ORIGINAL ARTICLE

CARDIOVASCULAR DISEASE RISK FACTOR ESTIMATION IN GUJARATI ASIAN INDIAN POPULATION USING FRAMINGHAM RISK EQUATION

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ABSTRACT

Introduction: Framingham 10 years risk estimation tools are potentially a cost-effective strategy for cardiovascular disease (CVD) prevention in developing countries. The current investigation was designed to predict CVD risk in healthy and asymptomatic Gujarati Asian Indians.

Methods: It was observational study of 2483 individuals of Gujarat state having no past or present history of major illness including CVD. The study cohort was stratified into three groups of low-, intermediate- and high risk of CVD according to the Framingham 10 years risk calculator and the contributing factors for higher CVD risk were studied.

Results : Out of 2483 individuals, (65.4%) had low risk of CVD event followed by 21.95% having intermediate and 12.65% showing high risk. The low level of HDL-C (85.03%), hypertension (63.69%) and elevated TC (60.83%) and LDL-C (60.83%) were found to be the main contributors for CVD risk. In high risk males the levels of TC (58.45%) and LDL-C (58.1%) were significantly elevated ($p<0.0001$), whereas levels of HDL-C (92.25%) markedly low in this subset of population, whereas in females hypertension (100%) and abnormalities of lipids (TC – 83.33%, LDL-C – 86.67%) were the contributors. The CVD risk increased with age in both the genders where maximum risk was found at the population being in the 60-69 years (male – 45.07%; female – 46.67%) of the age.

Conclusion: Higher risk in Gujarati Asian Indian community is mainly attributed by dyslipidemias and hypertension. Both of them being modifiable risk factors, the life style modification is highly advocated in this ethnic group.

Keywords: Gujarati Asians Indians, dyslipidemia, Framingham risk score, hypertension

INTRODUCTION

Cardiovascular diseases (CVD) are the leading causes of death in most of high-, low-, and middle-income countries.[1,2] In current scenario, area of research dealing with the stratification of individual risk most cost-effective allocation of preventive therapies. As the incidence of CVD is largely explained by reducing modifiable risk factorsthrough health promotion focusing on lifestyle is a logical way of preventing disease[3].

The Framingham risk Score (FRS) has traditionally been used as a predictor of the 10-year risk of CVD[4,5]. The current study was conducted to identify high risk individuals by using a Framingham risk equation [6].

METHODS

This observational and randomized screening study, conducted by U. N. Mehta Institute of cardiology and research centre was approved by Institutional ethics committee. Total 2483 individuals of both the genders (1477 males & 1006 females), who were apparently healthy, asymptomatic, disease free and ranging in age from 30 to 74 years were included in the study. The subjects taking any medications and with abnormal stress test were excluded from the investigation. All patients had

normal baseline electrocardiography (ECG) and 2D echocardiography. The details of demographic data, ethnicity, family history of CAD and smoking were collected for each individual. Subjects were advised to fast at least for twelve hour before blood investigations. Total cholesterol (TC), triglycerides (TG), total lipid (TL), lipoproteins - low density lipoproteins (LDL), high density lipoprotein (HDL), and very low density lipoprotein (VLDL), and glucose concentrations were measured by International Federation of Clinical Chemistry (IFCC) approved enzymatic methods using commercially available kit on auto analyzer (ARCHITECH PLUS ci4100, Germany). Lipids levels were classified according to the classification recommended by National Cholesterol Education Program (NCEP) and Adult Treatment Panel III (ATP III) guidelines. Blood pressure of the population was measured according to earlier reported guidelines and hypertension was diagnosed if the systolic blood pressure was higher than 140mm Hg or the diastolic blood pressure was above 90 mm Hg[7]. Four categories of body mass index (BMI) (weight in kilogram/the square of height in meters) were designed according to the WHO standards[8]. Framingham risk estimation model is based on age, treated and untreated systolic blood pressure, diabetes, smoking, Body Mass Index (BMI). This tool is designed to determine an individual's chances of developing cardiovascular disease (coronary heart disease or stroke) in adults aged 30 years and older who do not have CVD.

Statistical Analysis

Data was analysed using SPSS, version 20.0 (SPSS Inc., Chicago, IL, USA). Quantitative data was expressed as mean plus-minus SD whereas qualitative data was expressed in percentage by using SPSS. Comparisons between the groups were done using t test or chi square test wherever appropriate. A p value <0.05 was considered statistically significant.

RESULTS

The demographic profile of overall population is described in table 1. Mean age of the study group was 46.8 ± 10.35 years where males had significantly ($p<0.0001$) higher age 47.63 ± 10.77 as compared to females (45.59 ± 9.58). The results indicated that considerably large number of asymptomatic individuals were suffering from dyslipidemias (low HDL-C – 61.22%, high LDL-C – 40.88%, high TC – 39.3%, high triglyceride – 10.07%). 13.25% of the population was suffering from obesity and 10.87% of them had habit of smoking. High BMI was found in 13.25% and 4.31% of the population was diabetic in nature. The prominent cardiovascular risk factor found in male were low HDL-C level (88.49%), elevated TC (40.56%) and hypertension (33.99%) where as in females dyslipidemias of TC (37.48%) and LDL-C (37.38%) were widely prevalent. According to Framingham risk calculator the total population of the study group was divided into various categories of low-, intermediate- and high risk of developing cardiovascular diseases in 10 years (table 2).

Table 1: Demographic data of the study population

Variables	Population	Male (%)	Female (%)	P-value
Total	2483	1477 (59.48)	1006 (40.51)	
Age (years)	46.80±10.35	47.63±10.77	45.59±9.58	<0.0001
Total Cholesterol	976(39.31)	599(40.56)	377(37.48)	0.1334
Triglyceride	250(10.07)	191(12.93)	59(5.86)	<0.0001
HDL-C	1520(61.22)	1307(88.49)	213(21.17)	<0.0001
LDL-C	1015(40.88)	639(43.26)	376(37.38)	0.0039
LDL-C/HDL-C	1157(46.6)	815(55.18)	342(34)	<0.0001
TC/HDL-C	1325(53.36)	938(63.51)	387(38.47)	<0.0001
TG/HDL-C	555(22.35)	409(27.69)	146(14.51)	<0.0001
Total lipid	668(26.9)	461(31.21)	207(20.58)	<0.0001
VLDL	369(14.86)	276(18.69)	93(9.24)	<0.0001
Smoking	270(10.87)	217(14.69)	53(5.27)	<0.0001
BMI (≥30)	329(13.25)	162(10.97)	167(16.6)	0.0001
Diabetes	107(4.31)	75(5.08)	32(3.18)	0.0289
Hypertension	771(31.05)	502(33.99)	269(26.74)	0.0002

TC, total Cholesterol; HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein-cholesterol; VLDL, very low-density lipoprotein; BMI, body mass index

Table 2: Categorization of the study population according to Framingham risk

Variable	Low risk(%)	Intermediate risk(%)	High risk(%)	P-value
Total	1624(65.4)	545(21.95)	314(12.65)	
Total Cholesterol	511(31.47)	274(50.28)	191(60.83)	<0.0001
Triglyceride	110(6.77)	64(11.74)	76(24.2)	<0.0001
HDL-C	857(52.77)	396(72.66)	267(85.03)	<0.0001
LDL-C	529(32.57)	295(54.13)	191(60.83)	<0.0001
LDL-C /HDL-C	609(37.5)	325(59.63)	223(71.02)	<0.0001
TC/HDL-C	711(43.78)	365(66.97)	249(79.3)	<0.0001
TG/HDL-C	280(17.24)	148(27.16)	127(40.45)	<0.0001
Total lipid	293(18.04)	177(32.48)	148(47.13)	<0.0001
VLDL	176(10.84)	95(17.43)	98(31.21)	<0.0001
Smoking	109(6.71)	78(14.31)	82(26.11)	<0.0001
BMI (≥30)	214(13.18)	78(14.31)	37(11.78)	0.5684
Diabetes	18(1.11)	33(6.06)	56(17.83)	<0.0001
Hypertension	310(19.09)	261(47.89)	200(63.69)	<0.0001

TC, total Cholesterol; HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein-cholesterol; VLDL, very low-density lipoprotein; BMI, body mass index

Table 3: Gender and risk score wise categorization of the study population

	Male (%)			P-value	Female (%)			P-value
Variables	Low Risk	Intermediate	High Risk		Low Risk	Intermediate	High Risk	
Total Subjects	760(51.45)	433(29.32)	284(19.23)		864(85.88)	112(11.13)	30 (2.98)	
TC	232(30.53)	201(46.42)	166(58.45)	<0.0001	279(32.29)	73(65.18)	25(83.33)	<0.0001
Triglyceride	73(9.61)	50(11.55)	68(23.94)	<0.0001	37(4.28)	14(12.5)	8(26.67)	<0.0001
HDL-C	676(88.95)	369(85.22)	262(92.25)	0.0132	181(20.95)	27(24.11)	5(16.67)	0.6161
LDL-C	253(33.29)	221(51.04)	165(58.1)	<0.0001	276(31.94)	74(66.07)	26(86.67)	<0.0001
LDL-C/ HDL-C	365(48.03)	247(57.04)	203(71.48)	<0.0001	244(28.24)	78(69.64)	20(66.67)	<0.0001
TC/HDL-C	427(56.18)	283(65.36)	228(80.28)	<0.0001	284(32.87)	82(73.21)	21(70)	<0.0001
TG/HDL-C	173(22.76)	120(27.71)	116(40.85)	<0.0001	107(12.38)	28(25)	11(36.67)	<0.0001
Total lipid	153(20.13)	128(29.56)	130(45.77)	<0.0001	140(16.2)	49(43.75)	18(60)	<0.0001
VLDL	110(14.47)	78(18.01)	88(30.99)	<0.0001	66(7.64)	17(15.18)	10(33.33)	<0.0001
Cigarrate	73(9.61)	67(15.47)	77(27.11)	<0.0001	36(4.17)	12(10.71)	5(16.67)	0.0016
BMI (≥30)	74(9.73)	56(12.93)	32(11.27)	0.2325	140(16.20)	22(19.64)	5(16.67)	0.6547
Diabetes	7(0.92)	15(3.46)	53(18.66)	0.0004	11(1.27)	18(16.07)	3(10)	<0.0001
Hypertension	161(21.18)	78(18.01)	30(10.56)	<0.0001	283(32.75)	78(69.64)	30(100)	<0.0001

TC, total Cholesterol; HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein-cholesterol; VLDL, very low-density lipoprotein; BMI, body mass index

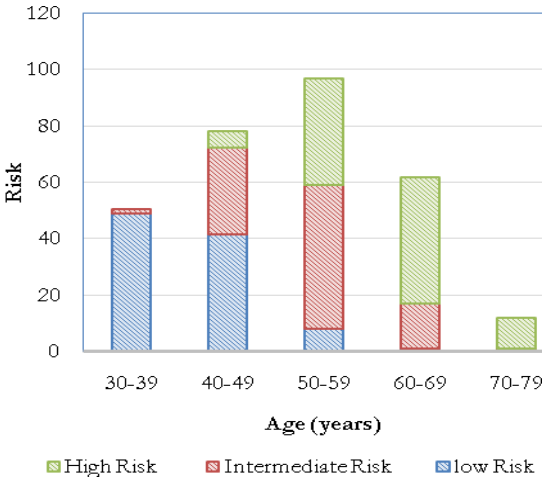

Figure 1: Framingham risk of CVD in males according to age

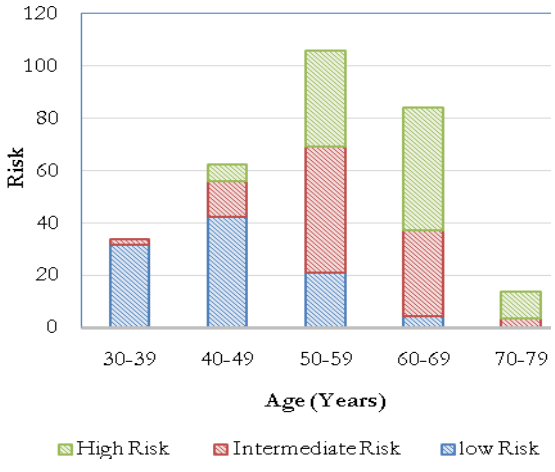

Figure 2: Framingham risk of CVD in females according to age

Out of 2483 individuals, 1624 (65.4%) had low risk of CVD event followed by 21.95% having intermediate and 12.65% showing high risk of CVD. The results indicated that almost all the risk factors possesses increasing trend from low risk to high risk group. Except from high BMI (p=0.5684) other parameters were significantly advanced in high risk group as compared to low risk and intermediate group population. The low level of HDL-C (85.03%), hypertension (63.69%) and elevated TC (60.83%) and LDL-C (60.83%) were the main contributors for higher 10 years coronary artery disease (CAD) risk in Gujarati Asian Indians. Ratios of various lipids (LDL-C/HDL-C - 71.02%, TC/HDL-C – 79.3% and TG/HDL-C – 40.45%) were significantly (p<0.0001) elevated in high risk group. We have observed that although showed an increasing pattern diabetes was prevalent only in 17.83% of the population being at high risk of CAD.

The population was further categorized according to their gender and Framingham risk as presented in table 3. In high risk males the levels of TC (58.45%) and LDL-C (58.1%) were significantly elevated (p<0.0001), whereas levels of HDL-C (92.25%) markedly low in this subset of population. However in females the CVD risk factors involved in advanced risk score were high blood pressure (100%) and abnormalities of lipids (TC – 83.33%, LDL-C – 86.67%). The CVD risk score of these asymptomatic individuals were also grouped according to their age also and is shown in figure 1 and 2. The result showed that risk of CVD increases with age in both the genders where maximum risk was found at the population being in the 60-69 years (male – 45.07%; female – 46.67%) of the age group.

DISCUSSION

The use of risk prediction tools derived from the Framingham Study has been widely recommended to health professionals for the identification of individuals at high risk of cardiovascular disease. The basis of this recommendation is an understanding that the intensity of management of risk factors should be proportional to an individual's absolute risk of experiencing a cardiovascular event.

One of the prime finding of this study is the key contribution of various dyslipidemias (high TC - 60.83%, low HDL-C – 85.03%, high LDL-C – 60.83) and hypertension (63.69%) in CVD risk development in Gujarati Asian Indians. However, in spite of their proven role in VD in other ethnic cohort smoking (26.11%), diabetes (17.83%) and obesity (11.78%) were found to be weakly associated with CAD risk in Gujarati Asian Indians. Disturbance in lipid metabolism often causes manifestation of various dyslipidemias triggering inflammatory processes inducing atherosclerotic disorders.[9] The establishment of relationship between total cholesterol and CHD risk was reported to be one of the first land mark finding of Framingham study. Recently, the "cholesterol centric" approach to CVD is an obsolete concept as the high levels of LDL, elevated TG, TL, VLDLs and low levels of HDL are also known to contribute in CVD which was later updated by Framingham investigators also.[10] Similarly this study results also showed key association between various dyslipidemias and high framingham risk score in Gujarati Asian Indians.

HDL being anti-atherogenic lipoprotein provides cardio-protection through various mechanisms such as reverse transport of cholesterol, preventing endothelial dysfunction and antioxidative properties. Various clinical and epidemiological studies have shown inverse relationship between HDL level and coronary events.[11]HDL abnormality was found to target the population at relatively early age in both the gender indicating early need for diet and life style modification.

Hypertension is one of the strongest attributable risk factor of CVD and several epidemiological studies such as INTERHEART and Framingham had recommended its use as a powerful predictor of future CVD events.[10,12] In the same manner this study also founds hypertension as one of the strongest predictor of high CVD risk showing higher frequencies (high risk group) in females (100%) as compared to male (10.5%), which is in accordance with earlier reported studies.[13] This remarkable loss of the estrogen protective effect in Gujarati females could be partially explained by less effective baroreflex buffering of blood pressure in women than men and presence of associated comorbidities.[14] The overall population affected by high blood pressure reported in our study (31.05%) was relatively higher than other documented studies (16.9%).[15]

We have observed that the risk of CVD increases with increasing age making natural aging as one of the risk factor for CVD event. Natural ageing allied increase in CVD risk was observed in both the genders in the current study as reported by others also for Gujarati Asian Indians. Ageing induces dysfunctional arteries by increasing arterial stiffness, oxidative stress and reducing arterial compli-

ance and promotes CVD risk factors.[16] Our results clearly states that the as people grow older CVD risk increases due to greater expression of Framingham equation risk factors, namely dyslipidemias and hypertension.

CONCLUSION

The present study states that 12.65% of the Gujarati Asian Indian community had higher CVD risk that is mainly contributed by various dyslipidemias and hypertension. The risk was higher in males and older population. This information could be used for designing of preventive strategies for modifiable risk factors of CVD - dyslipidemias and hypertension in this ethnic group of individuals.

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