

# Factors influencing left ventricular hypertrophy in children and adolescents with or without family history of premature myocardial infarction

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## Abstract

**Background:** Cardiovascular diseases are the highest ranking cause of mortality. The prevalence of cardiovascular diseases is increasing among people in developed and developing countries. Since left ventricular hypertrophy is one of the risk factors leading to extremely dangerous heart diseases and even sudden death at early ages, investigating its contributing factors can be beneficial. The purpose of this study was to determine factors contributing to left ventricular hypertrophy in students aged 7-18 years in Isfahan. Statistical population of this case-control study was the 7-18 year old students in Isfahan, who were studied in two groups of children with premature myocardial infarction in their parents and the control group.

**Materials and Methods:** After determining the sample size of 138 people, a two-part questionnaire was designed and demographic characteristics and anthropometric measures were recorded in students' profiles. The obtained information was analyzed using SPSS<sub>15</sub> software and logistic regression model and the results were reported at  $P < 0.05$ .

**Result:** The results showed that among the studied variables, gender, age, body mass index, and blood pressure were associated with the left ventricular hypertrophy.

**Conclusion:** Considering the results and previous studies in this field, it was observed that left ventricular hypertrophy exists at early ages, which is very dangerous and can lead to heart diseases at early ages. Factors such as being overweight, having high blood pressure, and being male cause left ventricular hypertrophy and lead to undiagnosable heart diseases.

**Key Words:** Body mass index, left ventricular hypertrophy, mean blood pressure, waist to hip ratio

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## INTRODUCTION

Given the importance of left ventricle in life and its very high contractile strength, symptoms of heart diseases are mainly related to the abnormalities in the left ventricle, and, in many cardiology diagnostic tests including heart scan, studying left ventricle constitutes the main purpose of the test.<sup>[1]</sup> Increased

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left ventricular mass (LVM) is very important due to its danger and is considered an important risk factor of heart diseases which can lead to sudden death at younger ages. The change in left vascular mass can lead to cardiovascular problems, pulmonary diseases, edema of extremities, and kidney problems. Moreover, left ventricular (LV) hypertrophy can generate edema in lungs, abdominal organs, and legs. The main finding in hypertrophic cardiomyopathy (HCM) shows an unjustified increase of LVM without dilated ventricle. Systolic function of left ventricle is usually normal but sometimes there is an increase in contractility.<sup>[2]</sup> In 1980s, 23% of all deaths around the world were caused by cardiovascular diseases, the rates of which were 48% and 16% in developed and developing countries, respectively.<sup>[3]</sup>

World Health Organization has estimated that cardiovascular diseases will significantly increase in East Mediterranean and African countries in 10 years so that the death caused by these diseases will increase by more than 25%.<sup>[4]</sup> According to the current statistics, half of all the deaths in the USA are due to cardiovascular diseases,<sup>[5]</sup> its related economic damage in 1986 was about \$80 billion. The main and secondary risk factors have an important role in generation or progress of these diseases.<sup>[3,6-8]</sup> Although cardiovascular diseases are known as older age diseases, almost 50% of cardiovascular diagnoses and 15% of mortality related to these diseases occur in patients under 65 years old. Many young people have at least two risk factors that make them susceptible to these diseases.<sup>[9]</sup> These risk factors remain unknown in healthy young individuals and, as a result, no measure is taken to control them. Many of these risk factors are changeable. Based on the evidence, a significant proportion of the load of current cardiovascular diseases can be prevented completely or partially by controlling risk factors. One of these risk factors that can be controlled or prevented is abnormal LV hypertrophy which is a very important factor in adult mortality due to heart diseases.<sup>[10-12]</sup> Since nearly 40% of mortality among the youth is due to cardiovascular diseases and considering the high rate of young population in Iran, this research tried to specify factors related to LVM which can lead to its increase in order to reduce suffering this disease.

## MATERIALS AND METHODS

This was a case-control study in which 7-18 year old students from Isfahan constituted the statistical population. They were studied in two groups of children suffering premature myocardial infarction in their parents and the control group.

Reluctance of parents or children to perform an echocardiography and also filling out the standard questionnaire were the exclusion criteria. Considering the geographical map of Isfahan and its division into different municipal regions, the two-stage cluster sampling method was used. The desired number of subjects was selected randomly and through school-by-school visiting in different regions. First, the samples were randomly selected from different areas in the city of Isfahan; then, the students were randomly selected from those schools. After determining the sample size, a questionnaire was designed in two parts, both of which were completed by a general physician. The students entered the study and demographic characteristics and anthropometric measurements were recorded in their profiles. Weight was measured with minimum clothes on and barefoot by the physician (accuracy of 100 g using Seca scale made in Japan) and standing height was measured barefoot with the accuracy of 1 mm using a Seca metal tape made in Japan. Based on Lohman recommendation, these measures were repeated three times and their mean was recorded.<sup>[13-15]</sup>

Sitting blood pressure was measured twice from the right hand with proper cuff size under the standard condition of World Health Organization and its mean was recorded. Fasting (at least 12 h) venous blood sample was taken by a qualified technician and all the experiments were done in the same unit.<sup>[16]</sup>

In this study, the relationship between LVM size and variables of age, gender, fat level, cholesterol, apolipoprotein a (apo a), body mass index (BMI), waist-hip ratio (WHR), oxidized low-density lipoprotein (LDL.ox), mean arterial pressure (MAP), mother's obesity, father's obesity, second-degree relative's obesity, father's diabetes, mother's diabetes, second-degree relative's diabetes, mother's or father's high blood pressure, second-degree relative's high blood pressure, father's infarction, mother's infarction, and second-degree relative's infarction were evaluated. WHR is one of the health indicators called normal below 0.8 and the BMI above 85 percentile for age and gender is called overweight.<sup>[17]</sup>

Statistical indices including frequency, mean, and standard deviation were used in the analysis of results. Logistic regression was used in multivariable analysis in order to determine influencing factors on the LV hypertrophy. All the results were reported at the  $P < 0.05$  level. The researchers were committed to the ethics stated by Ministry of Health and Medical Education in all stages of the research. Also, given that the total number of people was 138 people, it was not possible to answer all the questions

during data collection or the participants did not fill out the questionnaire completely. Therefore, the frequency sum in the tables was not equal to the total participants. Testing costs were paid by the project and measurement was done by a pediatric cardiologist using high-resolution echo Doppler.

## RESULTS

In this study, there were 138 students in the age range of 7-18 years (58 girls and 80 boys), 74 of whom (53.6%) were below 15 and 64 of whom (46.4%) were above 15. Among 138 studied participants, 102 people (73.9%) were not suffering LV hypertrophy and 36 (26.1%) were. The frequency distribution of those suffering blood pressure, diabetes, obesity, and infarction in fathers, mothers, and second-degree relatives in both healthy and non-healthy groups is given in Table 1.

The frequency distribution of blood cholesterol, mean blood pressure (MAP), body mass index (BMI), and WHR among 7-18 year old students in Isfahan is shown in Table 2.

The new variable of total cholesterol was produced due to the strong association of HDL, LDL, and triglyceride. Using the table, it was found that 6% of the total participants do not have hypercholesterolemia and 94% had hypercholesterolemia, the criterion of which is more than 90<sup>th</sup> percentile for age and gender<sup>[16]</sup> and indicates a very high incidence of this disease. As seen in Table 2, 90.6% of total students lacked risk factors and 117 (85.4%) were not overweight and 20 (14.6%) were overweight. In this study, WHR of 74.6% was normal and 34 (25.4%) had abnormal WHR.

The frequency distribution of apolipoprotein a (apo a) and fat status of 7-18 year old students in city of Isfahan are demonstrated in Table 3.

Table 3 shows that apolipoprotein a (apo.a) of 29 people (24.3%) was in group 1, 30 people (25.2%) in group 2, 29 (24.3%) in group 3, and 31 (26%) in group 4. Group 1 consisted of the data less than the first quartile; group 2 had the data between the first and second quartile (median). Similarly, the third group showed data which were less than the third quartile and the fourth group included the data more than the third quartile. According to Table 3, among all the people studied for LDL.ox, 30 people (24.5%) were in group 1, 31 (25.4%) were in group 2, 31 were in group 3 (24.5%), and 30 (24.5%) were in group 4. Group 1 included the data less than the first quartile and group 2 the data between the first and second quartile (median). Similarly, group 3 consisted of the data less than the third quartile and the group 4 included the data more than the third quartile.

In Table 3, the frequency distribution of independent variables of total fat indicates that 33 people (31.7%) were in group 1, 32 (30.7%) were in group 2, 17 (16.3%) were in group 3, and 22 (21.1) were in group 4. Group 1 included the data less than the first quartile and group 2 the data between the first and the second quartile (median). Likewise, group 3 included the data less than the third quartile and group 4 included the data more than the third quartile.

## DISCUSSION

The goal of this study was to investigate the factor related to LV hypertrophy in children in Isfahan. LV hypertrophy causes diseases such as heart failure, cardiomegaly, and other diseases. It imposes a fortune of diagnostic and treatment costs on governments and makes a lot of problems in economic, social and health areas, dealing with which requires accurate planning. Moreover, the diseases caused by this disorder will be latent for a long time or may lead to sudden death

**Table 1: Frequency distribution of those suffering blood pressure, diabetes, obesity, and infarction in fathers, mothers, and second-degree relatives in both healthy and unhealthy groups (7-18 year old students in Isfahan)**

Variable	Disease status	Father		Mother		Second-degree relative	
		Frequency	Percent	Frequency	Percentage	Frequency	Percentage
Blood pressure	Unhealthy	14	10.3	11	8	90	66
	Healthy	122	89.7	125	92	46	34
	Total	136	100	136	100	136	100
Diabetes	Unhealthy	10	7.4	9	6.6	69	50.7
	Healthy	126	92.6	127	93.4	67	49.3
	Total	136	100	136	100	136	100
Obesity	Unhealthy	28	20.6	36	26.5	81	59.6
	Healthy	108	79.4	100	73.5	55	40.4
	Total	136	100	136	100	136	100
Infarction	Unhealthy	106	77.9	2	1.5	62	45.6
	Healthy	30	22.1	134	98.5	74	54.4
	Total	136	100	136	100	136	100

**Table 2: Frequency distribution of blood cholesterol, mean blood pressure, body mass index, and waist-hip ratio among 7-18 year old student in Isfahan**

Variable	Variable status	Frequency	Percentage
Cholesterol	Abnormal	126	94
	Normal	8	6
	Total	134	100
MAP	Abnormal	12	9.4
	Normal	115	90.6
	Total	127	100
BMI	Abnormal	20	14.6
	Normal	117	85.4
	Total	137	100
WHR	Abnormal	100	74.6
	Normal	34	25.4
	Total	134	100

MAP: Mean blood pressure, BMI: Body mass index, WHR: Waist-hip ratio

**Table 3: Frequency distribution of apolipoprotein a (LDL.ox) and fat status of 7-18 year old students in Isfahan**

Variable	Group	Frequency	Percentage
Apo.a	Group 1	29	24.3
	Group 2	30	25.2
	Group 3	29	24.3
	Group 4	31	26
	Total	119	100
LDL.ox	Group 1	30	24.5
	Group 2	31	25.4
	Group 3	31	25.4
	Group 4	30	24.5
	Total	122	100
TG (triglyceride)	Group 1	33	31.7
	Group 2	32	30.7
	Group 3	17	16.3
	Group 4	22	21.1
	Total	104	100

Apo.a: Apolipoprotein a, LDL.ox: Oxidized low-density lipoprotein

at younger ages, which indicates the importance of knowing factors influencing LVM. Therefore, health and planning for determining LVM and its influencing factors are very important in order to prevent from heart diseases. In this study, among the mentioned variables, gender, age, body mass index, and mean blood pressure influenced thickness of left ventricle. Also, one study has shown the significance and positive correlation between BMI and LVM among healthy 9-18 year old children and teenagers in all six age and gender subgroups.<sup>[18]</sup> In another study conducted by Daniel *et al.*, to determine the relationship between LVM and systolic blood pressure and BMI, it was found that systolic blood pressure was associated with LVM/height indicator in a univariate analysis. Likewise, it was found that this indicator was positively associated with BMI *per se*.<sup>[19]</sup> In another study on 243 children (11 year old),<sup>[20]</sup> it was determined that overweight can lead to LV hypertrophy and there is

also a strong relationship between body fat and LVM. It has been also revealed that LVM in girls is higher than boys.

In a study by Donald *et al.* on influencing factors on LVM in 7-18 year old children and teenagers, a strong relationship was revealed between LVM, age, height, and weight. Also, there was a modest but significant relationship between systolic blood pressure and LVM diastolic blood pressure.<sup>[21]</sup>

Another study on 678 healthy children (8, 11, 14 at the beginning of the study) evaluated the participants every 4 months for 4 years. This study also demonstrated that age and male gender were two important factors for LVM.<sup>[22]</sup>

Studying the effect of obesity on LVM can be important because it can prevent from LV hypertrophy through weight control or weight loss in overweight people. Hence, many studies have been conducted in adult and children communities to study the effect of this variable. In several studies, there has been a positive and significant relationship between LVM and obesity.<sup>[23-25]</sup>

With regard to the effect of blood pressure on LVM, some studies on children and teenagers have also revealed a positive relationship between systolic blood pressure and LVM indicator.<sup>[26-31]</sup> Considering the obtained results and previous research in this field, it has been observed that LV hypertrophy is also seen at younger ages, which is very dangerous and may lead to heart diseases and sometimes death at early ages. It also seems that there is no connection between LVM and cholesterol and apo.a at younger ages and increment of risk factors increases over time.

Factors such as being overweight, having high mean blood pressure, and being male cause hypertrophy of LV wall, which leads to undiagnosable heart diseases.

## CONCLUSION

Considering the obtained results and past studies in this field, it was found that left ventricular hypertrophy can be also seen at younger ages, which is very important and can lead to heart diseases at younger ages. Factors such as being overweight, having high mean blood pressure, and being male cause hypertrophy of left ventricular wall, which leads to undiagnosable heart disease at younger ages.

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