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## Original Article

# 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



Midhun Sasikumar <sup>a</sup>, Sam David Marconi <sup>b</sup>, Aravind Dharmaraj <sup>a</sup>, Kedar Mehta <sup>c</sup>,  
Milan Das <sup>d</sup>, Sonu Goel <sup>e, f, \*</sup>

<sup>a</sup> The Wellcome Trust Research Laboratory, Division of Gastrointestinal Sciences, Christian Medical College Vellore, Tamil Nadu, 632002, India

<sup>b</sup> Department of Community Health, Christian Medical College Vellore, Tamil Nadu, 632002, India

<sup>c</sup> Department of Community Medicine, GMERS Gotri Vadodara, Gujarat, India

<sup>d</sup> International Institute for Population Sciences, India

<sup>e</sup> Honorary Professor Faculty of Human and Health Sciences Swansea University, United Kingdom

<sup>f</sup> Public Health Master's Program School of Medicine, University of Limerick, Ireland

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## ABSTRACT

**Objective:** Cardiovascular diseases (CVD) are one of the most addressed preventable diseases of public health importance. However, the risk estimates and use of these risk scores for CVD prevention are the least explored areas. So, in this study, we explored the different categories of Framingham heart study (FHS) 10-year-CVD risk score and their associated factors among the adult male population in Tamil Nadu, India.

**Methods:** We used the risk factor level data for male adults aged 18 years and above from the National Family Health Survey (NFHS-5) of Tamil Nadu state, India. Sociodemographic variables, behavioral factors, and physiological/biochemical factors were considered as the risk factor and were estimated using the world health organization (WHO) STEPS categories. FHS 10-year-CVD risk score was calculated using a body-mass index-based published Cox regression equation.

**Results:** Out of 2289 adult males, only 1.12% of the participants had a 10-year CVD risk score greater than 30% and ~4% of the total participants require statin treatment (FRS-CVD risk score  $\geq 20$ ). Educational status (aOR:14.21, 95 CI: 4.36–46.22- no formal schooling when compared to 10th and above standard), weekly fruit intake (aOR:0.51, 95 CI: 0.27–0.97 when compared to daily fruit intake) and abdominal obesity (aOR:2.43, 95 CI: 1.58–3.74) were found to be associated with higher FRS scores when adjusted for all other factors not involved in FRS calculation.

**Conclusion:** Widespread use of this score needs to be encouraged in clinical practices and patients with a higher risk of CVD events should be counselled for lifestyle modifications and compliance with treatment for decreasing the burden due to CVDs.

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## 1. Introduction

Non-communicable diseases (NCDs) are diseases of long duration and are one of the major public health problems as they inflict

human suffering and socioeconomic declines.<sup>1</sup> Globally NCDs cause around 41 million deaths (71% of total deaths) per year of which 15 million were in the age group 30–69 years similarly, 85% of the premature deaths from low-middle income countries were also contributed by NCDs.<sup>2</sup> The most important among these groups of diseases are cardiovascular diseases (CVDs) like coronary heart disease, stroke, and peripheral vascular diseases. Globally, an increase in mortality from 12.1 million to 18.6 million due to CVD was observed during the period from 1990 to 2019.<sup>3</sup> In India, CVD contributed 28.1% of the total deaths and 14.1% of the total

\* Corresponding author. Department of Community Medicine and School of Public Health Post Graduate Institute of Medical Education and Research, Chandigarh, India.

E-mail addresses: [sonu.goel@ul.ie](mailto:sonu.goel@ul.ie), [sonugoel007@yahoo.co.in](mailto:sonugoel007@yahoo.co.in), [sonu.goel@swansea.ac.uk](mailto:sonu.goel@swansea.ac.uk) (S. Goel).

disability-adjusted life years (DALYs) in 2016, compared to 15.2% and 6.9%, in 1990.<sup>4</sup>

Modifiable behaviours like tobacco and alcohol usage, unhealthy diet, and physical inactivity lead to physiological changes like elevated blood pressure, elevated cholesterol levels, elevated blood glucose levels, and obesity and predict higher rates of NCDs.<sup>5</sup> Risk estimates are used to calculate the probability of an outcome for these given risk factors.<sup>6</sup> These risk estimates play a major role in raising awareness among the population to communicate the risk in sub-groups to alter the behaviours and to adhere to the treatment or therapy.<sup>7</sup> The major risk prediction scores like World Health Organisation/International Society of Hypertension (WHO/ISH) charts<sup>8</sup> QRESEARCH cardiovascular risk algorithm (QRISK3<sup>9</sup>, Joint British Society calculator 3 (JBS3)<sup>10</sup> and Framingham risk score<sup>11</sup> etc. can be used to estimate the risk of CVD events and to motivate the community for the primary and secondary prevention of CVDs. A hospital-based study conducted among people with first myocardial infarction showed that the JBS3 score estimates the patients to be at high risk for cardiovascular events than the FHS-CVD risk score but both the scores were comparable.<sup>12</sup> A comparison of different CVD risk scores for Asian populations found that the FRS score had higher discrimination for cardiovascular mortality than WHO/ISH risk prediction charts.<sup>13</sup>

The state of Tamil Nadu is in the phase of epidemiological transition with an increased burden of CVD events and risk factors of CVD<sup>14</sup> and is ranked 3rd among states of India in mortality rate (36% of all deaths) due to CVD among the male population. Studies have shown that there is a gender difference<sup>15,16</sup> in the risk of having CVD events and the female participants were found to have some protection in their younger age group.<sup>16</sup> Similarly, an increasing trend in mortality was observed in the state accounting for 21% of deaths in 1990 and 36% in 2016 with a homogenous rise of 69% due to CVD.<sup>17</sup>

Some studies have assessed the prevalence of NCDs in Tamil Nadu,<sup>18–20</sup> but only a few studies assessed the prevalence of risk factors for NCDs,<sup>21,22</sup> especially for CVDs among male adults. Similarly, very few studies assessed the 10-year CVD event risk scores for individuals from Tamil Nadu.<sup>23,24</sup> In this study, we are assessing the prevalence of risk factors for CVD and the estimation of 10-year CVD event risk scores using the FHS 10-year CVD risk score calculation and the distribution of the score among male adults aged 18 years and above across all the districts of Tamil Nadu, India.

## 2. Methods

Data from National Family Health Survey-5 (NFHS-5)- a national, state/union territory, and district-level representative repeated cross-sectional survey, conducted between 2019 and 2021, has been used for the analysis. The survey is being conducted by the Ministry of Health and Family Welfare (MoHFW) and the Government of India and coordinated by the International Institute of Population Sciences (IIPS), Mumbai. The survey was conducted for 636,699 households in 28 states, and 8 union territories of India. A sample of 101,839 men was interviewed with a response rate of 92%. A detailed description of the sampling design and instruments used in the survey has been provided elsewhere.<sup>25</sup>

For the current study, datasets were extracted from Demography and Health Survey (DHS) program website. We included all the men from Tamil Nadu state who were in the age group 18 years and above. A total of 3372 men were interviewed with a response rate of 94.9%. We excluded participants for the particular analysis when data were missing for the same. A total of 2469 male participants were included at the end of the study after inclusion and exclusion.

The risk factors for cardiovascular diseases were of three types namely sociodemographic risk factors, behavioral risk factors, and physiological/biochemical measurements. Sociodemographic risk factors included the age of the participant, education status (stratified based on WHO STEPS instrument guidelines) occupational status (categorized according to the modified Kuppuswamy scale), and Wealth index (categorized as per NFHS-5 categorization). Behavioral risk factors included current tobacco smoking, use of smokeless tobacco, current alcohol usage, green leafy vegetable intake, and fruit intake stratified based on WHO STEPS instrument guidelines. Physiological/biochemical measurements included abdominal obesity, (measured in terms of waist circumference will be defined as greater than or equal to 90 cm in males), hypertension (Participants with systolic blood pressure  $\geq 140$  mm of Hg or diastolic blood pressure  $\geq 90$  mm of Hg or on medication, were considered to have hypertension), diabetes (random sugar  $143 \geq$  mg% or on medication) and BMI (based on WHO classification).

We calculated FHS 10-year CVD risk scores based on the BMI-based simple office non-laboratory predictors model as the NFHS-5 data doesn't have the details on lipid profile and

were categorized into four groups according to the 10-year risk of cardiovascular event, as per WHO guidelines<sup>26</sup>:

<10%, 10% to <20%, 20% to <30%,  $\geq 30\%$ .

We estimated the results for urban and rural sites separately. FHS 10-year CVD scores were categorized into two as having a relatively high FHS 10-year CVD risk score (FHS-CVD 10-year risk score  $\geq 20$ ) and not, for identifying factors associated with a high FHS 10-year CVD risk score/statin recommendation. There are various guidelines<sup>27,28</sup> for the statin recommendation, for this analysis we used the WHO package of essential noncommunicable (PEN) disease interventions for primary health care 2020<sup>28</sup>

### 2.1. Data analysis

Framingham risk score was used to estimate the 10-year CVD risk of each individual and will be calculated based on (BMI-based simple office-based non-laboratory predictors) published standard algorithm<sup>11</sup>

The general formula used to estimate the Framingham heart study 10-year CVD risk score ( $\bar{P}$ ).

$$\bar{P} = 1 - S_0(t)^{\exp\left(\sum_{i=1}^p \beta_i X_i - \sum_{i=1}^p \beta_i \bar{X}_i\right)}$$

where  $\beta_i$  is the beta-coefficient for each  $i$ th risk factor and  $S_0$  is the CVD event-free survival which is 0.88431 for the simple office-based Framingham risk score model at a 10-year follow-up obtained from the 2008 Framingham study for men.  $X_i$  is the log-transformed  $i$ th risk factor for the individuals in the data set, whereas  $\bar{X}_i$  is the mean log-transformed  $i$ th risk factor value from the Framingham study, and  $p$  denotes the number of risk factors.

Categorical variables were presented as proportions or percentages. The Association of risk factors other than that used in the FHS 10-year CVD risk score calculation with a relatively higher risk of CVD was estimated using crude odds ratios with a 95% Confidence Interval (CI) and  $p$  values significant at  $< 0.05$  level. Multiple logistic regression analyses were performed to study the association between the risk factors after adjusting for confounding factors with the same level of significance. STATA version 16.0 (StataCorp LLC, College Station, TX, USA) was used for all analysis, and adjustments for sampling weight, clustering, and strata were done using the `svyset` command.

### 3. Results

The background characteristics of the participants from rural and urban areas of Tamil Nadu are given in Table 1. There was a total of 2469 male participants, of which 1295 (51.88%) were from rural areas whereas 1174 (47.04%) were from urban areas. Most of the participants were in the age group 30–44 in both rural (44.37%) and urban areas (42.29). Most participants were Hindus (92.58%), had an education in secondary school (50.95%), and were skilled and unskilled manual labour (38.63%). A similar distribution of participants was observed in different categories of wealth Index.

The prevalence of behavioural risk factors and physiological measurements is given in Table 2. Most of the participants consumed fruits (1222/2469 (49.49%)) and leafy vegetables once weekly (1211/2469 (49.05%)). Around 19% (460/2469) of the participants were current smokers and 7.26% (179/2469) participants are currently using smokeless tobacco. A higher prevalence of alcohol consumption was observed among the rural male population than in urban (41.28% (535/1295) in rural areas and 30.46% (358/1175) in urban areas) with a total prevalence of 36.14% (892/2469). The age-stratified prevalence of current smokers shows that the majority (42.18%) of the current smokers were above 45 years of age from the rural area and urban areas majority of the smokers (54.07%) were in the age group 30–44 years. Similarly, the majority of the alcoholics were in the age group 30–44 years in both rural (47.06%) and urban areas (53.09%). Supplementary Table 1. When the different physiological measurements were compared, 40.2% (945/2361) of the male adults have a waist circumference greater than or equal to 90 cm. Most of the participants were obese (38.44%) followed by normal weight (32.57%) when different categories of BMI were compared. Among the participants, 27.12% (635/2341) were hypertensive or on medication for hypertension and 15.86% (366/2310) had diabetes mellitus or were under

medication for diabetes mellitus. Of all the participants 92.7% (2289/2469) of the participants had all the data required for the FHS 10-year CVD risk score calculation. Further analysis was carried out only for those who had an FHS 10-year CVD risk score calculated.

The percentage of participants classified into various WHO cardiovascular risk categories is shown in Table 3. The majority (81%) of the total participants had a 10-year CVD risk score of less than 10% and very few (1.12%) had a 10-year CVD risk score greater than 30%. Out of the total participants, around 4% (94/2506) of participants require statin treatment of which 56.38% (53/94) were from a rural area and 43.62% (41/94) were from an urban area. The majority of the male adults requiring statin were above the age group 45 years in both rural (52/53, 98.59%) and urban (38/41, 92.74%) areas whereas were poorest in rural areas (19/53, 35.74%) and contrast to this were richest in urban areas (18/42, 43.37%). A detailed description of the background characteristics of participants requiring statin and not requiring was given in Table 4.

When different districts in Tamil Nadu were compared for WHO cardiovascular risk categories and statin recommendations based on 10-year FRS CVD risk scores as shown in Fig. 1, Pudukkottai (10.36%), Karur (8.85%), Erode (9.28%) and Ariyalur (9.10%) districts showed a higher proportion of participants in higher risk category (risk above 20%) for whom statin was advised. Similarly, Madurai (89.05%) and Tiruvannamalai (88.15%) districts had a higher proportion of participants in lower risk categories (risk score less than 10%) of 10-year risk scores.

Multivariable analysis with factors not involved in the calculation of the Framingham risk score showed that having an education less than in higher schools (aOR:14.21, 95%CI: 4.36–46.22, *p*-value <0.001 for no education), fruit intake (aOR:0.51, 95%CI:0.27–0.97, *p*-value = 0.042), and abdominal obesity (aOR:2.43, 95% CI:1.58–3.74, *p*-value <0.001) were found to be significantly

**Table 1**  
Background characteristics of male adults aged 18 years and above from Tamil Nadu, India (*n* = 2469).

Characteristics	Rural N (%)	Urban N (%)	Total
<b>Age of the participant (in years)</b>			
18–29	414 (31.99)	385 (32.80)	799 (32.37)
30–44	575 (44.37)	496 (42.29)	1071 (43.38)
45–59	306 (23.64)	293 (24.92)	599 (24.25)
<b>Religion</b>			
Hindu	1235 (95.38)	1051 (89.49)	2286 (92.58)
Muslim	32 (2.45)	55 (4.73)	87 (3.54)
Christian	28 (2.17)	66 (5.61)	94 (3.80)
Jain	–	2 (0.16)	2 (0.08)
<b>Education</b>			
No formal schooling	88 (6.77)	51 (4.38)	139 (5.64)
Primary School (1–7)	180 (13.94)	118 (10.04)	298 (12.08)
Secondary School (8–10)	691 (53.34)	567 (48.31)	1258 (50.95)
Higher school (above 10)	336 (25.95)	438 (37.27)	774 (31.33)
<b>Occupation<sup>a</sup></b>			
Professional	98 (7.56)	194 (16.51)	292 (11.82)
Clerical	18 (1.42)	33 (2.81)	51 (2.08)
Sales	91 (7.07)	145 (12.37)	237 (9.60)
Service/household/domestic	99 (7.63)	106 (9.04)	205 (8.30)
Skilled and unskilled manual labour	487 (39.63)	4 (37.72)	953 (38.63)
Unemployed	114 (8.84)	127 (10.85)	241 (9.79)
Agricultural	361 (27.91)	83 (7.06)	444 (17.98)
Others	24 (1.86)	20 (1.73)	44 (1.79)
<b>Wealth index</b>			
Poorest	327 (25.23)	78 (6.68)	405 (16.41)
Poorer	391 (30.17)	149 (12.67)	540 (21.85)
Middle	264 (20.40)	234 (19.89)	498 (20.16)
Richer	212 (16.43)	304 (25.88)	516 (20.92)
Richest	101 (7.77)	409 (34.87)	510 (20.66)

<sup>a</sup> Data were not available for two participants.

**Table 2**  
Behavioural and physiological risk factors of cardiovascular diseases among male adults aged 18 years and above from Tamil Nadu, India.

Characteristics	Rural N (%)	Urban N (%)	Total <sup>a</sup>
<b>Behavioural risk factors</b>			
<b>Leafy vegetable intake</b>			
Never	6 (0.44)	8 (0.72)	14 (0.57)
Daily	550 (42.46)	523 (44.56)	1073 (43.46)
Weekly	661 (51.06)	550 (46.84)	1211 (49.05)
Occasionally	78 (6.04)	92 (7.88)	171 (6.92)
<b>Fruit intake</b>			
Never	8 (0.57)	7 (0.62)	15 (0.59)
Daily	181 (14.01)	271 (23.09)	452 (18.33)
Weekly	620 (47.89)	602 (51.25)	1222 (49.49)
Occasionally	486 (37.53)	294 (25.03)	780 (31.59)
<b>Smoking status</b>			
Smokers	245 (18.93)	215 (18.29)	460 (18.63)
Never smokers	1050 (81.07)	959 (81.71)	2009 (81.37)
<b>Smokeless tobacco usage</b>			
Users	115 (8.90)	64 (5.46)	179 (7.26)
Never users	1180 (91.10)	1110 (94.54)	2290 (92.74)
<b>Alcohol usage</b>			
Ever uses	534 (41.28)	358 (30.46)	892 (36.14)
Never uses	761 (58.72)	816 (69.54)	1577 (63.86)
<b>Physiological measurements</b>			
<b>Abdominal obesity</b> (waist circumference $\geq 90$ cm)			
Yes	409 (32.48)	536 (48.86)	945 (40.02)
No	851 (67.52)	565 (51.34)	1416 (59.98)
<b>BMI</b>			
<18.5 (underweight)	147 (11.37)	167 (14.26)	314 (12.74)
18.5–22.9 (normal)	511 (39.54)	292 (24.89)	804 (32.57)
23–24.9 (overweight)	199 (15.40)	202 (17.18)	401 (16.25)
$\geq 25$ (obese)	436 (33.69)	512 (43.67)	948 (38.44)
<b>Hypertension status</b> (SBP $\geq 140$ and/or DBP $\geq 90$ mmHg or currently on medication for raised BP)			
Yes	338 (26.82)	297 (27.46)	635 (27.12)
No	921 (73.18)	785 (72.54)	1706 (72.88)
<b>Diabetic status</b> (Random blood glucose level $\geq 143$ or currently on medication for raised blood glucose level)			
Yes	179 (14.42)	187 (17.53)	366 (15.86)
No	1062 (85.58)	882 (82.47)	1944 (84.14)

<sup>a</sup> Total n varies as the data were missing for some of the participants.

**Table 3**  
Distribution of 10-year FHS 10-year CVD risk score categories for male adults aged 18 years and above from Tamil Nadu, India (n = 2289).

FRS category	Rural No (%)	Urban No (%)	Total
<10	1010 (81.86)	845 (80.15)	1855 (81.07)
10–19.9	171 (13.85)	169 (16.00)	340 (14.84)
20–29.9	43 (3.46)	25 (2.38)	68 (2.96)
$\geq 30$	10 (0.83)	16 (1.47)	26 (1.12)

associated with a relatively higher risk of 10-year CVD risk score after adjusting for all other variables as given in Table 5.

#### 4. Discussion

In this study, we calculated the prevalence of risk factors and 10-year CVD Framingham risk score (BMI-based simple office-based non-laboratory predictors) among male adult participants interviewed in NFHS-5 from Tamil Nadu state in India. For calculating the FRS risk score we used the  $\beta$  coefficients and survival rates from the Framingham heart study.

When the prevalence of major risk factors for CVD was estimated, our study found that the prevalence of smoking was 18.63% and alcohol consumption was 36.14%. According to the GATS-2 report in India, 19.0% of all adult men smokes tobacco<sup>29</sup> which is

in concordance with our study findings and the national average for alcohol consumption among male was 29.2% which is quite lesser than the estimates from our study. Similarly in a study from urban areas of Tamil Nadu, the prevalence of alcohol consumption was found to be 39%<sup>30</sup> and 21.1% of all adult men from Tamil Nadu smoke tobacco.<sup>31</sup> As per NFHS-4 data, the overall prevalence of hypertension among male adults was 16.32% whereas, our study estimated a higher prevalence of 27.12%. The overall prevalence of diabetes among male adults from Tamil Nadu from our study was 15.86%, however, Indian estimates show an age-adjusted prevalence of 10.4%.<sup>32</sup> In India, the crude prevalence of overweight adults was 19.6%,<sup>33</sup> while our study's estimations of 38.44% were much higher.

A similar study conducted across different geographical regions in India found that the CVD risk was high in North, northeast and South India with a mean CVD risk score varying between 13.2% in Jharkhand to 19.5% in Kerala.<sup>34</sup> WHO recommends treatment with statins when the individual is having a CVD risk score  $\geq 20$ .<sup>35</sup> From our study statin was recommended for ~4.0% of the participants of which 56% were from the rural area of Tamil Nadu. According to a non-concurrent cohort research conducted in rural Tamil Nadu,<sup>36</sup> 18.44% of the male participants were eligible to use statins, which is significantly more than what our study predicted. The possible reason for this can be the low prevalence of smoking reported. Similarly, a study conducted in Delhi<sup>37</sup> also found that 16% of the male participants were eligible for a statin. A study from rural Tamil Nadu<sup>24</sup> irrespective of gender found that 9.2% of the participants were above 20% risk and in contrast to this a similar study<sup>23</sup> from the same area found that only 2.5% of the participants were above 20% risk when 10-year CVD risk scores were calculated using WHO/ISH risk prediction charts.

From a study conducted in Brazilian population found that 18.9% of the participants had a higher CVD risk ( $\geq 10$ ) which was higher than values estimated among male population from our study. They also found that male and older age group ( $\geq 45$  years) had significantly higher risk of CVD.<sup>38</sup> A study conducted in Saudi Arabia to identify the factors associated with high/intermediate risk of CVD (FRS  $\geq 10$ ) found that education levels of intermediate and below (aOR: 3.49) and central obesity (aOR:2.38) were associated with high/intermediate risk of CVD when adjusted for other variables not included in FRS risk score calculation which is in agreement with the factors identified from our study.<sup>39</sup>

Our study used the recent, largest, and most representative data available at a national level. We tried to include most of the sociodemographic, behavioural, physiological, and biochemical measurements for estimating the prevalence of risk factors for CVD. We also estimated the Framingham risk score for all the male adults from Tamil Nadu for whom data is available for the risk factors included in its calculation and it gives insight into the preventive and control measures for CVD in the upcoming decade. However, one of the limitations of this study is that we were not able to estimate the prevalence of other behavioural risk factors like physical activity measurement and dietary patterns as the data were not available. We were also not able to estimate the lipid based Framingham risk scores as those values were not available and hence we used a Simple office-based model with BMI values for 10-year CVD risk estimation which can alter the risk scores estimated, but the comparative study conducted in Vellore<sup>36</sup> has shown that there will not be much difference in median risk scores when the lipid based Primary model or BMI-based Simple office-based model is used for the risk score calculation. Similarly, the risk score that we estimated was based on the equation derived from the Framingham heart study conducted among the white population in the USA, the selection of appropriate risk scores for the Indian population is still a controversy as different studies have different observation on the

**Table 4**  
Background characteristics of male adults aged 18 years and above with and without statin recommendations from Tamil Nadu, India (n = 2289).

Characteristics	Rural		Urban	
	Statin recommended n (%)	Statin not recommended n (%)	Statin recommended n (%)	Statin not recommended n (%)
<b>Age of the participant</b>				
18–29	–	397 (33.58)	–	349 (34.39)
30–44	1 (1.41)	544 (46.06)	3 (7.26)	446 (43.96)
45–59	52 (98.59)	240 (20.36)	38 (92.74)	220 (21.65)
<b>Religion</b>				
Hindu	50 (94.77)	1126 (95.39)	37 (91.49)	924 (91.11)
Muslim	0	30 (2.56)	2 (5.35)	37 (3.63)
Christian	3 (5.23)	24 (2.05)	1 (3.16)	53 (5.26)
<b>Education</b>				
No formal schooling	15 (29.04)	67 (5.71)	3 (7.15)	43 (4.27)
Primary School (1–7)	7 (12.44)	168 (14.22)	7 (17.31)	104 (10.26)
Secondary School (8–10)	26 (50.12)	631 (53.48)	28 (68.86)	477 (47.04)
Higher school (above 10)	4 (8.41)	314 (26.6)	3 (6.69)	390 (38.43)
<b>Occupation</b>				
Professional	3 (5.66)	90 (7.62)	4 (10.00)	163 (16.11)
Clerical	–	16 (1.35)	2 (5.0)	30 (2.97)
Sales	2 (3.77)	85 (7.21)	5 (12.50)	122 (12.13)
Service/household/domestic	6 (11.32)	89 (7.53)	3 (7.5–)	91 (8.98)
Skilled and unskilled manual labour	26 (49.06)	436 (37.02)	19 (47.50)	408 (40.2)
Unemployed	1 (1.89)	110 (9.38)	–	109 (10.72)
Agricultural	14 (26.42)	329 (27.89)	7 (17.5)	70 (6.93)
Others	1 (1.89)	24 (2.00)	–	20 (1.97)
<b>Wealth index</b>				
Poorest	19 (35.74)	286 (24.21)	3 (7.71)	75 (7.39)
Poorer	11 (20.00)	369 (31.27)	4 (8.69)	130 (12.84)
Middle	8 (15.35)	247 (20.91)	10 (23.74)	198 (19.54)
Richer	11 (20.58)	186 (15.8)	7 (16.49)	274 (27.02)
Richest	4(8.33)	92 (7.81)	18 (43.37)	337 (33.21)

**Table 5**  
Factors associated with relatively higher FHS 10-year CVD risk scores among male adults aged 18 years and above from Tamil Nadu, India (n = 2289).

Characteristics	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	p-value
<b>Type of residence</b>			
Urban	Ref	Ref	Ref
Rural	1.12 (0.66–1.89)	1.22 (0.74–2.03)	0.420
<b>Religion</b>			
Hindu	Ref	Ref	Ref
Muslim	0.76 (0.11–5.47)	0.96 (0.15–5.95)	0.964
Christian	1.23 (0.48–3.16)	1.53 (0.53–4.38)	0.423
<b>Education</b>			
No formal schooling	16.21 (3.45–76.17)	14.21 (4.36–46.22)	<0.001 <sup>a</sup>
Primary School (1–7)	4.91 (2.05–11.80)	4.86 (1.92–12.28)	<0.001 <sup>a</sup>
Secondary School (8–10)	4.83 (2.12–11.00)	4.35 (1.92–9.80)	<0.001 <sup>a</sup>
Higher school (above 10)	Ref	Ref	Ref
<b>Occupation</b>			
Employed	7.74 (2.69–22.30)	2.89 (0.96–8.71)	0.060
Unemployed	Ref	Ref	Ref
<b>Wealth index</b>			
Poor	Ref	Ref	Ref
Middle	0.48 (0.14–1.59)	0.61 (0.28–1.35)	0.691
Rich	1.72 (0.24–2.18)	1.28 (0.63–2.62)	0.495
<b>Fruit intake</b>			
Daily	Ref	Ref	Ref
Weekly	0.64 (0.35–1.17)	0.51 (0.27–0.97)	0.042 <sup>a</sup>
Others	1.04 (0.46–2.63)	0.84 (0.42–1.68)	0.624
<b>Leafy vegetable intake</b>			
Daily	Ref	Ref	Ref
Weekly	0.87 (0.52–1.45)	0.94 (0.58–1.53)	0.809
Others	0.51 (0.19–1.29)	0.55 (0.21–1.46)	0.233
<b>Smokeless tobacco usage</b>			
Current users	3.03 (0.73–12.54)	1.92 (0.63–5.79)	0.247
Never	Ref	Ref	Ref
<b>Alcohol usage</b>			
Ever users	1.93 (1.14–3.25)	1.43 (0.94–2.17)	0.093
Never users	Ref	Ref	Ref
<b>Abdominal obesity</b>			
Yes	2.11 (1.15–3.88)	2.43 (1.58–3.74)	<0.001 <sup>a</sup>
No	Ref	Ref	Ref

<sup>a</sup> Statistically significant.

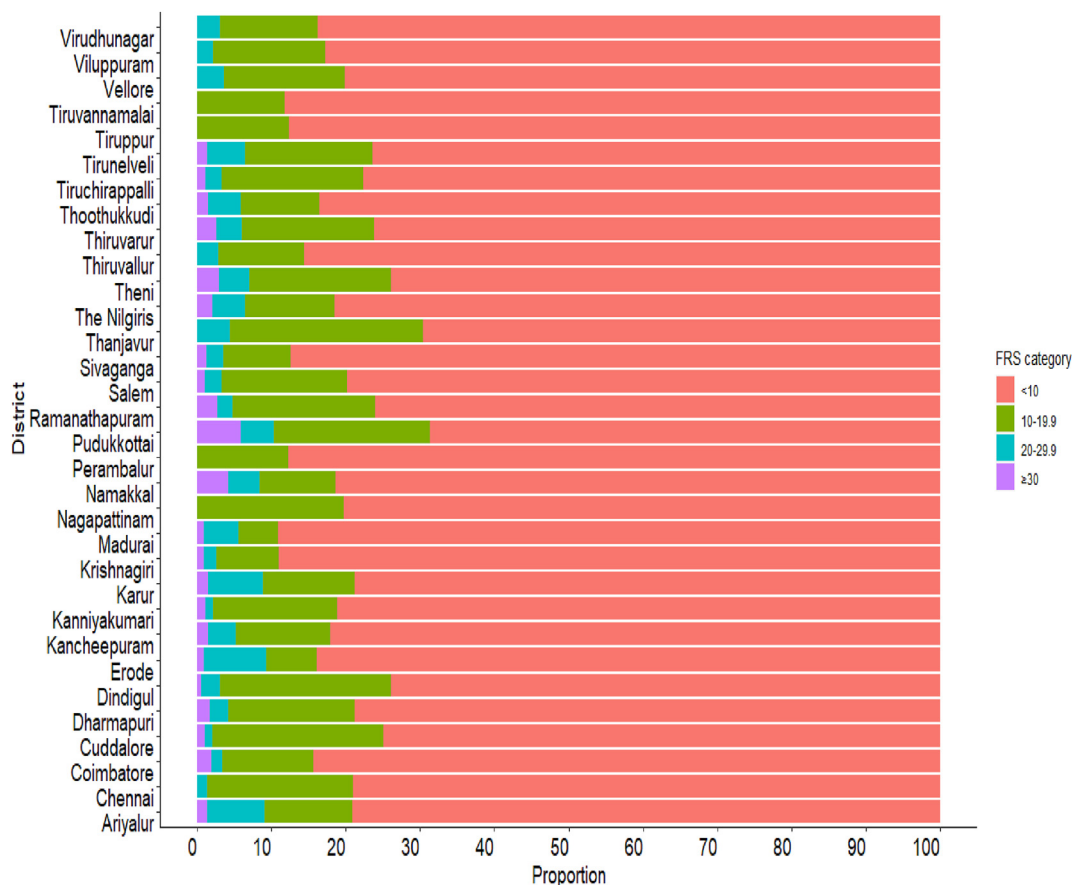


Fig. 1. Comparison of proportions of male adults aged 18 years and above in different categories of 10-year FHS 10-year CVD risk score in different districts of Tamil Nadu, India (n = 2289).

actual risk of the participant hence the ideal way to estimate the most appropriate risk is to use the recalibrated Framingham equations derived from the Indian population or to use an original risk equation estimated from a cohort of Indian population. Moreover, the Framingham risk score algorithm designed for the calculation of 10-year risk of CVD is advisable for participants within the age group of 30–74 years who were free from CVD at baseline, as our analysis involved participants with age less than 30 years it is advisable to use life time risk instead of 10 year risk as it may mislead their actual risk. Additionally, due to the lack of data we also assumed that the participants included in the analysis were initially free from CVD.

**5. Conclusion**

As the world is experiencing an epidemiological transition from communicable diseases to non-communicable diseases, the widespread use of simple and economic methods for estimating the risk has to be encouraged for preventive and control measures of risk factors.

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**Ethical consideration**

"The study was ethically approved by the Institute's Ethical Committee, Postgraduate Institute of Medical Education and

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**Declaration of Competing interest**

The authors have no conflicts of interest to declare.

**Appendix A. Supplementary data**

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ihj.2023.06.003>.

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