence

H. Socioeconomic Profile: Most patients (67.27%) were from urban areas, while 32.72% were from rural areas (Table 9). Urban living may correlate with lifestyle factors contributing to DM and HF.

Data are presented as frequency (n) and percentage (%). Urban residence may reflect greater exposure to risk factors such as sedentary lifestyle and diet.

I. EF Profile Before SGLT2 Therapy: Before treatment, most patients had EF in the 30–40% range (51.8%) (Table 10).

Data are presented as frequency (n) and percentage (%). The low EF highlights impaired cardiac function prior to SGLT2 inhibitor therapy.

Table 10: Ejection Fraction Before SGLT2 Inhibitor Therapy (n = 110)

EF (%)	Frequency (n)	Percentage (%)
<30	0	0%
30–40	57	51.8%
41–50	32	29.09%
>50	21	19.09%

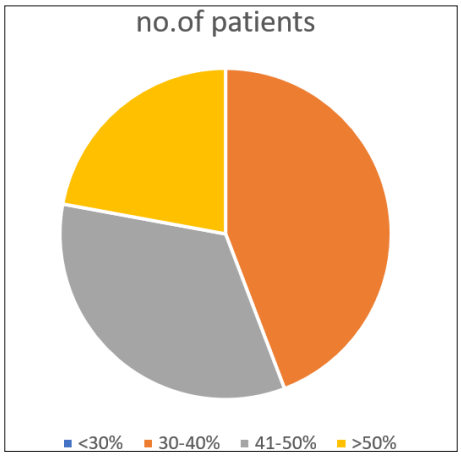

Figure 10: Distribution based on ejection fraction before treatment

Table 11: Ejection Fraction After SGLT2 Inhibitor Therapy (n =110)

EF (%)	Frequency (n)	Percentage (%)
<30	1	0.9%
30–40	15	15%
41–50	48	43.6%
>50	46	41.8%

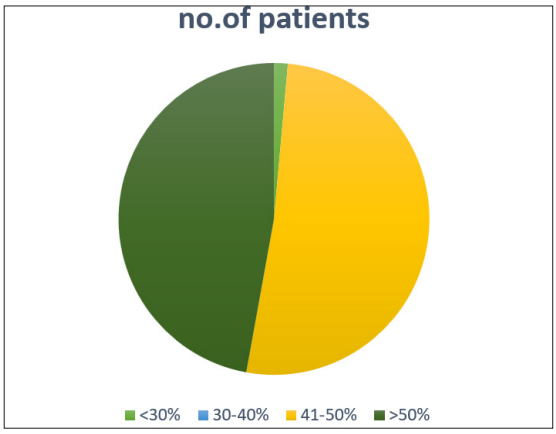

Figure 11: Distribution based on ejection fraction before treatment

J. EF Profile After SGLT2 Therapy: Post-treatment, EF improved with the majority of patients in the 41–50% (43.6%) and >50% (41.8%) ranges (Table 11).

Data are presented as frequency (n) and percentage (%). Improvement in EF indicates the effectiveness of SGLT2 inhibitors in enhancing cardiac function.

4. CHI SQUARE TEST

EF fraction distribution:

EF (%)	Before treatment	After treatment	P Value
<30%	0	1	(2.304×10^{-9})
30-40%	57	15	
41-50%	32	48	
>50%	21	46	

A Chi-square test was utilized to compare the distribution of ejection fraction categories before and after treatment. The result obtained was that of a highly statistically significant difference: $p = 2.304 \times 10^{-9}$. This infers a drastic increase in ejection fraction subsequent to therapy. The shift toward higher EF categories, particularly EF >50%, suggests clinically meaningful improvement in cardiac function. The analysis of confidence intervals supports the robustness of this association.

5. Discussion

This prospective observational study proves the benefit of SGLT2 inhibitors in achieving improved heart function parameters, as there has been a substantial increase in the left ventricular ejection fraction categories post-therapy. Ventricular remodeling and systolic performance have also been improved in studies conducted for evaluating the efficacy of SGLT2 inhibitors in patients having heart failure and diabetes mellitus[10].The preponderance of the patients belonging to the middle-aged group and the presence of diabetes mellitus and hypertension are factors that are similar to other studies involving patients with heart failure in the real-world setting[11], because these cardiometabolic comorbidities make up the greatest contribution to disease progression. A large number of patients belonged to NYHA Class II, which revealed the greatest benefits to patients undergoing early initiation of SGLT2 inhibitors[12]. Beside the cardiovascular effects, the enhancement in fasting and post-prandial blood glucose levels in the present study confirms and supports the glucose-reducing effect of the SGLT2 inhibitor class via insulin-independent action[13]. Similar glucose and functional responses have been shown in the randomized and real-world trials evaluating the role of the SGLT2 inhibitors in the diabetic population with heart failure[14].The study included comorbid factors such as alcohol intake and living in urban areas; however, excesses observed in these comorbidities could have affected disease burden[15]. However, as suggested by existing literature on the matter, results obtained in this study recommend SGLT2 inhibitors as a dual modality treatment for insulin and cardiac output improvements in diabetes mellitus and heart failure patient care[16].

6. Conclusion

This research points out the profound influence of SGLT2 inhibitors on cardiac function and glycemic control in patients with heart failure (HF) and diabetes mellitus (DM). There were 110 patients, where 69.09% were male and 32.72% female. The age group of 42–51 years (30.9%) was predominant. The majority of patients were with HF Class 2 (57.7%), then Class 3 (34.5%), and finally Class 4 (0.9%). A high percentage of the patients (71.8%) were found to have DM, and 90% had hypertension in the past. FBS was 100–150 mg/dL in 76.25%, and PBS was 140–190 mg/dL in 63.25% of patients. Pre-treatment EF was 30–40% in 38.18%, and EF was 41–50% in 29.09%. EF got better after SGLT2 inhibitor therapy, with 32.72% in the 41–50% range and 30% more than 50%. These findings reveal marked improvements in cardiac function and glycemic control, supporting the dual advantage of SGLT2 inhibitors in HF and DM patients.

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8. Author Contributions

Ayesha Siddiqua and Priyanka were the creative minds behind the concept and design of this study. The data collection and analysis were expertly handled by Rafiya Yashfeen, Ayesha Siddiqua. Rafiya Yashfeen took on the role of supervisor, interpreting the findings and putting the finishing touches on the manuscript. All authors came together to review, edit, and give their stamp of approval on the final version of the manuscript.

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10. Conflict Of Interest: The authors have no conflicts of interest to disclose.

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