Original Article

Cardiovascular Disease Risk Factors and 10 Year Risk of Cardiovascular Events among Women over the Age of 40 Years in an Urban Underprivileged Area of Bangalore City

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ABSTRACT

Background: Cardiovascular disease (CVD) is one of the leading causes of death among Indian women but not a focus of current strategies to improve women's health. **Objectives:** To assess 10-year CVD risk and estimate the prevalence of CVD risk factors among underprivileged women. **Methods:** A cross-sectional study among women aged 40–79 years in an urban underprivileged area of Bangalore city, using nonlaboratory-based World Health Organization and the International Society of Hypertension risk prediction chart and INTERHEART list of CVD risk factors. Blood pressure, random blood sugar, height, weight, and waist circumference were measured. The Chi-square test was done for the association between CVD risk status and risk factors. Multiple logistic regression performed to calculate adjusted odds ratios (ORs). **Results:** Of 1027 women, 11% women had high risk of CVD (≥20% risk of fatal/nonfatal cardiovascular event within next 10 years). The prevalence of CVD risk factors was high with 20.2% diabetes, 53.7% hypertension, 77% overweight/obesity, and 92% central obesity. Majority were physically inactive with unhealthy diet, lacking daily fruits and vegetables, excess consumption of salty food, junk food, red meat, and excess oil. Significantly higher CVD risk found among women who were sedentary during leisure time ($P = 0.028$), single/separated/widowed women (OR = 1.84 [1.26–4.29] $P = 0.002$), and women who did not walk or cycle as a regular means of transport (OR = 1.47 [1.98–2.19] $P = 0.041$). **Conclusion:** High risk of CVD among underprivileged women reveals an urgent need for community-based interventions for prevention of CVD. Screening and management of diabetes and hypertension must include weight reduction and health education strategies. Policy-makers need to initiate efforts toward improving affordability of healthy diets for the urban underprivileged.

KEYWORDS: *Cardiovascular disease risk, diabetes, hypertension, obesity, World Health Organization and the International Society of Hypertension risk prediction*

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death worldwide, with three-quarters of CVD deaths occurring in low- and middle-income countries.[1] The shift toward CVD as the leader of mortality in developing countries can be attributed to rapid urbanization and change in lifestyle. CVD does not just affect men; it is the number one killer of women as well. In developing countries, women who develop CVD are more likely to die from it than women in industrialized nations[2] due to reduced access to health care, low autonomy, and low index of suspicion of

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CVD as women are more likely to experience atypical symptoms of heart attack like shortness of breath, nausea, vomiting, and jaw pain.[1]

The Registrar General of India reports CVD as the most important cause of premature death among women.[3] Indians have been reported to have a high prevalence of hypertension, diabetes, dyslipidemia, and central obesity, resulting in a predisposition for CVD.[4] These metabolic risk factors appear a decade earlier among South Asians as compared to other races,[5] leading to significant loss of productive years of life and subsequent economic implications.

CVD is largely preventable, with evidence-based interventions that can be applied at a population-level, the first step toward which is the detection of those at high risk for CVD.[6]

The World Health Organization and the International Society of Hypertension (WHO/ISH) have developed risk prediction charts to determine the 10-year risk of a fatal or nonfatal major cardiovascular event, specific to different WHO Epidemiological sub-regions, with the nonlaboratory-based charts using five parameters: Age, sex, systolic blood pressure (SBP), smoking status, and the presence or absence of diabetes mellitus.[7] This can be used as a CVD risk screening tool as well as a tool for educating and motivating the subject to adopt a healthy lifestyle, based on the risks identified.

While health care for women in India focusses more on reproductive health, breast, and cervical cancer, there is a paucity of data regarding CVD risk and lack of women-specific strategies toward CVD. Women from poor and disadvantaged backgrounds such as those residing in urban underprivileged areas would greatly benefit from the preventive strategies for CVD. This study was therefore conducted with the objective of assessing the 10-year risk of cardiovascular events using WHO-ISH risk prediction charts and estimating the prevalence of CVD risk factors among women in an underprivileged area of Bangalore city.

METHODS

Study design and setting

This was a cross-sectional study conducted in the field practice area of the Urban Health Training Center (UHTC) of a medical college in Bangalore city, South India, comprising an underprivileged community with a population of around 10,000. Study participants: Adult women aged 40–79 years residing in this community. Sampling: Based on a previous study in rural Punjab, where 15.3% women had a high 10-year CVD using the WHO/ISH risk prediction chart,[8] the sample size was calculated with 20% relative precision and 95% confidence limits to be 531. However, since the subjects would be screened for CVD risk factors, including diabetes and hypertension, referred to the UHTC for further evaluation and management of NCDs, as well as receive lifestyle and dietary counseling, it was felt that no woman in this underprivileged community should miss this opportunity for screening. It was therefore decided to forgo sampling and instead invite all the women in the community to be a part of this study. Hence, universal sampling technique was employed.

Subject recruitment

House to house visits were conducted by a team of trained female community health workers (CHWs). Inclusion criteria - Women aged 40–79 years, as that is the age group included in the WHO/ISH risk prediction chart. Exclusion criteria - Those who had suffered a cardio-vascular event in the past (angina, myocardial infarction, transient ischemic attack, and stroke), subjects with mental or other illness that prevented them from understanding the questions, and subjects who were not present even after two visits by the CHWs.

Ethical consideration

Approval for the study was obtained from the Institutional Ethics Committee and written informed consent was obtained from all study participants. The Study IEC reference number is 316/2020.

Study instrument and data collection

Pretested, face-validated, structured interview schedule was used to capture sociodemographic details, including Modified BG Prasad Socioeconomic Classification[9] and various risk factors for such as dietary factors, tobacco, alcohol, physical activity, overweight, and obesity. Family history of diabetes, hypertension, heart attack, stroke, and death due to a heart attack or stroke in parents and grandparents were obtained from the study participants. Anthropometric measurements of height, weight, and waist circumference were recorded along with blood pressure using standardized methods and tools. SBP was taken as the mean of two readings 15 min apart. Random blood glucose was determined using a portable glucometer. Nonlaboratory-based WHO/ISH risk prediction chart #24 for South East Asia Region[7] was used to estimate the 10-year risk of developing a fatal or nonfatal cardiovascular event. The risk scoring uses age, sex, current SBP irrespective of treatment, smoking status, and the presence or absence of diabetes mellitus to classify subjects into five risk categories of <10%, 10%–20%, 20%–30%, 30%–40%, and ≥40%. Lipid profile was not done among the study subjects. The data were entered in EpiCollect application on mobile phones.

Operational definitions

High risk of CVD: ≥20% risk based on WHO/ISH CVD risk prediction chart.[10] Diabetes: Taking insulin or oral hypoglycemic drugs, and/or random blood sugar (RBS) reading of ≥200 mg/dl. Prediabetes: RBS ≥140–199 mg/dl.[11] Hypertension: SBP ≥140 mm Hg and/or diastolic blood pressure (DBP) ≥90 mmHg. Prehypertension: SBP 120–139 and/or DBP 80–89.[12] Tobacco users: Current tobacco users and those who quit using tobacco less than 1 year before the assessment.[7] Overweight and obesity: Body mass index (BMI) of 23–24.9 and ≥25 kg/m², respectively (Asian cut-offs). Central obesity: Waist circumference ≥80 cm.[13]

Data analysis

The data were analyzed using IBM Statistical Package for the Social Sciences version 20. The study variables were described using frequency, proportion, mean, standard deviation, median, and interquartile range. The Chi-square test was done to look for the association between the outcome variable (CVD risk status) and various exposure variables (sociodemographic variables and risk factors for CVD). The factors found to be significantly associated with the outcome were then subjected to a multiple logistic regression analysis to obtain adjusted odds ratios with 95% confidence intervals was calculated. $P < 0.05$ was considered statistically significant for all analyses.

RESULTS

Sociodemographic details

A total of 1027 women aged 40 years and above participated in this study. The mean age was 52.6 ± 9.6 years (range = 40–79) with 74% in the 40–59 years age group. Majority were Hindus (57.5%) and 34.6% were Christian. The median years of formal education was 7 (interquartile range [IQR] = 310) and median monthly per capita income was INR 2,400 (IQR = 1250, 3333). While 8% women did not receive any formal education, 47% studied till high school or higher. Majority (86.7%) were homemakers.

Prevalence of cardiovascular disease risk factors including diabetes, hypertension

High risk, that is ≥20% risk, of cardiovascular events in the next 10 years was predicted for 12% of study subjects. The prevalence of diabetes in our study was 20.2% and prevalence of hypertension was 53.7% with 25.7% prediabetics and 34.3% prehypertensives [Table 1]. Significantly higher risk for CVD was observed among post-menopausal age group (>45 years) as compared to perimenopausal age group (P=0.001) . Significantly higher CVD risk was found among women who were single/separated/widowed women (P=0.006) and who were

Table 1: Distribution of diabetes, hypertension and 10-yeasr cardiovascular disease risk among study subjects (n=1027)

Variable	Category	n (%)
Diabetes	Prediabetes	264 (25.7)
	Diabetes	293 (28.5)
Hypertension	Prehypertension	352 (34.3)
	Hypertension stage 1	326 (31.7)
	Hypertension stage 2	226 (22.0)
10-year risk of a cardiovascular event	<10%	765 (74.5)
	10%-<20%	139 (13.5)
	20%-<30%	73 (7.1)
	30%-<40%	14 (1.4)
	≥40%	36 (3.5)

mainly sedentary during leisure time (P=0.028) [Table 2]. The proportion of women who were both diabetic and hypertensive was 18.3%. WHO/ISH risk prediction chart takes into account current SBP irrespective of treatment; elevated SBP was found in 38.9% of the women. The mean BMI was found to be 27 ± 5.5 kg/m², with 150 (14.6%) overweight and 641 (62.4%) obese [Table 2]. Twenty-eight percent of overweight/obese women were found to be diabetic [Table 3].

Either smoking or tobacco-chewing or both was found among 6.2% of subjects. Only two women reported alcohol consumption, of whom one was a daily drinker. When asked about diet in the last 1 week, nearly all the participants did not consume fruits (99.2%) and vegetables (97.8%) daily. Nearly one in ten consumed salty food and 56.9% consumed red meat for three or more days in the week. Monthly per capita oil consumption was more than the permissible level of 500 ml, for 92.7% of the participants. One-fourth of the women performed moderate/strenuous physical activity in their leisure time and one-third used walking/cycling as a regular means of transport [Table 4].

Significantly higher risk for CVD was observed among postmenopausal age group (>45 years) as compared to perimenopausal age group (P = 0.001) [Table 2]. Significantly higher CVD risk was found among women who were single/separated/widowed women (P = 0.006) and who were mainly sedentary during leisure time (P = 0.028). After regression analysis, where all risk factors with P < 0.2 were entered into the regression model, it was found that single/separated/widowed women were nearly twice more likely to have high CVD risk as compared to married women (odds ratio [OR] = 1.84 [1.26–4.29] P = 0.002) and women who did not walk or cycle as a regular means of transport had one and a half times greater chance of high CVD risk as compared to those who did (OR = 1.47 [1.98–2.19] P = 0.041) [Table 5].

Table 2: Association of 10-years cardiovascular disease risk with sociodemographic factors (*n*=1027)

Variable	Category	Total, *n* (%)	High CVD risk (≥20%) (*n*=123; 12%), *n* (%)	Low CVD risk (<20%) (*n*=904; 88), *n* (%)	*P**
Age	Perimenopausal (40-45)	307 (29.9)	21 (6.8)	286 (93.2)	0.001[†]
	Menopausal (>45)	720 (70.1)	102 (14.2)	618 (85.8)	
Marital status	Married	669 (65.1)	66 (9.9)	603 (90.1)	0.006[†]
	Single/separate/widow	358 (34.9)	57 (15.9)	301 (84.1)	
Education	No formal education	86 (8.4)	7 (8.1)	72 (91.9)	0.380
	Primary school	209 (20.4)	26 (12.4)	183 (87.6)	
	Middle school	250 (24.3)	28 (11.2)	222 (88.8)	
	High school	396 (38.6)	54 (13.6)	342 (86.4)	
	Preuniversity and above	86 (8.4)	8 (9.3)	78 (90.7)	
Occupation	Home-maker	890 (86.7)	111 (12.5)	779 (87.5)	0.621
	Gainfully employed	137 (16.3)	12 (8.8)	125 (91.2)	
Socioeconomic class	Upper/upper middle	209 (20.4)	32 (15.3)	177 (84.7)	0.197
	Middle	315 (30.7)	32 (10.1)	284 (89.9)	
	Lower middle/lower	503 (49.0)	59 (11.8)	443 (88.2)	
Type of family	Nuclear	656 (63.9)	74 (11.3)	582 (88.7)	0.361
	Joint	371 (36.1)	49 (13.2)	322 (86.8)	

*Calculated using Chi-square test, [†]Statistically significant at *P*<0.05. CVD: Cardiovascular disease

Table 3: Association of 10-years cardiovascular disease risk with obesity (*n*=1027)

Variable	Category	Total, *n* (%)	ISH-CVD high risk (≥20%) (*n*=123; 12%), *n* (%)	ISH-CVD low risk (<20%) (*n*=904; 88%), *n* (%)	*P**
BMI (kg/m^2)	<18.5 (underweight)	46 (4.5)	7 (15.2)	39 (84.8)	0.48
	18.5-22.9 (normal)	190 (18.5)	19 (10.0)	171 (90.0)	
	23.0-24.9 (overweight)	150 (14.6)	23 (15.3)	127 (84.7)	
	25.0-29.9 (obese I)	356 (24.7)	38 (10.7)	318 (89.3)	
	≥30 (obese II)	285 (27.7)	36 (12.6)	249 (87.4)	
Waist circumference (cm)	≤79	81 (7.9)	6 (7.4)	75 (92.6)	0.187
	≥80	846 (92.1)	117 (12.4)	829 (87.6)	

*Calculated using Chi-square test. CVD: Cardiovascular disease, ISH: International Society of Hypertension, BMI: Body mass index

DISCUSSION

Our study assessed the 10-year risk of CVD among urban underprivileged women aged 40 years and above, using WHO/ISH risk prediction charts. These charts are available in two variants: "with cholesterol" and "without cholesterol." The latter has been shown to have concordance with the former and is a good option in resource-poor settings, to predict CVD risk.[14]

Our study found that more than one in ten women had a high risk of CVD, that is ≥20% chance of a cardiovascular event occurring within the next 10 years, which was aligned with the finding of a study in rural Ludhiana, where 15.3% of the women had high CVD risk.[8] However, a lower proportion was seen in two studies in Tamil Nadu. One in Salem, among women aged 40–70 years which found 6.5% high CVD risk[15] and the other in a village near Chennai among both men and women, where 6.25% had high CVD risk.[16] These geographic and rural/urban contextual differences have also been exhibited in a systematic analysis of coronary heart disease (CHD) rates

in India, where CHD rates were higher in rural North India and urban South India,[17] owing to commonality in patterns unhealthy diet and physical inactivity.

Even after adjusting for age and smoking, menopause is related to unfavourable lipid profile which in turn increases the risk of CVD.[18] Women with diabetes are at greater risk of CVD as compared to age matched men.[19] The combined risk of CVD when women have risk factors such as diabetes, hypertension, dyslipidemia, obesity, physical inactivity and smoking.[20] The number of diabetics in India has more than doubled from 26 million in 1990 to 65 million in 2016.[21] This high prevalence of diabetes has also been shown among women in urban Salem (18%)[15] and also reflected in our study which found that one in every five women were diabetic and one-fourth in prediabetic stage. A study in Bangalore found 15.1% diabetes and 13.8% prediabetes among urban slum-dwelling women.[22] The higher prevalence of diabetes in our study may be due to difference in the age composition of the study population as we only included women over the age

Table 4: Association of 10-years cardiovascular disease risk with dietary and lifestyle factors (n=1027)

Variable	Category	Total, n (%)	ISH-CVD high risk (≥20%) (n=123; 12), n (%)	ISH-CVD low risk (<20%) (n=904; 88), n (%)	P
Daily consumption of fruits	Yes	8 (0.8)	0	8 (100)	0.606*
	No	1019 (99.2)	123 (12.1)	896 (87.9)	
Daily consumption of vegetables	Yes	22 (2.2)	1 (4.5)	21 (95.5)	0.503*
	No	1005 (97.8)	122 (12.1)	883 (87.9)	
Consumption of salty foods in a week (days)	≤2	877 (85.4)	103 (11.7)	774 (88.3)	0.580†
	≥3	150 (14.5)	20 (13.3)	130 (86.7)	
Junk food/fried foods in a week (days)	≤2	939 (91.4)	107 (11.4)	832 (88.6)	0.061†
	≥3	88 (8.6)	16 (18.2)	72 (81.8)	
Consumption of red meat in a week (days)	≤2	443 (43.1)	58 (13.1)	385 (86.9)	0.337†
	≥3	584 (56.9)	65 (11.1)	519 (88.9)	
Per capita monthly consumption of oil (ml)	≤500	71 (7.3)	7 (9.9)	64 (90.1)	0.578†
	>500	952 (92.7)	115 (12.1)	837 (87.9)	
Physical activity in leisure time	Moderate or strenuous	252 (25.8)	20 (7.9)	232 (92.1)	0.028†
	Mainly sedentary	762 (74.2)	103 (13.5)	692 (86.5)	
Walking/cycling as regular means of transport	Yes	328 (31.9)	30 (9.1)	298 (90.9)	0.072†
	No	699 (68.1)	93 (13.3)	606 (86.7)	

*Calculated using Fischer's exact test, †Chi-square test, ‡Statistically significant at P<0.05. CVD: Cardiovascular disease, ISH: International Society of Hypertension

Table 5: Multiple logistic regression analysis of factors associated with high cardiovascular disease risk (n=1027)

Factor	OR	95% CI	P
Single/separate/widow	1.84	1.26-4.29	0.002*
Upper socioeconomic class	1.96	0.6-6.5	0.085
Central obesity	1.76	0.76-4.28	0.180
Sedentary during leisure time	1.59	0.31-5.12	0.108
Junk food/fried food ≥3 days/ weeks	4.691	0.70-31.67	0.113
Not walking or cycling as a means of transport	1.47	1.98-2.19	0.041*

*Statistically significant at P<0.05. OR: Odds ratio, CI: Confidence interval

of 40 years and not all adults. While the presence of hypertension and diabetes are both strong predictors of CVD,[23] the relative risk for fatal coronary heart disease associated with diabetes is 50% higher in women than it is in men.[24] This had public health implications as the high prevalence of diabetes among women is therefore a precursor to adverse CVD events in the near future.

Our study found an alarmingly high prevalence of hypertension, with more than half of the women having hypertension and one-third in the pre-hypertensive phase. Similarly high proportion of hypertension among women aged 40–70 years has been described in studies in Ludhiana (53.4%)[8] and Fatehgarh Sahib (70%)[25] in Punjab and in slums of Kolkatta (51.8%).[26] This finding indicates an opportunity for action, as reduction in blood pressure significantly lowers CVD risk.[5]

Both obesity and central obesity are linked to CVD, with Indians genetically predisposed especially to central obesity. Studies across India have found high levels of obesity; 56.1% central obesity and 55% overweight/obesity among women aged 45–64 years in slums of West Bengal,[27] 86% central obesity and 42.6% obesity in Punjab,[25] probably due to a combination of unhealthy diet and lack of physical activity coupled with the south Asian genetic predisposition to central adiposity. Our study found very high levels of obesity with nine out of ten women having central obesity and three-fourths being overweight/obese. This finding indicates a paradox of poverty and obesity, which occurs not only due to lack of awareness of the effects of junk food, salty food and fried foods but also lack of affordability of healthy diets. The rate of consumption of fruit and vegetables is surprisingly low in India; contrary to the perception that Indians, being predominantly vegetarians, would consume adequate quantities of fruit and vegetables; the high cost of fresh fruits and vegetables being a barrier to healthy eating.[28] Our study too found extremely low rates of daily fruit and vegetable intake along with consumption of salty food, junk food and too much oil. The adequate supply of rice, wheat, sugar and oil through the public distribution system in this community, ensures that daily carbohydrate and fat needs are met, however fresh fruit and vegetable consumption is often lacking in the diet. These dietary factors could explain why, when globally 19% of overweight/obese adults are said to be diabetic, in our study, 28% of overweight/obese women were found to be diabetic.

Physical activity is a proven means of primary prevention of not only CVD, but also disease-risk factors for CVD like diabetes, hypertension and obesity. Lack of physical activity was evident in our study population. Women who did not walk or cycle as a regular means of transport had one and a half times greater chance of high CVD risk.

Single/separated/widowed women were nearly twice more likely to have high CVD risk as compared to married women. This may be due to lack of financial and social support, which are barriers to healthy eating.

Our study looked at the traditional evidence-based risk factors for CVD, none of which are gender-specific. Areas of new research in CVD among women is emerging, looking at possible risk factors which have been less studied like gynaecological conditions such as polycystic ovarian syndrome and menopause, and pregnancy-related conditions like gestational diabetes and preeclampsia,[29] giving directions for future research.

The high prevalence of diseases which are risk factors for CVD like diabetes, hypertension and obesity, coupled with unhealthy diet and lack of physical activity has contributed to high CVD risk among urban underprivileged women in our study. These findings reveal a dire need for community-based interventions in this population. Along with screening, detection, treatment and monitoring of diabetes and hypertension, weight reduction strategies like small frequent meals, portion control and food-plate concept should be promoted. Community women's groups may be used as a platform for health education regarding CVD and its prevention, including healthy diet and physical activity. Policy makers need to address the economic disparities in accessing fresh fruit and vegetable by providing subsidized fruits and vegetables in urban slums overseen by the public distribution system and promoting innovative efforts such as farmers' markets and community gardens.

Limitations

We were not able to quantify physical activity in this study. Questions on tobacco and alcohol consumption may have elicited answers with a social desirability bias.

CONCLUSION

Our study found that 11% women had a high risk of CVD that is ≥20% chance of a cardiovascular event occurring within the next 10 years. The prevalence of CVD risk factors was high with 20.2% diabetes and 53.7% hypertension. Majority of the women were found to be overweight/obese, with nine in every ten women having central obesity. At the individual level, we recommend health education on addressing risk factors for CVD, early diagnosis, and specific treatment to prevent further complications. There is an urgent need for community-based interventions to improve healthy lifestyle in this population by means of promotion of physical activity measures such as Yoga, healthy eating habits such as inclusion of increased servings of fruits and vegetables, and reduced consumption of oil and salt. Screening and management of diabetes and hypertension should also include weight reduction and health education strategies for the prevention of CVD. Policy-makers need to initiate efforts to promote healthy eating among the urban underprivileged, by improving the affordability of healthy food like fruits and vegetables and restricting availability of salty and fried snacks, construction of urban infrastructure which facilitates physical activity such as parks and safe foot paths should be promoted. As a society, the urban underprivileged spend most of their youth of hard physical labor and effects of poverty which leaves them with little attention to physical and mental health. The society should develop community-based physical activity measures and other health promotion activities to improve the overall wellbeing.

Conflicts of interest
There are no conflicts of interest.

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