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Original Research Article

Prevalence of cardiovascular risk factors and risk profiling among urban adults of a southern Indian city

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ABSTRACT

Background: The global demographic and epidemiological transitions are increasing the burden of non-communicable diseases, with cardiovascular diseases (CVD) being the leading cause of mortality. Due to limited risk estimation studies in India, this study was conducted to address this gap, following the WHO's risk approach for CVD prevention.

Aim and Objective: The aim is to estimate the prevalence of cardiovascular disease risk factors and predict CVD risk among study subjects using a modified WHO STEPS questionnaire and WHO/ISH risk charts.

Materials and Methods: A community-based cross-sectional study was conducted in a South Indian city from September 2022 to November 2022 with a sample size of 198, using the WHO/ISH risk prediction tool to assess CVD risk factors. Data analysis was performed with Microsoft Excel and SPSS 21, using descriptive analysis for baseline demographics, Chi-square tests for associations, and multinomial logistic regression to identify independent CVD risk factors.

Results: The most prevalent risk factors were hypertension (36.9%), obesity (27.8%), dyslipidemia (27.7%), diabetes mellitus (21.7%), low physical activity (15.7%), smoking (13.1%), and alcohol intake (12.1%). Among participants, 16.5% had a high (>20%), 16% had a moderate (10-20%), and 67.5% had a low (<10%) risk of a fatal/non-fatal cardiovascular event in the next 10 years. Risk factors significantly associated with CVD (P<0.05) included age >40 years, dyslipidemia, physical inactivity, junk food consumption, smoking, diabetes mellitus, and hypertension. In the multinomial logistic regression model, age, physical inactivity, diabetes, and hypertension were significant predictors for both high and moderate risk.

Conclusion: Our study found a higher proportion of participants with high cardiovascular risk, with physical inactivity, diabetes mellitus, and hypertension being significant predictors, and diabetes mellitus having the highest odds. The WHO/ISH chart proved useful for estimating CVD risk in resource-limited settings.

1. Introduction

The world is approaching a significant demographic milestone, with life expectancy having increased dramatically over the past century due to shifts in major causes of disease. The rise in chronic non-communicable illnesses, such as heart disease, cancer, and diabetes, reflects changes in lifestyle and behaviour, as well as an aging population.[1] Of the 55.4 million global deaths in 2019, 66% were due to non-communicable diseases (NCDs), with over three-quarters occurring in low- and middle-income countries, and about 17.8% of these deaths occurring before the age of 70 in these regions.[2] Total deaths from non-communicable diseases are projected to reach 55 million

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by 2030 under current trends, disproportionately affecting poor and disadvantaged populations, thus widening health disparities between and within countries.[3]

According to WHO's Non-communicable Diseases (NCDs) Country Profiles (2020), India has a 23% probability of premature mortality from NCDs, with cardiovascular diseases accounting for an estimated 27% of all deaths. Ischemic heart disease and chronic obstructive pulmonary disease (COPD) are the leading causes, followed by stroke, which are the main contributors to Disability-Adjusted Life Years in India.[4]The significant burden of CVD in India results from the large population and high prevalence of CVD risk factors, driven by urbanization, industrialization, and economic growth. By 2045, about 800 million Indians are projected to live in cities.[5] Urbanization has led to lifestyle changes characterized by unhealthy eating, reduced physical activity, and tobacco use, which are linked to modifiable risk factors for chronic diseases such as hypertension, diabetes mellitus, dyslipidemia, and obesity. Four behavioral risk factors—tobacco use, unhealthy diet, physical inactivity, and excessive alcohol consumption—are responsible for significant proportions of these diseases.[6]

In Karnataka, CVD is the leading cause of death in the age group 40-69 years (37.2%) and the age group above 70 years (36.8%).[7] A study among South Indian states indicates that at least 18% of adults aged 30-74 years in urban Karnataka and almost 16% in rural Karnataka may experience serious cardiovascular events, such as heart attacks or strokes, in the next decade.[1] Since most CVD risk factors are modifiable, documenting baseline and future trends in CVD burden is essential. The aim of the study is to estimate the prevalence of cardiovascular disease risk factors and predict CVD risk among study subjects using a modified WHO STEPS questionnaire and WHO/ISH risk charts.

2. Materials and Methods

A Community based cross sectional study was conducted under the urban field practice area of tertiary medical college in Tumkur district of Karnataka, from September to November 2022. The sampling frame comprised of individuals aged between 35 and 64 years and systematic random sampling was employed. The sample size has been computed as 198 using the prevalence of major risk factor (Diabetes mellitus) of CVD in India which is 11.8%,[8] considering 5% absolute precision and 10% non-response rate (using the formula [$Z\alpha/2$)2P(1-P)/d2]). Inclusion criteria: Individuals who were 40 years of age and those who were willing to participate in the study by giving informed consent were included. Exclusion criteria: Individuals with confirmed coronary heart disease, stroke or other atherosclerotic diseases and bedridden patients was excluded. Socio demographic profile and information regarding smoking, alcohol, physical activity, diabetes and hypertension status were collected using pretested and structured questionnaire by interview. Anthropometric measurements like height, weight, waist circumference and hip circumference were recorded. Blood pressure was recorded using digital Omron apparatus and Accu-Check glucometer was used to record Random capillary Blood glucose. ERBA auto analyser was used for lipid analysis. WHO/ISH risk prediction chart for SEAR D (South East Asian sub-Region D) was used to predict the risk of developing CVD events in next 10 years. Statistical analysis: Data was analyzed using SPSS software version 22.0 and descriptive statistics were employed to express results through appropriate tables and figures. The association between various study categorical variables and CVD risk was calculated by using Chi-Square test. All P-values were significant when values were less than 0.05. Risk factors were analyzed using multinomial logistic regression to see how much each of these risk factors predicts cardiovascular high and moderate risk.

3. Results

In the present study of 198 participants, 47.5% were males and 52.5% were females aged between 35-64 years, minimum age group of the participants was 35 years and the maximum was 64 years with a mean age of the study participants was 51.05 ± 9.259. In the study population, 17.7% of them were illiterate, 4% having primary education, 48% secondary education, 18.8% having higher education, and 12.10% had completed graduation. Most of study participants belonged to middle-class (63.1%). (Table 1)

The most prevalent risk factor observed was hypertension 36.9%, which was followed by obesity and dyslipidemia (27.8% & 27.7%). Diabetes was prevalent among 21.7% of the study participants. Low physical activity was prevalent among 15.7%. Smoking (13.1%) and Alcohol use (12.1%) were observed among the study participants. In the study population, the most prevalent risk factor observed was hypertension 36.9%, which was followed by obesity and dyslipidemia (27.8% & 27.7%). Diabetes was prevalent among 21.7% of the study participants. Low physical activity was prevalent among 15.7%. Smoking (13.1%) and Alcohol use (12.1%) were observed among the study participants. (Figure 1)

Cardiovascular risk assessment was done according to colour coding from the WHO/ ISH risk prediction tool considering risk factors like age, sex, smoking, diabetes mellitus, hypertension, and total serum cholesterol level. WHO/ ISH risk prediction tool is applicable to subjects above 40 years of age, so from our study, 169 participants were eligible to be assessed by ISH prediction tool for the cardiovascular risk.

Ascribing to the guideline of prediction tool, 67.5% of the participants had 10% risk, 16% had 10-20 risk, 7.7% had 20-30% risk, 3.6% had 30-40% risk and 5.2% had more

than 40% risk of developing cardiovascular disease in the future 10 years.

The study participants who were categorized as per WHO/ISH prediction tool for risk of developing CVD were further re-categorized as Low-risk category, for those who have less than 10% of the risk, moderate risk category, for those with risk score 10-20%, and High-risk category, for those with a risk score of more than 20%. This is as per the methodology of ISH prediction chart. According to this, 67.5% had low risk, 16% had moderate risk and 16.5% of them had a high risk of developing CVD in the future 10 years. (Figure 2)

Age was found to be significantly associated with cardiovascular risk [P<0.05]. The other factors assessed for association with cardiovascular risk were gender, education, occupation, and socio-economic status, but the association was not statistically significant (P>0.05). (Table 2) Among the risk factors analysed for association with cardiovascular risk; initial analysis showed smoking, physical inactivity, dyslipidemia, junk food consumption, hypertension, and diabetes mellitus were found to be significantly associated with the cardiovascular risk category (P<0.05). Other risk factors like Body mass index, central obesity, fruit and vegetable consumption, and alcohol were not significantly associated with cardiovascular risk. (Table 4)

In the multinomial logistic regression model, the strength of the association of the above factors with cardiovascular risk was assessed. For moderate risk, age has 1.20 higher odds, hypertension 2.48 times, diabetics 2.57 times odds than the low risk of CVD. Individuals with inadequate physical activity have 0.147 times higher risk of falling into moderate risk category for CVD. Age, hypertension, diabetes, smoking, and dyslipidemia had an odds ratio of 1.29, 5.66, 6.57, 1.08, and 1.03 respectively and were significant high-risk predictors. Physical activity (0.353) and No Junk food consumption (0.472) had less odds of developing cardiovascular disease. (Table 4)

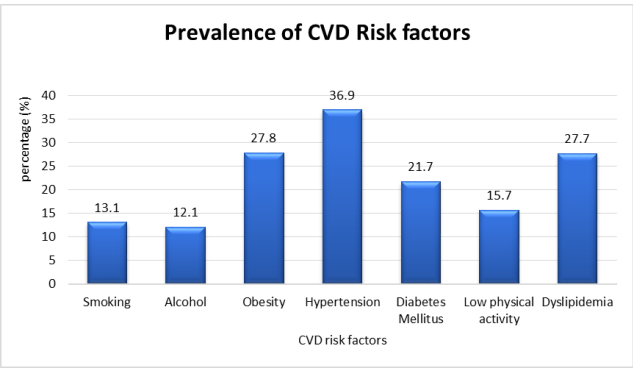

Figure 1: Prevalence of CVD risk factors

Table 1: Distribution of socio-demographic variables among the study participants

S. No.	Variables	Variable category	Frequency (%)
1	**Age**	35-44	54 (27.3)
		45-54	70 (35.4)
		55-64	74 (37.4)
2	**Sex**	Male	94 (47.5)
		Female	104 (52.5)
3	**Educational status**	No Education	35 (17.7)
		Primary school	8 (4)
		Middle School	33 (16.7)
		High School	62 (31.3)
		Post high school	36 (18.2)
		Graduate and above	24 (12.1)
4	**Occupation**	Unemployed / Housewife	83 (41.9)
		Unskilled	14 (7.1)
		Semi-skilled	40 (20.2)
		Skilled	31 (15.7)
		Shopkeeper	17 (8.6)
		Business	13 (6.6)
5	**Socio economic status**	Lower	13 (6.6)
		upper lower	58 (29.3)
		lower middle	61 (30.8)
		upper middle	64 (32.3)
		Upper	2 (1)

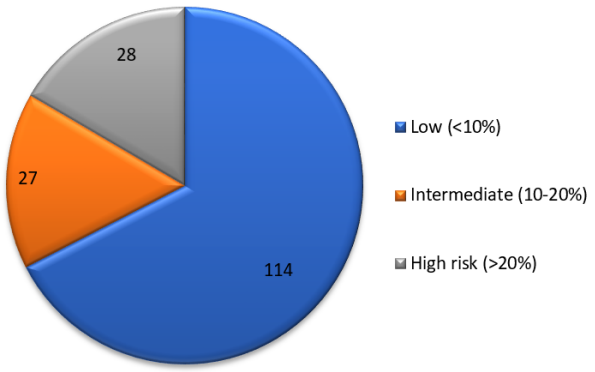

Figure 2: Distribution of the study population according to cardiovascular risk assessment

Table 2: Socio-demographic factors associated with cardiovascular risk pattern

Variable	Category	Low risk (<10%) n (%)	Moderate risk (10-20%) n(%)	High risk (>20%) n(%)	Chi square	P-value
Age	35-44	25 (86.2)	3 (10.3)	1 (3.4)	23.702	**<0.01**
	45-54	54 (79.4)	9 (13.2)	5 (7.4)		
	55-64	35 (48.6)	15 (20.8)	22 (30.6)		
Sex	Male	48 (60)	15 (18.8)	17 (21.3)	3.993	0.136
	Female	66 (74.2)	12 (13.5)	11 (12.4)		
Educational status	No education	16 (50)	9 (28.1)	7 (21.9)	13.949	0.175
	Primary school	7 (87.5)	0	1 (12.5)		
	Middle school	22 (78.6)	4 (14.3)	2 (7.1)		
	High school	43 (76.8)	6 (10.7)	7 (12.5)		
	Post high school	14 (53.8)	5 (19.2)	7 (26.9)		
	Graduate	12 (63.2)	3 (15.8)	4 (21.1)		
Occupation	Unemployed / housewife	43 (59.7)	14 (19.4)	15 (20.8)	7.729	0.65
	Unskilled	9 (69.2)	2 (15.4)	2 (15.4)		
	Semiskilled	29 (82.9)	3 (8.6)	3 (8.6)		
	Skilled	18 (72)	3 (12)	4 (16)		
	Shopkeeper	8 (61.5)	2 (15.4)	3 (23.1)		
	Business	7 (63.6)	3 (27.3)	1 (9.1)		
Socioeconomic status	Lower	4 (36.4)	4 (36.4)	3 (27.3)	7.989	0.444
	Upper lower	33 (66)	10 (20)	7 (14)		
	Lower middle	36 (73.5)	5 (10.2)	8 (16.3)		
	Upper middle	40 (69)	8 (13.8)	10 (17.2)		
	Upper	1 (100)	0	0		

4. Discussion

In our study among the residents of Tumkur, Karnataka, 17% had high risk (>20%), 16% had moderate risk (10-20%) and 67% (<10%) had a low risk of getting a fatal/non-fatal cardiovascular event in the next 10 years.

The study conducted by Geldsetzer et.al. pooled data from two large household surveys in India and predicted a 10-year risk of a CVD event with the Framingham risk score and concluded that mean CVD risk varied from 13.2% [95% CI: 12.7% ± 13.6%] in Jharkhand to 19.5% [95% CI: 19.1% ± 19.9%] in Kerala. CVD risk tended to be highest in North, Northeast, and South India.[9] The finding in our study is in concordance with this as it falls within the above range. The difference in the distribution of cardiovascular risk among all the studies is due to the place of study, whether rural or urban. Although the coronary artery disease (CAD) rates are lower in rural than urban India, the overall CAD burden is higher in rural India. This is because more Indians live in rural areas, where access to health care is limited. CAD rates are also increasing in rural areas as lifestyles are more westernized,[10] this may be the reason why the study in rural Karnataka areas is showing more prevalence than our study. The study by Amogashree et al.[11] showed a very high proportion of high-risk (56.80%) because it could be due to the high prevalence of hypertension and also no consideration of total cholesterol while using the WHO/ISH prediction chart.

Various studies show the difference in CHD risk in different countries. Koju et al.[12] have revealed a variable level of prevalence of CVD risk (high risk) using similar WHO/ISH risk prediction charts in some of the Asian countries like China 1.1%, Iran 1.7%, Sri Lanka 2.2%, Nepal 9.8%, and Pakistan 10.0%. This varied distribution of cardiovascular risk is due to differences in their geographic area, genetic composition, lifestyle, and behavioral habits.

We conducted multinomial logistic regression with the risk factor data of our participants for the cardiovascular risk categories. Among them, Age was a strong predictor of cardiovascular risk; it is similar to the results by Gift Norman et.al., Gill et al.[13,14] The reason for this consistent association of age is that as age increases the prevalence of important risk factor burden (diabetes and hypertension) also increases. Hence the predisposition to get a cardiovascular disease also becomes higher. In our study, age had 1.2 times more odds for high and moderate CVD risk. An article by Dhingra et al.[15] also mentioned that the age remains an independent predictor of CVD risk after

Table 3: Association of risk factors with cardiovascular risk score categories

Variable	Category	Low Risk (<10%) N(%)	Moderate Risk (10-20%) N(%)	High Risk (>20%) N(%)	CHI-Square	P-value
Alcohol	Yes	15 (68.2)	2 (9.1)	5 (22.7)	1.332	0.514
	No	99 (67.3)	25 (17)	23 (15.6)		
Smoking	Yes	11 (55)	2 (10)	7 (35)	5.68	0.05
	No	103 (69.1)	25 (16.8)	21 (14.1)		
Dyslipidemia	Yes	11 (55)	2 (10)	7 (35)	38.059	<0.01
	No	103 (69.1)	25 (16.8)	21 (14.1)		
Hypertension	Present	31 (49.2)	13 (20.6)	19 (30.2)	28.696	<0.01
	Absent	83 (78.3)	14 (13.2)	9 (8.5)		
Body mass index	Undernourished	5 (100)	0	0	8.844	0.183
	Normal	24 (75)	5 (15.6)	3 (9.4)		
	Overweight	48 (57.6)	16 (19.3)	3 (9.4)		
	Obese	37 (75.5)	6 (12.2)	6 (12.2)		
Diabetes mellitus	Present	29 (54.7)	11 (20.8)	13 (24.5)	5.914	0.05
	Absent	85 (73.3)	16 (13.8)	15 (12.9)		
Central obesity	Yes	22 (73.3)	3 (10)	5 (16.7)	1.002	0.606
	No	92 (66.2)	25 (17.3)	23 (16.5)		
Physical activity	< 600 METS	12 (38.7)	12 (38.7)	7 (22.6)	17.759	<0.01
	>600 METS	102 (73.9)	15 (10.9)	21 (15.2)		
Junk food	Nil	59 (58.4)	18 (17.8)	24 (23.8)	16.931	0.031
	Present	55 (80.9)	9 (13.2)	4 (5.9)		
Fruit and Vegetable consumption	<3 servings	78 (67.1)	21 (18.1)	17 (14.7)	1.867	0.393
	>3 servings	36 (67.9)	6 (11.3)	11 (20.8)		

Table 4: Association of cardiovascular risk category with significant risk factors in multivariate logistic regression

Variable	Category	Odds ratio	p-value	95% c. I for or	
				L.B	U.B
Moderate Risk	Age	1.203	0.01	1.111	1.302
	Blood pressure	2.486	0.038	1.052	5.887
	Diabetes	2.578	0.037	1.059	6.278
	Smoking	0.749	0.718	0.156	3.596
	Physical activity	0.147	0.01	0.056	0.387
	Junk consumption	0.868	0.433	0.609	1.237
	Dyslipidemia	1.008	0.1222	0.998	1.019
High Risk	Age	1.289	0.01	1.169	1.422
	Blood pressure	5.652	0.01	2.312	13.819
	Diabetes	6.57	0.01	2.759	16.513
	Smoking	1.084	0.035	1.084	8.986
	Physical activity	0.353	0.05	0.124	1.002
	Junk consumption	0.472	<0.01	0.269	0.828
	Dyslipidemia	1.03	<0.01	1.017	1.044

The reference category is low risk.

Pseudo R-square (Nagelkerke) = 0.822 (82.2%)

adjusting for traditional risk factors in a multivariable CVD prediction model.

Smoking, physical inactivity, dyslipidemia, junk food consumption, diabetes, and hypertension were all found to be significantly associated with high cardiovascular risk in our study. There is already proven evidence from research about the significant contribution of these factors to cardiovascular disease. In our study, the proportion of high-risk was 35.3% in physical inactivity from their peers in low risk. This was consistent with a study by Vasankari et al.[16] which showed a significant association between sedentary behaviour and high cardiovascular risk.

Many studies that have demonstrated the association between physical activity and CVDs have reported a reduced risk of death from coronary heart disease and a reduced risk of overall CVDs, in a dose-response fashion. Gift Norman et.al.[13] also showed an association between physical inactivity and cardiovascular risk.

In our study adjusted odds ratio of smoking was 1.08 [CI-1.08-8.98] for high CVD risk. This was similar to results from Ghorepade AG and Dasgupta A et.al.[17,18] Diabetes and hypertension were significant predictors of high cardiovascular risk in our study with adjusted odds ratio of 6.57 [CI-2.75-16.51] and 5.65 [2.31-13.81] for high risk and 2.57 [CI-1.05-6.27] and 2.48 [1.05-5.88] for moderate CVD risk respectively. People with DM have a two to fourfold increase in risk of incident coronary heart disease, ischemic stroke and a 1.5 to 3.6-fold increase in mortality.[17] Most population-based studies confirm that hypertension increases an individual's risk of various cardiovascular consequences approximately two to three times.[19] Contribution of these two risk factors in causing the cardiovascular risk in our study is consistent with the existing evidence.

Age, smoking, dyslipidemia, diabetes, hypertension and physical inactivity were significant predictors of moderate and high CVD risk. This shows the importance of these factors' role in causing CVD risk.

5. Conclusion

This study identified the proportion of individuals with high, moderate, and low risk of getting a fatal/non-fatal cardiovascular event in the next 10 years using the WHO/ISH risk prediction chart. Two-thirds of the study participants were in low cardiovascular risk. Among the various socio-demographic and risk factors checked for association with cardiovascular risk category; age, physical activity, smoking, junk food consumption, dyslipidemia, diabetes, and hypertension were found to be significantly associated with CVD risk. The strength of association assessed using multinomial logistic regression showed that age, physical inactivity, diabetes mellitus, and hypertension were significant predictors for both high and moderate risk in our study. In addition to the above, Smoking, junk food consumption, and dyslipidemia are significant predictors of high cardiovascular risk. So, the role these factors play in increasing the CVD risk for an individual is high. Smoking, junk food consumption, physical activity, diabetes mellitus, and hypertension are the modifiable factors and among that diabetes mellitus had the highest odds of CVD risk.

So, the preventive strategies and policy changes should be directed at reducing the burden of the four modifiable factors (smoking, dyslipidemia, diabetes and hypertension) which will help to bringing down the overall cardiovascular risk in the community.

6. Limitations

The study was conducted in subjects living in Tumkur city, Karnataka only so it may affect its generalizability. In our study CVD risk was assessed using the WHO / ISH risk prediction chart which considered only some of the risk factors like age, sex, smoking, hypertension, and diabetes mellitus for assessing CVD risk. So other risk factors like obesity, central obesity, and alcohol intake, though highly prevalent were not considered during CVD risk assessment.

7. Recommendations

The various modifiable factors (smoking, dyslipidemia, diabetes mellitus, and hypertension) identified in the study, which are contributing to elevating the CVD risk, should receive thrust while the implementation of national health programs. In the same line, Health education efforts have to be reiterated in order to encourage people to adopt healthy lifestyles. In all health camps, WHO/ ISH prediction charts could be explored to provide individual counseling to modify lifestyles according to their risk categories. The high and moderate risk categories need to be followed up regularly. Finally, it is also recommended to assess the treatment outcome based on the total CVD risk as estimated by the WHO/ISH risk charts. Because of its easy-to-administer nature, this tool can be translated into native languages, piloted and used by frontline health workers to identify high-risk individuals.

8. Source of Funding

None.

9. Conflict of Interest

None.

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