A Cross-Sectional Study on Cardiovascular Disease Risk Assessment among the Adult Population in Poonamallee Taluka, Tiruvallur District, Tamil Nadu

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Abstract:

Introduction: Non – Communicable Diseases, driven by factors like increased life expectancy, urbanization and unhealthy lifestyles have become a leading cause of morbidity and mortality worldwide. India is undergoing a health transition, with Cardio Vascular Diseases now representing a significant part of its disease burden. **Objectives:** To estimate the prevalence of CVD risk and its associated factors using World Health Organization/ International Society of Hypertension risk prediction charts. **Method:** A community-based cross-sectional study was conducted for a period of 18 months among 545 participants in Poonamallee Taluk, Tiruvallur district. Participants were selected using a multistage simple random sampling method. Sociodemographic data were collected through interviews, and blood samples were taken to assess blood sugar and cholesterol levels. Descriptive statistics for background variables were computed using SPSS 21. The association between various factors and cardiovascular disease (CVD) risk was analysed using the chi-square test. Multiple logistic regression was performed to identify independent risk factors. **Results:** The mean age of the study subjects was 54.3$\pm$9 years with 60.2% being females. The 10-year CVD risk, based on the WHO/ISH risk prediction chart 30.6% had low risk (5 – 10%) and 30.3% had moderate risk (10 - $\leq$20%). Age, gender, education, socio – economic status and family history of NCDs, were significantly associated with CVD risk ($p<0.05$). **Conclusion:** This study highlighted that 11.8% have a high prevalence of CVD risk factors among adults over 40 years. The findings emphasize the importance of targeted interventions, including promoting physical activity, healthy diets, and regular screenings.

Keywords: Cardiovascular Diseases, Epidemiological transition, Risk assessment.

Introduction:

Non–Communicable Diseases (NCD's) has emerged as a predominant cause for morbidity and mortality globally, driven by factors such as increased in life expectancy, urbanization and unhealthy life styles.[1] According to WHO in 2023, NCDs are responsible for 41 million deaths each year, accounting for 74% of all global fatalities. Among these, 77% occur in low- and middle-income countries.[2] Among NCDs, Cardiovascular disease (CVDs) stand out as the leading cause, contributing to approximately 32% of all deaths globally in 2019.[3] The number of CVD's has doubled from 271 million in 1990 to 523 million in 2019 and during the same time period, the number of related death has risen from 12.1 million to 18.6 million. This rise in prevalence of CVD has been striking.[4]

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India is experiencing a notable health transition marked by a rising incidence of NCDs, partially CVDs, which now account for a significant percentage of the country's disease burden and mortality rates. States like Kerala, Tamil Nadu and Punjab exhibit higher prevalence rates, reflecting varying levels of epidemiological transition.[5] Economic development, altered eating patterns, decreased physical activity and raising alcohol and cigarette use are some of the factors causing this trend.[6] Recognising the urgency of addressing this public health challenge, India has implemented national policies aimed at reducing premature deaths from CVDs by managing risk factors like diabetes mellitus and hypertension, promoting their early diagnosis and treatment. Efforts like the National Program for Non Communicable Disease (NPNCD) underscore India's commitment to combating the growing impact of NCDs on its population.[7,8] With rapid urbanization in Poonamallee Taluk, there has been a significant rise in these risk factors. The above-mentioned facts necessitate the need to quantify the risk of CVD and its association with various study variables, providing valuable data for early interventions and public health strategies to reduce CVD related morbidity and mortality in the region.

Method:

This cross-sectional study was conducted in the villages of Poonamallee Taluk from January 2021 to March 2022, covering a period of 18 months. A sample size of 488 participants was determined based on the prevalence of cardiovascular disease (CVD) risk observed in a study by Ghorpade et al.,[1] using the formula $N = (Z\alpha)^2PQ/L^2$, where P = 17%, Q = 83%, L = 20%, and α = 5%. Adjusting for a 10% non-response rate, the optimum sample size was approximated to be 545 subjects. Based on the sample size 545, among 24 villages 7 villages were taken and from each village 78 participants were selected by simple random sampling method.

The study employed a multi-stage simple random sampling technique to select participants, ensuring representation across the study area (Figure 1). Eligible participants were adults aged 40 years and above, excluding individuals with terminal illness, mental disorders, or pre-existing diagnoses of cardiovascular disease or stroke. Prior to data collection, participants were fully briefed on the study objectives and provided informed and written consent. Data was collected through face-to-face interviews using a semi-structured questionnaire comprising two sections.

Section 1: socio-demographic details and detailed history of risk factors of CVD

Section 2: Assessment tools – Anthropometric measurements (height in meters and weight in Kilograms), blood pressure measurement, WHO risk prediction chart (Laboratory based charts - Age, Gender, presence or absence of Diabetes mellitus, Smoking status and Total blood Cholesterol level). the validation statistics showed that the WHO/ISH risk prediction charts had a sensitivity of 60% and a specificity of 93.2% in identifying cases of Coronary heart disease, as reported by Abd El- Wahab et al. [9]

A qualified lab technician took a 4ml blood sample from each subject and transmitted it to the lab, where results for total blood sugar and cholesterol were recorded for study purpose. With the above information the 10 - year CVD risk was assessed.[10]

The ten– year cardiovascular risk using the WHO risk prediction charts, begin by selecting the appropriate chart based on the individual's diabetes status. Next, choose the relevant table for either males or females, as this distinction can impact risk assessment. Then, determine the individual's smoking status by selecting either the smoker or non - smoker box. Afterward, identify the correct age group box for the individual. Finally locate the cell where the individual's systolic blood pressure and cholesterol levels intersects within the selected age group box; the color of this cell indicate the individual's 10-year cardiovascular risk level. This structured approach enables effective use of the risk

prediction charts for accurate evaluation. Green colour - <5% - very low risk; Yellow colour -5 to <10% -low risk; Orange colour – 10 to < 20% - Moderate risk; Red colour – 20 to <30% - high risk and Deep red ≥ 30% - very high risk. [10,11]

The data collected were analyzed using SPSS version 21. The background study variables were subjected compilation of descriptive statistics. The Chi square test was used to find the association between various study variables with CVD risk. In addition, logistic regression was done to find out significant contributing factor for CVD and p value < 0.05 was taken as significant. Institutional ethical committee approval was granted from a private medical college in Kacheepuram district (SMC/IEC/2021/07/001)

Operational Definition:

1. Physical Activity:[12]

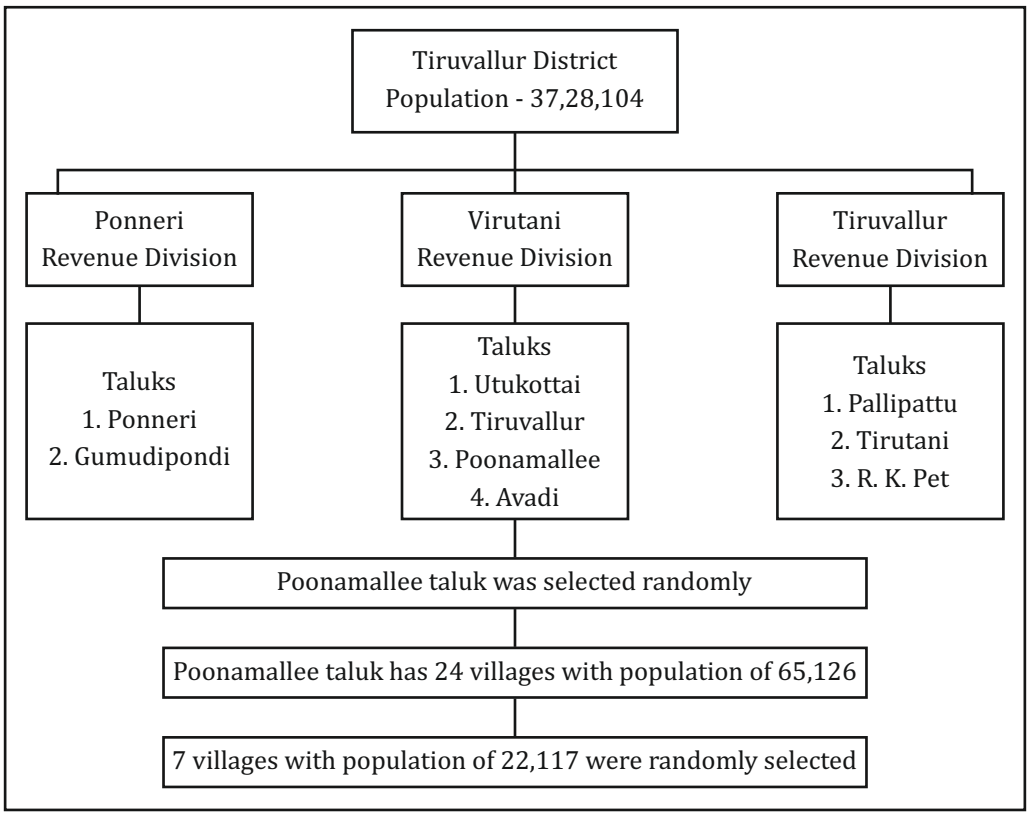
   Low – Person who do not engage in physical activity

   Moderate – Person who is doing moderate intensity activity for 5 or more days and walking of at least 30 minutes per day

   Heavy –Person with 7 days of any combination of walking, moderate or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET minutes a week.

2. Body Mass index[13] - BMI was calculated as per WHO guidelines for Asians.
3. Hypertension[14] - Person known case of HTN, Systolic ≥140 mmHg or diastolic ≥ 90 mmHg, those who are anti – hypertensive medications.
4. Diabetes Mellitus[15] - Person Known Case, Random Blood Sugar ≥ 200 mg/dl or on oral hypoglycaemic drugs and insulin.
5. Hypercholesterolemia[16] - 200mg/dl or ≥5.2 mmol/ L.
6. Perceived Stress Scale (PSS)[17] - Low – 0-13, Moderate – 14 – 26, High – 27 – 40.

Figure 1: Sampling method and Selection of study participants



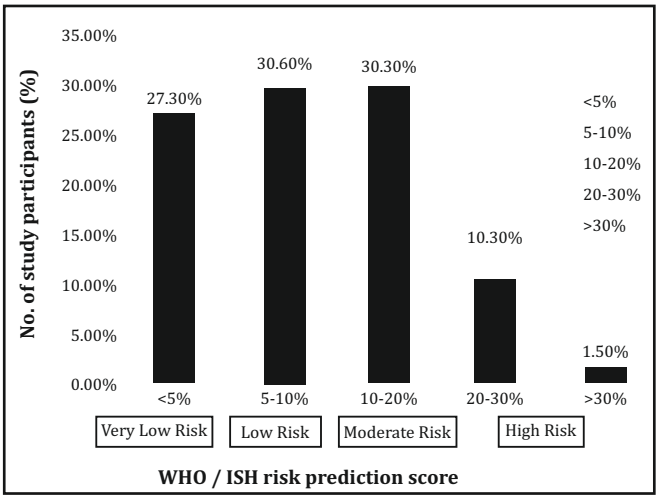
Results:

The mean age of the study subjects was 54.3±9 years. Among total participants, 328 (60.2%) were females aged 40-44 years 110 (20.2%). The majority 490 (89.9%) identified as Hindu. Additionally, 212 (38.9%) belonged to the middle class and 190 (34.9%) were illiterate. Furthermore, 250 (45.9%) were unemployed. 247 (45.2%) reported a family history of NCDs. Diabetes was reported by 293 (53.8%), hypertension by 202 (37.1%) and both the conditions by 119 (21.8%) of the subjects. A history of alcohol use was reported by 105 (19.3%), while 101 (18.5%) were smokers. Pickle consumption was noted in 450 (82.6%) of the subjects and 344 (63.1%) reported consuming fruits 2 to 3 days in a week. Adding salt after cooking was a habit for 135 (24.8%) of the subjects, whereas 412 (75.6%) stated consuming an appropriate amount of salt (5 – 9 gms). Saturated oil (palm oil) was used for cooking by 274 (50.3%) and 80 (14.7%) mentioned a habit of consuming processed foods. A sedentary lifestyle (low physical activity) was reported by 313 (57.4%) of the subjects. Hypercholesterolemia (≥ 5.2 mmol/L) was found in 226 (41.5%) of the subjects. Obesity was assessed according to WHO BMI and was found that 223 (40.9%) had normal BMI and 511 (93.8%) had moderate level of stress among the subjects.

Based on WHO/ISH risk prediction chart 30.6% had low risk (5 – 10%) and 30.3% had moderate risk (10 - <20%) (Figure 2).

According to the WHO risk prediction chart the 10 -year risk of developing CVD was evaluated. The analysis revealed that socio-demographic variables such as age, gender, religion, education, Socio-economic status and family history of NCD were statistically significant ($p < 0.05$) in relation to CVD risk scores. However, dietary factors, including consumption of pickles and the addition of salt after cooking were not statistically significant. Additionally, BMI was not significantly associated with the CVD risk score. The statistically significant risk factors for the CVD risk score are presented in the table 1.

Figure 2: Prevalence of CVD risk prediction according to WHO/ISH charts among the study participants (N = 545)



The prevalence of high CVD risk increases with increasing age, with 41.2% among older age group (70-74) when compared with their younger individuals 4.6%. Religion-wise, Hindus (12%) are at high risk of developing CVD compared to Muslims (8.3%). In the current study, 19.6% of participants from lower middle class had high risk of getting CVD than 13.1% of the participants from upper middle-class. The significant factors identified in the bivariate analysis were included in a multivariate logistic regression. Among these risk factors religion, marriage status, economic status, fruit intake, processed food usage, type of cooking oil, alcohol use, physical activity, family history of NCD and stress were not found to be independent risk factors linked with CVD risk. The notable factors outlined in Table 2. The mean age of the study participants is 55 years.

Discussion:

It is widely acknowledged that myocardial infarction, stroke or death are seldom due to single risk factor alone, rather these outcomes are typically the result of combination of multiple risk factors. Over the previous three decades, research has consistently identified CVD's as a major cause of death in India. Our study employed the WHO/ISH risk stratification guide to assess the likelihood of

Table 1: Association between NCD Risk Factors and WHO Risk Score (N = 545)

Variables	Very Low risk (< 5%) N = 149	Low risk (5 – 10%) N = 167	Moderate (10–20%) N = 165	High risk (>20%) N = 64	$\chi 2$	p value
Fruits consumed in a week						
No	21 (10.4)	43 (21.4)	92 (45.8)	45 (22.4)	102.31	<0.001*
1 or 2 days	75 (35.3)	72 (33.8)	51 (23.9)	15 (7)		
>3 days	53 (40.5)	52 (39.7)	22 (16.7)	4 (3.1)		
Processed food						
No	144 (31)	146 (31.4)	132 (28.4)	43 (9.2)	36.37	<0.001*
Yes	5 (6.3)	21 (26.2)	33 (41.3)	21 (26.2)		
Salt consumed						
Don't know	1 (9.1)	2 (18.2)	6 (54.5)	2 (18.2)	20.82	0.013*
Just right	122 (29.6)	120 (29.1)	124 (30.1)	46 (11.2)		
Too little	11 (14.3)	36 (46.8)	22 (28.6)	8 (10.3)		
Too much	15 (33.3)	9 (20)	13 (28.9)	8 (17.8)		
Type of oil						
Sunflower	65 (33)	69 (35)	51 (25.9)	12 (6.1)	26.74	<0.001*
Groundnut	22 (29.7)	28 (37.8)	19 (25.7)	5 (6.8)		
Palm	62 (22.6)	70 (25.5)	95 (34.7)	47 (17.2)		
Usage of alcohol						
Yes	16 (15.3)	42 (40)	35 (33.3)	12 (11.4)	11.09	0.011*
No	133 (30.3)	125 (28.4)	130 (29.5)	52 (11.8)		
Smoking form Current tobacco user						
Yes	7 (6.9)	18 (17.8)	47 (46.6)	29 (28.7)	66.76	<0.001*
No	142 (32)	149 (33.6)	118 (26.6)	35 (7.8)		
Smokeless tobacco						
Yes	6 (9.2)	13 (20)	19 (29.3)	27 (41.5)	67.4	<0.001*
No	143 (29.8)	154 (32.1)	146 (30.4)	37 (7.7)		
Physical activity						
Low	59 (18.8)	100 (31.9)	113 (36.2)	41 (13.1)	33.91	<0.001*
Moderate	83 (38.2)	66 (30.4)	46 (21.2)	22 (10.2)		
Heavy	7 (46.7)	1 (6.6)	6 (40)	1 (6.7)		
Diabetes Mellitus						
Yes	30 (10.2)	101 (34.5)	113 (38.6)	49 (16.7)	98.54	<0.001*
No	119 (47.2)	66 (26.2)	52 (20.6)	15 (6)		
Hypertension						
Yes	22 (10.9)	57 (29.2)	80 (41.1)	38 (18.8)	58.02	<0.001*
No	127 (37)	110 (31.5)	85 (23.9)	26 (7.6)		
Both (DM/ HTN)						
Yes	4 (3.4)	34 (28.6)	51 (42.9)	30 (25.1)	63.7	<0.001*
No	145 (34)	133 (31.2)	114 (26.8)	34 (8)		
Stress levels						
Low	8 (47.1)	6 (35.3)	1 (5.9)	2 (11.7)	12.96	0.044*
Moderate	136 (26.6)	157 (30.7)	156 (30.5)	62 (12.2)		
High	5 (29.4)	4 (23.5)	8 (47.1)	0		
Cholesterol						
< 5.2mmol/L	90 (28.2)	115 (36)	86 (26.9)	28 (8.9)	16.11	0.001*
≥ 5.2mmol/L	59 (26.1)	52 (23)	79 (34.9)	36 (16)		

*p value <0.05 is significant; Percentages are calculated row wise

Table 2: Multi Variate Regression Analysis of Risk Factors for CVD Risk Scores (N = 545)

Variables	Categories	AOR	95%CI	p-value
Age	> 55 years	58.49	17.49 – 76.54	<0.001*
	<55 years		1	
Gender	Male	0.21	0.083 – 0.567	0.002*
	Female		1	
Religion	Hindu	0.64	0.281 – 1.958	0.445
	Others		1	
Education	Illiterate	3.62	1.722 – 7.623	0.001*
	Literate		1	
Marital status	Widow & divorce	1.21	0.494 – 2.969	0.676
	Married		1	
Socio economic class	Lower middle, Lower	2.31	0.997 – 5.362	0.051
	Upper, upper middle & middle		1	
Fruits intake	Yes	0.5	0.252 – 1.008	0.053
	No		1	
Processed food usage	Yes	0.71	0.303 – 1.704	0.454
	No		1	
Type of oil	Saturated	0.83	0.421 – 1.670	0.616
	PUFA		1	
Smoking tobacco usage	Yes	12.76	4.415 – 36.89	<0.001*
	No		1	
Smokeless tobacco usage	Yes	14.11	4.57 – 43.53	<0.001*
	No		1	
Alcohol usage	Yes	0.56	0.20 – 1.57	0.271
	No		1	
Physical activity	Moderate & vigorous	0.57	0.284 – 1.175	0.13
	Low		1	
Family history of NCD	Yes	0.94	0.492 – 1.821	0.87
	No		1	
History of NCD	Yes	16.22	6.82 – 38.56	<0.001*
	No		1	
Stress	Moderate & high	5.75	0.631 - 52.52	0.121
	Low		1	
Cholesterol	> 5.2 mmol/L	6.55	3.172 - 13.54	<0.001*
	< 5.2mmol/ L		1	

* statistically significant p value < 0.05 (two tailed)

developing CVD within the next decade. It was found that 27.3% of participants were classified as very low risk, 30.6% as low risk risk, 30.3% as moderate risk, and 11.8% as high risk. This contrasts with the study by Ghorapade et al. conducted in Pondicherry, which reported 86% of participants at low risk and 17% at moderate risk.[1] Such differences may be attributed to regional variations in risk factors.

In this study 39.8% of participants were male and 60.2% were females. It was found that males were 0.21 times odds of getting CVD when compared to females and this was found to be statistically significant Jaiswal et al study similarly showed that 2.7% of males were at moderate risk for CVD in the next decade, while only 0.1% of females.[18] This underscores a notable association between CVD risk and gender. Regarding education, illiterates were at 3.62 times odds of developing CVD when compared to literates and it was statistically significant (p=0.001) which aligns with Kumar et al, with 17.3% of illiterates at high risk of CVD as compared to 4.4% of professionals.[19] This indicates that individuals

with higher education levels are more likely to be aware of risk factors, which can lead to healthier behaviors such as regular physical activity and balanced diets.

The current study found that smokers had 12.76 times higher odds of developing CVD compared to non - smokers. Similarly, Trideep et al[20] reported that 35.2% of smokers were at heightened risk of getting CVD whereas only 1.4% of non – smokers, also showing a statistically significant difference (p = 0.001). These findings highlight the elevated risk of getting CVD among smokers due to tobacco chemicals that contribute to plaque formation and artery narrowing. Furthermore, the present study observed that smokeless tobacco users at 14.11 times higher odds of developing CVD compared to non – users. This aligns with Rani et al study, which found that 44.8% of smokeless tobacco users were at high risk compared to non – users.[21] This indicates that smokeless tobacco can lead to inflammation, vasoconstriction, clot formation and direct damages to coronary arteries.

The current study found that 13.1% of participants with minimal physical activity were at high risk of developing CVD compared to 6.7% of those with heavy physical activity (p<0.001). These findings were consistent with the study done by Devamani et al[22] and Johnson et al[23] where the participants with inadequate physical activity (63.3% - 74.2%) were at high risk of developing CVD and was statistically significant (p=0.025). Physical inactivity, influenced by cultural and lifestyle factors lead to artery blockage. In the present study, higher BMI levels were associated with an increased likelihood of high CVD risk (p = 0.715) whereas a study done by Muthunarayanan et al[24] was contrast to the study, 1.9% of participants with BMI >25 had high CVD risk compared to 6.3% with normal BMI (p = 0.017). This discrepancy might be due to usage of different BMI classifications (International WHO standards), cultural practices, sedentary life style and unhealthy diet.

In the present study, increased stress levels significantly raised the likelihood of developing moderate grade 2 CVD risk (Likelihood ratio = 12.96; p = 0.044). Stress can elevate inflammation, leading to high blood pressure and lower HDL cholesterol which harms the heart.

In the present study, 41.5% of participants had hypercholesterolemia, with 16% at high risk of CVD compared to 8.9% with normal cholesterol levels (p<0.001) which was contrast with Deori et al[20] with 20% risk in participants with high cholesterol but this was not significant. This discrepancy would be due difference in behavior, diet and culture.

Our study identified that age, gender, education, tobacco use, history of NCD and cholesterol are the independent risk factors for CVD. Both modifiable and non- modifiable risk factors equally contribute to CVD development. The WHO/ISH CVD risk prediction charts can serve as simple screening tool for peripheral health workers, aiding in risk stratification and informed decision making. By implementing appropriate interventions such as health education and treatment the incidence of CVDs at the community level can be reduced.

Conclusion:

This cross-sectional study evaluated cardiovascular disease (CVD) risk among adults over 40 years in Poonamallee Taluk, Tiruvallur District, Tamil Nadu. The results reveal a significant prevalence of (11.8%) high CVD risk factors in this population, emphasizing the need for targeted interventions and awareness programs. Promoting physical activity, healthy diets, and regular health screenings is essential for reducing CVD risk. Future research should assess the long-term impact of these interventions to enhance cardiovascular health in the community.

Declaration:

Funding: Nil

Conflicts of interest: Nil

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