Am J Cardiovasc Dis 2022;12(1):38-41
www.AJCD.us /ISSN:2160-200X/AJCD0139856

*Original Article*

# Left ventricular hypertrophy is independently associated with all-cause mortality

Mohammad Reza Movahed[1,2], Radhakrishnan Ramaraj[1], Coraly Manrique[1], Mehrnoosh Hashemzadeh[2,3]

*[1]University of Arizona Sarver Heart Center, Tucson, AZ 85724, USA; [2]University of Arizona, Phoenix, AZ 85004, USA; [3]Pima College, Tucson, AZ 85709, USA*

Received October 15, 2021; Accepted January 25, 2022; Epub February 15, 2022; Published February 28, 2022

**Abstract:** Background: Left Ventricular Hypertrophy (LVH) is associated with adverse outcomes. The goal of this study was to evaluate any association between LVH and all-cause mortality using a large echocardiographic database. Methods: We retrospectively evaluated 2,352 echocardiograms between the ages 16-99 years that were performed from 1983 to 1998 for clinical reasons in Southern California. Mortality data were extracted from the national mortality database at the end of the year 2007. Using uni- and multi-variant analysis, we evaluated any association between total mortality and echocardiographic presence of LVH defined as any wall thickness >11 mm. Results: LVH was significantly associated with all-cause mortality [207/583 (35.5%) of patients died with LVH vs. 416/1769 (23.5%) of patients with normal wall thickness, P<0.001, HR 1.79, CI: 1.46-2.19]. Using multivariate analysis adjusting for age, gender, abnormal left ventricular systolic function, and significant valvular abnormalities, LVH remained independently associated with all-cause mortality (OR 1.39, CI 1.10-1.74, P=0.005). Conclusion: Using a large echocardiographic database, we found that LVH is independently associated with all-cause mortality. Our finding confirms the negative effect of LVH on the long-term outcome.

**Keywords:** Left ventricular hypertrophy, cardiovascular death: mortality, left ventricular mass, LVH, echocardiography

## Introduction

Left ventricular hypertrophy (LVH) is a risk factor for adverse cardiovascular events including sudden cardiac death [1, 2]. Higher left ventricle wall mass can be a compensatory mechanism to adjust for the increase in ventricular wall stress but it can be harmful to the left ventricle function [3]. Various epidemiological studies have shown that LVH increases the risk of cardiovascular events and LVH has been reported to be an important risk factor compared to other risk factors for morbidity and mortality [4-6]. It has been shown that the risk of death is higher in the presence of LVH [7]. Various means are available to assess LVH. Electrocardiogram (ECG) is easily available but has only a sensitivity of <35% with a specificity of <60% [8]. Echocardiography is the gold standard for detecting LVH [9]. Many studies have identified that LVH has been associated with cardiovascular deaths [6]. In this study, we evaluated the association between LVH with total mortality using a large echocardiographic database.

## Methods

We analyzed 2,352 patients who had echocardiograms performed for various clinical reasons between the ages of 16-99 from the year 1983 to 1998 at the University of California, Irvine Medical Center. Echocardiograms were performed on patients who were admitted to the hospital or were done as an outpatient. Echocardiographic findings included all standard measurements including wall thickness performed in the parasternal long-axis view. Mortality data were extracted from the national mortality database at the end of the study in 2007. We used uni- and multi-variant analysis to evaluate total mortality relation with the echocardiographic presence of LVH defined as any wall thickness >11 mm. We used SPSS statistical package for our study utilizing the Chi-square test for univariate analysis. Multiple regression analysis was performed adjusting

**Table 1.** Baseline characteristics of patients with or without left ventricular hypertrophy (LVH)

| | LVH | Without LVH | *P* Value |
|---|---|---|---|
| Mean age | 57.04 | 50.4 | <0.001 |
| HTN | 32.2% | 21.3% | <0.001 |
| HPL | 3.6% | 4.5% | 0.31 |
| Atrial Fibrillation | 19.1% | 21.1% | 0.29 |
| CVA | 7.6 | 5.2 | 0.03 |
| DM | 13.1 | 10.2 | 0.04 |
| CRF | 8.4 | 4.9 | 0.001 |
| Syncope | 2.2 | 1.7 | 0.12 |
| Male | 54% | 45% | <0.001 |
| CHF | 24.0 | 20.9 | 0.11 |
| CAD | 10.7 | 8.7 | 0.14 |

Hyperlipidemia: HPL; cerebrovascular accident: CVA; diabetes mellitus: DM; chronic renal failure: CRF; congestive heart failure: CHF; coronary artery disease: CAD.

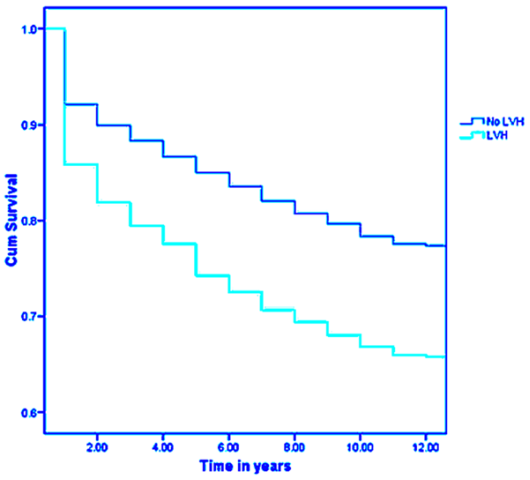


**Figure 1.** Kaplan-Meier survival curve over the years in patients with LVH vs. no LVH.

for significant valvular abnormalities, gender, abnormal left ventricular systolic function, and age. A Kaplan-Meier survival cure was generated over the study period. A *P*-value of <0.05 was considered statistically significant.

## Results

The mean age of the study population was 53.1. The mean age of patients with LVH was 57 vs. 50 in patients without LVH. Hypertension was the most common comorbidity and was followed by congestive heart failure and atrial fibrillation (**Table 1**). Hypertension, stroke, diabetes mellitus, chronic renal failure, and male gender were more commonly present in patients with LVH (**Table 1**). LVH was significantly associated with all-cause mortality [207/583 (35.5%) of patients died with LVH vs. 416/1769 (23.5%) of patients with normal wall thickness, P<0.001, HR 1.79, CI: 1.46-2.19]. **Table 1** shows the baseline characteristics of patients with or without LVH. Using multivariate analysis adjusting for age, gender, abnormal left ventricular systolic function, and significant valvular abnormalities, LVH remained independently associated with all-cause mortality (HR 1.39, CI 1.10-1.74, P=0.005, **Table 1**). Kaplan-Meier survival curve can be seen in **Figure 1**.

## Discussion

Electrocardiogram (ECG) is the main modality for LVH detection. For LVH diagnosis, Echocardiography is more sensitive than ECG (16% vs. 2.1%) [10]. Echocardiography can also measure left ventricular mass and is helpful for serial measurements [4, 10-13]. LVH is a well-known risk factor for increased cardiovascular (CV) mortality and morbidity. Increasing age and body weight are the major risk factors for the development of LVH [14, 15]. Various other conditions are related to the development of LVH such as diabetes, hyperlipidemia, and valvular heart diseases [16-18]. Certain population groups have been found to have increased LVH especially African Americans and patients with metabolic syndrome [17, 19]. There is an increased risk of CV mortality with increasing left ventricular mass [18, 20]. In our study, we found that using multivariate analysis adjusting for age, gender, abnormal left ventricular systolic function, and significant valvular abnormalities, LVH remained independently associated with all-cause mortality [(HR 1.39, CI 1.10-1.74, P=0.005, 207/583 (35.5%) of patients died with LVH vs. 416/1769 (23.5%) of patients with normal wall thickness, P<0.001, HR 1.79, CI: 1.46-2.19] (**Table 2**). This study is one of the largest studies with a long-term mortality evaluation of over 10 years using an echocardiographic database. This will make this study a unique study. The reason for the poor outcome of patients with LVH is not well understood but appears to be multifactorial. Coronary flow reserve and left ventricular ejection fraction can be adversely affected with higher left ventricular mass and hypertrophy [19, 21, 22]. Prevalence of ventricular arrhythmias and sud-

**Table 2.** Univariate and multivariate hazard ratio for 10 years mortality in patients with or without LVH

| | Hazzard Ratio | Confidential Interval | *P* Values |
|---|---|---|---|
| Univariate analysis for 10 years Mortality in pt with LVH vs. no LVH | 1.79 | 1.46-2.19 | P<0.001 |
| Multivariate analysis for 10 years Mortality in pt with LVH vs. no LVH | 1.39 | 1.10-1.74 | P=0.005 |

Pt: patient; LVH: left ventricular hypertrophy.

den cardiac arrest appear to be also higher in patients with LVH [1, 23-25]. All these factors can play a major role in higher mortality observed in patients with LVH. We found a much higher prevalence of hypertension in patients with LVH. This is in concordant with many studies showing hypertension as a major risk for LVH [26] with the reduction in LVH with successful treatment of hypertension [27, 28]. Higher mortality in patients with LVH has been reported in diverse populations [29, 30]. As Framingham suggested [31], LVH is associated with many comorbidities that in part can explain the higher mortality rate in this population. Our study revealed a persistent higher mortality rate in patients with LVH despite multivariate adjustment suggesting that LVH itself can have direct adverse outcomes.

## Limitations

Our study was a retrospective study limiting our results. However, a large number of patients studied suggests that our results are valid. Our database was extracted from echocardiograms that were performed in patients with clinical indications and not healthy asymptomatic population limiting our interpretation. We did not have data about left ventricular mass which could have added more accurate information in regard to the prognostic value of left ventricular mass as a better surrogate for LVH.

## Disclosure of conflict of interest

None.

**Address correspondence to:** Dr. Mohammad Reza Movahed, University of Arizona Sarver Heart Center, 1501 North Campbell Avenue, Tucson, AZ 85724, USA. E-mail: rmova@aol.com

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