Original Article

DOI: 10.7860/JCDR/2024/68893.19404

Community Section

Risk Assessment for Non-Communicable Diseases among Adults of 18 to 29 Years Age in a Rural Area of Madurai District, Tamil Nadu, India: A Cross-sectional Study

A RA BOORNEMA[1], S VASUNDARA[2], M AARTHY[3]

ABSTRACT

Introduction: Non-Communicable Diseases (NCDs) are the leading cause of morbidity and mortality globally. In India, the Ministry of Health and Family Welfare reported a rise in mortality rates from 37% in 1990 to 61% in 2016. Additionally, the prevalence of diabetes mellitus and hypertension among young adults was higher than estimated. As the behavioural risk factors are mainly established in adolescence, screening at an earlier age becomes essential.

Aim: To estimate the risk for diabetes mellitus and hypertension among individuals aged 18-29 years and to assess the association between the risk factors and at-risk individuals.

Materials and Methods: A community-based cross-sectional study was conducted in the field practice area of Madurai Medical College, Madurai, Tamil Nadu, India, to estimate the risk for diabetes mellitus and hypertension among individuals aged 18-29 years. The National Health Mission (NHM) protocol was used for risk assessment, based on American Diabetic Association (ADA) and Joint National Committee (JNC) 8 guidelines. Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) 20.0 software.

Results: A total of 154 residents were included in the study. The mean age of the study participants was 24.64±4.70 years. Approximately 60% of the study participants were males and 40% were females. A total of 54% of the participants were married. Most subjects had completed high school (33.8%), followed by 28.6% who completed postgraduation. Disease categorisation revealed that 54 (35%) were non-diabetics, 89 (58%) were pre-diabetics, and 11 (7%) had diabetes mellitus. Similarly, 24 (16%) were non-hypertensive, 115 (75%) had high normal values, and 15 (9%) had probable stage I hypertension. A statistically significant association was observed between hypertension and educational level, alcoholism, Systolic Blood Pressure (SBP), and Diastolic Blood Pressure (DBP), whereas diabetes mellitus was not significantly associated with any variables. The probabilistic prediction for hypertension using the logistic regression model included alcoholism and SBP, which contributed to 25.6% of the variations in prediction hypertension.

Conclusion: The study results highlight a significant burden of undiagnosed cases of diabetes and hypertension in the community. This indicates the need for systematic screening, early lifestyle modifications, appropriate treatment, and regular follow-up for such individuals.

Keywords: Diabetes, Hypertension, Screening, Young adults

INTRODUCTION

India is experiencing a rapid transition with an increasing burden of NCDs in recent years [1]. NCDs are the leading cause of morbidity and mortality worldwide, with three-fourths of deaths occurring in low and middle-income countries like India. Between 1990 and 2016, the disease burden in India due to NCDs increased from 48% to 75% [2]. Diabetes and hypertension are among the most prevalent NCDs and major public health problems in India, with their prevalence rapidly increasing in both urban and rural populations. They are also risk factors for cardiovascular diseases, renal disorders, cataracts, and dementia in old age [3].

The global prevalence of diabetes mellitus for all age groups was around 2.8% in 2000 and is estimated to increase to 4.4% by 2030 [4]. India leads the world with the largest number of diabetic subjects, earning the title of the Diabetes Capital of the World [5]. The World Health Organisation (WHO) has estimated that by 2025, the global burden of hypertension will reach 1.56 billion, with an estimated increase of about 60% for India compared to data from 2000. The prevalence of hypertension is also increasing at rates of 30% in urban populations and 10% in rural populations [6].

The most concerning aspect of these diseases in India is the shift in the age of onset of diabetes to a younger age and its spread to rural areas in recent years [7]. Hence, the NHM, which provides an overarching umbrella encompassing existing NCD control programs under one roof, has emphasised screening young adults aged 18 to 29 years for diabetes and hypertension with a formulated protocol. The present study was conducted using the protocol developed by NHM (Tamilnadu) based on Standards of care in Diabetes proposed by the ADA and JNC 8 to estimate the risk for diabetes mellitus and hypertension among individuals aged 18-29 years [8,9]. Additionally, the study focuses on assessing the association between the risk factors and individuals at risk.

MATERIALS AND METHODS

This is an observational community-based cross-sectional study conducted among individuals aged 18-29 years in the field practice area of Madurai Medical College, Madurai, Tamil Nadu, India. Data collection was carried out from July 2023 to August 2023 for two months using a multistage sampling technique. Institutional Ethical Clearance was obtained from Madurai Medical College (Reg. No. ECR/1365/Inst/TN/2020 dated 11.11.2022), and written informed consent was obtained from the study participants.

Inclusion criteria: Those residents aged 18 to 29 years and were willing to participate were included in the study.

Exclusion criteria: Individuals who were known cases of diabetes mellitus and hypertension, pregnant and lactating women were excluded from the study.

Sample size calculation: The sample size was calculated based on the prevalence of hypertension as 10.9% [10]. The sample size for the present study was calculated with an absolute precision (D) of 5% and a confidence interval of 95%. After substituting in the formula $Z^{2*}PQ/D^2$, (Z=Standardised normal deviate at a 95% confidence interval, which is 1.96):

$$\text{Sample size} = \frac{3.84*10.9*89.1}{25}$$

The sample size obtained was 150. A total of 154 individuals were included in the study.

Procedure

A brief history was taken regarding socio-demographic details such as age, gender, residence, education, occupation, including contact details. Behavioural risk factors like smoking, alcohol consumption, and physical activity were determined based on the cut-offs recommended by STEP wise approach to NCD risk factor Surveillance (STEPS) guidelines by WHO [11]. Subsequently, a brief history regarding the current use of tobacco (smoke and smokeless forms) and alcohol consumption (quantity and frequency) was collected.

Participants who had smoked in the past 30 days were considered current smokers for this survey. Consumption of >60 gm of alcohol on an average day in the past 30 days was considered as alcohol use. Participants with less than the equivalent of 150 minutes of moderate-intensity physical activity per week were categorised as having insufficient physical activity [12]. After taking a brief history, the diabetic risk score was calculated. The components include gender, family history of diabetes, history of gestational diabetes, history of hypertension, physical activity, and weight status, which were assessed by Waist Circumference (WC) and Body Mass Index (BMI). The WC had three categories for males and females. Subjects with WC <80 cm (female) and <90 cm (male) were coded as 0 (score: 0); WC ≥81-89 cm (female), ≥91-99 cm (male) as 1 (score: 10) and WC ≥90 cm (female), ≥100 cm (male) as 2 [13].

Subjects with a diabetic risk score <5 were considered to have no risk for diabetes mellitus. Individuals with a diabetic risk score of more than 5 will be considered as having a risk for developing the disease, and these individuals were referred for further evaluation by Random Blood Sugar (RBS). Individuals with RBS less than 110 mg/dL was diagnosed as non-diabetics. Individuals with RBS 110-199 mg/dL and those with RBS above 200 mg/dL without symptoms of diabetes mellitus were considered pre-diabetics, and they were advised for further reconfirmation with fasting and postprandial blood sugars. Individuals with RBS above 200 mg/dL with symptoms of diabetes mellitus were considered as diabetics, and these individuals were sent for re-assessment by the physician.

Height and weight were noted using standardised methods, and BMI was categorised using the classification recommended for Asians. WC and Hip Circumference (HC) were measured using a constant tension tape. WC was measured at the end of a normal expiration, with arms relaxed at the sides, at the mid-point between the lower part of the lowest rib and the highest point of the hip on the mid-axillary line. HC was measured at the maximum curvature of the buttocks.

To assess the risk factors for hypertension, along with a brief history, height and weight were checked, and BMI was calculated. Blood pressure was checked thrice using a Blood Pressure (BP) apparatus at five-minute intervals, and the average value of the last two readings were recorded. Individuals with Systolic Blood Pressure (SBP) <120 mmHg and Diastolic Blood Pressure (DBP) <80 mmHg was considered non-hypertensive. Individuals with SBP 120-139 mmHg and DBP 80-89 mmHg were considered as high normal. Individuals with SBP 140-159 mmHg and DBP 90-99 mmHg was considered as probable stage I hypertension. Individuals with high normal and probable stage I hypertension was referred for further evaluation.

STATISTICAL ANALYSIS

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) 20.0 and MS Excel. Descriptive statistical measures like frequency distribution were calculated for all categorical variables, and the mean with standard distribution was calculated for numerical variables. The association between two categorical variables was determined using the Chi-square test/Fisher's exact test/linear by linear association. The association between categorical and numerical variables was assessed using the independent sample t-test. The binary logistic regression model was used to predict the probability of the event occurrence using the potential independent variables. A significance level of five per cent was considered statistically significant ($p<0.05$).

RESULTS

A total of 154 residents were included in the study. The mean age of the study participants was 24.64±4.70 years. Around 60% of the study population were males, and 40% were females. Approximately 54% of the participants were married. The majority of the subjects had completed high school (33.8%), followed by 28.6% who had completed postgraduation [Table/Fig-1].

Variables	Frequency (%)
Age (in years)	24.64±4.70
Gender	
Male	92 (59.7)
Female	62 (40.3)
Marital status	
Married	83 (53.9)
Unmarried	71 (46.1)
Education	
Illiterate	5 (3.2)
Middle school	32 (20.8)
High school	52 (33.8)
Diploma	21 (13.6)
Postgraduate	44 (28.6)
Occupation	
Unemployed	59 (38.3)
Unskilled	22 (14.3)
Skilled	43 (27.9)
Semiprofessional	13 (8.4)
Professional	17 (11)

[Table/Fig-1]: Distribution of study participants based on socio-demographic factors (n=154).

Among the study participants, 54 (35%) were non-diabetics, 89 (58%) were pre-diabetics, and 11 (7%) had diabetes mellitus. Similarly, 24 (16%) were non-hypertensive, 115 (75%) had high normal values, and 15 (9%) had probable stage I hypertension [Table/Fig-2].

Categorisation	Frequency (%)
Diabetes mellitus	
Non-diabetics	54 (35%)
Pre-diabetics	89 (58%)
Diabetes mellitus	11 (7%)

Hypertension	
Non-hypertensive	24 (16%)
High normal	115 (75%)
Stage 1 Hypertension	15 (9%)

[Table/Fig-2]: Categorisation of study participants for diabetes mellitus and hypertension (n=154).

Only a small proportion of study subjects were substance abusers (smokers: 28.6%, alcoholism: 24.7%, and tobacco users: 1.9%). 39% of the study participants had a family history of diabetes mellitus, and 42.9% had a family history of hypertension [Table/Fig-3].

The statistically significant values (p<0.05) reveal that there was a significant association between hypertension with educational level, alcoholism, SBP, and DBP. On the other hand, diabetes mellitus was not significantly associated with any variables [Table/Fig-4].

[Table/Fig-5] shows the output of the binary logistic forward selection model. Based on bivariate analysis [Table/Fig-4], the following potential variables such as education, alcoholism, SBP, and DBP, which are correlated with hypertension, are used in the probabilistic model. The proposed model excluded the least important variables such as education and DBP from the prediction model with reference to the p-value (p-value >0.05). Hence, the final prediction model included alcoholism and SBP, which contributed to 25.6% of the variations in the prediction of hypertension. In addition, the odds ratios were more than 1, which concludes that excess alcohol intake and an elevation in SBP were risk factors for hypertension. Though the p-value for alcohol intake is marginal (0.054), a high odds ratio of 3.838 can be taken into consideration, hence stating its importance. The probabilistic prediction model is given as follows: P(Hypertension)=(e-12.434+0.074SBP+1.345Alco.)/(1-e-12.434+0.074SBP+1.345Alco.).

Variables	Frequency (%)
Smoking	
No	110 (71.4)
Yes	44 (28.6)
Alcoholism	
No	116 (75.3)
Yes	38 (24.7)
Tobacco intake	
No	151 (98.1)
Yes	3 (1.9)
Physical activity	
No	92 (59.7)
Yes	62 (40.3)
Presence of family history	
Diabetes mellitus	60 (39)
Hypertension	66 (42.9)
Both	48 (31.1)
Weight (in kg)	62.45±9.85
Height (in cm)	159.97±9.56
Waist Circumference (WC) (in cm)	68.46±21.56
Hip Circumference (HC) (in cm)	46.17±24.27
Systolic BP (SBP) (in mmHg)	120.22±13.96
Diastolic BP (DBP) (in mmHg)	77.68±8.90

[Table/Fig-3]: Distribution of behavioural and risk factors among the study participants (n=154).

DISCUSSION

The burden of NCDs has been increasing in India. Diabetes and hypertension are among the most common NCDs affecting present population. The prevalence of NCDs has been found to rise in young adults in recent years [4]. The present study was conducted to emphasise the significance of early screening in adults aged 18 years and above. In the present study, the prevalence of diabetes mellitus and hypertension was found to be 7% and 9%, respectively, while studies conducted in various parts of South India have reported a higher prevalence of diabetes mellitus and hypertension, which are shown in [Table/Fig-6] [5,14-16]. The low prevalence in the present study could be attributed to the difference in the age group of the study population compared to other studies.

Additionally, a nationwide study conducted among 1.3 million adults in 2018 reported a notable rise in the prevalence of hypertension in the younger age group (18-25 years) [17]. Though the prevalence of diabetes mellitus and hypertension was low, around 58% of the present study population were pre-diabetics, and 75% of them had high normal blood pressure, which should be viewed seriously to prevent them from progressing into a frank disease. Similar results were obtained in studies conducted in the northern part of Tamil Nadu, where 77% of the study population had high normal blood pressure [12]. A study conducted by Mohan V et al., in Chennai, Tamil Nadu, reported a gradual increase in the prevalence of Impaired Glucose Tolerance (IGT) [7]. The prevalence of the present study was in contrast with the study conducted by Dev S et al., in the Thiruvallur district, where only 3.2% of the study participants were newly diagnosed with Diabetes mellitus [5]. Also, Tripathy JP et al., in Punjab reported that only 2.8% of young adults in the age group of 18-24 years were pre-diabetic [18].

Variables	Diabetes mellitus		p-value	Hypertension		p-value
	No	Yes		No	Yes	
Gender						
Male	87 (94.5%)	5 (5.5%)	0.352 FE	84 (91.3%)	8 (8.7%)	0.527 FE
Female	56 (90.3%)	6 (9.7%)		59 (95.2%)	3 (4.8%)	
Age (years)	24.31±3.53	28.91±11.79	0.226 C	24.25±3.55	29.73±11.34	0.141 C
Marital status						
Married	76 (91.6%)	7 (8.4%)	0.501 C	75 (90.4%)	8 (9.6%)	0.194 C
Unmarried	67 (94.4%)	4 (5.6%)		68 (95.8%)	3 (4.2%)	
Education						
Illiterate	4 (80%)	1 (20%)	0.115 L	4 (80%)	1 (20%)	**0.039** L*
Middle school	28 (87.5%)	4 (12.5%)		28 (87.5%)	4 (12.5%)	
High school	49 (94.2%)	3 (5.8%)		49 (94.2%)	3 (5.8%)	
Diploma	20 (95.2%)	1 (4.8%)		18 (85.7%)	3 (14.3%)	
Postgraduate	42 (95.5%)	2 (4.5%)		44 (100%)	0	

Occupation						
Unemployed	56 (94.9%)	3 (5.1%)	0.534 L	56 (94.9%)	3 (5.1%)	0.534 L
Unskilled	20 (90.9%)	2 (9.1%)		19 (86.4%)	3 (13.6%)	
Skilled	37 (86.1%)	6 (13.9%)		39 (90.7%)	4 (9.3%)	
Semiprofessional	13 (100%)	0		12 (92.3%)	1 (7.7%)	
Professional	17 (100%)	0		17 (100%)	0	
Smoking						
No	101 (91.9%)	9 (8.1%)	0.730 FE	105 (95.5%)	5 (4.5%)	0.077 FE
Yes	42 (95.5%)	2 (4.5%)		38 (86.4%)	6 (13.6%)	
Alcoholism						
No	108 (93.1%)	8 (6.9%)	1.000 FE	111 (95.7%)	5 (4.3%)	**0.027** FE *
Yes	35 (92.1%)	3 (7.9%)		32 (84.2%)	6 (15.8%)	
Tobacco intake						
No	140 (92.8%)	11 (7.2%)	1.000 FE	140 (92.8%)	11 (7.2%)	1.000 FE
Yes	3 (100%)	0		3 (100%)	0	
Exercise						
No	84 (91.3%)	8 (8.7%)	0.527 FE	86 (93.5%)	6 (6.5%)	0.757 FE
Yes	59 (95.2%)	3 (4.8%)		57 (91.9%)	5 (8.1%)	
Family history of diabetes mellitus						
No	84 (89.4%)	10 (10.6%)	0.051 FE	86 (91.5%)	8 (8.5%)	0.530 FE
Yes	59 (98.3%)	1 (1.7%)		57 (95%)	3 (5%)	
Family history of hypertension						
No	81 (92%)	7 (8%)	0.759 FE	82 (93.2%)	6 (6.8%)	1.000 FE
Yes	62 (94%)	4 (6%)		61 (92.4%)	5 (7.6%)	
Anthropometric variables						
Weight	62.78±9.80	58.18±9.95	0.136 C	62.42±9.78	62.91±11.26	0.874 C
Height	160.24±9.57	156.45±9.07	0.207 C	160.37±9.63	154.73±6.87	0.059 C
Waist circumference (WC)	68.93±21.67	55.33±15.04	0.286 C	68.16±21.70	73.40±20.55	0.600 C
Systolic BP (SBP)	120.31±13.45	119.00±20.25	0.776 C	118.90±12.36	135.45±21.62	**0.030** C*
Diastolic BP (DBP)	77.66±8.92	78.00±9.19	0.911 C	77.17±8.63	83.64±10.27	**0.020** C*

[Table/Fig-4]: Association between demographic and hemodynamic parameters with diabetes mellitus and hypertension using bivariate analysis.
*C/FE/L: Chi-square test/Fisher's-exact test/Logistic regression

Variables	Beta	SE (Beta)	p-value	OR	95% CI for OR	
					Lower	Upper
Alcoholism (yes)	1.345	0.699	0.054	3.838	0.975	15.114
Systolic Blood Pressure (SBP)	0.074	0.022	0.001	1.077	1.031	1.125
Constant	-12.434	3.071	0	0		

[Table/Fig-5]: Probabilistic prediction model for hypertension using logistic regression model.

S. No.	Author's name and year (Reference No.)	Place of study	Population studied (n)	Prevalence of diabetes mellitus (by screening)	Prevalence of hypertension (by screening)
1	Dev S et al., [5]	Thiruvallur district, Tamil Nadu	188 (18-60 years)	3.2%)	-
2	Oommen AM et al., [14]	Vellore, Tamil Nadu	3799 (30-64 years)	11.2%	17%
3	Jayanna K et al., [15]	Karnataka	3950 (18 and above)	12%	19%
4	Sarma PS et al., [16]	Kerala	12012 (18-69 years)	19.2%	30.4%
5	Present study	Madurai, Tamil Nadu	154 (18-29 years)	7%	9%

[Table/Fig-6]: Comparison of the prevalence of diabetes mellitus and hypertension in various studies done in India [5,14-16].

Tobacco use, unhealthy diet, harmful alcohol consumption, and physical inactivity are some of the main behavioural risk factors for these diseases, as shown in [Table/Fig-3]. The prevalence of current smoking and alcohol use was 28.6% and 24.7%, respectively. Similarly, a study conducted in Vellore by Oommen AM et al., reported a high prevalence of smoking, alcohol consumption, and physical inactivity (23%, 62%, and 43%, respectively) [14]. Studies conducted in Pondicherry by Sivanantham P et al., reported prevalence rates of alcohol and tobacco use at 40.4% and 24.4%, respectively [2]. In contrast, a study conducted by Jayanna K et al., in Karnataka reported only 11.1% tobacco use and 5.5% alcohol consumption [16]. This observation emphasises the importance of strengthening tobacco control policies and implementation. Additionally, awareness about the hazardous nature of tobacco and alcohol concerning NCDs should be created. Around 60% of the study participants were physically inactive, which was quite high compared to the national-level cross-sectional survey conducted during 2017-18 [19].

The present study reports that a behavioural risk factor like alcohol consumption significantly increases the risk of hypertension. Education was also found to be significantly associated with hypertension. This could be due to the fact that people with higher education levels had relatively higher awareness regarding the risk factors of the disease. This result contrasts with the study conducted by Geldsetzer P et al., who reported that the differences in the probability of diabetes mellitus and hypertension by educational category were generally small [17]. No significant association was found for diabetes mellitus with any of the variables.

In the present study, the authors used a probabilistic prediction model using logistic regression to determine the correlation for potential variables such as education, alcohol consumption, systolic and diastolic blood pressure with hypertension. The final prediction model included only alcohol consumption and SBP for evaluation.

Alcohol consumption and elevations in SBP posed a high-risk for hypertension. Although the p-value for hypertension was marginal, a high odds ratio of 3.838 should be taken into consideration. Hence, alcohol consumption should be viewed seriously, as people may misunderstand the beneficial effects of limited alcohol intake. A comprehensive strategy must integrate actions to minimise exposure to risk factors at an earlier age and reduce risks in high-risk individuals to provide a quality life.

Limitation(s)

There is a possibility of under-reporting certain behavioural risk factors, which could be a concern in young adults. Additionally, the measurement of blood glucose was conducted using a glucometer device instead of venous blood glucose estimation due to logistic constraints.

CONCLUSION(S)

Although the prevalence of diabetes mellitus and hypertension is low, this study highlights a significant burden of undiagnosed cases of diabetes mellitus and hypertension in the community. Therefore, systematic screening and awareness programs can be implemented to identify the undiagnosed cases in the community and offer early lifestyle modifications, treatment, and regular follow-up. Since the behavioural risk factors emerge at a young age, behaviour change communication can be implemented to achieve healthy behavioural changes to prevent the progression from pre-diabetes to diabetes mellitus and from high normal blood pressure values to Stage I hypertension.

REFERENCES

[1] Christe DM, Vijaya S, Tharangini K. Screening for non-communicable diseases. 2020;9(3):1092-96.
[2] Sivanantham P, Sahoo J, Lakshminarayan S, Bobby Z, Kar SS. Profile of risk factors for Non-Communicable Diseases (NCDs) in a highly urbanized district of India: Findings from Puducherry district-wide STEPS Survey, 2019-20. 2021;16(1):e0245254.
[3] Meitei WB, Ladusingh L. Transition specific risk factors affecting the lifestyle disease progression from diabetes to hypertension in India. 2019;11(8):1055-71.
[4] Khan MS, Kashyap S, Khan AA, Ahmad A, Arfin I, Mahmood SE. Risk factor analysis among type 2 diabetes mellitus and hypertension patients in an urban population-A cross sectional community based study. 2020;7(11):06-12.
[5] Dev S, Jain T, Sivaprakasam P, Raja D. Risk factor assessment and screening for diabetes in field practice area of a private medical college in Thiruvallur district of Tamil Nadu. Int J Community Med Public Health. 2017;4(8):2670-73.
[6] Kandasamy K, Sundaram RS, Kameswaran R. Assessment on prevalence of hypertension and its associated risk factors along with MMAS score in a rural community: A home based screening. 2018;11(8):337.
[7] Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, et al. Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India-The Chennai Urban Rural Epidemiology Study (CURES-17). Diabetologia. 2006;49(6):1175-78.
[8] Hernandez-Vila E. A Review of the JNC 8 Blood Pressure Guideline. Tex Heart Inst J. 2015;42(3):226-28.
[9] ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, et al. Introduction and Methodology: Standards of Care in Diabetes- 2023. 2023;46(Suppl 1):S01-04.
[10] Virk A, Samdarshi N, Saini P, Mohapatra A, Sahoo S, Goel S. Prevalence and determinants of hypertension and associated comorbidities in non-pregnant women of reproductive age group (15-49 years): Evidence from National Family Health Survey (NFHS-4), India. J Family Med Prim Care. 2022;11(9):5865-73.
[11] World Health Organization. WHO STEPS Surveillance Manual: STEPwise Approach to Non-Communicable Disease Risk Factors Surveillance. Geneva: World Health Organization; 2017.
[12] Vijayakarthikeyan M, Krishnakumar J, Umadevi R. Cross-sectional study on the prevalence of risk factors for non-communicable disease in a rural area of Kancheepuram, Tamil Nadu. 2017;4(12):4600-07.
[13] Singh MM, Mangla V, Pangtey R, Garg S. Risk assessment of diabetes using the Indian Diabetes Risk Score: A study on young medical students from northern India. 2019;23(1):86-90.
[14] 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.
[15] Jayanna K, Swaroop N, Kar A, Ramanaik S, Pati MK, Pujar A, et al. Designing a comprehensive Non-Communicable Diseases (NCD) programme for hypertension and diabetes at primary health care level: Evidence and experience from urban Karnataka, South India. BMC Public Health. 2019;19(1):409.
[16] Sarma PS, Sadanandan R, Thulaseedharan JV, Soman B, Srinivasan K, Varma RP, et al. Prevalence of risk factors of non-communicable diseases in Kerala, India: Results of a cross-sectional study. BMJ Open. 2019;9(11):e027880.
[17] Geldsetzer P, Manne-goehler J, Theilmann M, Davies JI, Awasthi A, Vollmer S, et al. Diabetes and hypertension in India a nationally representative study of 1.3 million adults. JAMA Intern Med. 2018;178(3):363-72.
[18] Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S, Pal A, et al. Prevalence and risk factors of diabetes in a large community-based study in North India: Results from a STEPS survey in Punjab, India. Diabetol Metab Syndr. 2017;9:01-08.
[19] Mathur P, Kulothungan V, Leburu S, Krishnan A, Chaturvedi HK, Salve HR. National noncommunicable disease monitoring survey (NNMS) in India: Estimating risk factor prevalence in adult population. PLoS One. 2021;16(3):e0246712.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Community Medicine, Madurai Medical College, Madurai, Tamil Nadu, India.
2. Undergraduate Student, Department of Community Medicine, Madurai Medical College, Madurai, Tamil Nadu, India.
3. Assistant Professor, Department of Community Medicine, Madurai Medical College, Madurai, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
A Ra Boornema,
Assistant Professor, Department of Community Medicine, Madurai Medical College, Madurai-625020, Tamil Nadu, India.
E-mail: drpoornichandran@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 06, 2023
- Manual Googling: Mar 13, 2024
- iThenticate Software: Mar 15, 2024 (16%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Dec 02, 2023**
Date of Peer Review: **Feb 08, 2024**
Date of Acceptance: **Mar 18, 2024**
Date of Publishing: **May 01, 2024**