# Prevalence and Predictors of Left Ventricular Diastolic Dysfunction in a Hispanic Patient Population

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## Abstract

Minimal data exist on attributes of diastolic dysfunction in the Hispanic population. The purpose of this study was to evaluate the prevalence and predictors of diastolic dysfunction in a Hispanic patient population. We performed a retrospective review of 166 consecutive echocardiograms in a southwestern Texas Hospital that caters to a large Hispanic patient population. We identified all echocardiograms that met criteria for diastolic dysfunction and assessed baseline demographics and comorbidities in the cohort of Hispanic patients. A multivariate analysis was performed to identify the independent predictors of diastolic dysfunction. A total of 129 out of 166 patients (77.8%) were of Hispanic origin. Out of the 129 patients, 87 (67.4%) had some degree of diastolic dysfunction in this population suggesting a high prevalence in the study cohort. In the diastolic dysfunction group, the mean age was 64.5 ± 13.9, 37% were male and 63% female, 78% had diabetes, 85% had hypertension, and 49% had some degree of renal insufficiency (stages 3–5). A logistic multivariate analysis showed that diabetes was an independent predictor of diastolic dysfunction with odds ratio of 2.69 (95% confidence interval [CI], 1.06–6.28; $p = 0.038$). Similarly age (per year increase) and chronic kidney disease were independent predictors of diastolic dysfunction. We demonstrated that older age, presence of diabetes, and renal dysfunction are independent predictors of diastolic dysfunction in the Hispanic patient population. Strategies geared toward reducing diabetes and preventing renal dysfunction are likely to decrease prevalence of diastolic dysfunction and heart failure in this community.

**Keywords**
- left ventricular dysfunction
- diabetes complications
- Hispanic patient population
- prevalence

Left ventricular (LV) diastolic dysfunction refers to an abnormality of diastolic distensibility, filling, or relaxation of the left ventricle, regardless of whether the ejection fraction is normal or abnormal and whether the patient is symptomatic or asymptomatic.[1] Diastolic dysfunction can be either a result of myocardial ischemia/hypoxia[2] that slows ventricular relaxation due to change in myocardial energy availability or could be a result of increase in passive stiffness as a result of metabolic derangements and structural remodeling in several conditions, for example, diabetes mellitus and hypertension.[3]

Furthermore, it has been shown that besides other existing risk factors for diastolic dysfunction such as hypertension, age, coronary artery disease, and others, the presence of diabetes itself is an independent factor for the development of diastolic dysfunction regardless of concomitant coronary artery disease.[4] The pathogenetic mechanism is mainly explained by the interstitial accumulation of advanced-glycated

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end products, which include collagen, elastin, and other proteins, as well as fibrosis in the myocardium that have been reported in diabetes hearts, which can increase end-diastolic stiffness as well as LV mass.[5] Furthermore, diastolic dysfunction reflects an early sign in the temporal sequence of ischemic events in coronary heart disease. The ischemic cascade, beginning with an oxygen demand supply imbalance and metabolic alterations, identifies diastolic disorders of the left ventricle as an early phenomenon; sometimes before systolic dysfunction, electrocardiographic changes, or chest pain occur.[6]

Finally, it has been documented in previous studies that the prevalence of diastolic dysfunction increases with age, even among healthy adults and can be higher if comorbidities such as diabetes, hypertension, or coronary artery disease are present. This can range from 2.8 to 27.3% depending on the population studied.[7–9] However, minimal data exist on prevalence of diastolic dysfunction in the Hispanic patient population. Thus, it was our goal to investigate the prevalence and predictors of diastolic dysfunction in a Hispanic patient population.

## Methods

### Study Group

In this study, we performed a retrospective review of 274 consecutive echocardiograms done from January 2009 to December 2011 at the University Medical Center in southwestern Texas that provides care to a large Hispanic patient population. To recruit these patients, we used the criteria for diastolic dysfunction according to the American Society of Echocardiography (ASE) in conjunction with the European Society of Echocardiography. In 108 echocardiograms, diastolic function could not be assessed due to the presence of atrial fibrillation, tachycardia, confounding valvular heart disease, paced rhythm, or other unspecified reasons. Among the 166 patients where diastolic function was assessed, 129 were of Hispanic origin and constitute the study cohort. Of the 129 patients, 87 had some degree of diastolic dysfunction in this population.

Criteria for the diagnosis of isolated diastolic dysfunction used in this study were as follows:

1. Normal or mildly abnormal LV size and systolic function (LV ejection fraction $> 50\%$ and an LV end-diastolic volume $< 97$ mL/m$^2$).
2. Evidence of LV diastolic dysfunction as evidenced by:
   (a) Transmittal Doppler inflow velocity patterns. Mitral inflow patterns are identified by the mitral E/A ratio and deceleration time of early filling velocity. They include normal, impaired LV relaxation, pseudonormal LV filling, and restrictive LV filling.
   (b) Tissue Doppler imaging (elevated filling pressures are present when the $E/e'$ ratio $> 12$ to 15; normal less than 8).
   (c) Color M-mode flow propagation velocity ($V_p < 50$). A $V_p > 50$ cm/s is considered normal. The presence of an abnormally reduced $V_p$ can help distinguish patients with pseudonormal filling.

### Population Characteristics

All patients that met the criteria for diastolic dysfunction as well as the general population group underwent an assessment of baseline demographics and comorbidities. The variables assessed were: age, gender, body mass index, diabetes mellitus, hypertension, presence of coronary artery disease, past myocardial infarction, aortic stenosis, restrictive cardiomyopathy, hypertrophic cardiomyopathy, lipid profile, and glomerular filtration rate.

### Statistical Analysis

Prevalence was calculated as the ratio of persons with diastolic dysfunction during the specified time period of the study divided by the population during the same time period. Multiple logistic regression analysis was performed to assess the association between patient characteristics and diastolic dysfunction. A multivariate logistic regression analysis was performed for presence of any degree of diastolic dysfunction adjusted for age, gender, body mass index, diabetes mellitus, hypertension, presence of coronary artery disease, past myocardial infarction, aortic stenosis, restrictive cardiomyopathy, hypertrophic cardiomyopathy, lipid profile, and glomerular filtration rate. The C-statistic reflecting area under the curve was calculated. All analyses were done with SPSS 21 (IBM Corporation, NY).

## Results

In this cohort, 108 of the 274 patients were excluded due to unobtainable data on diastolic function. Among the 166 patients where diastolic function was assessed, 129 were of Hispanic origin and constitute the study cohort. Of the 129 patients, 87 had some degree of diastolic dysfunction in this population suggesting a high prevalence of 67.4% in this study cohort; among those with diastolic dysfunction, the mean age was $64.5 \pm 13.9$, 37% were male and 63% female, 78% had diabetes, 85% had hypertension and 49% had some degree of renal insufficiency (stages 3–5). The control group (those without diastolic dysfunction) had a mean age of $50.1 \pm 11.7$, 31% were male and 69% were female, 42% had diabetes, 66% had hypertension, and 9% had renal insufficiency (stages 3–5). Details of the baseline characteristics are summarized in ►**Table 1**.

Subsequently, a logistic multivariate analysis was performed, which showed that diabetes was an independent predictor of diastolic dysfunction with odds ratio of 2.69 (95% confidence interval [CI], 1.06–6.28; $p = 0.038$). Similarly, age (per year increase) with odds ratio of 1.07 (95% CI, 1.02–1.11; $p < 0.0001$) and chronic kidney disease with odds ratio of 2.08 (95% CI, 1.26–, 3.43; $p = 0.004$) were also independent predictors of diastolic dysfunction. Other variables such hypertension, coronary artery disease, and being overweight (body mass index $> 25$) were also seen in this population; however, after performing the multivariate model analysis and adjusting for baseline characteristics, these variables were no longer independent predictors. The c-index of the multivariate model was 0.88. The findings of the logistic model are described in ►**Table 2**.

**Table 1** Baseline characteristics of the population (Hispanic patient population)

| Clinical measurements | Entire cohort ($n = 129$) | Diastolic dysfunction | |
|---|---|---|---|
| | | No (control) ($n = 42$) | Yes ($n = 87$) |
| Variable | | | |
| Anthropometrics | | | |
| Age (mean, SD) | 59.85 ± 14.84 | 50.11 ± 11.74 | 64.55 ± 13.92 |
| Gender | *n* (%) | *n* (%) | |
| Female | 84 (65.1) | 29 (69) | 55(63.2) |
| Male | 45 (34.9) | 13 (31) | 32 (36.8) |
| Body mass index, kg/m$^2$ | | | |
| < 25 | 32 (24.8) | 8 (19) | 24 (27.6) |
| > 25 | 91 (70.5) | 34 (81) | 57 (65.5) |
| NA | 6 (4.7) | | 6 (6.9) |
| Comorbidities | | | |
| Diabetes mellitus | | | |
| No | 43 (33.3) | 24 (57.1) | 19 (21.8) |
| Yes | 86 (66.7) | 18 (42.9) | 68 (78.2) |
| Hypertension | | | |
| No | 26 (20.2) | 14 (33.3) | 12 (13.8) |
| Yes | 102 (79.1) | 28 (66.7) | 74 (85.1) |
| NA | 1 (0.8) | | 1(1.1) |
| Coronary artery disease | | | |
| No | 96 (74.4) | 36 (85.7) | 60 (69) |
| Yes | 33 (25.6) | 6 (14.3) | 27 (31) |
| Past myocardial infarction | | | |
| No | 101 (78.3) | 37 (88.1) | 64 (73.6) |
| Yes | 28 (21.7) | 5 (11.9) | 23 (26.4) |
| Biochemical data | | | |
| High-density lipoprotein, mg/dL | | | |
| < 45 | 82 (63.6) | 33 (78.6) | 49 (56.3) |
| > 45 | 35 (27.1) | 9 (21.4) | 26 (29.9) |
| NA | 12 (9.3) | | 12 (13.8) |
| Low-density lipoprotein, mg/dL | | | |
| < 100 | 68 (52.7) | 21 (50) | 47 (54) |
| 101–159 | 41 (31.8) | 18 (42.9) | 23 (26.4) |
| > 160 | 8 (6.2) | 3 (7.1) | 5 (5.7) |
| NA | 12 (9.3) | | 12 (13.8) |
| Glomerular filtration rate, mL/min/1.73 m$^2$ | | | |
| Stage 1 > 90 | 46 (35.7) | 26 (61.9) | 20 (23) |
| Stage 2 > 60–89 | 37 (28.7) | 12 (28.6) | 25 (28.7) |
| Stage 3 > 30–59 | 29 (22.5) | 3 (7.1) | 26 (29.9) |
| Stage 4 > 15–29 | 5 (3.9) | 0 (0) | 5 (5.7) |
| Stage 5 < 15 | 12 (9.3) | 1 (2.4) | 11 (12.6) |

Abbreviations: NA, not available; SD, standard deviation.
*Note*: Data are presented as mean ± SD or *n* (%). Control: control group without diastolic dysfunction.

**Table 2** Independent predictors for diastolic dysfunction

| Risk factor | Adjusted odds ratio with 95% confidence interval | *p* value |
|---|---|---|
| Diabetes (yes) | 2.69 (1.06–6.28) | 0.038 |
| Age | 1.07 (1.02–1.11) | $< 0.0001$ |
| Chronic kidney disease | 2.08 (1.26–3.43) | 0.004 |

## Discussion

In this cohort study, we demonstrate that in a Hispanic patient population, the prevalence of LV diastolic dysfunction as defined by the ASE/European Society of Echocardiography was quite high at 67.4%. The present study also shows that older age, diabetes, hypertension, coronary artery disease, and kidney disease are frequently associated with diastolic dysfunction. Thus, diastolic dysfunction may represent an early cardiac abnormality in subjects with such risks factors. The Hispanic patient population may be particularly at risk, since most of the risk factors for such dysfunction are commonly present. Of note, in our study, hypertension (although being present in other reports such as the one performed by Vasan et al[10]) was not an independent predictor for diastolic dysfunction. Furthermore, male gender, which was more prevalent in some other trials and suggested as an independent factor for diastolic dysfunction,[11] was not a predictor for diastolic dysfunction in our study cohort.

On the contrary, age as previously evaluated in previous reports plays a preponderant role in the prevalence of diastolic dysfunction, the higher the age, the higher the likelihood of diastolic abnormalities.[7] Similarly, diabetes mellitus has been established as a risk factor for the development of diastolic dysfunction. In fact, diastolic dysfunction is often the first manifestation of myocardial involvement in diabetic patients.[12] Moreover, it has been demonstrated that there exists an important association between heart failure with normal ejection fraction and type 2 diabetes mellitus, in which the prevalence of abnormal LV diastolic function has been reported to be 43 to 75%.[13] In our study, diabetes mellitus was present in 66% of the entire cohort and had a prevalence of 78% in the diastolic dysfunction group.

Diabetes in the Hispanic patient population has a prevalence of 11.8% in the United States[14] and is expected to increase. In our study population, age, diabetes mellitus, and renal dysfunction were strong independent predictors for diastolic dysfunction. Thus, strategies aimed at reducing or preventing the development of diabetes[15] and/or chronic kidney disease may likely reduce the prevalence of diastolic dysfunction in this particular population. Novel therapies may be particularly effective in this high-risk population to ameliorate diastolic dysfunction.[16]

## Study Limitations

A limitation of this analysis is its relatively small sample size. However, strength of the analysis is that this is the first study on diastolic dysfunction in a Hispanic patient population. The prevalence of diastolic dysfunction is quite high at 67.4% and may reflect prevalence in patients referred for echocardiography and overestimate true prevalence.

## Conclusions

The Hispanic patient population can be considered a vulnerable group since they are at increased risk for developing chronic diseases such as diabetes, hypertension, and coronary artery disease among others. In our study, we demonstrated a high prevalence of risk factors associated with diastolic dysfunction in the Hispanic patient population. The data suggest that we need to aggressively use effective strategies to treat and reduce the prevalence of diastolic dysfunction in this community to reduce development of heart failure.

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