E-ISSN: 3048-6041 | Volume- 2, Issue- 10 | October 2025

A Study on the Assessment of Cardiovascular Risk Using WHO CVD Risk Prediction Chart Among Indian Diabetes Population: Using NFHS-5 (2019-21) Secondary Dataset

Dulumoni Das[1], Sandipan Paul[2*]

[1,2]Depeartment of Statistics, Cotton University

[*]Corresponding Author Email- sandipanstat@gmail.com

Abstract

Cardiovascular disease (CVD) is a major complication among individuals with diabetes, yet population-level evidence in India remains limited. Assesses 10-year CVD risk among adult men and women with diabetes using WHO laboratory- and non-laboratory-based risk prediction charts and nationally representative NFHS-5 data (2019-21). Results highlight that age, education, wealth, and regional factors significantly influence risk, with females generally exhibiting lower absolute risk but higher socio-economic vulnerability. Caste differences are minimal, while sector (urban-rural) effects vary by gender. Findings underscore importance of early detection, gender-sensitive screening, region-specific interventions, and integration of WHO risk tools into public health programs to reduce premature CVD mortality in India.

Keywords: - CVD, Diabetes Mellitus, WHO Risk Score, Public health, Indian Population.

1. Introduction

Cardiovascular diseases (CVDs) have become a leading cause of death across the world, as well as a burden to health and economic challenges in developing countries. Epidemiological transition in South Asia, in India, has made diabetes one of the most significant risk factors, which has led to the development of cardiovascular complications. Risk stratification is necessary to prevent and intervene in time as diabetes among the urban and rural populations continues to increase. The World Health Organization (WHO) has launched CVD risk prediction charts to establish evidence-based evaluation of future cardiovascular events, which are adjusted to regional populations, such as South Asia. These charts involve demographic and clinical variables like age, sex, smoking status, blood pressure, cholesterol, and history of diabetes. Analysis focuses on the impact of cardiovascular risk factors on Indian adults with diabetes using nationally representative data provided by the National Family Health Survey-5 (2019-21). It also highlights the importance of population-level screening as a guide to preventive strategies and to informing public health policy.

2. Literature Review

2.1 Impact of Cardiovascular Disease in South Asia

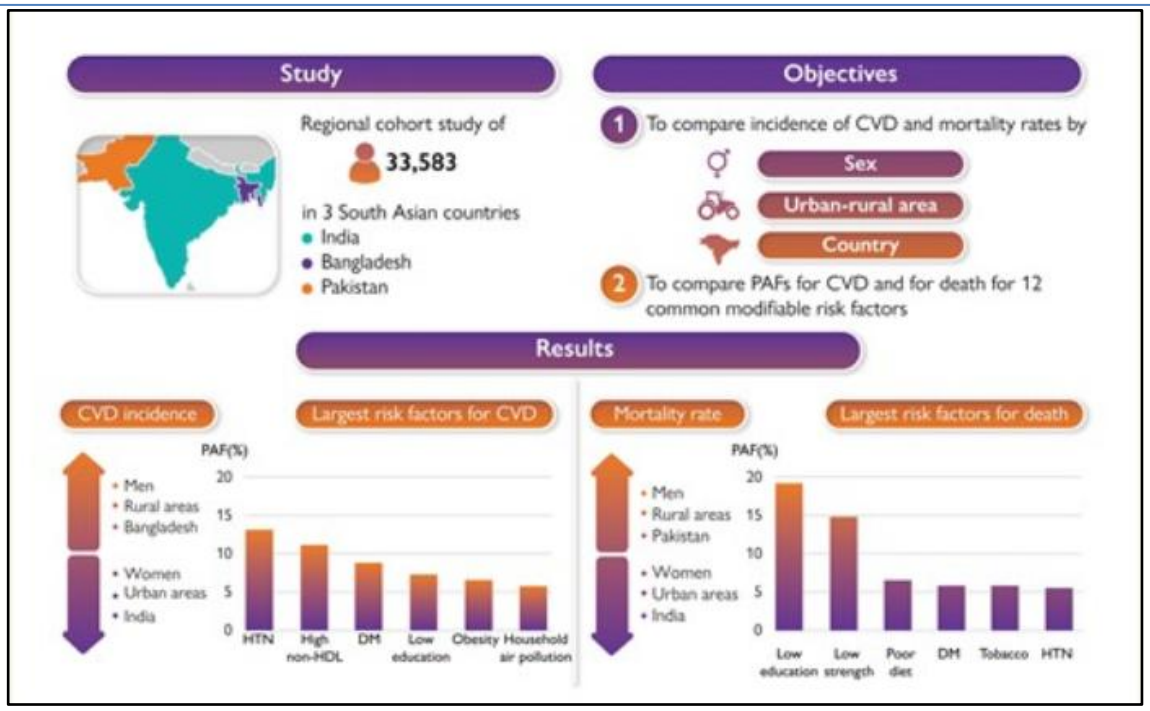

Figure 1: Regional Burden and Risk Factors of Cardiovascular Disease in South Asia

(Source: [1])

This figure represents CVD incidence, mortality rates, and major risk factors among South Asian populations, highlighting variations by sex, urban–rural residence, and country-specific patterns across India, Bangladesh, and Pakistan. CVD is a cause of the highest mortality in the world and South Asia is a hot spot in terms of prevalence of risk factors [1]. There is an increasing dual burden of communicable and non-communicable diseases, with diabetes and hypertension dramatically increasing the CVD morbidity in India [3]. Research has shown that South Asians acquire cardiovascular-related problems at earlier ages than western populations, and in many cases, they die of these conditions.

2.2 Diabetes as a Major Determinant of CVD Risk

Diabetes mellitus significantly increases cardiovascular risk through enhancing endothelial dysfunction, atherosclerosis, as well as lipid abnormalities. Evidence Epidemiological studies show that diabetic people are two to four times more at risk of heart disease and stroke [2]. Type 2 diabetes has increased drastically in Indian population, with urbanization, sedentary lifestyles, and dietary changes all adding to the extent of this problem [4]. Effective risk prediction in this cohort will become essential in terms of preventing premature mortality and improving care.

2.3 WHO CVD Risk Prediction Tools

Comparing and predicting ten-year CVD event rates using WHO laboratory and non-laboratory risk prediction charts, stratified by sex, emphasizing their applicability for cardiovascular risk assessment in Asian populations. World Health Organization (WHO) has

developed CVD risk prediction charts tailored for specific regions, including South Asia, to support global prevention strategies [7].

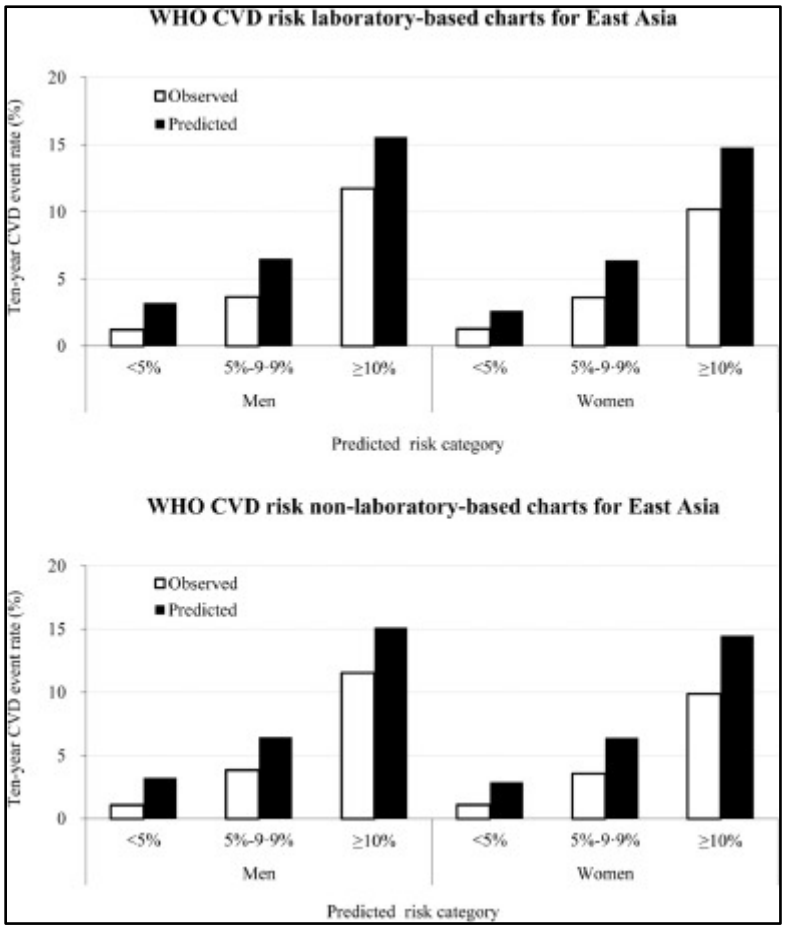

Figure 2: Observed vs. Predicted Ten-Year Cardiovascular Risk Using WHO CVD Charts

(Source: [7])

These tools classify individuals into different risk classifications based on demographic and clinical factors such as age, gender, systolic blood pressure, smoking status, cholesterol, and diabetes [9]. There are both laboratory-based and non-laboratory versions of these tools, used in a variety of settings in healthcare [5]. These tools allow targeted action, including intensively managing high-risk individuals and using resources efficiently.

3. Methodology

Secondary data analysis is performed using nationally representative National Family Health Survey-5 (NFHS-5), carried out between 2019 and 2021. NFHS-5 is recognized as one of a largest and most comprehensive health surveys in India [10]. Survey uses two-stage sampling to collect demographic and health related information about households across demographics in every state and union territory [8]. This national-level survey is a source of statistics on indicators of non-communicable diseases and is relevant to assessing cardiovascular risk among those who have diabetes.

Component	Description
Data Source	NFHS-5 (2019-21), nationally representative household survey
Study Population	Adult male and female participants with diabetes
Risk Assessment Tool	WHO CVD Risk Prediction Charts (South Asia - laboratory & non-laboratory)
Key Variables	Age, SBP, Sex,BMI, socio-demographic factors
Risk Categories	<5%, 5-10%, 10-20%, ≥20% 10-year CVD risk
Statistical Methods	Descriptive analysis and chi-square tests ($p < 0.01$)

Table 1: Summary of Methodological Framework

4. Results

Analysis of the NFHS-5 dataset highlighted key patterns of cardiovascular disease (CVD) risk among male participants with diabetes. The WHO risk prediction framework, both laboratory-based and non-laboratory-based, provided a structured estimate of 10-year CVD risk. Results are summarized below across socio-demographic and economic factors.

Age Distribution and CVD Risk

Age Group	<5% (n, %)	5-10% (n, %)	10-20% (n, %)	20-30% (n, %)	Total (n, %)
40-44	1,086 (61.6)	627 (35.6)	49 (2.8)	1 (0.0)	1,763 (100)
45-49	1,076 (49.6)	958 (44.1)	135 (6.2)	2 (0.1)	2,171 (100)
50-54	430 (21.5)	1,174 (58.8)	365 (18.2)	30 (1.5)	1,998 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 2: CVD Risk Distribution by Age (Male Participants with Diabetes)

Age Group	<5% (n, %)	5-10% (n, %)	10-20% (n, %)	Total (n, %)
40-44	10,571 (92.6)	799 (7.0)	49 (0.4)	11,419 (100)
45-49	11,874 (82.4)	2,318 (16.1)	223 (1.5)	14,415 (100)
50-54	12 (61.1)	10 (38.9)	1 (4.3)	23 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 3: CVD Risk Distribution by Age (Female Participants with Diabetes)

The analysis indicates that the majority of Indian adults with diabetes fall under the low to moderate cardiovascular risk category, while a smaller but significant proportion face high or very high risk. Gender differences are evident, with males showing higher risk levels. These findings emphasize importance of targeted screening and preventive strategies.

Regional Variations

Region	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
North	233 (36.1)	331 (51.3)	76 (11.7)	6 (0.9)	646 (100)
Central	411 (37.7)	538 (49.3)	128 (11.7)	15 (1.4)	1,093 (100)
East	624 (42.7)	714 (48.8)	123 (8.4)	1 (0.1)	1,462 (100)
Northeast	80 (33.7)	131 (55.1)	25 (10.4)	2 (0.8)	238 (100)
West	395 (44.3)	409 (45.8)	86 (9.6)	3 (0.3)	893 (100)
South	848 (52.9)	637 (39.8)	112 (7.0)	6 (0.4)	1,603 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 4: Male CVD Risk Distribution by Region

Regional disparities are significant ($\chi^2 = 126.23$, $p < 0.001$). Males in the South had the highest proportion in the <5% risk category (52.9%), whereas the Central and Northeast regions showed elevated shares in the 10–20% risk category (11.7% and 10.4%).

Region	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
North	2,324 (87.9)	311 (11.8)	9 (0.3)	2,644 (100)
Central	4,071 (82.8)	778 (15.8)	69 (1.4)	4,918 (100)
East	5,414 (86.0)	784 (12.5)	94 (1.5)	6,293 (100)
Northeast	647 (71.5)	231 (25.5)	27 (3.0)	905 (100)
West	2,966 (89.0)	334 (10.0)	33 (1.0)	3,333 (100)
South	7,034 (90.6)	689 (8.9)	42 (0.5)	7,765 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 5: Female CVD Risk Distribution by Region

CVD risk among females showed significant regional differences ($\chi^2 = 400.89$, $p < 0.001$). The South had the highest proportion in the <5% risk group (90.6%), while Northeast had the largest share in the 10-20% category (3.0%), indicating regional health disparities.

Religion and CVD Risk

Religion	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
Hindu	2,081 (42.9)	2,275 (46.9)	471 (9.7)	20 (0.4)	4,847 (100)
Muslim	345 (47.0)	334 (45.4)	48 (6.5)	8 (1.1)	735 (100)
Others	166 (47.2)	151 (43.1)	29 (8.4)	5 (1.4)	351 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 6: CVD Risk Distribution by Religion (Male Participants with Diabetes)

Religion influenced CVD risk significantly ($\chi^2 = 22.44$, $p = 0.001$). Hindus had largest sample size, with nearly 10% in 10-20% risk category, while Muslims and others showed slightly lower proportions in this group.

Religion	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
Hindu	18,095 (87.1)	2,466 (11.9)	217 (1.0)	20,778 (100)
Muslim	2,924 (85.0)	470 (13.6)	47 (1.4)	3,441 (100)
Others	1,437 (87.7)	191 (11.7)	10 (0.6)	1,638 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 7: CVD Risk Distribution by Religion (Female Participants with Diabetes)

Among females, religion is not statistically significant association with CVD risk ($\chi^2 = 15.98$, $p = 0.003$). Males showed higher proportions in the 10-20% risk category (up to 10%), whereas females are predominantly in <5% risk group, with smaller fractions in higher risk categories. These findings suggest that while religion correlates with CVD risk, gender differences are more pronounced than religious differences.

Caste and CVD Risk

Caste	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
SC	2,266 (43.7)	2,417 (46.6)	471 (9.1)	30 (0.6)	5,184 (100)

ST	119 (36.5)	171 (52.3)	35 (10.8)	1 (0.3)	326 (100)
Others	206 (48.6)	172 (40.8)	43 (10.2)	2 (0.5)	423 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 8: CVD Risk Distribution by Caste (Male Participants with Diabetes)

Caste differences are less pronounced ($\chi^2 = 13.66$, $p = 0.03$, not significant).

Caste	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
SC	20,205 (87.6)	2,646 (11.5)	214 (0.9)	23,065 (100)
ST	961 (76.9)	255 (20.5)	33 (2.6)	1,250 (100)
Others	1,291 (83.7)	225 (14.6)	27 (1.7)	1,543 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 9: CVD Risk Distribution by Caste (Female Participants with Diabetes)

Caste is significantly associated with CVD risk ($\chi^2 = 144.49$, $p < 0.001$) among females. Caste-based differences were more prominent among female participants, where ST women had a noticeably higher share in moderate-risk categories. Caste differences are smaller and not statistically significant for male participants. Caste interacts differently with CVD risk across genders, with female ST populations being particularly vulnerable.

Sector and CVD Risk

Sector	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
Urban	961 (43.8)	1,010 (46.0)	213 (9.7)	10 (0.5)	2,194 (100)
Rural	1,631 (43.6)	1,750 (46.8)	336 (9.0)	22 (0.6)	3,739 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 10: CVD Risk Distribution by Sector (Male Participants with Diabetes)

Urban–rural differences are minimal, with nearly identical distributions across categories ($\chi^2 = 1.42$, $p = 0.70$, not significant).

Sector	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
Urban	8,742 (89.0)	1,001 (10.2)	76 (0.8)	9,820 (100)
Rural	13,714 (85.5)	2,126 (13.3)	197 (1.2)	16,037 (100)

Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 11: CVD Risk Distribution by Sector (Female Participants with Diabetes)

Sector had a significant association with CVD risk ($\chi^2 = 67.48$, $p < 0.001$) for females. Urban women are more likely to fall in the <5% risk category (89%) compared to rural women (85.5%). Rural women had higher proportions in the 5-10% and 10-20% categories, suggesting slightly elevated cardiovascular risk among rural females.

Education and CVD Risk

Education	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
No Education	364 (36.4)	542 (54.4)	86 (8.7)	5 (0.5)	997 (100)
Primary	356 (37.7)	476 (50.4)	106 (11.2)	6 (0.6)	943 (100)
Secondary	1,418 (45.6)	1,374 (44.2)	294 (9.5)	20 (0.6)	3,106 (100)
Higher	455 (51.3)	368 (41.5)	62 (7.0)	2 (0.2)	887 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 12: CVD Risk Distribution by Education (Male Participants with Diabetes)

Education showed a significant relationship ($\chi^2 = 70.2$, $p < 0.001$) among males.

Education Level	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
No Education	8,042 (82.6)	1,543 (15.8)	155 (1.6)	9,740 (100)
Primary	4,008 (85.5)	612 (13.0)	70 (1.5)	4,690 (100)
Secondary	8,806 (90.6)	865 (8.9)	46 (0.5)	9,718 (100)
Higher	1,601 (93.6)	107 (6.2)	2 (0.1)	1,709 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 13: CVD Risk Distribution by Education (Female Participants with Diabetes)

For females, education is also significantly associated with CVD risk ($\chi^2 = 373.74$, $p < 0.001$). Both males and females with higher education predominantly fall into the lowest risk

category, while those with little or no education show higher proportions in the moderate-risk category. The effect of education is particularly pronounced among women.

Wealth Quintile and CVD Risk

Wealth Quintile	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**20-30% (n, %)**	**Total (n, %)**
Poorest	325 (39.3)	428 (51.8)	73 (8.8)	1 (0.1)	827 (100)
Poorer	396 (40.3)	486 (49.5)	90 (9.2)	11 (1.1)	983 (100)
Middle	502 (42.4)	561 (47.4)	113 (9.6)	8 (0.7)	1,184 (100)
Richer	651 (44.3)	660 (44.9)	155 (10.5)	4 (0.3)	1,470 (100)
Richest	718 (48.9)	624 (42.5)	118 (8.0)	9 (0.6)	1,469 (100)
Total	**2,592 (43.7)**	**2,760 (46.5)**	**549 (9.3)**	**33 (0.6)**	**5,933 (100)**

Table 14: CVD Risk Distribution by Wealth Quintile (Male Participants with Diabetes)

Wealth status is significantly associated with risk ($\chi^2 = 44.96$, $p < 0.001$) among males.

Wealth Quintile	**<5% (n, %)**	**5-10% (n, %)**	**10-20% (n, %)**	**Total (n, %)**
Poorest	2,921 (80.6)	614 (16.9)	89 (2.5)	3,625 (100)
Poorer	3,506 (83.1)	637 (15.1)	74 (1.8)	4,217 (100)
Middle	4,644 (85.5)	734 (13.5)	54 (1.0)	5,432 (100)
Richer	5,590 (89.7)	601 (9.6)	39 (0.6)	6,230 (100)
Richest	5,796 (91.2)	541 (8.5)	17 (0.3)	6,353 (100)
Total	**22,457 (86.9)**	**3,127 (12.1)**	**273 (1.1)**	**25,857 (100)**

Table 15: CVD Risk Distribution by Wealth Quintile (Female Participants)

Among females, wealth also had a significant effect on CVD risk ($\chi^2 = 388.6$, $p < 0.001$). Both males and females in higher wealth quintiles predominantly fall under the <5% risk category, whereas poorer participants, especially women, show higher proportions in moderate-risk groups, highlighting protective effect of economic advantage on CVD risk. Two charts provide visual comparisons of laboratory-based and non-laboratory-based WHO CVD risk predictions.

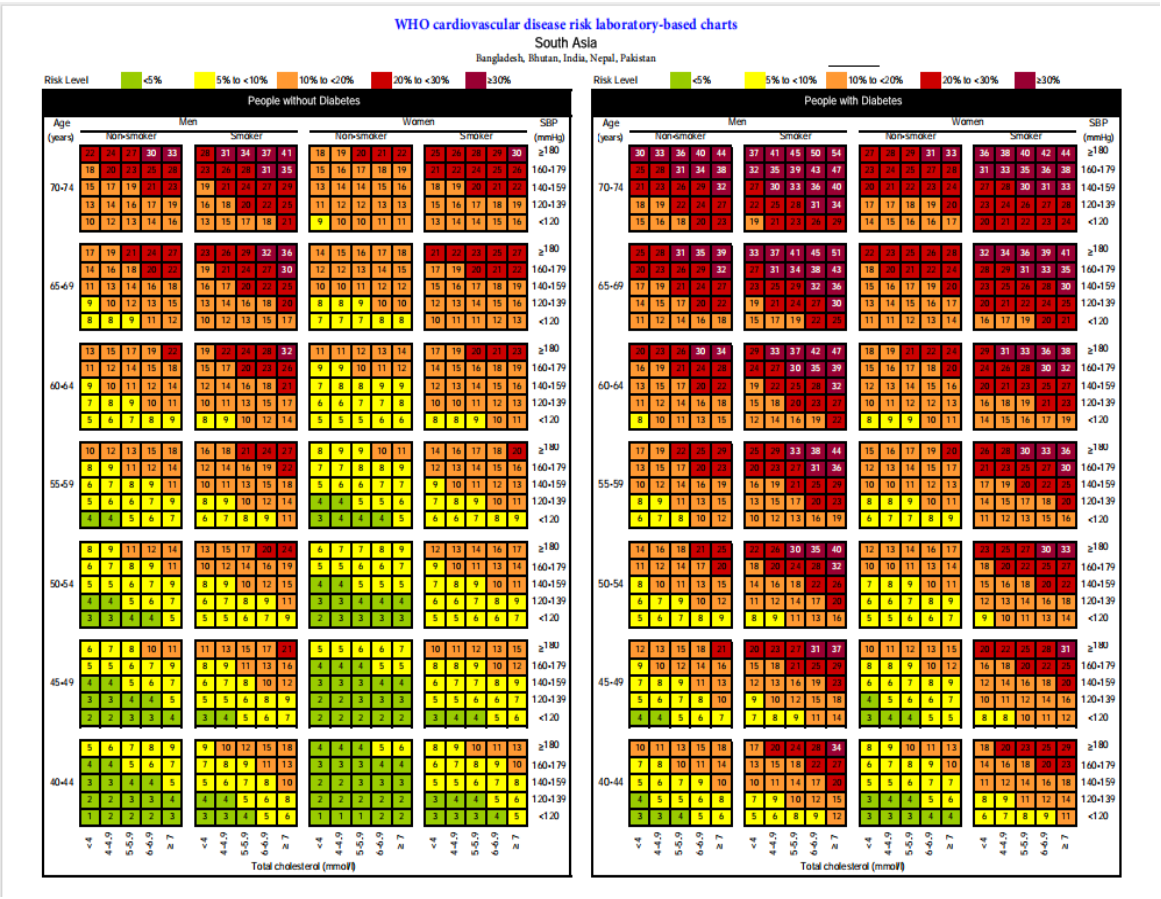

Figure 3: WHO cardiovascular disease risk laboratory-based chart

Laboratory-based WHO CVD risk chart for South Asia illustrates risk levels by age, sex, cholesterol, blood pressure, and diabetes status. Highlighting how multiple clinical factors contribute to cardiovascular risk stratification in regional populations.

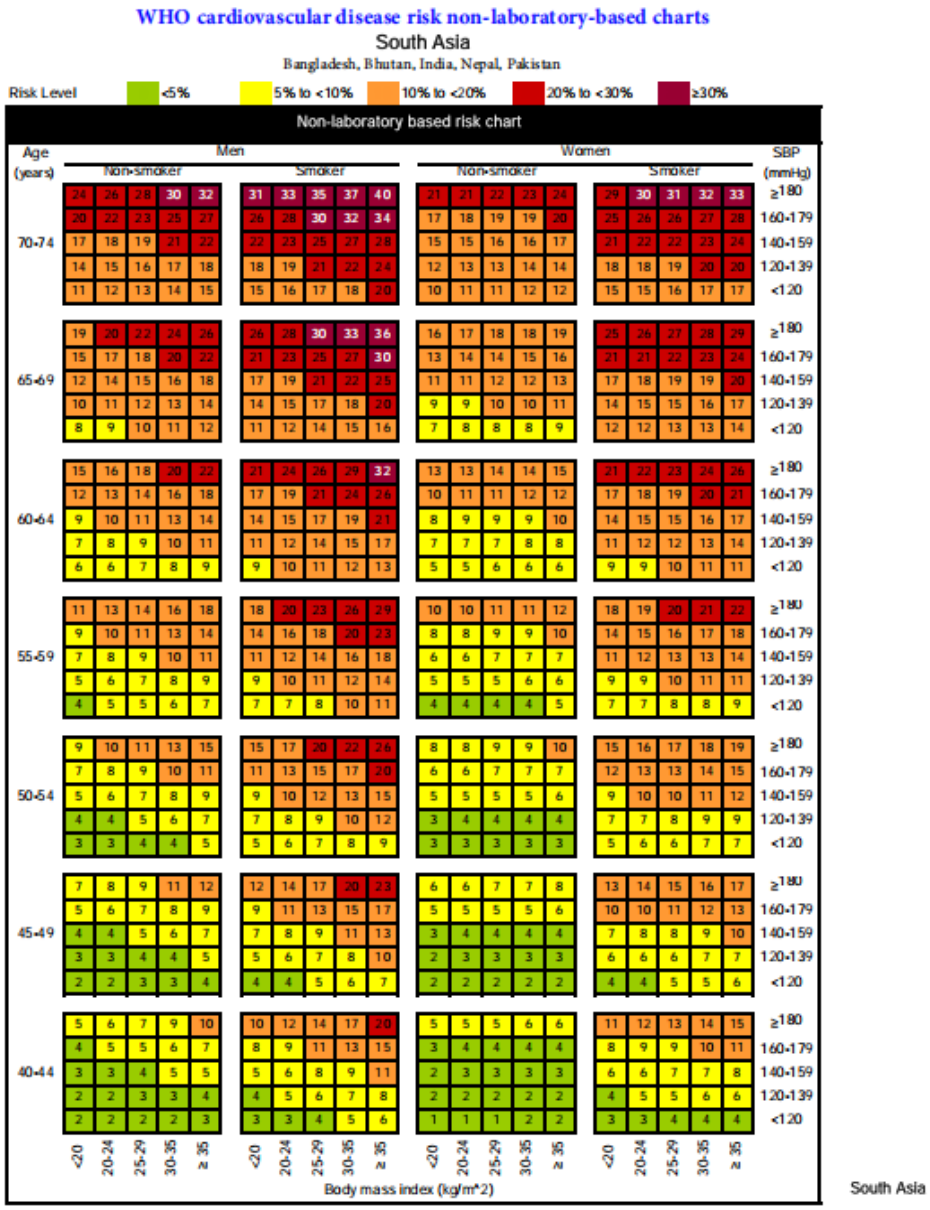

Figure 4: WHO cardiovascular disease risk non-laboratory-based chart

Non-laboratory-based WHO CVD risk chart for South Asia evaluates risk through age, sex, smoking status, BMI, and blood pressure. Also offering a practical tool for assessing cardiovascular disease risk where laboratory resources are limited.

5. Discussion

Findings indicate that cardiovascular disease (CVD) risk among Indian adults with diabetes is influenced by a complex interplay of demographic, socio-economic, and regional factors, with gender differences. Age remains the most decisive determinant, as older adults consistently exhibit higher CVD risk, reflecting compounded vulnerability of diabetes with aging

Factor	**Key Findings**

Age	Older adults, both male and female, fall into higher CVD risk categories.
Region	South shows lower risk, likely due to better healthcare access and awareness, Central and Northeast show elevated risk.
Education	Higher education is associated with lower risk (<5% category), particularly among women.
Wealth	Wealthier adults are more concentrated in low-risk groups, whereas poorer populations show higher moderate-risk proportions.
Caste	Caste shows minimal or inconsistent association with CVD risk.
Urban-Rural	Sector shows mixed results, urban-rural differences are significant for females but minimal for males.

Table 16: Summary of Key Findings

These results highlight the multifactorial nature of CVD risk in Indian adults with diabetes. Gender differences are evident, such as females generally showing lower absolute risk, but socio-economic vulnerabilities, especially low wealth and education, strongly increase risk. Analysis shows the need for targeted public health strategies focusing on age, education, wealth, and regions to reduce cardiovascular complications and improve population-level outcomes.

6. Conclusion and Recommendations

Cardiovascular disease (CVD) risk among Indian adults with diabetes is influenced by demographic, socio-economic, regional factors, and gender differences. Age remains the strongest determinant, with older adults at higher risk. Socio-economic factors such as education and wealth significantly affect risk, particularly among women, while regional disparities highlight vulnerable populations in Central and North-eastern regions. Females generally have lower absolute risk but are impacted by socio-economic vulnerabilities.

These recommendations include:

- Integrating WHO CVD Risk Charts into routine diabetes screenings for both men and women.
- Prioritizing preventive strategies for middle-aged and high-risk adults, considering gender-specific needs.
- Strengthen outpatient care and health infrastructure in Central and North-eastern regions.
- Promotes education, awareness, and lifestyle interventions targeting disadvantaged populations.

- Interventions with national and global agendas for the reduction of non-communicable diseases, ensuring equitable access for all genders.

References

1. Joseph, P., Kutty, V.R., Mohan, V., Kumar, R., Mony, P., Vijayakumar, K., Islam, S., Iqbal, R., Kazmi, K., Rahman, O. and Yusuf, R., 2022. Cardiovascular disease, mortality, and their associations with modifiable risk factors in a multi-national South Asia cohort: a PURE substudy. European heart journal, 43(30), pp.2831-2840. https://academic.oup.com/eurheartj/article-abstract/43/30/2831/6613111
2. Stefil, M., Bell, J., Calvert, P. and Lip, G.Y., 2023. Heightened risks of cardiovascular disease in south Asian populations: causes and consequences. Expert Review of Cardiovascular Therapy, 21(4), pp.281-291. https://www.tandfonline.com/doi/abs/10.1080/14779072.2023.2187780
3. Raheem, A., Ahmed, S., Kakar, A.W., Majeed, H., Tareen, I., Tariq, K., ur Rehman, Z. and Karim, M., 2022. Burden of cardiovascular diseases in South Asian region from 1990 to 2019: Findings from the global burden of disease study. Pakistan Heart Journal, 55(1), pp.15-21. https://pakheartjournal.com/index.php/pk/article/view/2264
4. Wong, N.D. and Sattar, N., 2023. Cardiovascular risk in diabetes mellitus: epidemiology, assessment and prevention. Nature Reviews Cardiology, 20(10), pp.685-695. https://www.nature.com/articles/s41569-023-00877-z
5. Teshale, A.B., Htun, H.L., Owen, A., Gasevic, D., Phyo, A.Z.Z., Fancourt, D., Ryan, J., Steptoe, A. and Freak-Poli, R., 2023. The role of social determinants of health in cardiovascular diseases: an umbrella review. Journal of the American Heart Association, 12(13), p.e029765. https://www.ahajournals.org/doi/abs/10.1161/JAHA.123.029765
6. Jyotsna, F.N.U., Ahmed, A., Kumar, K., Kaur, P., Chaudhary, M.H., Kumar, S., Khan, E., Khanam, B., Shah, S.U., Varrassi, G. and Khatri, M., 2023. Exploring the complex connection between diabetes and cardiovascular disease: analyzing approaches to mitigate cardiovascular risk in patients with diabetes. Cureus, 15(8). https://www.cureus.com/articles/179078-exploring-the-complex-connection-between-diabetes-and-cardiovascular-disease-analyzing-approaches-to-mitigate-cardiovascular-risk-in-patients-with-diabetes.pdf
7. Li, J., Liu, F., Yang, X., Cao, J., Chen, S., Chen, J., Huang, K., Shen, C., Liu, X., Yu, L. and Zhao, Y., 2021. Validating World Health Organization cardiovascular disease risk charts and optimizing risk assessment in China. The Lancet Regional Health–Western Pacific, 8. https://www.thelancet.com/journals/lanwpc/article/PIIS2666-6065(21)00005-5/fulltext?uuid=uuid%3A68d4de58-b4fa-4bf0-ac26-e5e3dd54db01
8. Sivanantham, P., S, M.K., Essakky, S., Singh, M., Ghosh, S., Mehndiratta, A. and Kar, S.S., 2023. Cost-effectiveness of implementing risk-based cardiovascular disease (CVD) management using updated WHO CVD risk prediction charts in India. Plos

one, 18(8), p.e0285542. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0285542

9. Thulani, U.B., Mettananda, K.C.D., Warnakulasuriya, D.T.D., Peiris, T.S.G., Kasturiratne, K.T.A.A., Ranawaka, U.K., Chakrewarthy, S., Dassanayake, A.S., Kurukulasooriya, S.A.F., Niriella, M.A. and de Silva, S.T., 2021. Validation of the World Health Organization/International Society of Hypertension (WHO/ISH) cardiovascular risk predictions in Sri Lankans based on findings from a prospective cohort study. PLoS One, 16(6), p.e0252267. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0252267
10. Mettananda, K.C.D., Gunasekara, N., Thampoe, R., Madurangi, S. and Pathmeswaran, A., 2021. Place of cardiovascular risk prediction models in South Asians; agreement between Framingham risk score and WHO/ISH risk charts. International Journal of Clinical Practice, 75(7), p.e14190. https://onlinelibrary.wiley.com/doi/abs/10.1111/ijcp.14190
11. Sasikumar, M., Marconi, S.D., Dharmaraj, A., Mehta, K., Das, M. and Goel, S., 2023. Prevalence of risk factors and estimation of 10-year risk for cardiovascular diseases among male adult population of Tamil Nadu India-an insight from the National Family Health Survey–5. Indian Heart Journal, 75(4), pp.251-257. https://www.sciencedirect.com/science/article/pii/S0019483223001049
12. Nagaria, T., Singh, N., Verma, M., Singh, A., Jain, K., Verma, N., Dengani, M., Agrawal, S., Singh, S. and Goel, S., 2025. Prevalence of HTN and its risk factors among tribal population in Chhattisgarh (India) as per the fifth round of the National Family Health Survey. PloS one, 20(4), p.e0318268. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0318268
13. Pattnaik, S., Murmu, J., Agrawal, R., Rehman, T., Kanungo, S. and Pati, S., 2023. Prevalence, pattern and determinants of disabilities in India: Insights from NFHS-5 (2019–21). Frontiers in Public Health, 11, p.1036499. https://www.frontiersin.org/articles/10.3389/fpubh.2023.1036499/full
14. Singh, N., Shukla, S.K., John, P., Bajpai, R., Chugh, P., Sengupta, R., Pushkar, R.R., Yadav, N., Singh, N. and Sadanandan, R., 2025. Unveiling the twin epidemics of hypertension and diabetes: a cross-sectional analysis of sex-specific prevalence, risk, and hotspots in India's epidemiological transition zones. BMC Public Health, 25(1), p.1734. https://link.springer.com/article/10.1186/s12889-025-22983-y