Prevalence and Risk Factors of Diabetes, Hypertension and Other Non-Communicable Diseases in a Tribal Population in South India

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Abstract

Introduction: The prevalence of non-communicable diseases is increasing in tribal areas of India owing to the development and adoption of modern lifestyle. This study was done to assess the prevalence and risk factors of obesity, diabetes and hypertension in a tribal area in South India. Materials and Methods: A cross-sectional study was conducted among all men and women 40 years and above in ten randomly selected villages in three village panchayats located in a hilly area in Vellore district, Tamil Nadu. Minimum sample size calculated was 370. Data collection was done using a pretested questionnaire, clinical examination, and capillary blood glucose measurement. Prevalence and 95% confidence interval were estimated for diabetes and hypertension. By univariate and multivariate logistic regression, the Odds Ratio was calculated to identify the risk factors. SPSS version 16.0 was used. A value of P < 0.05 was considered statistically significant. Results: The study included 502 subjects, 212 (42.2%) males and 290 (57.8%) females. The proportion of generalized and abdominal obesity was 21% and 36.5%. The prevalence of diabetes and hypertension among the tribal population was 7.4% and 36.5%. Approximately 62% of diabetes and 68% of hypertension were newly diagnosed during this study. Higher age, female sex, generalized and abdominal obesity, and diabetes were risk factors for hypertension and abdominal obesity and hypertension were risk factors for diabetes. Conclusion: The prevalence of diabetes and hypertension is high with two-thirds being newly diagnosed during study in this tribal population mandating early screening, awareness campaigns for early health-seeking and improvement in health access.

Keywords: Diabetes, hypertension, obesity, prevalence, South India, tribal

INTRODUCTION

Diabetes mellitus, hypertension, and other non-communicable diseases (NCD) are increasing in epidemic proportions throughout the world including developing countries like India. The recent INDIAB study quotes an overall prevalence of diabetes in 15 states as 7.3% and of pre-diabetes to be 10.3%.1

In rural Tamil Nadu, the prevalence of diabetes (7.8%) and hypertension (26.2%) was lesser than the urban prevalence.2,3 Both of these contribute heavily to the non-communicable disease burden of India.

Diabetes and other NCDs are increasingly recognized in rural areas. Studies reveal that there is an urban-rural convergence of prevalence of hypertension as the increase in urban areas has stabilized but in rural areas, there is a continued rise in the past decades.4 Much of this is attributable to the rapid “development” and adoption of western/modern lifestyle in the last few decades in these regions.

Around 11.3% of our rural population is tribal and contribute to the less commonly addressed tribal problems.5 It is generally believed that the tribal group may not have a significant burden
of non-communicable diseases due to their simple lifestyle, healthy dietary habits, heavy physical work, and a cleaner environment. A systematic review of hypertension among tribal populations in India had revealed an increasing prevalence of hypertension across three decades.[6] The National Nutrition Monitoring Bureau had done a multi-state survey among tribal population a decade ago wherein the prevalence of hypertension varied from 8% in Gujarat to 51% in Orissa.[7,8] In Tamil Nadu it was 18.2%. The prevalence of diabetes among tribal people in India varied from 0.7% in Rajasthan to 9% in Tripura.[9]

The tribal population of India is one of the most marginalized and vulnerable sections of society.[5,10] The health care infrastructure, health expenditure, accessibility to hospital, health manpower etc., are very poor in these areas making them a neglected pocket. While there is some focus on nutritional deficiencies, vector-borne diseases, tuberculosis, etc., chronic diseases are getting the least attention.[11] Studies highlighting the tribal prevalence of these conditions therefore become the need of the hour. Hence it was proposed to study the prevalence of diabetes, hypertension, and other NCDs and the associated risk factors in one such tribal population from Javadhu hills from northern Tamil Nadu.

**Materials and Methods**

**Ethics**

Permission to conduct the study was obtained from the Directorate of Public Health. Ethical approval was obtained from the Institutional Ethics Committee of Sri Ramachandra Institute of Higher Education and Research. (IEC-NI/18/JUL/65/34) The study has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki. Written informed consent was obtained from each study participant before data collection.

**Study design**

**Study area**

This study was conducted as a population-based cross-sectional study during August 2018. It was done among a tribal population of Vellore district, Tamil Nadu which has 20 Panchayat Unions. Alangayam is the only Panchayat union with a tribal population. It has 29 village panchayats with 1,22,736 population as of the 2011 census. Of these, only three are in the hills with 10, 8, and 14 villages each. For this study, 10 villages were randomly chosen – 3-3-4 from the three Panchayats.

**Study participants**

Inclusion criteria: All men and women, 40 years and above and who were permanent residents of the study area and who were available at the time of interview. This age group was selected to improve the yield in this otherwise under-reached population.

Exclusion criteria: Those who were unwilling to participate and who were too sick or bedridden and unable to answer.

**Sample size calculation**

A study by Shankar Radhakrishnan et al.[12] among the tribal population of Salem district shows the prevalence of Hypertension to be 31.6%. Using the formula, \( N = \frac{Z^2 \cdot pq \cdot L}{\alpha^2} \) and assuming \( \alpha \) to be 5% and taking relative precision \( L \) as 15% of prevalence, the minimum sample size required was 370.

**Data collection**

Data collection was done using a pre-tested questionnaire. Their morbidity profile for non-communicable diseases was asked in history and the investigators attempted to verify the records if available. Anthropometry namely height and weight were measured among the study participants using standard procedures. Waist circumference (WC) was measured as the horizontal circumference at the mid-point between the lowest rib and iliac crest in centimeters.[13] Abdominal obesity was defined as WC ≥ 90 cm in males and 80 cm in females.[14] BMI was calculated using the formula – weight in kilograms divided by the square of the height in meters. WHO Asian cut-offs were used to classify the subjects into underweight (<18.5), normal (18.5-24.9), overweight (25-29.9) and obese (30 and above).[15]

Random blood glucose (RBS) was measured on all the study participants using a glucometer. The subjects were considered as having diabetes if the levels are 200 mg/dl or above.[16] blood pressure (BP) was measured using Omron HEM 7120 Fully Automatic Digital Blood Pressure Monitor. The subjects were made to sit comfortably for 5-10 minutes before measuring BP. BP was measured in a sitting position in the left arm with the apparatus at the level of the heart. The subjects were categorized as hypertensives if they are a known case of hypertension or if their systolic BP is ≥140 or their diastolic BP is ≥90 mm Hg and pre-hypertensives if Systolic BP was 120–139 or diastolic BP was 90–99 according to the recommendations of the Joint National Committee 7 report.[17]

**Statistics**

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 16 (IBM Corporation, Somers, New York, USA, 10589, 2009) software. Descriptive statistics was calculated as percentages, mean and standard deviation (SD). Prevalence of the morbidities was presented as percentages and 95% confidence interval (95%CI). Odds ratio (OR) was calculated to look for strength of association between different background variables, risk factors and the outcome variables. To determine the predictors for diabetes and hypertension, multivariate logistic regression analysis was done by the ‘Enter’ method and adjusted odds ratio was calculated. A value of \( P < 0.05 \) was considered statistically significant.

**Results**

In all the 10 villages put together, the number of men and women 40 years and above who gave consent to participate...
in the study was 502. There were 212 (42.2%) males and 290 (57.8%) females. The mean (SD) age of study participants was 55.1 (10.86). Close to 90% of the people were working in farming-related jobs. Two-thirds of the tribal people were illiterates (63.8%) and another quarter (25.5%) had studied till primary school. Only 1.6% had attended higher secondary school or were graduates. Two-thirds (66%) were in Joint family and one-third in nuclear family.

Family history of diabetes and hypertension was given by 2.4% each. Around 83% of the study participants were leading a lifestyle with moderate physical activity. History of smoking and alcohol use was given by 20 (9%) and 55 (24.8%) of males. Men smoked about 1.4 packs of beedis per day and the average duration was 24.4 years. Tobacco chewing habit was present among 2.3% of males and 2.9% of females respectively. But these were not associated with the prevalence of diabetes or hypertension.

More than two-thirds (67%) of the study population were having their BMI in the normal range while 11.3%, 17%, 19.6%, and 2.2% were in the underweight, overweight, pre-obese, and obese categories, respectively. The mean (SD) BMI among males and females was 22.59 (3.42) and 22.51 (3.69), respectively. The proportion of abdominal obesity among the study population was 36.5%. It was more among males compared to females ($P = 0.009$). [Figure 1] The mean (SD) WC among males was 78.41 cm (9.925) and that among females was 75.11 cm (10.064). Upon cross-tabulation, it was found that 5.2% of underweight and 26% of normal BMI individuals had abdominal obesity. No association of BMI or WC was found in different age groups.

The prevalence of diabetes among the tribal population was 37 (7.4%) (95%CI 5.08-9.66) of whom 14 (38%) were known cases and 23 (62%) were newly diagnosed. Mean duration of diabetes among known diabetics was 4 (3.17) years. Hypertension was present among 183 (36.5% 95%CI 32.24-40.66) of whom 125 (68.3%) were newly diagnosed. Known Hypertensives were 58 (11.6%) and the mean duration was 1.68 (1.275) years. History of both diabetes and hypertension was given by 6 (1.2%). Prehypertension was present in another third (32.1% - 95% CI 27.99-36.15). None of them reported a history of any cardiovascular disease but 4 (0.8% - 95% CI - 0.02-1.57) gave a past history of stroke. [Figure 2]

It is seen from Table 1 that the prevalence of diabetes is higher among those aged above 60 years, females, uneducated, those who are not working, physically inactive, those who are overweight-obese, and have abdominal obesity. After logistic regression, those with abdominal obesity had 4.176 times the risk for diabetes compared to those in the normal range ($P = 0.005$) and those with hypertension had 2.464 times the risk of diabetes as compared to normotensives ($P = 0.020$).

From Table 2, It is seen that the prevalence of hypertension is more among those aged more than 60 years, females, illiterates, people who are not currently working, physically inactive ones, those in the BMI range of overweight/obesity, those with abdominal obesity. After logistic regression, the risk factors that had statistical significance were age more than 60 years (AOR 2.365), females (AOR 1.883), BMI in the obese range (AOR 6.716), abdominal obesity (AOR 1.953), and diabetes (AOR 2.362).

There was not much difference in prevalence of diabetes or hypertension among users and non-users of smoking/tobacco or alcohol. (Results not shown in table) These variables were not included in the multivariate regression model.

**Discussion**

This cross-sectional population-based study on tribal populations was done to find the prevalence of diabetes, hypertension, and other non-communicable diseases and the associated risk factors. It included 502 people who were 40 years of age or more. Close to two-thirds of the people were uneducated. This might be because of the inclusion of subjects 40 years and above.

The proportion of underweight and overweight/obese in this population was 12% and 21% and that of abdominal obesity was 36.5%. But when comparing with the Tamil Nadu state findings in NFHS-4 (2015–2016) among women...
40–49 years (23.5], the mean BMI was found to be lower in this study (22.51). Also as per NFHS 4, the proportion of overweight/obese in Tamil Nadu was 28.2% and 30.9% for men and women of 15–49 years age group.[18] In the current study, 56% of the participants were above 50 years of age. A higher mean BMI as well as a higher proportion of obesity may be expected but it is found to be lower than the rest of the state. In this study, the prevalence of obesity was almost similar among males and females but in most studies in India, the obesity prevalence is higher among females.[19] Contrary to this trend, in this study the proportion of abdominal obesity is significantly higher among males. The prevalence of underweight in this study was lower compared to other studies done in tribal areas although the trend of the higher proportion of tribal women being underweight is similar.[8,20–22]

The habit of smoking, tobacco use, and alcohol use were present among 9%, 2.3%, and 25% of males, and among females, tobacco use was 2.9%. The habits among males are much lower compared to rural Tamil Nadu (tobacco—31% and alcohol—47% among males) but tobacco use among females (3%) was similar.[18] The study in tribal Maharashtra shows the smoking/tobacco use among males and females ranging from 40–65% and alcohol use among males as 25%–42% and among females as 9%–18%.[23] A similarly high prevalence was found in the NNNB report among tribals from various states.[8] The findings in this study are much lower compared to these as well as studies from northern, central, or north-eastern parts.[22–26]

The majority of the tribal people were leading a physically active lifestyle. As transport is very limited in most villages, they have to walk to every place be it for their occupation or purchase or any other work. There was a difficulty in assessing socio-economic standards by their per capita income as almost all were in unorganized sector (farming). But they were predominantly in the lowest wealth quintile.

The prevalence of diabetes was 7.4% and that of pre-diabetes was 15.3%. A systematic review from north-east, central, and north-western Indian studies give a pooled prevalence of diabetes in tribal people to be 5.9% and that of impaired glucose tolerance to be ranging from 6.6% to 12.9%.[9]

### Table 1: Prevalence and association of risk factors with Diabetes among study subjects – Univariate and Logistic regression

| Risk factor profile | N (%) | Prevalence of Diabetes No (%) | Unadjusted Odds ratio (95%CI) | P | Adjusted Odds ratio (95%CI) | P |
|---------------------|-------|-------------------------------|-------------------------------|---|-----------------------------|---|
| **Age**             |       |                               |                               |   |                             |   |
| Up to 60 years      | 365 (72.7) | 25 (6.9) | 1 | 0.457 | 1 | 0.292 |
| >60 years           | 137 (27.3) | 12 (8.8) | 1.312 (0.640-2.692) | 1.546 (0.688-3.474) |   |   |
| **Sex**             |       |                               |                               |   |                             |   |
| Males               | 222 (44.2) | 17 (7.7) | 1 | 0.844 | 1 | 0.708 |
| Females             | 280 (55.8) | 20 (7.2) | 0.935 (0.546-2.095) | 1.160 (0.534-2.519) |   |   |
| **Education**       |       |                               |                               |   |                             |   |
| Illiterates         | 318 (63.7) | 17 (5.3) | 1 | 0.020* | 1 | 0.083 |
| Literates           | 182 (36.3) | 20 (11) | 2.186 (1.114-4.290) | 1.921 (0.919-4.014) |   |   |
| **Occupation**      |       |                               |                               |   |                             |   |
| Working             | 446 (89.2) | 31 (7) | 1 | 0.270 | 1 | 0.509 |
| Not working/retired/housewife | 54 (10.8) | 6 (11) | 1.673 (0.664-4.215) | 1.448 (0.482-4.347) |   |   |
| **BMI (n=495)**     |       |                               |                               |   |                             |   |
| Normal              | 247 (49.9) | 11 (4.5) | 1 | 1 |   |   |
| Underweight         | 56 (11.3) | 2 (3.6) | 0.795 (0.171-3.689) | 0.769 | 1.216 (0.247-5.983) | 0.810 |
| Overweight          | 84 (17.0) | 6 (7.1) | 1.650 (0.591-4.609) | 0.339 | 0.891 (0.288-2.759) | 0.842 |
| Pre-obese           | 97 (19.6) | 14 (14.7) | 3.708 (1.618-8.496) | 0.002* | 1.165 (0.418-3.252) | 0.770 |
| Obese               | 11 (2.2) | 4 (36.4) | 12.260 (3.118-48.207) | 0.000* | 3.721 (0.793-17.450) | 0.096 |
| **Waist circumference** |       |                               |                               |   |                             |   |
| Normal              | 318 (63.5) | 10 (3.1) | 1 | 1 |   |   |
| Abdominal obesity   | 132 (26.3) | 27 (14.9) | 4.906 (2.199-10.946) | 0.000* | 4.176 (1.552-11.237) | 0.005* |
| ** Physical activity** |       |                               |                               |   |                             |   |
| Active              | 415 (82.7) | 30 (7.2) | 1 | 0.747 | 1 | 0.483 |
| Inactive            | 87 (17.3) | 7 (8.1) | 1.152 (0.488-2.716) | 0.768 (0.280-2.108) |   |   |
| **Hypertension**    |       |                               |                               |   |                             |   |
| No                  | 318 (63.6) | 13 (4.1) | 1 | 0.000 | 1 | 0.020 |
| Yes                 | 182 (36.4) | 24 (13.2) | 3.564 (1.767-7.189) | 2.464 (1.152-5.272) |   |   |
| **Total**           | 502 (100) | 37 (7.37) | 95% CI (5.1-9.7) |   |   |   |

*P < 0.05 – statistically significant
the prevalence is well within the range for both. The rural prevalence of diabetes in Tamil Nadu was 7.8% and that of pre-diabetes was 7.1% according to ICMR-INDIAB study.[2] The mean age of participants in our study is 55 years whereas in theirs it is 40 years. Despite this difference, a similar prevalence of diabetes indicates a lower prevalence in this population because age is a known risk factor of diabetes. The prevalence of hypertension was very high in the order of 36.5%. Another third of the population was in the pre-hypertensive range. A systematic review on hypertension among tribes from different parts of tribal India with 140/90 as cut-off shows the pooled prevalence to be 16.1%. [3] Thus the prevalence is more than twice the pooled prevalence. Invariably all these studies have taken subjects as those aged > 17 or 19 years whereas this study includes people who are 40 years or above. Higher age being a known risk factor for hypertension, the higher prevalence in this study is understandable. Also, the review showed a higher prevalence among males whereas in this study females are at 1.9 times higher risk compared to males.[6] A study from tribals in another part of Tamil Nadu shows a similar the prevalence of hypertension.[12] There is a hypothesis that blood pressure increases with increase in altitude due to many physiological mechanisms.[27,28] This hilly area comes under a low altitude territory with an average height of around 1300 m above sea level. Most studies and reviews on blood pressure and altitude focus on high altitude areas such as in the Himalayas.[26,27,29,30] Whether low altitude can also lead to an increase in BP needs to be studied further.

In this study, age more than 60 years, female sex, BMI in obesity range, abdominal obesity, and diabetes were found to be risk factors for hypertension by logistic regression. Increasing age is a risk factor in most studies.[3,22,23,26,31] Females are twice at risk for HTN in the current study whereas ICMR-INDIAB study and a study from tribal Uttarakhand show a higher prevalence among males.[3,23] Obesity – both generalized and abdominal is risk factors for hypertension in the INDIAB study as well as in the study from Mandla.[15,22]
Smoking, alcohol, physical inactivity, education status were not associated with HTN in this study though many studies show an association.[3,7,22,23] The risk factors for diabetes in this study were abdominal obesity and hypertension which was similar to the INDIBA study.[1]

**Limitations**
Fasting blood sugar values could not be done due to the travel involved which would have given a more accurate value. Also, mercury sphygmomanometer might have been more reliable for BP measurement than automated machines. The medical record availability was very poor among the tribal people for physical verification.

**Conclusion**
The prevalence of hypertension and pre-hypertension was very high in this study population whereas that of diabetes was comparable with that of the state rural prevalence. A high proportion of the hypertensives and diabetics were newly diagnosed indicating poor health care availability as well as health-seeking.

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**Ethics approval**
Ethical approval was obtained from the Institutional Ethics Committee of Sri Ramachandra Institute of Higher Education and Research. (IEC-NI/18/JUL/65/34).

**Consent to participate**
Written informed consent was obtained from each study participant.

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**Conflicts of interest**
There are no conflicts of interest.

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