Original Article

Biological risk factors for coronary artery disease among adults residing in rural area of North Karnataka, India

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Abstract

Background: Coronary artery disease (CAD) accounts for 60% of all deaths and 47% of burden of diseases which is progressively increasing in rural population in terms of absolute numbers. Biological risk factors contribute significantly to the cardiovascular burden. Hence, this study was undertaken to assess the biological risk factors among adults residing in rural area. **Materials and Methods:** A community-based cross-sectional study conducted among 980 adults aged between 20 and 60 years residing in rural area of Belagavi district, India. World Health Organization-STEPS-based predesigned questionnaire was used for data collection by house-to-house visit after obtaining written informed consent. Sociodemographic variables and biological risk factors which included hypertension, self-reported diabetes mellitus, overweight, and obesity were assessed. Statistical analysis was done using Pearson's Chi-square test and *P* value less than 0.05 was considered significant. **Results:** In the present study, 48.8% were men and 51.2% were women. Prevalence of hypertension was 26.6%, self-reported diabetes mellitus 6.3%, overweight 26.7%, and obesity was 7.0%. Men had higher prevalence of hypertension and overweight, whereas women had higher prevalence of diabetes and obesity. A significant gender difference was noted with the biological risk factors for CAD ($P < 0.05$). Advancing age, lesser education, and retirement from the job were the contributors for the increasing prevalence of these risk factors ($P < 0.05$); however, the socioeconomic status did not show any influence ($P > 0.05$). **Conclusion:** Biological risk factors, which included hypertension, diabetes, and overweight, were observed in a significantly higher proportion among men, whereas women were more obese with a significant higher proportion. Advancing age, lesser education, and retirement from the job were the contributors for the increasing prevalence of these risk factors.

Keywords: Adults, biological risk factors, coronary artery disease, North Karnataka, rural area

Introduction

The globe is witnessing a rapid epidemiological transition. Infectious and nutritional diseases are receding among adults, whereas noncommunicable diseases are becoming increasingly common as the cause of morbidity and mortality.[1] In recent years, most of the developing countries including India are facing this challenge. Cardiovascular diseases (CVDs), which include coronary artery disease (CAD), are responsible for 60% of all deaths and 47% of burden of diseases.[2] As per the World Health Report – 2002, CVDs will be the largest cause of death and disability in India by 2020.[3] It has been estimated that 2% reduction in chronic diseases' death rates per year globally could result in saving about 36 million premature deaths by the year 2015.[4] The CAD has assumed the "epidemic" proportion in India and many other developing countries. The prevalence rates can be estimated from several studies over the past several decades which have ranged from 1.6% to 7.4% in rural population and 1% to 13.2% in urban population.[5] Though the disease is more prevalent in urban population, it is progressively increasing in rural population in terms of absolute numbers.[6]

The majority of the individuals who develop heart attacks and strokes every year have one or more cardiovascular risk factors.

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Most of these cardiovascular events are preventable if meaningful action is taken against the risk factors.[7] Early detection of CAD risk factors and appropriate intervention reduces the mortality by 35–60%.[8] Major biological coronary risk factors – high blood pressure, overweight, obesity, and diabetes – are found to be escalating in rural population and correlate positively with the increase in CAD.[8]

The basis of CAD prevention is the identification of the major common risk factors and their prevention and control. The risk factors of today are the diseases of tomorrow.[9] Thus, there is a felt need to establish CAD risk factors surveillance in a country, especially in the rural area. The primary care family physicians play a pivotal role in health-care delivery in the rural area and risk assessment will enable for a tangible action for CAD control. Once we have such data, interventions can be planned and implemented at primary care level to minimize biological risk factors, thereby minimizing the health risks of increasing CAD-related mortality and morbidity. Thus, a community-based study to assess the biological risk factors for CAD among adults residing in rural area was conducted.

Materials and Methods

The community-based cross-sectional study conducted from January 2013 to June 2015 among adults aged between 20 and 60 years residing in the villages of Kakati subcenter under Primary Health Centre, Vantamuri, Belagavi District, Karnataka, India. The study was approved by the Institutional Ethics Committee for Human Subject's Research, Jawaharlal Nehru Medical College, Belagavi. The sample size (N) was calculated using the formula $N = 4pq/d^2$, where P is the prevalence of overweight as 11%[10] and d is the absolute error as 2%; the sample size obtained was 980. Sampling frame of the adult residents of the villages was prepared using the recent voter's list and participants were included in study by simple random sampling technique using standard random number table.

Written informed consent was obtained from every participant. A pilot study was conducted and necessary modifications were made as per the local requirements. Data were collected by visiting the selected houses using a predesigned questionnaire based on World Health Organization (WHO)-STEPS Surveillance Manual,[9] which included personal and sociodemographic variables, namely, age, gender, education, main work status, and socioeconomic status (SES) classified as per the modified BG Prasad Classification. The biological risk factors assessment included raised blood pressure, history of diabetes mellitus, overweight, and obesity.[9]

Self-reported history of diabetes was assessed either by documentation by physician or if the person is on oral hypoglycemic agents or insulin or both.[11] During the course of interview, three measurements of blood pressure of each study participant were measured using mercury sphygmomanometer at an interval of 5 min in sitting position. The average of last two SBP and DBP reading in mmHg was noted to describe the blood pressure of the participant.[5] Study participants were classified as "normotensive," "prehypertensive," or "hypertensive (grade I and II)" on the basis of their blood pressure levels according to JNC VII criteria.[12]

Body weight was measured without any foot wear and with minimal clothing to the nearest 0.1 kg using a standard portable adult weighing machine, which was standardized periodically during the study.[6] As per the revised guidelines recommended by WHO, persons with BMI values of less than 18.5 were classified as "underweight," 18.5–24.99 were classified as "normal weight," 25.0–29.99 were classified as "overweight/preobese," and 30.0 and above were classified as "obese."[13] Waist circumference (WC) >80 cm for women and >90 cm for men was considered to have abdominal obesity.[14] The ratio of waist-to-hip circumference (WHR) >0.85 in women and >1.0 in men was considered to have abdominal obesity.[15]

Data were expressed in percentages and were entered in the excel spreadsheet using numerical codes. Analysis was performed using Statistical Package for Social Sciences, version 20.0. Mean ± standard deviation was derived for the continuous variables. Categorical data analysis was done using Pearson's Chi-square test and probability value (P value) of less than 0.05 was considered as statistically significant.

Results

Among the 980 participants of the study, 478 (48.8%) were men with mean age 38.2 ± 10.66 years and 502 (51.2%) were women with mean age 40.4 ± 11.32 years. In our study, 23.9% participants were between age group of 20–29 years, 25.5% between 30 and 39 years, 26.7% between 40 and 49 years, and 23.9% were more than or equal to 50 years. When we assessed their main work status, 6.6% of the participants were government employees, 12.1% were nongovernment employees, 38.6% were self-employed, 36.2% were homemakers, 2.2% were students, 1.7% were retired, and 2.6% were unemployed. Regarding highest level of education, 28.5% did not have any formal education, 14% studied up to primary school level, 13.7% up to higher primary level, 28.8% up to high school level, and 15.1% above high school level. Majority of study participants, 37.6%, belonged to class IV SES as per modified BG Prasad Classification, followed by 30.1% in class III, 15.6% in class II, 13.5% in class V, and least in class I, that is, 3.2%.

The prevalence of hypertension was 26.6%, grade I and grade II being 19.7% and 6.9%, respectively. Hypertension prevalence was slightly higher in males (27.8%) as compared to females (25.5%) and was statistically significant ($P = 0.004$). However, the prevalence of self-reported hypertension (who were diagnosed prior and/or on antihypertensives) in our study was 20.2%. The prevalence among women was higher (22.9%) compared to men (17.4%) ($P = 0.031$). Prevalence of self-reported history of diabetes mellitus was 6.3%. Men had higher prevalence (7.9%) as compared to women (4.8%) ($P = 0.042$). The overall prevalence

of overweight and obesity were 26.7% and 7.0%, respectively, as per the BMI criteria. The proportion of overweight was higher among men compared to women (31.8% vs. 21.7%), whereas among obese, women outnumbered men (10.3% vs. 3.5%). This difference was statistically significant ($P < 0.0001$). The prevalence of abdominal obesity assessed using WC criteria was 37.9%, and based on waist: hip ratio, criterion was 69.2%. The proportion among women was double than that of men ($P < 0.0001$) [Table 1].

The proportion of hypertensives, diabetics, overweight, and obese individuals increased as age advanced and maximum prevalence was in ≥50 years group with statistical association ($P < 0.0001$) [Table 2].

The prevalence of hypertension was significantly high (39.1%) among participants without any formal education and the prevalence decreased with higher education levels ($P < 0.001$). Self-reported diabetes prevalence was high in participants with education of primary level or less ($P < 0.020$). Overweight and obesity assessed by BMI categories did not differ with education level ($P = 0.096$). However, lesser or no formal education contributed to the higher proportion of abdominal obesity assessed by WC and WHR categories ($P < 0.0001$) [Table 3].

Retired personnel had highest proportion of diabetes (29.4%), hypertension (35.5%), and overweight (35.3%) as compared to the other work status. Homemakers had higher proportion of abdominal obesity ($P < 0.0001$). However, the hypertension did not vary significantly across different work status ($P = 0.218$). Additionally, any of the biological risk factors assessed in this study did not differ significantly among different SES of the participants ($P > 0.05$) [Table 4].

Discussion

This study assessed various biological risk factors for CAD among the adult residents in the rural area. The higher women participants in this study (51.2% vs. 48.8%) were comparable with two studies conducted in rural area of Faridabad and Delhi districts of North India, where the proportion of women was higher (52.0%; 62.5%) as compared to men (48.0%; 37.5%), respectively.[16,17]

The prevalence of hypertension was among 26.6% of the participants, with higher prevalence among men. A study conducted at rural area of Indonesia and Nepal reported a similar overall prevalence of 21.6% and 26.0%, respectively.[18,19] A study done in rural area of Pune district also substantiated our findings of higher proportion of hypertension among men (19.7%) compared to women (15.6%).[20] Three other studies reported overall higher prevalence of hypertension of 36.9%, 35.3%, and 36% done at New Delhi, Eastern Nepal, and Bhutan, respectively.[17,21,22] Self-reported hypertension was much

Table 1: Gender-wise distribution of the participants according to various categories of biological risk factors (*n*=980)

Biological risk factors	Categories	Men (%)	Women (%)	Total (%)	χ^2, *P*
BP categories	Normal	119 (24.9)	178 (35.5)	297 (30.3)	13.588,
	Pre-hypertension	226 (47.3)	196 (39.0)	422 (43.1)	*P*=0.004*
	Hypertension grade I	100 (20.9)	93 (18.5)	193 (19.7)	
	Hypertension grade II	33 (6.9)	35 (7.0)	68 (6.9)	
History of diabetes mellitus	Present	38 (7.9)	24 (4.8)	62 (6.3)	4.419,
	Absent	440 (92.1)	478 (95.2)	918 (93.7)	*P*=0.042*
BMI categories	Underweight	40 (8.4)	61 (12.2)	101 (10.3)	28.854,
	Normal	269 (56.3)	280 (55.8)	549 (56.0)	*P*<0.0001*
	Overweight	152 (31.8)	109 (21.7)	261 (26.7)	
	Obese	17 (3.5)	52 (10.3)	69 (7.0)	
WC categories	Normal	368 (77.0)	241 (48.0)	609 (62.1)	87.407,
	Abnormal	110 (23.0)	261 (52.0)	371 (37.9)	*P*<0.0001*
WHR categories	Normal	282 (59.0)	20 (4.0)	302 (30.8)	347.562,
	Abnormal	196 (41.0)	482 (96.0)	678 (69.2)	*P*<0.0001
Total		478 (100)	502 (100)	980 (100)	

Table 2: Association between age groups and biological risk factors for CAD (*n*=980)

Age group in years	Number	Hypertensives (%)	Self-reported diabetics (%)	Overweight (%)	Obese (%)	Abnormal WC(%)	Abnormal WHR (%)
20-29	234	17 (7.3)	03 (1.3)	30 (12.8)	02 (0.9)	47 (20.1)	145 (62.0)
30-39	250	48 (19.2)	08 (3.2)	64 (25.6)	13 (5.2)	69 (27.6)	145 (58.0)
40-49	262	88 (33.6)	21 (8.0)	103 (40.1)	25 (9.5)	139 (53.1)	201 (76.6)
≥50	234	108 (46.2)	30 (12.8)	62 (26.5)	29 (12.4)	116 (49.6)	187 (79.9)
Total	980	261 (26.6)	62 (6.3)	261 (26.6)	69 (7.0)	371 (37.9)	678 (69.2)
χ^2		104.112	32.084	85.837		81.965	39.998
Degrees of freedom		3	3	6		3	3
P		<0.0001*	<0.0001*	<0.0001*		<0.0001*	<0.0001*

Table 3: Association between educational status and biological risk factors for CAD (*n*=980)

Educational status	Number	Hypertensives (%)	Self-reported diabetics (%)	Overweight (%)	Obese (%)	Abnormal WC (%)	Abnormal WHR (%)
No formal education	279	109 (39.1)	19 (6.8)	79 (28.3)	18 (6.5)	132 (47.3)	225 (80.3)
Primary	137	33 (24.1)	17 (12.4)	33 (24.1)	19 (13.9)	61 (44.5)	108 (78.8)
Higher primary	134	36 (26.9)	07 (5.2)	37 (27.6)	05 (3.7)	41 (30.6)	82 (61.2)
High school	282	54 (19.1)	12 (4.3)	75 (26.6)	19 (6.7)	92 (32.6)	187 (66.3)
College/Graduate	148	29 (19.6)	07 (4.7)	37 (25.0)	08 (5.4)	45 (30.4)	76 (51.4)
Total	980	261 (26.6)	62 (6.3)	261 (26.6)	69 (7.0)	371 (37.9)	678 (69.2)
χ^2		34.373	11.615	13.501		22.969	50.351
Degrees of freedom		4	4	8		4	4
P		<0.0001*	0.020*	0.096		<0.0001*	<0.0001*

Table 4: Association between main work status and biological risk factors for CAD (*n*=980)

Main work status	Number	Hypertensives (%)	Self-reported diabetics (%)	Overweight (%)	Obese (%)	Abnormal WC (%)	Abnormal WHR (%)
Govt. employee	65	15 (23.1)	04 (6.2)	21 (32.3)	07 (10.8)	31 (47.7)	45 (69.2)
Nongovt. employee	119	25 (21.0)	07 (5.9)	37 (31.1)	05 (4.2)	31 (26.1)	61 (51.3)
Self-employee	378	112 (29.6)	25 (6.6)	113 (29.9)	16 (4.3)	124 (32.8)	225 (59.5)
Student	21	02 (9.5)	0 (0)	03 (14.3)	0 (0)	02 (9.5)	11 (52.4)
Retired	17	06 (35.5)	5 (29.4)	06 (35.3)	01 (5.9)	06 (35.3)	09 (52.9)
Unemployed	25	08 (32.0)	03 (12.0)	04 (16.0)	02 (8.0)	07 (28.0)	13 (52.0)
Total	980	261 (26.6)	62 (6.3)	261 (26.6)	69 (7.0)	371 (37.9)	678 (69.2)
χ^2		8.286	19.104	27.072		37.253	104.634
Degrees of freedom		6	6	12		6	6
P		0.218	0.004	0.008		<0.0001	<0.0001

lower (20.2%) as compared to a study done in the rural area of Mukim Dengkil, Malaysia (31.7%).[23] A similar study done at rural Faridabad district showed a higher prevalence of self-reported hypertension among women (6.8%) compared to men (3.5%).[16] In our study, 6.3% of them reported having diabetes mellitus, with higher proportion among men (7.9%) than women (4.8%). Study conducted at rural area of Tamil Nadu reported a lower prevalence of 4.0%.[24] Another study done in 18 states of India documented a higher prevalence among women (4.4%) than men (3.3%).[25] A study conducted in the rural area of Nigeria reported prevalence of 8.0%, of which 6.1% was self-reported which was consistent with our study.[26]

The overall prevalence of overweight and obesity assessed by BMI categories was 26.7% and 7.0%, respectively. Study conducted in rural area of Pune reported 18.0% of overweight and 3.2% of obesity which was much less compared to our study.[20] Study conducted among adults of rural Nepal reported a composite prevalence of BMI ≥25 kg/m^2 as 21%.[19] The prevalence of obesity among women was high compared to men. Similar findings were documented in a study done in other rural areas of Mukim Dengkil, Malaysia, and Tamil Nadu, India.[23,24] Overall, 33.7% of the participants had BMI >25.0 in our study which was well in accordance with the estimated range of overall prevalence for Southeast Asia, that is, 26.3–56.0%.[27] Abdominal obesity assessed by WC and WHR showed higher proportion, 37.9% and 69.2%, respectively, with significantly higher proportion among women. Other similar studies documented a lesser over all prevalence, but the proportion was higher among women.[17,20,24,25,28] The remarkable high WHR and WC (measure of abdominal obesity) observed in our study in both men (41.0% and 23.0%, respectively) and women (96.0% and 52.0%, respectively) require special attention. A study conducted in semi-rural population of the community of Gueoul in Senegal reported the prevalence of abdominal obesity as 53.9% and global obesity as 13%.[29]

Similar finding with twofold increased prevalence among women was observed in a study done in rural area of Thiruvananthapuram district, Kerala.[30] Increased predisposition to premature CAD in Indians has been attributed to the "Asian Indian phenotype," characterized by less of generalized obesity measured by BMI and greater central body obesity as shown by greater WC and WHR.[31] Our study substantiates this hypothesis.

In our study, the association of various biological risk factors with age was statistically significant for hypertension, self-reported DM, overweight and obesity, and WC and WHR categories. The proportion of the risk factors increased with the advancing age. Similar findings were reported by other studies conducted in rural areas of Nigeria, Eastern Nepal, Malaysia, Vietnam, Indonesia, Tamil Nadu, Maharashtra, and Northern India.[18,20,21,23,24,32-34] There was a higher prevalence of hypertension at older ages, among females (8.2%) compared to males (7.7%) in a study conducted in the rural areas of North West Tanzania.[35]

An inverse-graded relationship of various risk factors and educational status was observed for hypertension, self-reported

DM, abnormal WC, and WHR categories where the prevalence decreased with increased education levels. Prevalence of overweight and obesity did not differ statistically with education, though the lowest prevalence was among highest level of education ($P = 0.09$). Similar finding was noted in a multicenter community-based studies conducted in India.[36,37] This assessment at primary care level is necessary to stratify the persons with risk factors and decide the accessibility and affordability so that effective strategies can be implemented.

The association of various risk factors with main work status was statistically significant for – self-reported DM, overweight, obesity, and abnormal WC and WHR categories. Prevalence of hypertension did not show statistical difference between work categories. Retired individuals had highest prevalence of self-reported DM and overweight. Government employees were more obese. Homemakers who were predominantly women were having highest prevalence of central obesity. Similar findings were noted in a study conducted in rural Vietnam.[33] In our study, SES did not show any association with biological risk factors. Self-reported DM, high blood pressure, and abdominal obesity did not differ in their prevalence across the SES class. A similar finding was observed in a multicenter study conducted in 18 states of India and rural Vietnam.[25,33] The risk factor assessment at the primary care level in the rural area will help the policy makers in formulating need-based programs which can be effectively implemented.

Limitations

This study did not address the behavioral and biochemical risk factors for CAD though they formed an important part of the risk assessment. The prevalence of diabetes mellitus was not measured by blood glucose assessment due to the constraint of resources and lack of feasibility.

Implications

Residents of the rural area lack the necessary health-care infrastructure and management facilities for CAD due to variety of constraints, including the low SES and lack of education. Thus, aiming at the primary prevention by assessment of the modifiable biological risk factors and doing selective screening instead of universal screening and targeted interventions can be undertaken to minimize the risk factors and hence combat the problem of increasing CAD-related mortality and morbidity in the economically disadvantaged group of the society. Risk assessment by primary care physicians can aid in planning the appropriate interventions suiting to the local needs.

Conclusion

Biological risk factors, which included hypertension, diabetes, and overweight, were observed in a significantly higher proportion among men, whereas women were more obese with a significant higher proportion. Advancing age, lesser education, and retirement from the job were the contributors for the increasing prevalence of these risk factors; however, the SES did not show any influence on the risk factors. Our study demonstrated a significant higher prevalence of biological risk factors for CAD in rural population in South India. Burden of CAD risk factors in this population reflects the epidemiological transition which requires an immediate attention.

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Author contributions

AK developed the protocol, conceptualized the project design, analyzed and interpreted the data, and drafted the article; PRW developed the idea, supervised and monitored all aspects of this study, and assisted in analysis and revised the manuscript critically for important intellectual content; RSP provided the necessary technical support as subject expert with clinical assistance. All authors have read and approved the final draft of the manuscript.

Ethical approval

Ethical clearance was obtained from the Institutional Ethics Committee of J. N. Medical College, KLE Academy of Higher Education and Research, Belagavi. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed written/thumb print consent was obtained from all respondents after a full explanation of the nature, purpose and procedures used for the study.

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Conflicts of interest

There are no conflicts of interest.

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