RESEARCH ARTICLE

BURDEN OF CARDIOVASCULAR RISK FACTORS OF A RURAL POPULATION IN SOUTH INDIA USING THE WHO MULTIVARIABLE RISK PREDICTION ALGORITHM

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ABSTRACT
Background: Cardiovascular diseases (CVD) account for almost half of all non-communicable disease related deaths and are now the leading cause of death in low- and middle-income countries including India. There is no published data on multivariable risk prediction for cardiovascular disease from rural India.
Aims & Objective: Determine the cardiovascular risk profile and the 10 year risk of fatal and non-fatal cardiovascular event in a rural population.
Materials and Methods: A community based cross sectional study was done in 47 villages of Karnataka over a period of 3 years. A total of 3780 adults were screened for CVD risk factors. Various risk stratification criteria including the WHO 10 year risk of fatal/ non-fatal CVD event were used to study the magnitude of individual and aggregated risk factors for CVD.
Results: The study reveals a high prevalence of CVD risk factors despite using three different risk stratification methods. The prevalence of at least one modifiable CVD risk factor in the population was 98.5%. An alarming 15.2% of the population had a high risk (>30%) of getting fatal or non-fatal MI or stroke in 10 years. Older age, lack of education, physical inactivity and family history of MI/ stroke were associated with high risk for CVD.
Conclusion: The prevalence of CVD risk factors as well as the probability of a fatal or non-fatal cardiovascular event is very high in this rural population. This warrants strategies that would improve awareness and promote healthy life-styles to reduce the risk of cardiovascular disease in this population.
Key Words: Cardiovascular Diseases; Risk Factors; Rural Population; WHO; Prevalence

Introduction

The cardiovascular disease (CVD) burden of India is expected to double in the next two decades, making it the single largest cause of death and the second largest cause of disability by the year 2020.[1-3] Recent trends show that these risk factors are spreading fast from urban to rural populations. Further, because of weak health systems, the number of people with undiagnosed, untreated and uncontrolled CVD risk factors are also higher in rural populations.[4] Epidemiological studies in India show a sizeable burden of CVD in adult rural (3–5%) and urban (7–10%) populations.[5] While the exact aetiology of this predisposition to CVD among Indians is still debated, rapid transition in diet and lifestyles with urbanization are identified as the major contributors to this epidemic.[6]

Data from several cross-sectional studies confirm the high prevalence of risk factors such as smoking, type 2 diabetes, high blood pressure, dyslipidaemia and obesity in Indians.[7-14] However, there is no published data on multivariable risk prediction for cardiovascular disease from rural India.[2]

Screening for risk factors, providing information about its implications, importance of life style modifications and management of treatable conditions are critical steps to reduce the burden of cardiovascular disease in the community. This study is an action based research where a rural population was screened for risk factors and a community-based program was initiated to reduce the cardiovascular disease risk burden, with an overall aim to minimize the CVD morbidity and mortality in these communities. The objective of the study was to estimate the burden of individual and aggregated risk factors and predict the 10 year risk of fatal and non-fatal cardiovascular event in this population using WHO risk prediction chart.

Materials and Methods

This cross- sectional study was carried out as a part of CVD prevention project by the community health department in Devanahalli taluk in Bangalore Rural District, Karnataka. The data collected over 3 years has been analyzed and reported in this article.

Sample Size: Assuming the age adjusted prevalence of hypertension as 30%[2], with a precision of 2% at 99% confidence interval, the sample size was estimated as 3495.

Screening camps for CVD risk factors were organized among adults above 20 years. Awareness programs (street play) were held in the chosen villages to sensitize the community on CVD and a free screening camp was held in the same village.

The screening team consisted of doctors, nurses and field workers. All eligible individuals were interviewed using a semi structured questionnaire which contained basic demographic details and information on history of hypertension, diabetes or heart disease, dietary habits, physical activity and personal habits such as smoking and alcohol intake. The body mass index (BMI) was calculated using the formula weight (kg)/height (m^2). Blood pressure (BP) was recorded by a trained physicians. in the sitting position in the right arm with a mercury sphygmomanometer (Diamond Deluxe BP apparatus, Pune, India). Three readings were taken 5 minutes apart and the mean of the two lower readings was taken as final BP. Hypertension was diagnosed based on a past medical history or if the BP was > 140/90 mm Hg as per JNC 7 criteria.[15] Diabetes screening was done using Glucometer. A value more than 200 mg/dl and a value between 180-200 mg/dl were considered as diabetes and pre-diabetes respectively.

After completion of the risk assessment, the risk profile was discussed with the individual and counselling on risk minimisation was given, if found to have modifiable risk factors. Follow up counselling and management of treatable conditions were undertaken by trained field workers through planned home visits.

Classification of CVD Risk Profile of the Participants: For studying the burden of CVD risk, three different methods were used. Firstly, the individual and the aggregated risk factors were studied. Secondly, the World Health Organization (WHO) risk prediction algorithm and thirdly direct risk factors (hypertension, diabetes and pre-existing CVD) were assessed.

WHO/International Society of Hypertension (ISH) risk prediction D chart (without serum cholesterol)[16,17] is a multivariable risk prediction algorithm which indicates 10-year risk of a fatal or nonfatal major cardiovascular event (myocardial infarction or stroke) according to age, sex, blood pressure, smoking status and diabetes mellitus for South East Asian Region. The risk level is classified as <10%, 10% - < 20%, 20% - <30%, 30% - <40% and 40% or more. The charts provide approximate estimates of CVD risk in people who do not have established coronary heart disease, stroke or other atherosclerotic disease.[16,17]

This study was approved by the Institutional Review Board. Patient identity has been kept confidential. The cardiovascular risk factor screening was done free of cost. The screened population who had any one of the risk factors was followed up at regular intervals.

Results

According to the census 2011[18], the total population of the selected 47 villages was 46,185. Assuming that 60%[18] of the population is above 20 years of age, the total target population was 27,700. In this study, a total of 3780 (13.64%) adults were screened for risk factors related to cardiovascular diseases. The baseline characteristics of the screened population were as follows: Almost all of them were Hindus, belonging to middle or poor socio – economic status and more than half (52.3%) of them were illiterate. Agriculture and animal husbandry was the main source of income. The mean age of the screened population was 47.1 ± 13.51 years of which 49.4% were males. The mean blood pressure (124.87 ± 18.48 / 81.49 ± 11.12), blood sugar (117.85 ± 50.68) and BMI (22.19 ± 4.28) were in the normal range.

Table 1 shows the prevalence of various risk factors among the study population. Hypertension emerged as the most prevalent risk factor, more than one third (35.24%) were hypertensive and another 33.65% population were pre- hypertensive. 11.24% were diabetic. Only 11.6% of the hypertensive and 8.6% of the diabetic have been diagnosed earlier. Many (78.7% among hypertensives and 90.1% in diabetics) of them were on regular medications. Majority [3392 (89.73%)] of the population did not have adequate physical activity but only 113 (2.9%) of the population reported that they were consuming unhealthy diet. The staple diet of the population consists of ragi, rice and vegetables. Fries, chips and non-vegetarian dishes are not consumed regularly (less than once a week). Consumption of aerated drinks, cakes, pastries and cookies is not a habit among these people.

Figure 1 depicts the presence of the aggregated risk burden in the population by classifying on the basis of number of risk factors present, single or combination. Presence of multiple risk factors possesses a greater risk of getting a myocardial infarction or stroke because of

their complex interactions and synergistic effect. Only a negligible proportion (1.5%) is without any behavioural or physiological risk factors for CVD. An alarming 68% had a combination of 2 or more risk factors.

Table-1: Prevalence of cardiovascular risk factors in the population

Variables	Male (N=1874) Number (%)	Female (N= 1906) Number (%)	Total (N=3780) Number (%)
Physiological Risk Factors			
Hypertension	754 (40.23)	578 (30.33)	1332 (35.24)
Pre hypertension	628 (33.51)	644 (33.79)	1272 (33.65)
Stage 1 hypertension	439 (23.43)	310 (16.26)	750 (19.84)
Stage 2 hypertension	152 (8.11)	241 (12.64)	394 (10.42)
Diabetes	235 (12.54)	190 (9.97)	425 (11.24)
Pre diabetes	35 (1.87)	27 (1.42)	62 (1.64)
Hypertension and Diabetes	146 (7.79)	120 (6.30)	266 (7.04)
Existing CVD*	52 (2.77)	39 (2.05)	91 (2.41)
Behavioural Risk Factors			
Overweight & obese	661 (35.27)	694 (36.41)	1355 (35.8)
Physical inactivity	1670 (89.11)	1722 (90.35)	3392 (89.7)
Unhealthy diet	65 (3.47)	48 (2.52)	113 (2.99)
Alcohol consumption	572 (30.52)	81 (4.25)	653 (17.28)
Smoking	564 (30.10)	6 (0.31)	570 (15.08)

* Cardiovascular disease

Table 2: Association of variables with WHO risk categories

Parameter		Low (<10%) No. (%)	Moderate (10-<30%) No. (%)	High (≥ 30%) No. (%)	χ^2	p value
Age	40-60	447 (78)	91 (15.9)	35 (6.1)	350.4	0.000*
	60-80	4 (2.1)	105 (55.3)	81 (42.6)		
Education	None	253 (52)	144 (29.5)	90 (18.5)	31.54	0.000*
	School	182 (70.5)	51 (19.8)	25 (9.7)		
	College	16 (88.8)	1 (5.6)	1 (5.6)		
Smoking	Yes	64 (48.8)	42 (32.1)	25 (19.1)	6.88	0.032*
	No	387 (61.3)	154 (24.4)	91 (14.4)		
Family History	Yes	69 (65.1)	19 (17.9)	18 (17)	3.89	0.143
	No	382 (58.2)	177 (26.9)	98 (14.9)		
Physical Activity	Yes	87 (43.3)	72 (35.8)	42 (20.9)	28.28	0.00*
	No	364 (64.8)	124 (22.1)	74 (13.1)		

* Significant

Table 3: Multi nominal logistic regression of various parameters and WHO risk categories

Parameter		Low Risk	Moderate Risk			High Risk		
			Adjusted OR	CI	p value	Adjusted OR	CI	p value
Age	40-60[R]	R	127.43	45.3-358.4	0.00*	279.5	94.9-822.5	0.000*
	60-80	R						
Education	Educated	R	2.3	1.43-3.7	0.001*	3.35	1.7-6	0.000*
	None							
Smoking	No [R]	R	1.74	1.02-2.9	0.041*	1.77	0.92-3.4	0.087
	Yes	R						
Physical Activity	Yes [R]	R	1.96	1.2-3.1	0.004*	1.78	1.01-3.1	0.045*
	No	R						
Family History	No [R]		1.10	0.59-2.06	0.75	2.44	1.18-5.05	0.016*
	Yes							

* Significant; R: Reference category Dependant variable, WHO risk category more than 10% risk

A further risk prediction of the screened risk population (Figure 2) was done in our study based on WHO 10-year risk prediction chart of a fatal or nonfatal major cardiovascular event like myocardial infarction (MI) or stroke. Of the total, the algorithm could be applied only on 763 individuals.[16,17] The risk for a fatal or non-fatal CVD events were grouped as "low risk" (<10%), "moderate risk" (10- < 20%, 20- < 30%) and high risk (≥ 30%). It was found that 15.2% of the population between 40 – 80 years had more than 30% risk of fatal or non-fatal myocardial infarction or stroke in 10 years.

Table-4: Direct risk factors and its correlates: A multivariate logistic regression analysis

Parameter		Adjusted OR	CI	p value
Age	<40[R] / > 40	5.6	4.6-6.7	0.00*
Gender	Female [R] / Male	1.5	1.2-1.7	0.00*
Unhealthy Diet	No [R] / Yes	1.79	1.2-2.6	0.005*
Alcohol	No [R] / Yes	1.20	0.99-1.4	0.06
Family History	No [R] / Yes	1.46	1.2-1.8	0.00*
BMI Risk	No [R] / Yes	2.6	2.25-3.03	0.00*

* Significant; R: Reference category Dependant variable, Presence of direct risk factors (Hypertension, Diabetes and pre-existing heart disease have been considered as direct risk factors)

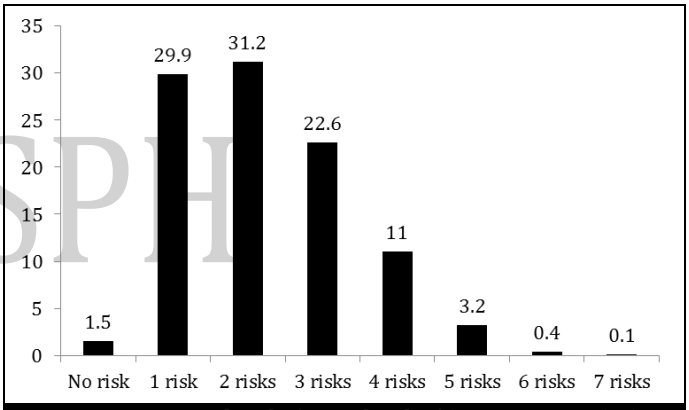

Figure-1: Aggregated risk factor burden*(in percentages) (n = 3780) [* Hypertension, diabetes, preexisting heart disease, unhealthy diet, risk BMI, inadequate physical activity, smoking, alcohol were taken as risk factors]

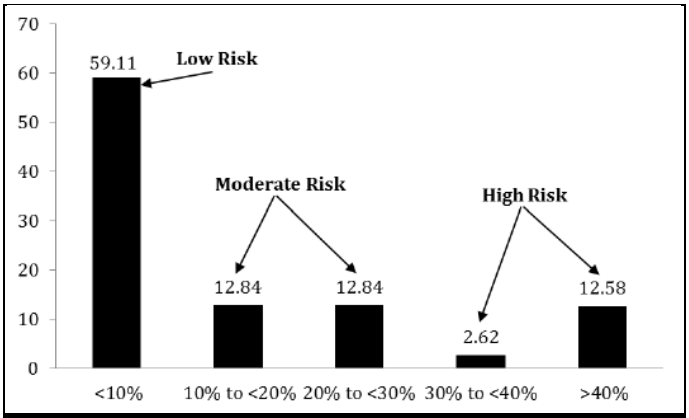

Figure-2: Prevalence of WHO risk categories (in percentages)

The demographic and behavioural parameters associated with various WHO risk groups were analysed by Chi-square and Univariate analysis. Table 2 lists the variables (age, education level, smoking and lack of physical

activity) which were significantly associated with WHO risk categories and the gender, unhealthy diet, alcohol consumption and BMI were not associated. All the variables with p value < 0.25 in Chi-square analysis were included in the multi-nominal logistic model. Advanced age, low education levels, lack of physical activity and family history were the significant factors associated with high risk as compared to low risk. (Table 3)

This study also tried to describe the profile of people with direct risk factors ((hypertension, diabetes and existing cardiovascular disease) either alone or in combination. Of the total screened population, 1538 (40.7%) had any one of these risk factors or a combination. Among them more than two thirds (72%) were in the economically productive age group (20 -60 yrs) and majority were males (56.8%). Age more than 40 years (OR =5.6), increased BMI (OR =2.6), male gender (OR = 1.5) and unhealthy diet (OR =1.46) were found to be independently associated with this outcome in multivariate logistic regression analysis. (Table 4)

Discussion

Many studies have reported CVDs as major cause of death in India and in the last 30 years, the prevalence of hypertension has doubled while that of diabetes has trebled.[2] Our study has estimated the prevalence of multiple cardiovascular risk factors and classified the population using WHO/ISH risk prediction chart. None of the Indian studies have predicted the probability of a major cardiovascular event (myocardial infarction or stroke) using existing risk factors.

In the present study the prevalence of hypertension was 35.24%. The findings were in accordance with other Indian studies where the prevalence of hypertension ranged from 26% - 33%. The mean blood pressure (124.87 ± 18.48 / 81.49 ±11.12), blood sugar (117.85 ± 50.68) and BMI were in the normal range. The studies conducted in India heart watch study[19], Tamil Nadu[20], and National health profile[21] survey also reported mean blood pressure of the population in normal range. The prevalence of pre hypertension was 27.14% which is concurrent to other studies conducted in India (20%-40%).[22,23] The prevalence of diabetes showed considerable variation ranging from 1 to 33% in different Indian studies where our study reported 11.2%.[19,21]

Though the mean BMI (median 22.0) of the population was in normal range, a sizeable proportion (39.9%) was overweight or obese. This is in accordance with studies conducted in other parts of India where the prevalence ranged from 18% to 45%.[19,20] Indians were reported to lead a sedentary lifestyle by almost all the national level studies including our study (80%- 89%).[19,21]

The study reported a higher prevalence of smoking (30.5%) and alcohol (30%) consumption among males as compared to females than in other studies. According to GATS report 2009-10, 15% of males and 1.90% of females smoke in India.24 National health profile survey reported that 11% - 20% of the population consume alcohol.[21] In all the studies including ours, the smoking and alcohol consumption were almost negligible among females.

Though there are no Indian studies using the WHO risk prediction chart, a recent study has compared the same in three other low and middle income Asian countries. Our study reported 28.04% of people at greater than 20 % risk category which is alarmingly more than that reported in other Asian countries like Pakistan (10%), Cambodia (1.3%), Mongolia (3.3%) and Malaysia (6%).[25] This higher prevalence may be attributed to the fact that other studies have considered the age group of 40-64 years, while the present study included an older age group of 40-80 years. Also perhaps genetic and ethnic predispositions may have played a role.

This is the first study from India on prediction of fatal/non-fatal CVD events using the WHO multivariable risk algorithm. CVD risk stratification of a population is better than assessing individual risk factors in prioritizing resource allocation, planning health interventions, and measuring effectiveness of intervention programs in low and middle income countries like India. In this study, the individual and adjusted effects of the risk factors excluded in WHO risk algorithm (BMI, unhealthy diet, family history, alcohol, physical activity) were analysed for people with low and high risk of getting a CVD event.

The study had certain limitations. The assessment of risk factors in a screened population may not reflect the true community prevalence which would be better served using a probability sampling. Hence the prevalence of risk factors may be spuriously high. Further, the screened population was only 13% of the population in the eligible age group. It is also known that the WHO multivariable risk prediction algorithm underestimates the actual CVD risk in certain conditions.

Conclusion

The prevalence of cardiovascular risk factors is quite alarming in this rural population. The 10 year risk of MI or stroke is also correspondingly high (28.04 %). If this were true of other rural areas, it confirms the prediction that India would be the heart disease capital in the world by 2020. This warrants strategies that would improve awareness and promote healthy life-styles to reduce the risk of cardiovascular disease in this population.

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