

## Comparison of cardiovascular risk factors among coronary artery bypass graft patients in 2010 and 2016: A single-center study in Guilan province, Iran

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### Original Article

#### Abstract

**BACKGROUND:** There has been a change in the risk factor profile of patients with coronary artery disease (CAD) in the western world. We sought to compare the risk factor profile of patients undergoing coronary artery bypass graft (CABG) surgery in northern part of Iran in 2010 and 2016.

**METHODS:** In a cross-sectional study, medical records of 296 CABG patients in 2010 and 500 patients in 2016 were collected from a referral university hospital in Guilan province, Iran. We compared the risk factor profile using chi-square test or independent t-test as needed in the two time points, 2010 and 2016.

**RESULTS:** The age of CABG patients significantly decreased from  $62.49 \pm 8.05$  to  $58.09 \pm 9.20$  over time. The frequency of hypertension (HTN) (66.2% vs. 59.1%,  $P = 0.045$ ), diabetes mellitus (DM) (51.8% vs. 43.6%,  $P = 0.025$ ), smoking (35.6% vs. 28.0%,  $P = 0.028$ ), and patients with multimorbidity (31.8% vs. 26.7%,  $P = 0.001$ ) increased in the second period compared to the first period of study. Whereas, the prevalence of hypercholesterolemia and positive family history of coronary heart disease (CHD) remained stable over time (49.6% vs. 49.0%,  $P = 0.870$ ; 10.5% vs. 11.1%,  $P = 0.810$ , respectively).

**CONCLUSION:** We observed a dramatic increase in DM, HTN, and cigarette smoking as well as the multimorbidity prevalence in 2016 compared to 2010. Even with considering all study limitations, primary and secondary prevention program to decrease cardiovascular disease is required.

**Keywords:** Coronary Artery Bypass Grafting, Risk Factors, Diabetes Mellitus, Hypertension, Smoking

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#### Introduction

Cardiovascular disease (CVD) is known as an important leading global health burden.<sup>1</sup> The worldwide burden of disease has changed from communicable disease to non-communicable disease specially CVD.<sup>2,3</sup> The frequency of all causes of mortality related to non-communicable disease (NCD) increased approximately by 10% from 1990 to 2010 in Iran as a developing country.<sup>4</sup> CVDs including coronary artery disease (CAD), stroke, and vascular diseases are the important components of NCD burden in Iran like the rest of the world.<sup>5</sup> According to the World Health Organization

(WHO), by 2050, Iran will encounter an aging population problem.<sup>6</sup> Recent evidence estimated that the burden of CVD will increase by 2025 due to aging phenomenon among Iranian population.<sup>6</sup> As a result of increased frequency of metabolic risk factors like unhealthy diet, low physical activity, and smoking<sup>7</sup> as well as aging population, CVD has become an important health problem in Iran. The Global Burden of Disease Study 2013 (GBD 2013) showed that total disability-adjusted life years (DALYs) related to diabetes increased by more than 100% from 1990 to 2013 in the eastern Mediterranean region.<sup>8</sup> Interestingly, findings of the

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Caspian III Study points to the considerable prevalence of cardiometabolic risk factors such as body mass index (BMI), triglyceride (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and fasting blood sugar (FBS) even in Iranian adolescents.<sup>9</sup> On the other hand, older population suffer from coexistence of more than one disease in the same person, defined as multimorbidity.<sup>10</sup> Previous studies mentioned the effect of coexistence of more than one disease in the same person known as multimorbidity on acceleration of disability and mortality<sup>11</sup> as well as higher cost of care.<sup>12</sup> Prevalence of multimorbidity in a large Iranian population was substantial<sup>13</sup> and was similar to Canadian population.<sup>14</sup> Every year, many coronary artery bypass graft (CABG) surgeries are conducted in Guilan province, Iran. Accordingly, we sought to compare the frequency of cardiovascular risk factors and number of multimorbidity among CABG patients in 2010 and 2016.

### Materials and Methods

This was a cross-sectional study based on data records of a university referral hospital in Guilan province, the northern part of Iran. The medical records of 296 patients undergoing isolated CABG in 2009-2010 and 500 patients in 2015-2016 were included by convenience sampling method. All data collection was retrospectively conducted at the end of 2016. Any record of cardiac surgery for valvular disease, concomitant operations, those undergoing re-operative CABG, and incomplete medical data were excluded from the study.

Demographic data and medical history were derived by reviewing hospital records. A standardized checklist was completed by a trained research assistant to collect cardiovascular risk factors for each patient. Data on the diagnosis of diabetes mellitus (DM), hypertension (HTN), hypercholesterolemia, smoking, and family history of CAD were extracted from patients' history taken by cardiology residents in both phases of the study. Serum factors like FBS, TC, HDL, low-density lipoprotein (LDL), and TG related to the first day of admission for each patient were included in the study. Multimorbidity was defined as the presence of two or more chronic conditions in one patient. We categorized multimorbidity into four groups based on simultaneous presence of CAD plus other morbidity such as DM, HTN, and hypercholesterolemia including 1) CAD without any other disease, 2) CAD plus one chronic condition,

3) CAD plus two chronic conditions, and 4) CAD plus three chronic conditions.

Design and protocol of the study was approved and funded by Vice-Chancellor for Research of Guilan University of Medical Sciences and Cardiovascular Disease Research Center (research number: IR.GUMS.REC.1394.282). Informed consent was not feasible because of retrospective data gathering. But researchers ensured that all medical records were used only for medical research.

Data analyses were conducted using SPSS software (version 16, SPSS Inc., Chicago, IL, USA). Categorical variables and continuous variables were described as frequencies (percentages) and mean  $\pm$  standard deviation (SD), respectively. To compare the frequency of DM, HTN, hypercholesterolemia, smoking, male sex, and family history of CAD between two periods of study, we used chi-square test. Independent t-test was used to compare the mean of continuous factors like age and serum factors. Univariate analysis of covariance (ANCOVA) was conducted to examine the effect of age on the serum laboratory factors. All tests were two-sided and  $P < 0.050$  was considered statistically significant.

### Results

The baseline characteristics and frequency of risk factors are reported in table 1. A total of 296 patients with CABG in first period (2009-2010) and 500 patients in second period (2015-2016) were included in the present study. Several patients were excluded in the first period of study due to incomplete data records ( $n = 12$ ), repeated CABG ( $n = 18$ ), and other cardiac surgery ( $n = 28$ ). In the second period, 24 patients were excluded for other cardiac surgery and 17 patients for repeated surgery.

As shown in table 1, the number of patients undergoing CABG in second period increased from 296 surgery to 500 surgery. There was a significant decrease in the mean age of CABG patients ( $58.09 \pm 9.20$  vs.  $62.49 \pm 8.05$ ,  $P = 0.010$ ). The frequency of patients in various age groups were significantly different ( $P = 0.001$ ), as the rate of CABG among patients aged 50 and younger increased from 5.4% in the first period to 16.4% in the second period. Although the number of female patients in the second period (34.8%) was greater than that in the first period (32.4%), there was no significant difference between two points of study ( $P = 0.400$ ).

**Table 1.** Prevalence of cardiovascular risk factors in two periods of study

Variables	2009-2010 (n = 296)	2015-2016 (n = 500)	P*
Age (year) (mean ± SD)	62.35 ± 8.07	60.88 ± 9.10	0.024 <sup>#</sup>
BMI (kg/m <sup>2</sup> ) (mean ± SD)	27.70 ± 4.20	28.10 ± 4.30	0.310 <sup>#</sup>
Age category (year) [n (%)]			< 0.001*
< 50	16 (5.4)	73 (14.6)	
50-70	238 (80.4)	359 (71.8)	
> 70	42 (14.2)	68 (13.6)	
Sex (male) [n (%)]	200 (67.6)	326 (65.2)	0.400*
Smoking [n (%)]	83 (28.0)	178 (35.6)	0.028*
Diabetes [n (%)]	129 (43.6)	259 (51.8)	0.025*
Hypertension [n (%)]	175 (59.1)	331 (66.2)	0.045*
Hypercholesterolemia [n (%)]	145 (49.0)	233 (49.6)	0.870*
Family history of CHD [n (%)]	31 (10.5)	55 (11.1)	0.810*
BMI categories (kg/m <sup>2</sup> ) [n (%)]			0.320*
Underweight/Normal (< 24.9)	16 (5.4)	23 (4.6)	
Overweight (25-29.9)	261 (88.2)	456 (91.2)	
Obese > 30	19 (6.4)	21 (4.2)	
Comorbidity number [n (%)]			< 0.001*
0	75 (25.3)	31 (6.2)	
1	72 (24.3)	155 (31.0)	
2	70 (23.6)	155 (31.0)	
3	79 (26.7)	159 (31.8)	

\* Chi-square test; <sup>#</sup> Independent t-test

SD: Standard deviation; CHD: Coronary heart disease; BMI: Body mass index

The percentage of HTN (66.2% vs. 59.1%,  $P = 0.045$ ), DM (51.8% vs. 43.6%,  $P = 0.025$ ), and smoking (35.6% vs. 28.0%,  $P = 0.028$ ) were significantly higher in the second period of the study compared to the first period. Whereas, the prevalence of hypercholesterolemia and patients with family history of coronary heart disease (CHD) did not significantly changed over time (49.6% vs. 49.0%,  $P = 0.870$ ; 11.1% vs. 10.5%,  $P = 0.810$ , respectively). Furthermore, there was no significant increase in the mean of BMI between two study periods ( $P = 0.310$ ). As shown in table 1, the number of patients with multimorbidity increased in 2016 compared to 2010 ( $P = 0.001$ ). The frequency of patients with two simultaneous diseases was 31% in second period, while approximately 23.6% of patients in first period had two chronic diseases. In

addition, a dramatic decrease was observed in patients with only one chronic disease during study period.

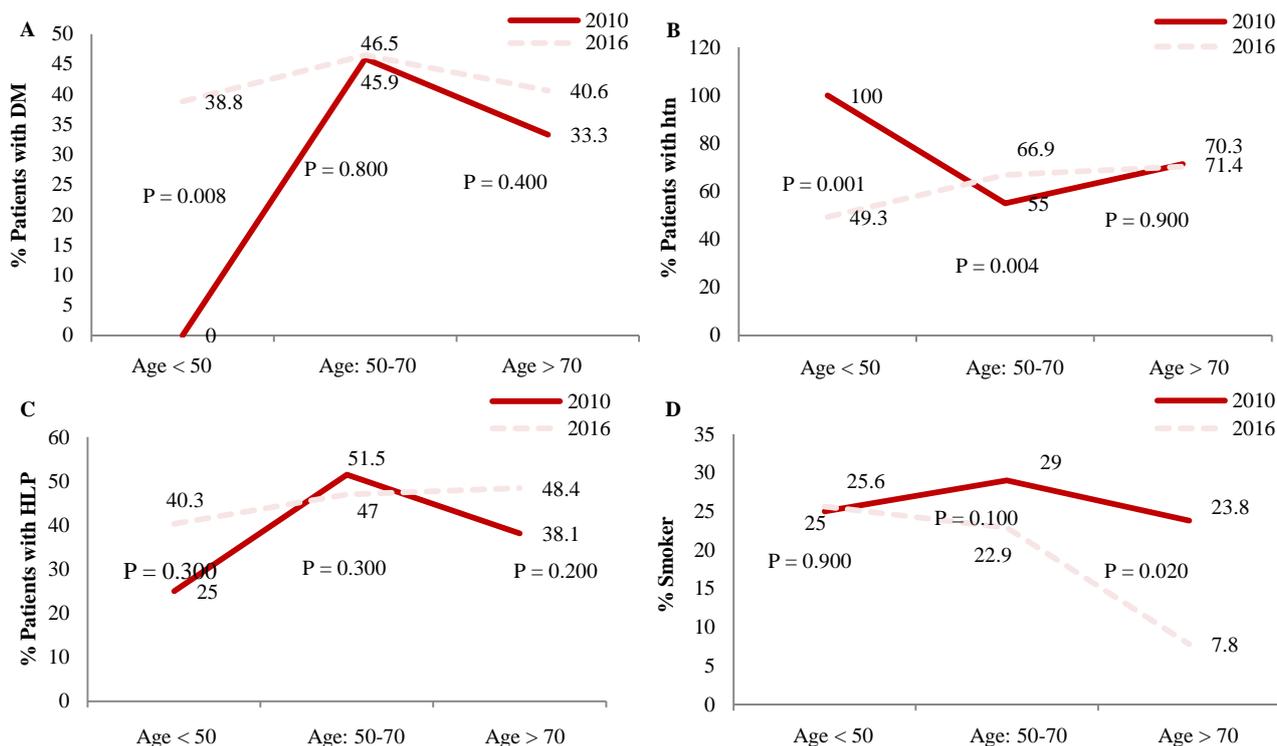
In table 2, the serum level of laboratory data including FBS, LDL, TC, HDL, and TG significantly increased from 2009-2010 to 2015-2016. A one-way ANCOVA was conducted to compare the serum level of laboratory data between two periods of study whilst adjusting for age. Levene's test and normality checks were carried out and the assumptions met. As shown in table 2, result of ANCOVA analysis indicated that only FBS [ $F(1, 9.8)$ ,  $P = 0.002$ ], LDL [ $F(1, 21.2)$ ,  $P = 0.001$ ], and HDL [ $F(1, 92.3)$ ,  $P < 0.001$ ] significantly increased. After adjusting for age, there was no significant increase in TC in second period of the study [ $F(1, 2.09)$ ,  $P = 0.089$ ].

**Table 2.** Comparison of mean fasting blood sugar (FBS) and lipids profile in two periods of study

Variables	2009-2010	2015-2016	P*	Df	F	P <sup>#</sup>
	Mean ± SD	Mean ± SD				
FBS (mg/dl)	115.30 ± 31.90	124.40 ± 41.90	0.002	1	9.8	0.002
Cholesterol (mg/dl)	152.30 ± 42.30	159.90 ± 46.70	0.027	1	2.9	0.089
LDL (mg/dl)	86.80 ± 15.20	93.99 ± 22.10	< 0.001	1	21.2	< 0.001
HDL (mg/dl)	33.60 ± 6.70	39.40 ± 8.70	< 0.001	1	92.3	< 0.001
TG (mg/dl)	153.88 ± 17.69	156.93 ± 17.68	0.024	1	3.3	0.060

\* Independent t-test; <sup>#</sup> Adjusted for age using analysis of covariance (ANCOVA)

SD: Standard deviation; FBS: Fasting blood sugar; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; TG: Triglyceride; Df: Degree of freedom



**Figure 1.** Differences in frequency of cardiovascular risk factors in two periods of study by age groups  
 A: Diabetes mellitus (DM), B: Hypertension (HTN), C: Hypercholesterolemia (HL), D: Smoking; P-value related chi-square test to compare the frequency of DM, HTN, hyperlipoproteinemia (HLP), and smoking between two periods of study by three age groups

The frequency of cardiovascular risk factors was illustrated in various age groups based on two periods of study in figure 1. Study population in both periods of study was divided into three age groups: age < 50 years, 50-70 years, and > 70 years. As shown in figure 1, the number of diabetic patients younger than 50 in second period were significantly higher compared to the first period (38.8% vs. 0,  $P = 0.008$ ). However, there was no significant difference in the frequency of diabetic patients in those aged 50-70 years (45.9% in 2010 vs. 46.5% in 2016,  $P = 0.800$ ). Although the rate of diabetic patients in second period in patients aged 70 and older were higher than first period of study, we could not detect a statistically significant difference (33.3% vs. 40.6%,  $P = 0.400$ ). According to figure 1, the frequency of HTN in patients younger than 50 as well as those aged 50-70 in second period of study significantly increased compared to the first period ( $P = 0.001$ ,  $P = 0.004$ , respectively). However, there was no significant increase in the frequency of HTN in patients older than 70 years ( $P = 0.900$ ).

About hypercholesterolemia, no significant changes were observed in various age groups during the study periods (25.0% in 2010 vs. 40.3% in 2016,  $P = 0.300$  for age < 50; 51.5% vs. 47.0%,  $P = 0.200$

for age 50-70; 38.1% vs. 48.4%,  $P = 0.200$  for age > 70). The frequency of cigarette smoking in patients younger than 50 years old increased a little in 2016 compared to 2010, but there was no significant difference (25.0% in 2010 vs. 25.6% in 2016,  $P = 0.900$ ). On the other hand, the frequency of smoking decreased among patients aged 50-70 years as well as those aged 70 and older (29.0% in 2010 vs. 22.9% in 2016,  $P = 0.100$ ; 23.8% in 2010 vs. 7.8% in 2016,  $P = 0.020$ , respectively).

### Discussion

This study showed a decrease in the age of CABG patients in the second period of study, so that 13% of patients in 2016 were younger than 50 years old compared to 4.2% in 2010. Moreover, prevalence of lifestyle-related risk factors such as DM and HTN increased in 2016 in comparison to 2010. Further, we showed that both DM and HTN in younger patients had tragic increment in 2016; as we had no diabetic patients in first period of study among patients younger than 50 years old. Consistent with our study, Poddar et al. showed an increase in the prevalence of HTN and DM in younger patients undergoing revascularization during two periods of the study.<sup>15</sup> Two recent studies reported an increase

in BMI level, prevalence of DM, HTN, and hypercholesterolemia in patients undergoing CABG over time.<sup>16,17</sup> According to the study on prospective data gathered in Tehran heart center, Tehran, Iran, in 2005, prevalence of DM and HTN in CABG patients was 27% and 34%, respectively,<sup>18</sup> which were lower than our data in 2010 and also in 2016. Interestingly, the number of female patients in both periods of present study was greater than Mandegar *et al.*<sup>18</sup> study in 2005. Similarly, Lopez-de-Andres *et al.*<sup>19</sup> based on Spanish national hospital discharge data showed that CABG incidence rate increased from 2001 to 2011. And also, female proportion in non-diabetic patients who underwent CABG increased during the 11-year study period in Spain.<sup>19</sup>

National Health and Nutrition Examination Survey (NHANES) in the United States (US) reported no significant decreasing trend in cardiovascular risk factors in women younger than 60 years of age and men younger than 40 during 12-year period.<sup>20</sup> Another similar finding in an Iranian study was related to increase in metabolic syndrome trend over the 12 years.<sup>21</sup> Hence, we can expect the higher prevalence of cardiometabolic risk factors in patients with coronary disease.

In addition to increasing in DM and HTN prevalence, cigarette smoking was more common in second point of the present study, especially in younger patients. Aligned with our finding, Poddar *et al.*<sup>15</sup> in a clinic-based data registry on 1914 patients with CAD aged  $\leq 45$  years showed that there was no decrease in smoking prevalence. Our study showed that cigarette smoking in the second period was more common in younger patients, while in the first phase of the study older patients were more smokers. Nowadays, a new health problem known as waterpipe has become prevalent among young population in the middle east countries<sup>22</sup> and even western countries.<sup>23</sup> A recent report by Sibai *et al.*<sup>24</sup> showed that long-term use of waterpipe increased the risk of coronary stenosis.

Furthermore, parallel to previous studies, we observed an overall increase in the frequency of comorbidities among CABG patients.<sup>25,26</sup> Thorsteinsson *et al.* indicated that CABG was increasingly performed on patients with a higher number of comorbidities between 1996 and 2012 in Denmark.<sup>25</sup> Also, the increasing trend of comorbidities prevalence was reported in a population-based study on 94328 patients undergoing CABG from 1987 to 2006.<sup>26</sup> Rising number of multimorbidity in cardiac patients leads

to more difficult medical care and more cost of care. Furthermore, cardiologists and other physicians as well as health care workers need new protocol to help better multimorbidity care.

An important finding of the present study was a remarkable increase in the total number of coronary artery bypass over time. However, some medical records in the first period were excluded for incomplete history and weak archives. Another probable explanation could be related to new reform in health care system in Iran to reduce patients' payments for medical costs. Many patients suffered from chest pain and dyspnea for several years, but heavy cost of health care services was an important barrier for referring to physician and following up. A cross-sectional study in a large province of Iran showed that patients' payments for cost of medical equipment in hospitalized patients decreased after implementation of health reform in 2015.<sup>27</sup> In addition, one more probable explanation can be related to increase in the number of general cardiologists and surgeons in the hospital. More cardiologists provide more facility for quick diagnostic assessments and then greater number of medical interventions like percutaneous coronary intervention (PCI) and CABG. However, previous studies mentioned the greater growth of PCI compared to CABG.<sup>28,29</sup> But no information on PCI in our hospital was collected in this study.

Present study involved some limitations: due to the retrospective design of the study, the accuracy of data depended on recorded history. To decrease this error, we assessed all history recorded by cardiology residents. However, all medical histories were self-report for lacking electronic data registry system which was related to family physicians system. Furthermore, we could not collect information about other important chronic diseases like chronic kidney disease and respiratory disease. In addition, during this period of time, indications for CABG and PCI were changed. However, in the present study, we just reviewed the information about CABG. On the other hand, a number of patients delayed treatment due to the high cost of surgery. Recent health system reform in Iran reduced the health care cost for people.<sup>30</sup> Hence, we observed a considerable increase in the number of cardiac surgery.

In spite of having several limitations, our findings have some strength points as well. Since majority of Guilan citizens receive cardiovascular services from one and only university hospital, our finding can be extended to a large part of northern area of Iran.

However, it is worth mentioning that as a result of low cost of health care services in university hospital, our results might be more related to rural and lower socioeconomic status individuals.

### Conclusion

CABG rate had increasing frequency in second period compared to the first period, and also age of people undergoing CABG was declined in second period compared to the first period of the study. In addition, the frequency of the cardiovascular risk factors like DM, HTN, and cigarette smoking increased during study period. Moreover, this superiority was observed in younger patients. Further, the prevalence of patients with multimorbidity increased in 2016 compared to 2010. More number of patients with multimorbidity undergoing CABG leads to more difficult medical care and more costs of care.

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### Conflict of Interests

Authors have no conflict of interests.

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