Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(4), 1497-1501 | ISSN:2251-6727

# "Study of Left Ventricular Systolic and Diastolic Function in Chronic Kidney Disease"

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***(Received: 16 May 2025 Revised: 20 June 2025 Accepted: 24 July 2025)***

**KEYWORDS**

Chronic Kidney Disease, Left Ventricular Dysfunction, Hypertension, Echocardiography , Cardiovascular Risk, Serum Creatinine.

**ABSTRACT:**

Background: Chronic Kidney Disease (CKD) is a progressive condition associated with significant cardiovascular complications, particularly left ventricular dysfunction. Cardiovascular disease is the leading cause of mortality in CKD patients, and left ventricular systolic and diastolic dysfunction play a crucial role in adverse outcomes. Echocardiography serves as a vital tool in assessing cardiac dysfunction in CKD patients, enabling early detection and intervention.

Aim: The study aims to assess the prevalence of left ventricular systolic and diastolic dysfunction in CKD patients and evaluate its correlation with estimated glomerular filtration rate (eGFR) and hypertension.

Materials and Methods: This cross-sectional study was conducted at Aarupadai Veedu Medical College and Hospital over 18 months. A total of 70 CKD patients were included based on defined inclusion and exclusion criteria. Electrocardiography (ECG) and two-dimensional echocardiography (2D-ECHO) were used to evaluate left ventricular function. Data were statistically analyzed using SPSS v23.0, with a significance level set at $p<0.05$.

Results: The mean age of the participants was 52.05 years, with a male predominance (64.3%). Hypertension was prevalent in 80% of cases, and 65.7% of patients were on dialysis. ECG findings indicated left ventricular hypertrophy (LVH) in 62.9% of cases. Left ventricular dysfunction was observed in varying degrees: 31.4% had grade 2 dysfunction, 18.6% had grade 1, 11.4% had moderate biventricular dysfunction, and 10.0% had grade 0 dysfunction, while 28.6% had normal cardiac function. A significant association was found between serum creatinine levels and left ventricular dysfunction ($p<0.05$). Hypertensive CKD patients had a significantly higher incidence of left ventricular dysfunction compared to normotensive individuals ($p<0.05$).

Conclusion: The study underscores the high prevalence of left ventricular dysfunction in CKD patients, particularly among those with hypertension and elevated serum creatinine levels. Early detection through echocardiography and timely interventions may help mitigate cardiovascular risks in this vulnerable population.

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**Introduction:**

Chronic kidney disease (CKD) represents a significant public health challenge, characterized by progressive structural and functional deterioration of the renal glomeruli.[1,2] This decline in kidney health leads to a gradual loss of renal function, significantly increasing the risk of cardiovascular complications that can result in premature mortality. As CKD advances, its consequences worsen over time, ultimately culminating in end-stage renal failure, necessitating dialysis or transplantation for survival.[3] Earlier stages of CKD can be detected through laboratory testing. Accumulating evidence in the past 3 decades indicates that the identification of CKD in earlier stages can prevent its progression and delay the onset and progression of its outcomes.[4,5]

Globally, inconsistencies persist in the definition, classification, and diagnostic criteria for chronic kidney disease (CKD), leading to a lack of standardization. To address this issue, the National Kidney Foundation (NKF) and the Dialysis Outcomes Quality Initiative (DOQI) advisory board established clinical practice guidelines in 2012 to provide a uniform framework for defining and staging CKD. According to these guidelines, CKD is characterized by renal damage persisting for at least three months, identified through structural or functional abnormalities, even in the absence of a reduced glomerular filtration rate (GFR). Diagnosis may be based on pathological findings, biomarkers, or imaging abnormalities. Additionally, CKD is defined by a GFR of less than 60 mL/min/1.73m² for three months or longer, with or without evidence of kidney damage.[2]

CKD is not a static condition. It tends to progress and worsen over time to ultimately end up with kidney failure because of the progress of the disease To the best of our knowledge, there are limited studies that have investigated the prevalence and risk factors associated with left ventricular dysfunction in CKD patients using echocardiography.[6–10] The proposed study aims to address this gap in knowledge by using echocardiography to assess the prevalence of left ventricular dysfunction in CKD. The study results can provide valuable insights into the pathophysiology of left ventricular dysfunction in CKD patients, which can guide the development of targeted interventions to prevent or treat this condition. Additionally, the study results can contribute to the growing body of literature on the cardiovascular complications of CKD, ultimately improving patient outcomes.[11–14] The study aims to assess the prevalence of left ventricular systolic and diastolic dysfunction in CKD patients and evaluate its correlation with estimated glomerular filtration rate (eGFR) and hypertension.

**Material & Method**

The study was a cross-sectional study conducted at Aarupadai Veedu Medical College and Hospital after approval from the institutional ethics committee. Data were collected from patients diagnosed with chronic kidney disease (CKD) who were receiving inpatient and outpatient care from the Medicine and Nephrology departments. The study included adult patients (aged 18 years or older) with CKD, defined by a decreased glomerular filtration rate (GFR) or kidney damage for at least three months. Patients with documented ischemic heart disease, congenital heart disease, valvular heart disease, or cardiomyopathies were excluded from the study.

The sample size of 70 was determined using a statistical formula for estimating single proportion, based on an expected proportion of electrocardiographic (ECG) and echocardiographic (ECHO) changes in CKD patients as 0.75 with a relative precision of 12%. A study by Sachdeva et al. served as the reference. The study employed consecutive sampling as the sampling technique.

The study was conducted over 18 months, and data collection included a detailed history, clinical assessment, and laboratory investigations (renal function tests including serum urea, serum creatinine, and uric acid levels). ECG and 2D echocardiography were used to assess cardiac function changes in CKD patients. Data were collected using a structured proforma and observational methods. The independent variable was CKD, categorized into different stages based on eGFR, while the outcome variables included electrocardiographic and echocardiographic changes such as prolonged QT interval, ST-segment depression, left ventricular hypertrophy, left atrial enlargement, and diastolic dysfunction.

The study posed minimal risk, as only a routine 5 mL blood sample was required for laboratory investigations. Data analysis was performed using SPSS v23.0 on

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JCHR (2025) 15(4), 1497-1501 | ISSN:2251-6727

Windows 10. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to summarize the data. Unpaired t-tests were applied for continuous variables, while chi-square tests were used for categorical data. A p-value of <0.05 was considered statistically significant. The results were represented using tables, figures, bar diagrams, and pie charts to illustrate the findings effectively.

**Result:** Present study included total of 70 participants with mean age of 52.05±14.16yrs.

Table 1: Showing gender, comorbid conditions and ECG changes distribution

| | | Count | N % |
|---|---|---|---|
| Gender | Female | 25 | 35.7% |
| | Male | 45 | 64.3% |
| Diabetes Mellitus | No | 37 | 52.9% |
| | Yes | 33 | 47.1% |
| Hypertension | No | 14 | 20.0% |
| | Yes | 56 | 80.0% |
| Dialysis | No | 24 | 34.3% |
| | Yes | 46 | 65.7% |
| ECG | LVH | 44 | 62.9% |
| | NSR | 26 | 37.1% |
| Systolic and Diastolic function | 0 | 7 | 10.0% |
| | 1 | 13 | 18.6% |
| | 2 | 22 | 31.4% |
| | Moderate Biventricular disfunction | 8 | 11.4% |
| | Normal Systolic and Diastolic function | 20 | 28.6% |

Among them 64.3% were male and 35.7% were female with male preponderance in the present study. The systolic and diastolic function showing the changes grade 2 in 31.4%, 18.6% with grade 1, 11.4% with moderate biventricular dysfunction and 10.0% with grade 0 dysfunction. 28.6% of patients having normal systolic and diastolic function.

Table 2: Association of the serum creatinine with systolic and diastolic function

| | | Creatinine | | p-value |
|---|---|---|---|---|
| | | Mean | SD | |
| Systolic and Diastolic function | 0 | 4.4 | 1.5 | 0.05* |
| | 1 | 5.2 | 1.7 | |
| | 2 | 5.4 | 2.2 | |
| | Moderate Biventricular disfunction | 4.4 | 2.0 | |
| | Normal Systolic and Diastolic function | 3.3 | 1.6 | |

There is significant association between the serum creatinine level with the systolic and diastolic dysfunction. The mean creatinine was significantly lower in patients with normal systolic and diastolic function compared to the patients with dyfunction.($p<0.05$)

Table 3: Association of the hypertension with systolic and diastolic function

| | | Hypertension | | | | Chi-square (p-value) |
|---|---|---|---|---|---|---|
| | | No | | Yes | | |
| | | Count | N % | Count | N % | |
| | 0 | 0 | 0.0% | 7 | 12.5% | |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Systolic and Diastolic function | 1 | 1 | 7.1% | 12 | 21.4% | 11.61 (0.02)* |
| | 2 | 3 | 21.4% | 19 | 33.9% | |
| | Moderate Biventricular disfunction | 1 | 7.1% | 7 | 12.5% | |
| | Normal Systolic and Diastolic function | 9 | 64.3% | 11 | 19.6% | |

There is significant higher incidence of the systolic and diastolic dysfunction among the patients with hypertension compared to patients without hyperetension.($p<0.05$)

**Discussion:**

Present study included total of 70 participants mean age of 52.05yrs, with 64.3% were male and 35.7% were female with male preponderance in the present study. The Diabetes mellitus was present in 47.1%, Hypertension in 80% and 65.7% of the patients were on dialysis. In study by Kang et al., the mean age of the patients was 52.5yrs with 66% were male patients.[14] Another study by Romejko K et al., documented with mean age of 63yrs in CKD group, with presence of hypertension in 42.9%.[15] However in study by Sagi et al., the mean age of patients was 46.3yrs with 63% male patients.[16]

ECG showing the pattern of LVH in 62.9% of the cases. The systolic and diastolic function showing the changes grade 2 in 31.4%, 18.6% with grade 1, 11.4% with moderate biventricular dysfunction and 10.0% with grade 0 dysfunction. 28.6% of patients having normal systolic and diastolic function. In study by De-Lima JJ et al., the LV diastolic dysfunction (LVDD) was present in 75% of patients, with grade 1 DD being the most common abnormality and pseudonormal pattern the predominant form of moderate–severe DD. Both moderate–severe LVDD (HR 1.379, CI 1.074–1.770) and LV systolic dysfunction (LVSD) (HR 1.814, CI 1.265–2.576) independently predicted mortality, with a graded and progressive relationship between LVDD severity and death risk." The impact of isolated moderate–severe LVDD on mortality was comparable to that of isolated LVSD, emphasizing the prognostic significance of diastolic dysfunction in patient survival.[8] There is significant association between the serum creatinine level with the systolic and diastolic dysfunction. The mean creatinine was significantly lower in patients with normal systolic and diastolic function compared to the patients with dyfunction.($p<0.05$) There is significant higher incidence of the systolic and diastolic dysfunction among the patients with hypertension compared to patients without hypertension.($p<0.05$)

In study by Sagi B et al., among IgAN patients, those with CKD 3–5 exhibited a significantly higher incidence of diastolic dysfunction (72% vs. 39%, $p = 0.003$) compared to CKD 1–2. Left ventricular rigidity (LVR) was closely correlated with SI ($p = 0.009$) and eGFR ($p = 0.038$). Linear regression analysis identified age, E/A, and E/Ea as independent predictors of SI, while SI predicted LVR, and E/A and hypertension were predictors of eGFR. These findings suggest that in CKD, increased cardiac rigidity and vascular stiffness are closely linked to declining renal function, contributing to diastolic dysfunction and vascular alterations that can be detected even in early stages of CKD."[16]

**Conclusion**:

These findings highlight the importance of early cardiac evaluation in CKD patients, particularly those with hypertension and elevated serum creatinine levels. Regular monitoring and timely interventions could help prevent cardiovascular complications and improve patient outcomes. Further large-scale, longitudinal studies are needed to develop targeted therapeutic strategies for preserving cardiac function in CKD patients.

*Funding: Nil*

*Conflict of interest: Nil*

*Acknowledgement:*

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