# Epidemiological Analysis of Major Cardiovascular Risk Factors in 1,508 Indian Adults Stratified by Age and Gender

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**ABSTRACT**

**BACKGROUND**

Routine screening of healthy individuals for the presence of cardiovascular risk factors is important for identification of high-risk coronary artery disease (CAD) patients at early stage and to provide preventive care. Considering the high burden of CAD, such investigations are of significant importance in Indian context.

**METHODS**

In this cross-sectional study, adult individuals (18 – 68 years) were evaluated for pre-existing diseases, lipid profile, blood glucose profile, thyroid profile, haemoglobin (Hb) and vitamins D3 and B12 levels after obtaining informed consent. These variables were compared between patients stratified based on their gender and age (< 40, 40 – 60, > 60 years).

**RESULTS**

A total of 1,508 participants (mean age: 49 ± 11 years; 49.9 % females) were investigated. Hypertension, diabetes, dyslipidaemia, anaemia, vitamin D3 and B12 deficiencies, hyperthyroidism, and hypothyroidism were observed in 31.2 %, 26.5 %, 32.0 %, 8.6 %, 35.3 %, 25.1 %, 21.0 % and 0.6 % of patients respectively. Prevalence of hypertension, diabetes, and dyslipidaemia increased with ageing, while deficiencies of Hb, vitamin D3, and vitamin B12 as well as hyperthyroidism and hypothyroidism were comparable across all age groups. Males were more prone to hypertension, diabetes, and dyslipidaemia, while females were more prone to have Hb deficiency, hyperthyroidism, and hypothyroidism. Total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), fasting blood sugar (FBS), vitamin D3, and vitamin B12 were elevated with increase in age, while Hb levels decreased. Males exhibited higher levels of TG, low-density lipoprotein cholesterol (LDL-C), TC / HDL, LDL / HDL, FBS, and Hb, while females displayed higher levels of vitamin D3 and B12.

**CONCLUSIONS**

Our findings verify the role of age and gender on majority of cardiovascular risk factors. The high prevalence of cardiovascular risk factors is alarming and demands the need for appropriate health-care measures.

**KEYWORDS**

Age, Coronary Artery Disease, Gender, Risk Factor

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## BACKGROUND

Cardiovascular disease (CVD) is one of the most significant causes of morbidity and mortality in India.[1] A quarter (about 24 %) of all mortality is attributable to CVD. According to an estimate, the age-standardised CVD death rate of 2.72 per 1,000 populations in India is higher than the global average of 2.35 per 1,000 populations. Further, certain features of the CVD epidemic in India are major causes of concern, which include its augmented accumulation, early age of disease onset, and high mortality rate.[2] The incidence of coronary artery disease is estimated at about 47 million per year, causing another 2.3 million deaths annually.[3] Of significance, the presentation of CVD occurs at early age (< 50 years) in approximately 50 % of cases, with nearly 25 % patients under the age of 40 years. Further, the years of life lost due to CVD-related premature mortality has increased by 59 % in two decades (from 23.2 million to 37 million). Regardless of heterogeneity in the prevalence of cardiovascular risk factors, CVD remains an alarming health concern across different regions in India. Preventive screening strategies are need of the hour to reduce burden of CAD in the country. Hence, emphasis on prevention, early diagnosis, and appropriate and timely management are strongly recommended.[2] Although numerous risk factors have been established to predict the development of CVD, established programs to screen the conventional risk factors in apparently healthy individuals are lacking in India.[4] Further, this risk factor profile may be different between the young and older age groups and between males and females.[5] In this scenario, we conducted the present study to assess the prevalence of conventional risk factors of CAD in apparently healthy adult population. We also wanted to assess the effect of gender and age on major cardiovascular risk factors.

## METHODS

In this cross-sectional study, adult individuals (18 – 68 years), who were not having known cardiovascular disease and attending health screening program at Shree Krishna Hospital, Karamsad, Gujarat between January 2012 and December 2016, were considered for enrolment. Patients who did not give consent or those who had undergone previous coronary interventions were excluded from the study. The study protocol was approved by the institutional ethics committee. The informed consent was obtained from each enrolled individual.

### Data Collection

All data were collected at source-medical record database of the hospital. Demographic variables included age and gender. Further investigations comprised estimation of pre-existing disease and conventional CVD risk factors including hypertension, diabetes mellitus, dyslipidaemia, smoking and tobacco-chewing habits, and family history of premature coronary artery disease. In addition, 5 mL blood was collected from each individual after overnight fast of at least 8 hrs. The blood samples were investigated for lipid profile, blood glucose profile, thyroid profile, haemoglobin and vitamins D3 and B12 levels. Here, the quantitative estimation of total cholesterol and high-density lipoprotein cholesterol was done and estimated using COBAS Integra 400 plus analyser (Roche, Switzerland). Triglyceride levels were determined by GPO-PAP enzymatic colorimetric endpoint. Low-density lipoprotein cholesterol levels were calculated using the Friedewald formula. Very low-density lipoprotein cholesterol (VLDL-C) levels were also calculated accordingly. In addition, lipid ratios of TC to HDL-C cholesterol and LDL-C to HDL-C were calculated. Blood glucose profile, thyroid profile, haemoglobin and vitamins D3 and B12 levels were estimated by standardised methods.

### Statistical Analysis

The collected data on various risk factor variables were compared between patients stratified based on their gender (i.e. male, female) and age (i.e. < 40, 40 – 60, > 60 years). The chi-square test was used to identify statistical differences between the gender- and age-groups for comorbidities (i.e. categorical variables). The Student's t test was used to identify statistical differences between the gender-groups for laboratory parameters (i.e. continuous variables) while the one-way analysis of variance (ANOVA) test was used to identify statistical differences between the age-groups for laboratory parameters (i.e. continuous variables).

## RESULTS

### Demographic Details

A total of 1,508 participants were investigated in this study. The mean age of enrolled participants was 49±11 years. Of enrolled participants, 753 (49.9 %) were males and 755 (50.1 %) were females. Age stratification patients revealed that 340 (22.6 %) were of < 40 years of age, 932 (61.8 %) were of 40 - 60 years of age, and 236 (15.6 %) were of > 60 years of age. Of overall participants, various pre-existing diseases were prevalent in 471 (31.2 %) cases of hypertension, 399 (26.5 %) cases of diabetes, 483 (32.0 %) cases of dyslipidaemia, 140 (9.3 %) cases of anaemia, 532 (35.3 %) cases of vitamin D3 deficiency, 379 (25.1 %) cases of vitamin B12 deficiency, 316 (21.0 %) cases of hyperthyroidism, and 9 (0.6 %) cases of hypothyroidism (Figure 1).

### Influence of Gender on Pre-Existing Conditions

Hypertension, diabetes, and dyslipidaemia was significantly more common in males, while anaemia, vitamin D3 deficiency, and hyperthyroidism were significantly more common in females (Table 1). Prevalence of hypothyroidism and vitamin B12 deficiency were similar across both genders (Table 1).

**Influence of Age on Pre-Existing Conditions**

Prevalence of hypertension, diabetes, and dyslipidaemia was seen to increase significantly with age (Table 1). Vitamin D3 and B12 and Hb deficiencies as well as hyperthyroidism and hypothyroidism were not significantly different across the age groups (Table 1).

**Influence of Gender on Laboratory Parameters**

While TC was significantly higher in females, the TC / HDL-C and LDL-C / HDL-C were favourable in females due to significantly higher HDL-C in females (Table 2). FBS and TG levels were significantly higher in males (Table 2).

**Influence of Age on Laboratory Parameters**

There was a trend of rising TC, TG, HDL-C, VLDL-C, and FBS with increasing age that was statistically significant (Table 2). Middle aged population (40 - 60 years) have the highest LDL-C as was high TC / HDL and LDL / HDL ratio suggesting unfavourable lipid profile in this age group (Table 2). Haemoglobin levels showed progressive fall as age progresses (Table 2).

| Comorbidity | Overall (N = 1508) | Influence of Gender | | | Influence of Age | | | |
|---|---|---|---|---|---|---|---|---|
| | | Male (N = 753) | Female (N = 755) | P Value | < 40 years (N = 340) | 40 - 60 years (N = 932) | > 60 years (N = 236) | P Value |
| Hypertension | 471 (31.2 %) | 254 (33.7 %) | 217 (28.7 %) | 0.040 | 25 (7.4 %) | 325 (34.9 %) | 121 (51.3 %) | < 0.001 |
| Dyslipidaemia | 483 (32.0 %) | 276 (36.7 %) | 207 (27.4 %) | < 0.001 | 82 (24.1 %) | 310 (33.3 %) | 91 (38.6 %) | 0.001 |
| Diabetes | 399 (26.5 %) | 220 (29.2 %) | 179 (23.7 %) | 0.017 | 29 (8.5 %) | 277 (29.7 %) | 93 (39.4 %) | < 0.001 |
| Anaemia | 140 (9.3 %) | 32 (4.2 %) | 108 (14.3 %) | < 0.001 | 33 (9.7 %) | 85 (9.1 %) | 22 (9.3 %) | 0.943 |
| Vitamin D3 deficiency | 532 (35.3 %) | 244 (32.4 %) | 288 (38.1 %) | 0.021 | 118 (34.7 %) | 337 (36.2 %) | 77 (32.6 %) | 0.577 |
| Vitamin B12 deficiency | 379 (25.1 %) | 197 (26.2 %) | 182 (24.1 %) | 0.373 | 86 (25.3 %) | 251 (26.9 %) | 42 (17.8 %) | 0.016 |
| Hyperthyroidism | 316 (21.0 %) | 123 (16.3 %) | 193 (25.6 %) | 0.507 | 55 (16.2 %) | 209 (22.4 %) | 52 (22.0 %) | 0.800 |
| Hypothyroidism | 9 (0.6 %) | 3 (0.4 %) | 6 (0.8 %) | < 0.001 | 2 (0.6 %) | 5 (0.5 %) | 2 (0.8 %) | 0.048 |

***Table 1. Effect of Age and Gender on Comorbidities***

| Comorbidity | Overall (N = 1508) | Influence of Gender | | | Influence of Age | | | |
|---|---|---|---|---|---|---|---|---|
| | | Male (N = 753) | Female (N = 755) | P Value | < 40 years (N = 340) | 40 - 60 years (N = 932) | > 60 years (N = 236) | P Value |
| **TC** | 181.45 ± 39.36 | 179.18 ± 39.72 | 182.89 ± 36.33 | 0.038 | 171.8 ± 36.21 | 183.81 ± 38.55 | 183.54 ± 36.95 | < 0.001 |
| **TG** | 125.15 ± 67.78 | 136.23 ± 70.48 | 114.50 ± 63.27 | < 0.001 | 120.13 ± 74.99 | 126.16 ± 64.48 | 129.55 ± 65.52 | 0.002 |
| HDL-C | 47.75 ± 13.45 | 42.70 ± 11.28 | 52.74 ± 13.55 | < 0.001 | 45.92 ± 12.57 | 47.72 ± 13.26 | 50.46 ± 14.86 | 0.001 |
| LDL-C | 107.85 ± 32.05 | 108.97 ± 33.29 | 107.04 ± 30.43 | 0.348 | 101.69 ± 29.55 | 110.60 ± 32.35 | 106.94 ± 32.13 | < 0.001 |
| VLDL-C | 25.04 ± 13.56 | 27.25 ± 14.11 | 22.90 ± 12.65 | < 0.001 | 24.03 ± 14.99 | 25.23 ± 12.91 | 25.91 ± 13.89 | 0.002 |
| TC / HDL | 4.03 1.27 | 4.41 ± 1.31 | 3.64 ± 1.02 | < 0.001 | 3.98 ± 1.32 | 4.07 ± 1.21 | 3.90 ± 1.24 | 0.055 |
| LDL / HDL | 2.42 ± 0.96 | 2.70 ± 1.03 | 2.15 ± 0.80 | < 0.001 | 2.38 ± 0.99 | 2.48 ± 0.95 | 2.30 ± 0.93 | 0.015 |
| FBS | 114.54 ± 38.68 | 116.69 ± 39.19 | 112.41 ± 38.07 | < 0.001 | 101.53± 20.62 | 117.90 ± 42.55 | 120.04 ± 38.60 | < 0.001 |
| Hb | 13.18 ± 1.78 | 14.15 ± 1.59 | 12.21 ± 1.39 | < 0.001 | 13.56 ± 1.82 | 13.09 ± 1.81 | 13.00 ± 1.51 | < 0.001 |

***Table 2. Effect of Gender and Age on Laboratory Parameters***

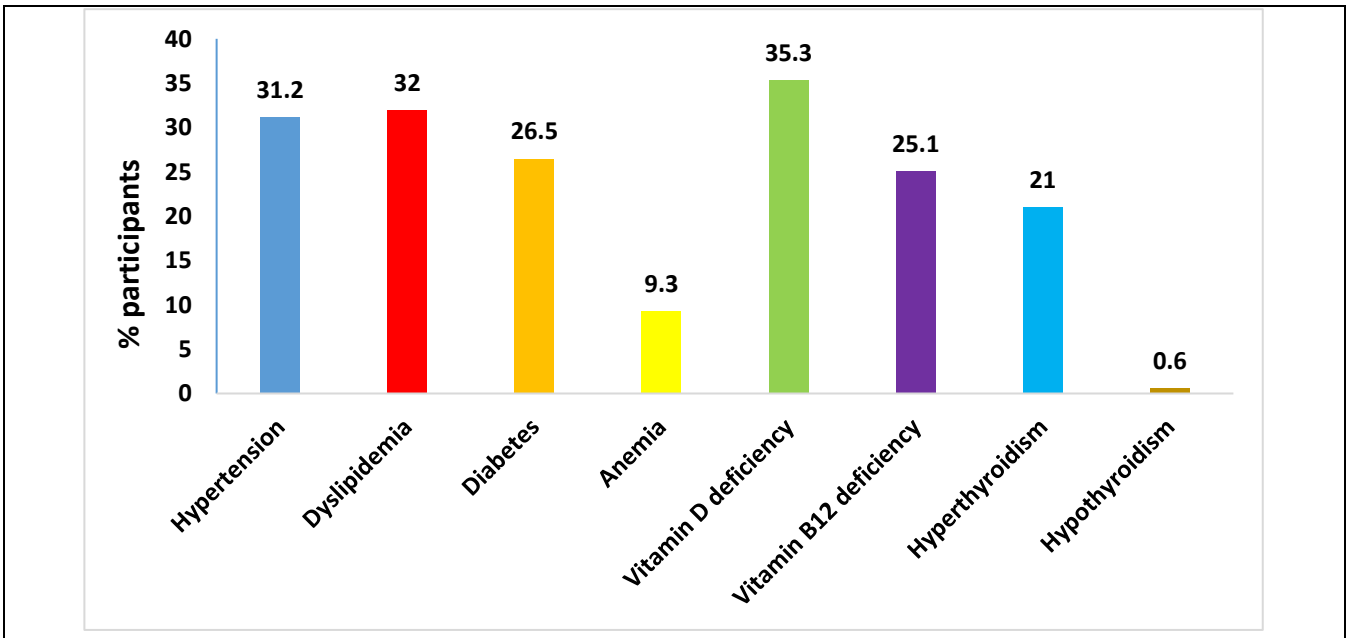


***Figure 1. Pre-Existing Conditions in Overall Study Population***

## DISCUSSION

Cardiovascular diseases and its risk factors are increasing with a rapid pace in Indian population. (6) For CAD, about 200 risk factors have been recognised or hypothesized.[5] Of them, hypertension, diabetes, dyslipidaemia, anaemia, thyroid disorders, vitamin deficiencies, etc. are well-established and most widely accepted risk factors.

Considering the epidemic burden of CAD in India, there is a vital need to routinely screen healthy individuals for the presence of these risk factors in order to identify high-risk CAD patients. However, lack of health screening programs and lack of preventive measures has remained major challenges related to increasing risk factors for CAD and demands the need for appropriate preventive health-care measures in India.[6]

We conducted one such screening study and found a high prevalence of cardiovascular risk factors in a cohort of 1,508 otherwise healthy subjects. Of note, the frequency of hypertension (31.2 %), diabetes (26.5 %), and dyslipidaemia (32.0 %) in the screening of 1,508 subjects was alarming. In addition, vitamin D3 deficiency (35.3 %), vitamin B12 deficiency (25.1 %), and hyperthyroidism (21.0 %) demands attention. Earlier, numerous studies over the past few decades have also shown a rising prevalence of these risk factors in Indian population.[5,6] Further, very few large-scale studies have evaluated the effect of gender and age on major cardiovascular risk factors in Indian context till date. In our study, the cohort comprised equivalent representation of males (N = 753) and females (N = 755). Further, the age distribution suggests real-world scenario with groupings of < 40 years (N = 340), 40 – 60 years (N = 932), and > 60 years (N = 236). In terms of the influence of gender, we observed that males were more prone to cardiovascular risk factors like hypertension, diabetes, and dyslipidaemia. On the other hand, anaemia, vitamin D3 deficiency, and hyperthyroidism were significantly more common in females. These findings were similar to previous reports.[7-10] Of significance, we also observed that female subjects had significantly higher levels of TC with significantly higher HDL-C (good cholesterol) levels in our study. In addition, the observations of high levels of lipid profiles and FBS among males are in line with previous reports.[7-10]

Overall, it has been observed that women have a more favourable CAD risk factor profile with lower blood pressure, less atherogenic lipid profile, and lower prevalence of other cardiovascular risk factors. Further, women develop CVD later than man.[9] However, they display higher expression of cardiovascular risk factors. It has been observed that women with diabetes are at 3 – 7 fold increased risk for cardiovascular complications as compared to their male counterparts. Further, blood pressure intensifies more sharply in ageing women compared with men. Although the prevalence of smokers remains higher in men, smoking at younger age is found to be more deleterious in women than in men.[10] Hypercholesterolemia and central obesity also display a liner relationship with CVD risk specifically in women.[11] In terms of influence of age, we observed that the occurrence of hypertension, diabetes, and dyslipidaemia increased significantly with age. These findings are also similar to the reports published previously.[5,12] In addition, we observed a trend of rise in lipid profile levels and FBS levels and decrease in haemoglobin levels with increasing age. It is perceptive that if age is an independent risk factor, the lifetime risk of CAD would continue to increase with ageing. However, the burden of CAD with ageing can be reduced partially by the modification of traditional coexisting CVD risk factors.[12] Overall, these findings indicate the influence of age and gender on majority of cardiovascular risk factors.

## CONCLUSIONS

Based on the study findings, it seems reasonable to draw some conclusion. Prevalence of hypertension, diabetes, and dyslipidaemia was seen to increase significantly with age. Further, there was a trend of rising TC, TG, HDL-C, VLDL-C, and FBS levels with increasing age. Haemoglobin levels showed progressive fall as age progresses. On the other hand, hypertension, diabetes, and dyslipidaemia was significantly more common among males, while anaemia, vitamin D3 deficiency, and hyperthyroidism were significantly more common among females. Further, the TC and HDL-C levels were significantly higher among females, while TG and FBS levels were significantly higher among males. These findings indicate the influence of age and gender on majority of cardiovascular risk factors. In addition, the high prevalence of cardiovascular risk factors in otherwise healthy subjects in our study is alarming and demands the need for appropriate health-care measures.

### Study Limitations

This was a community-based and not a hospital-based study. Hence, study data may not be representative of general population prevalence. However, any population study of this nature is not feasible in developing countries. Further, the data on body-mass index or obesity of study subjects was not retrieved. However, we believe that the present data represents real world scenario of laboratory abnormalities in the screening population which seems to be healthy otherwise.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
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