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Cardiovascular Disease Risk Profile and Risk Prediction Among Unskilled Workers of a Tertiary Care Teaching Hospital

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ABSTRACT

Background: The prevalence of CVD risk factors in India is steadily increasing moreover CVD in Indians has been shown to occur prematurely. The study was designed to estimate the 10-year cardiovascular risk using region specific WHO/ISH risk prediction chart among unskilled workers of a tertiary care teaching hospital and to determine factors associated with risk.

Material and methods: This was a hospital based cross sectional study conducted among 250 workers selected by simple random sampling. Using structured questionnaire, life style related risk factors namely, average daily consumption of fruits and vegetables, physical activity, perceived stress, tobacco and alcohol use was collected. BMI and BP were measured using standard protocol and classified following standard guidelines. Bio-chemical parameters were also measured.

Results: Among 250 workers, 37.2% and 10% consumed daily minimal recommended level of vegetables and fruits respectively, 21.1% was current tobacco user, 17.2% was alcohol drinkers, 50.4% were obese, 18.8% had high blood pressure and 6% had elevated cholesterol. Among the workers 46.7 % had <10% risk, 5.3% had 10% to <20% risk and, 3.3% had 20% to <30% risk to develop CVD within future 10 years of lifetime. Drivers and current alcoholics were associated with being in the high-risk group.

Conclusion: Employer initiated regular work place health screening and services need to be aimed at the unskilled workers, especially for CVD targeting drivers and alcoholics.

Keywords: cardio-vascular risk, drivers, prediction, screening, unskilled workers

INTRODUCTION

Cardiovascular disease (CVD) including heart attack and stroke is the single largest cause for mortality and morbidity in the world. It claims 17.5 million lives a year globally.[1] The overall burden continues to grow in both developed and developing countries with an increasing toll in low- and middle-income countries. The epidemic of cardiovascular disease in India is progressing rapidly.[2] The Global Burden of Disease study estimated that the age-standardized CVD death rate in India to be 272 per lakh population which is higher than the global average of 235 per lakh population.[3] Additionally, CVD in Indians has been shown to occur prematurely. Demographic and health transitions, industrialization, unhealthy life styles are the likely causes of increased CVD burden in India. The prevalence of CVD risk factors in India is steadily increasing and this was evident from the results of the nationally representative studies done namely the Indian Council of Medical Research, INdiaDIABetes (ICMR-INDIAB) study,[4] the WHO-ICMR six-site survey and Integrated Disease Surveillance Project (IDSP) risk factor survey done in Tamil Nadu.[5]

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We need effective and feasible approaches to prevent people from getting CVDs. The CVD risk prediction charts are useful tools to identify various levels of risk to develop cardiovascular disease (both fatal and non-fatal) during the 10-year period of life. This helps the service provider to develop risk specific interventions to modify their life style related risky behaviors and also to motivate patients for follow up. It importantly assists the physician to select appropriate drugs namely ant-diabetic, antihypertensive, lipid-lowering drugs and aspirin. Unskilled workers form a part of marginalized sector of the community. By virtue of their lower socio-economic status, lack of health awareness, and high mechanical workload, their health care seeking behavior is compromised and could be at higher chances of unhealthy life style behaviors like tobacco and alcohol consumption. Screening for Non-Communicable Diseases (NCD) risk factors and predicting their CVD risk helps them to improve their health care attention. Hence the present study was designed with the objectives to identify the cardiovascular risk factors among unskilled workers of a tertiary care teaching hospital using the World Health Organization-STEPS method, to estimate the 10-year cardiovascular risk using region specific WHO/ISH (International Society of Hypertension) risk prediction chart among them and to determine the association between risk factors and CVD risk stratification.

MATERIALS AND METHOD

Study design and study setting: It was a workplace (hospital) based cross sectional study. The study was carried out in the department of Community Medicine, in a tertiary care teaching hospital located in Villupuram-Puducherry highway. The data collection on risk factors of CVD and risk prediction was completed in two months period (August 2019 and September 2019).

Study participants, sample size and sampling: Unskilled workers (sweepers, peons, drivers, security guards, laboratory and hospital attendant) of both genders working in the hospital block and college campus of a tertiary care teaching hospital in Puducherry were the study participants. It was calculated to be 250 using OpenEpi software version 3.0 taking into consideration the least prevalent risk factor for CVD that is 24% Diabetes based on a previous study done in Tamil Nadu,[6] with 5% absolute precision and 95% confidence interval and 10% non-response rate. Simple random sampling was adopted to select the study participants from the available name list at Human Resource Department that served as sampling frame.

Data collection procedure: The study was carried out after obtaining clearance from the Institute Research Committee and Institute Ethics Committee (EC/26/2019 dated 05/06/2019). Written informed consent was obtained from all study participants after introducing the purpose of the study. Information on study variables was collected using a predesigned pilot tested structured questionnaire (modified WHO STEPS questionnaire).[7] The principal investigator was involved in data collection procedure after getting trained by the guide. The study participants were given the filled in laboratory forms at the end of interview and were asked to check their fasting and two hour post prandial blood sugar and also the fasting blood cholesterol levels at the central research laboratory. They were reminded over mobile phone by the investigator if they fail to give blood samples. If the test results were high, they were advised to consult General Medicine OPD for further management. The duplicate reports were collected by the investigator. The costs for these tests were borne by the researcher for all participants. The following risk factors, measurements and bio-chemical parameters were collected from the participants.

Definitions and methods

Average daily consumption of fruits and vegetables was obtained in terms of number of portions (one portion=100 g) consumed per day and was classified into normal (≥300 g of vegetables and ≥100 g of fruits) and low consumption based on National Nutrition Guidelines.[8] Frequency and duration of moderate to vigorous physical activity during a typical week, for at least 10 minutes continuously to get to and from places (This includes at work, at home, walking to travel from place to place, any other walking that you have done solely for recreation, sport, exercise, or leisure) was used to classify the physical activity. The minimally recommended level of physical activity by WHO, is one should do at least 150 minutes of moderate-intensity physical activity throughout the week, or do at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.[9] Those who were doing either the minimum recommended level or above were classified under adequate category of physical activity and others as inadequate.

Stress was assessed and classified into low, medium and high based on 10 item Perceived Stress Scale.[10] Participants were divided into never user, past user and current user of smokeless and smoke form of tobacco based on standard definitions of GATS survey.[11] Height of the participant was measured using inch tape and digital bathroom weighing scale was used to measure the weight as per standard protocol.[12] Blood pressure was measured using digital sphygmomanometer (OMRON HEM-7111) at three occasions and the average of the three was noted. The calculated mean blood pressure was used to classify their hypertension status based on updated JNC 8 guidelines.[13] Fasting and two hour post prandial blood sugar and fasting total cholesterol was estimated at the central Biochemistry laboratory.

The WHO epidemiological sub-region-specific WHO/ISH (International Society of Hypertension) risk prediction chart was used to estimate 10-year

risk of a fatal or non-fatal major cardiovascular event (myocardial infarction or stroke) according to age, sex, blood pressure, smoking status, total blood cholesterol and presence or absence of diabetes mellitus.[14] The participants were informed about the risk to develop CVD in future. They were educated about the complications and life style modifications.

Statistical analysis: Data was entered in EpiData Manager Software (version 4.2, EpiData Association, Odense, Denmark). SPSS statistical package version 24 (SPSS Inc, Chicago, IL) was used for data analysis. Categorical variables were described in frequency and percentage. Numerical variables were summarized using mean (standard deviation) or median (interquartile range) based on the distribution. Predicted CVD risks were reported in percentage with its 95% confidence interval. Simple binary logistic regression was carried out to find out the unadjusted odd's ratio, a measure of strength of association between various independent CVD risk factors (socio-demographic and life style related that were not included in the risk prediction using WHO/ISH chart) and predicted CVD risk group. Adjusted analysis was performed with those variables that were significantly ($p<0.10$) associated with unadjusted analysis. All statistical tests used were two tailed and p value <0.05 was considered to be statistically significant.

RESULTS

Out of 250 unskilled workers, majority (51.6%) was in the age group of 40-59 years, 44.8% of them belong to 20-39 years group and only 3.6% of them were ≥ 60 years. Females (57.6%) were slightly more than male (42.4%) participants. Majority (60%) of them studied up to 10th standard. 16.4% of them had no formal school education. Of them 99 (39.6%) worked in housekeeping and laundry section, 26 (10.4%) were drivers, 52 (20.8%) were ward attenders, 44 (17.6%) were maintenance workers and 11.6% of them were employed under various jobs namely security staff, electrical workers and hospital canteen maids. Most of them (40.4%) earned 3000-5999 INR per month and 26% earned ≥ 10,000 INR per month. Most of them (92%) were currently married and 13 (5.2%) were unmarried. Most (96.4%) of them were Hindu by religion, eight were Muslims and only one Christian **(Table-1).**

Most (96.8%) of the workers consumed mixed diet and only 3.2% were vegetarians. Of them 37.2% consumed the recommended vegetable intake of ≥ 3 portions per day and only 10% consumed the recommended fruit intake of ≥ 1 portions per day. Physical activity was adequately carried out by 13.2% of them only. As reported by them, currently 21.1% used tobacco in any form and 75.6% were non users of tobacco. Based on the response provided by them, 43 (17.2%) were current alcohol consumers, five (2%) were past drinkers and 202 (80.8%) were never consumers of alcoholic beverages. Among them 26.8% perceived that they had low levels of stress and 29.6% had high level of stress during the past one month of their life time. Majority (50.4%) was obese, 18.8% were overweight, 25.2% were normal and 5.6% were underweight based on BMI. Only 33.6% had normal blood pressure, 47.6% were pre-hypertensive, 12% were in stage-I and 6.8% in stage-II of hypertension. Most (67.6%) of them had normal cholesterol values, 26.4% had borderline and 6% had elevated cholesterol values. Already 8.8% of them were known diabetes mellitus patients, 10.4% was hypertensive and 1.6% was treated for cardiovascular diseases **(Table-2).**

Among them, 136 participants were eligible for 10-year risk prediction of a fatal or non-fatal major cardiovascular event (myocardial infarction or stroke), according to age, sex, blood pressure, smoking status, total blood cholesterol and presence or absence of diabetes mellitus using WHO/ISH risk prediction chart for Indian population (four were excluded as they had pre-existing CVD and others were of age <40 years). Based on this chart, 115 (46.7%) of the eligible participant had <10% risk, 13 (5.3%) had 10 to <20% risk, and 8 (3.3%) had 20 to <30% risk **(Figure-1).** For studying the association between various risk factors (socio-demographic and life style related) and the CVD risk group, those who had <10% risk and those who were <40 years were grouped as low risk category (n=225). Rest all (n=21) were included in high-risk category.

Table-1: Socio-demographic details of the study participants (N=250)

Characteristics	Participants (%)
Age category in years	
20-39	112 (44.8)
40-59	129 (51.6)
≥ 60	9 (3.6)
Gender	
Male	106 (42.4)
Female	144 (57.6)
Education	
No formal schooling	41 (16.4)
1st – 5th standard	31 (12.4)
6th – 10th standard	150 (60)
11th – 12th standard	28 (11.2)
Occupation	
Drivers	26 (10.4)
Ward attenders	52 (20.8)
Housekeeping and laundry	99 (39.6)
Maintenance workers	44 (17.6)
Others	29 (11.6)
Income in INR	
3000 – 5999	101 (40.4)
6000 – 9999	83 (33.2)
≥ 10,000	66 (26.4)
Marital status	
Unmarried	13 (5.2)
Married	230 (92)
Others	7 (2.8)
Religion	
Hindu	241 (96.4)
Muslim	8 (3.2)
Christian	1 (0.4)

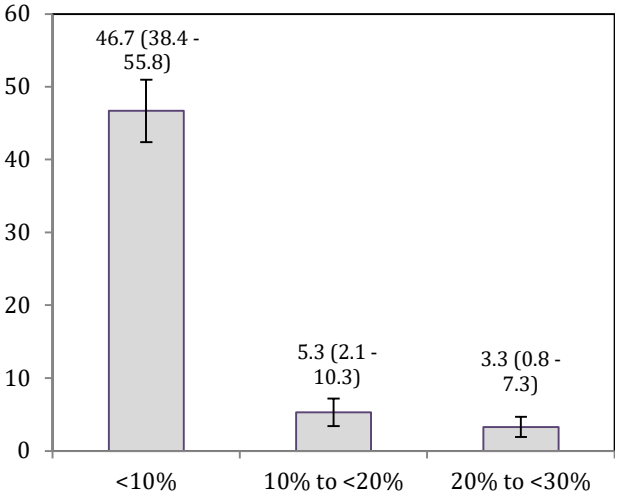
Table-2: Details of risk factors for CVD among the study participants (N=250).

Characteristics	Participants (%)
Diet	
Mixed	242 (96.8)
Vegetarian	8 (3.2)
Vegetable intake per day*	
Normal (≥ 3 portions)	93 (37.2)
Low (<3 portions)	157 (62.8)
Fruit intake per day*	
Normal (≥ 1 portion)	25 (10)
Low (< portion)	225 (90)
Physical activity	
Adequate	33 (13.2)
Inadequate	217 (86.8)
Tobacco usage (any form)	
Current user	53 (21.1)
Past user	8 (3.2)
Never user	189 (75.6)
Alcohol consumption	
Current user	43 (17.2)
Past user	5 (2)
Never user	202 (80.8)
Perceives stress	
Low	67 (26.8)
Medium	109 (43.6)
High	74 (29.6)
Body Mass Index (Kg/m^2)	
Underweight	14 (5.6)
Normal	63 (25.2)
Overweight	47 (18.8)
Obese	126 (50.4)
Stage of hypertension	
Prehypertension	119 (47.6)
Normal	84 (33.6)
Stage-I	30 (12)
Stage-II	17 (6.8)
Total cholesterol status	
Normal	169 (67.6)
Borderline	66 (26.4)
Elevated	15 (6)
Known co-morbidities	
Diabetes mellitus	22 (8.8)
Hypertension	26 (10.4)
Cardio-vascular disease	4 (1.6)

*One portion=100 grams

When compared to workers who studied up to 12th standard, others were at higher chance for being in the high-risk group but this finding was not statistically significant. Drivers had 10.5 (95% CI: 1.2 - 92) times higher chance for being in the high-risk group compared to others and this was statistically significant. Maintenance workers had lower chance to be in high-risk group but this was not significant. Compared to those who earn lesser monthly income, the higher salaried participants were at higher chance to be in high risk but were not significant. Muslims were 1.5 times (95% CI: 0.2 – 13.2) at higher chance to be in high risk than Hindus (p value 0.68).

Widows and divorced workers were 1.7 times at higher chance to be in high-risk group (95% CI: 0.2 – 14.8) than currently married but p value insignificant.



Note: Figures within parenthesis indicate the 95% confidence interval.

Figure-1: Details of 10-year risk of major cardio-vascular event (myocardial infarction or stroke), according to age, sex, blood pressure, smoking status, total blood cholesterol and presence or absence of diabetes mellitus for Indians using WHO/ISH risk prediction charts (N=136)

Recommended vegetable and fruit intakes per day, adequate physical activity, levels of stress were inversely associated with high-risk CVD group and these findings were not statistically significant. Compared to workers who had never drank alcoholic beverages, the current alcohol consumers were at 2.6 times significantly higher chance to be in high-risk group to develop CVD (95% CI: 1.1 – 7). Underweight workers had 1.1 times, overweight workers had 2.2 times and obese workers had 1.3 times higher chance to be in high-risk group compared to workers having normal BMI however this finding was not significant statistically **(Table-3).** In adjusted analysis occupation by drivers had significantly higher chance to be in high-risk group to develop CVD (95% CI: 1.1 - 84), p value 0.04.

DISCUSSION

In the present study 21.1% of the participants was current user of tobacco in any form, the recent nationwide survey conducted in India, fourth National Family Health Survey (NFHS) reported 31.7% of the adult men were current tobacco users and 2.2% among women in Tamil Nadu.[15] Global Adult Tobacco Survey reported that 28.6% of adults used tobacco in any form.[16] The prevalence of current tobacco use in the present study was slightly lower than the adult figure at national level report. The current study was done among unskilled workers of hospital whereas the national figures were related to all adults, this probably could be a reason for lesser prevalence as people who work in health care facility had more opportunity to be aware of ill effects of tobacco.

Table-3: Association between CVD risk stratification and socio-demographic and behavioral risk factors that are not used for risk prediction using WHO-ISH chart (N=246)

Characteristics	CVD risk stratification		Unadjusted OR (95% CI)	p value
	High risk (n=21)	Low risk (n=225)		
Education				
No formal schooling	3 (7.3)	38 (92.7)	2.1 (0.2 – 21)	0.52
1st – 5th standard	3 (10)	27 (90)	3 (0.3 – 30)	0.35
6th – 10th standard	14 (9.5)	133 (90.5)	2.8 (0.4 – 22)	0.32
11th – 12th standard	1 (3.6)	27 (96.4)	1 (Reference)	NA
Occupation				
Drivers	7 (28)	18 (72)	10.5 (1.2 – 92)	0.03*
Ward attenders	2 (3.9)	49 (96.1)	1.1 (0.1 – 12.7)	0.94
Housekeeping & laundry	10 (10.1)	89 (89.9)	3 (0.4 – 24.7)	0.30
Maintenance workers	1 (2.3)	42 (97.7)	0.6 (0.1 – 10.7)	0.75
Others	1 (3.6)	27 (96.4)	1 (Reference)	NA
Income in INR				
3000 – 5999	8 (8)	92 (92)	1 (Reference)	NA
6000 – 9999	7 (8.4)	76 (91.6)	1.1 (0.4 – 3)	0.91
≥ 10,000	6 (9.5)	57 (90.5)	1.2 (0.4 – 3.7)	0.74
Religion				
Hindu	20 (8.4)	217 (91.6)	1 (Reference)	NA
Muslim	1 (12.5)	7 (87.5)	1.5 (0.2 – 13.2)	0.68
Christian	0	1 (100)	NA	NA
Marital status				
Married	20 (8.8)	206 (91.2)	1 (Reference)	NA
Single	0	13 (100)	NA	NA
Others	1 (14.3)	6 (85.7)	1.7 (0.2 – 14.8)	0.62
Vegetable intake per day				
Normal (≥ 3 portions)	8 (8.8)	83 (91.2)	1 (Reference)	NA
Low (<3 portions)	13 (8.4)	142 (91.6)	0.95 (0.4 -2.4)	0.91
Fruit intake per day				
Normal (≥ 1 portion)	3 (12)	22 (88)	1 (Reference)	NA
Low (< portion)	18 (8.1)	203 (91.9)	0.65 (0.2 – 2.4)	0.51
Physical activity				
Adequate	3 (9.4)	29 (90.6)	1 (Reference)	NA
Inadequate	18 (8.4)	196 (91.6)	0.88 (0.25 – 3.2)	0.85
Perceived stress				
Low	8 (12.3)	57 (87.7)	1 (Reference)	NA
Medium	9 (8.3)	100 (91.7)	0.64 (0.23 – 1.7)	0.38
High	4 (5.6)	68 (94.4)	0.42 (0.12 – 1.5)	0.17
Alcohol usage				
Current	7 (16.7)	35 (83.3)	2.6 (1.1 – 7)	0.04*
Past	0	4 (100)	NA	NA
Never	14 (7)	186 (93)	1 (Reference)	NA
Body Mass Index (Kg/m^2)				
Underweight	1 (7.1)	13 (92.9)	1.1 (0.1 – 11)	0.91
Normal	4 (6.3)	59 (93.7)	1 (Reference)	NA
Overweight	6 (12.8)	41 (87.2)	2.2 (0.6 – 8.1)	0.26
Obese	10 (8.2)	112 (91.8)	1.3 (04 – 4.2)	0.69

Note: OR-Odds Ratio, CI-Confidence Interval, * statistically significant (p <0.05), NA-Not Applicable.

The other reason for less prevalence could be the tendency to give a socially desired response by the workers. Tobacco use is the single most common risk factor which kills more people through CVD related death. Hence tobacco control is essential for preventing and controlling deaths and disability caused by CVDs.

Our study found that 50.4% of the workers were obese; according to national ICMR-INDIAB study prevalence rate of obesity varies from 11.8% to 31.3%.[17] The prevalence of obesity was much higher than the national figure could be due to difference in classification of BMI followed and difference in profile of study participant. But it was similar to a study done in Puducherry, which showed 54% of hospital workers were obese and 64% among rural adults.[18,19] The prevalence of high obesity in study area needs further research for identification of factors responsible for it and for designing interventions to reduce obesity and deaths related to it.

In the current study 18.8% of the workers had stage-I and above grade of hypertension. NFHS showed age-adjusted hypertension was more in men (24.5%) than women (20.0%).[20] NFHS-4 result revealed 14.5% of men and 7.8% of women in Tamil Nadu and 12.6% men and 8.4% women in Puducherry had stage-I and above grade of hypertension.[15,21] This prevalence of hypertension in the current study was

slightly higher than the state level prevalence. Study done among central government employees in Puducherry showed the prevalence as 25.5% which was higher than the present study.[18] As a result of this study additionally 8.4% of workers were newly detected to have stage-I and above grade of hypertension. In spite of the fact that hypertension can be easily screened and detected; there was no earmarked screening program available in the study setting. Hence the study provides insight for the service providers to start special screening service to unskilled workers.

Drivers had significantly higher odds to be in high-risk group to develop CVD in the current study. This could be due to the fact that the prevalence of various risk factors like smoking, alcoholism, and hypertension were more among them. Few previous studies done among drivers showed high prevalence of smoking tobacco and alcohol usage by them. [22–24] Their nature of work and working hours, peer pressure and conducive social environment could be the reasons for increased prevalence of unhealthy behaviors.

Most of the unskilled workers are unaware that they are stressed and could be diseased. They do not have any formal training in risk identification, screening and de-stressing. They are usually not amenable to suggestions and deny they are at risk. Healthcare organizations must embrace their responsibility to build a risk-free working environment and an efficient system to screen for CVD among this high-risk group. Specific leadership behaviors and positive organizational cultures are required to improve their health status. There must be an institutional commitment to transparent communication, reducing administrative and regulatory burdens related to their health services. But onus remains on them to undergo preventive health checkups, engage in physical activity, and modify their individual health risk. Medical institutions should conduct periodic health checkups for their employees and provide exercise facilities near the work site.[25]

The strengths of this study were measuring comprehensive list of CVD risk factors including biochemical parameters, use of standard protocols for measuring risk factors, and selection of fairly representative sample of unskilled workers in the study setting. Other than understanding the prevalence of CVD risk factors, it helped in the identification of undetected hypertension, diabetes and elevated cholesterol levels of some of the participants. Limitations include self-reporting of behavior related risk factors, though this was minimized by ensuring adequate privacy and confidentiality of collected information.

CONCLUSION

The prevalence of various CVD related risk factors was high among the unskilled workers of the tertiary level health care facility, especially among drivers and alcoholics. The unskilled workers, risky and vulnerable section of population since employed in the tertiary health care facility, they have additional benefit for early detection, appropriate treatment, and regular follow up. Employer initiated regular work place health screening and medical care services need to be aimed at the unskilled workers, especially for CVD targeting drivers and alcoholics.

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REFERENCES

1. World Health Organization, Cardiovascular diseases [Internet]. SEARO [cited 2019 Jan 23];Available from: http://www.searo.who.int/india/topics/cardiovascular_diseases/en/
2. Dorairaj P, Panniyammakal J, Ambuj R. Cardiovascular Diseases in India. Circulation 2016;133(16):1605–20.
3. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet 2015;385(9963):117–71.
4. Anjana RM, Deepa M, Pradeepa R, Mahanta J, Narain K, Das HK, et al. Prevalence of diabetes and prediabetes in 15 states of India: results from the ICMR–INDIAB population-based cross-sectional study. Lancet Diabetes Endocrinol 2017;5(8):585–96.
5. Deepa M, Pradeepa R, Anjana R, Mohan V. Noncommunicable diseases risk factor surveillance: experience and challenge from India. Indian J Community Med Off Publ Indian Assoc Prev Soc Med 2011;36(Suppl 1):S50-56.
6. Oommen AM, Abraham VJ, George K, Jose VJ. Prevalence of risk factors for non-communicable diseases in rural & urban Tamil Nadu. Indian J Med Res 2016;144(3):460–71.
7. NCDs | STEPwise approach to surveillance (STEPS) [Internet]. WHO [cited 2019 Jan 23];Available from: http://www.who.int/ncds/surveillance/steps/en/
8. National Institute of Nutrition. Dietary Guidelines for Indians: A Manual. [Internet]. 2011 [cited 2017 May 28];Available from: http://ninindia.org/dietaryguidelinesforninwebsite.pdf
9. World Health Organisation. Physical Activity Recommendations [Internet]. [cited 2019 Oct 30];Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity
10. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983;24(4):385–96.
11. World Health Organisation. Global Tobacco Surveillance System (GTSS), Global Adult Tobacco Survey (GATS): Indicator

Guidelines: Definition and Syntax. [Internet]. 2009 [cited 2017 Dec 9];Available from: http://www.who.int/tobacco/surveillance/en_tfi_gats_indicator_guidelines.pdf

12. Centre for Disease Control. National Health and Nutrition Examination Survey (NHANES): Anthropometry Procedures Manual [Internet]. 2007 [cited 2016 Dec 31];Available from: https://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf
13. The JNC 8 Hypertension Guidelines: An In-Depth Guide [Internet]. AJMC [cited 2019 Jan 23];Available from: https://www.ajmc.com/journals/evidence-based-diabetes-management/2014/january-2014/the-jnc-8-hypertension-guidelines-an-in-depth-guide
14. WHO | Cardiovascular risk prediction charts [Internet]. WHO [cited 2019 Jan 23];Available from: https://www.who.int/cardiovascular_diseases/publications/Chart_predictions/en/
15. International Institute for Population Sciences. National Family Health Survey-4, State Fact Sheet: Tamil Nadu [Internet]. Mumbai: Available from: http://rchiips.org/NFHS/pdf/NFHS4/TN_FactSheet.pdf
16. World Health Organisation. Global Adult Tobacco Survey. Fact Sheet | India 2016-17 [Internet]. Available from: https://www.who.int/tobacco/surveillance/survey/gats/GATS_India_2016-17_FactSheet.pdf
17. Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. Diabetes Metab Syndr 2019;13(1):318–21.
18. Aswin K, Ghorpade AG, Kar SS, Kumar G. Cardiovascular Disease Risk Factor Profiling of Group C Employees in JIPMER, Puducherry. J Fam Med Prim Care 2014;3(3):255–9.
19. Venugopal V, Dongre AR, Saravanan S. Prevalence and determinants of metabolic syndrome among the rural adult population of Puducherry. Indian J Community Med 2019;44(1):21.
20. Gupta R, Ram CVS. Hypertension epidemiology in India: emerging aspects. Curr Opin Cardiol 2019;34(4):331–41.
21. International Institute for Population Sciences. National Family Health Survey-4, State Fact Sheet: Puducherry [Internet]. Mumbai: Available from: http://rchiips.org/Nfhs/FCTS/PY/PY_FactSheet_635_Puducherry.pdf
22. Shin SY, Lee CG, Song HS, Kim SH, Lee HS, Jung MS, et al. Cardiovascular Disease Risk of Bus Drivers in a City of Korea. Ann Occup Environ Med 2013;25:34.
23. Casmir EA, Amam CM, Obianuju BO, Tim PG, David AW, Oyewole AK, et al. Prevalence of cardiometabolic risk factors among professional male long–distance bus drivers in Lagos, south–west Nigeria: a cross–sectional study. Cardiovasc J Afr 2018;29(2):106–14.
24. Udayar S, Kumar R, Kumar P, Vairamuthu S, Thatuku S. Study of cardiovascular risk factors among transport drivers in rural areas of Andhra Pradesh. Ntl J of Community Med 2015;6(4):566–70.
25. Mohanty A, Kabi A, Mohanty AP. Health problems in healthcare workers: A review. J Fam Med Prim Care 2019;8(8):2568–72.