Introduction

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality globally. An estimated 17.9 million people died from CVDs in 2019, representing 32% of all global deaths. Over three quarters of CVD death take place in low- and middle-income countries. In 2016, India reported 63% of total deaths due to non-communicable diseases (NCDs), of which 27% were attributed to CVDs. CVDs also account for 45% of deaths in the 40–69 years age group.

Various epidemiological studies suggest increased prevalence of CVD risk factors such as tobacco consumption, smoking, physical inactivity, unhealthy diet, and harmful consumption of alcohol. Effects of the behavioral risk factors may show up in individuals as raised blood pressure, raised blood glucose, raised blood lipids, and overweight and obesity. These “intermediate risks factors” can be measured in primary care facilities and indicate an increased risk of heart attack, stroke, heart failure, and other complications.

Abstract

Background: The problems of cardiovascular diseases are on the rise and the tribal population are also not an exception to it. The present study aims to estimate the prevalence of risk factors of cardiovascular diseases and to find association of hypertension and diabetes with various risk factors among the Tharu tribe of Bihar, India. Methodology: The present study was an observational, cross-sectional study conducted on 252 individuals of 20–60 years age group. Risk factors related to cardiovascular diseases were assessed. Results: Among 252 participants, the prevalence of hypertension and diabetes was 32.5% and 4.8%, respectively. Around 30% of study participants were smokers, 39% were habitual of chewing tobacco, and about half of the population were not involved in active physical activities (49.2%). Raised blood glucose level was significantly associated with gender, age, smoking status, and tobacco chewing while hypertension was significantly associated with age, smoking status, and body mass index. Conclusions: Increased number of various risk factors among the tribal population makes them vulnerable to cardiovascular diseases and other complications.

Keywords: Bihar, cardiovascular diseases, diabetes, hypertension, Tharu tribe

Community-based assessment of risk factors for cardiovascular diseases in a tribal population of Tharus in Bihar, India

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Received: 08-01-2022 \nRevised: 12-03-2022 \nAccepted: 19-03-2022 \nPublished: 30-08-2022

How to cite this article: Kumar D, Kumari R, Anwar K, Singh R. Community-based assessment of risk factors for cardiovascular diseases in a Tribal population of Tharus in Bihar, India. J Family Med Prim Care 2022;11:4404-9.
hypertension, diabetes and obesity in India with regional variations across the country. A country such as India with its enormous diversity has huge variation in prevalence and risk factors of NCDs. Studies conducted in urban and rural settings regarding CVD risk factors have shown significant differences. Within the Indian context, tribal population, restricted to rural areas, are associated with poverty, illiteracy, and malnutrition. Thus, they are assumed to be untouched by NCDs which are lifestyle-driven diseases. However, recent studies have produced evidence for increasing trend of NCDs among tribal populations.

Hypertension and diabetes are important risk factors for cardiovascular disease. The etiologies of these diseases are multi-factorial in nature. Some risk factors are modifiable, such as physical inactivity, smoking, diet, and overweight, whereas some are non-modifiable, such as old age and genetic predisposition. In spite of incredible progress in the field of medicine, and curative and preventive health measures, diabetes and hypertension are on rise in the general population, and the tribal population is also not an exception. Tribal populations are generally ignored in health-related policy making. The data of cardiovascular diseases and their associated risk factors in the tribal population of Bihar were lacking. Therefore, the present study was conducted among a tribal population (the Tharu people) of 20–60 years age group to estimate the prevalence of risk factors of cardiovascular diseases and to find an association of hypertension and diabetes with different risk factors.

**Material and Methods**

Study design and participants: The present community-based, cross-sectional study was conducted among Tharu tribes, which are recognized as scheduled tribes by the Government of India. The Tharu people are indigenous people living in the Terai plains on the border of Nepal and India, mostly in Bihar and some districts of Uttarakhand and Uttar Pradesh. The total tribal population in Bihar consists of 1.28% and in West Champaran district they consist of 6.35%. The present community-based cross-sectional study was conducted in Gaunaha and Sidhaw (Bagha 2) block of West Champaran district of Bihar state in March 2018 (Figures 1 and 2). West Champaran was selected for this study because a predominant population of Tharu tribes resides in this district. Gaunaha and Sidhaw are the two most populous blocks of tribal population of West Champaran. The study population consisted of all tribal adults in the 20–60 years age group. The most common risk factors for the CVD assessed in this study are diabetes, hypertension, physical activities, tobacco chewing, cigarette smoking, and dangerous alcohol consumption.

**Sample size calculation**

The sample size was calculated on the basis of the prevalence of hypertension (17%) and diabetes (7%) from a previous study by using the formula: \[ N = (Z_α)^2 \times P \times Q / L^2 \]. Taking 5% absolute error, the sample size came out to be 226 for hypertension and 105 for diabetes. So, a sample of 226 participants was sufficient to study the prevalence of both hypertension and diabetes. Taking a non-response of 10%, the final sample size was adjusted to 250.

**Sampling procedure**

Two blocks, that is, Sidhaw (Bagha 2) and Gaunaha, with a maximum number of tribal populations from West Champaran districts, were selected. Five villages from each block where the tribal population resides were chosen and from each village, 25 persons of 20–60 years and those who were willing to participate in the study were selected using simple random sampling technique. Thus 125 participants from each block were enrolled for the study.

**Study tools**

A pre-tested, semi-structured questionnaire was used for data collection. The sociodemographic details of study participants like gender, age and socioeconomic status were obtained. The socioeconomic status was assessed by using modified BG Prasad classification. Risk factors of cardiovascular diseases were assessed among tribal adults.

Tobacco chewers constituted individuals who were currently chewing tobacco while tobacco non-chewers included those who hadn’t chewed tobacco ever or had not chewed tobacco for the past one year. Similarly, smokers constituted individuals who were currently smoking while non-smokers included those who hadn’t smoked ever or for the past one year. Consumption of alcoholic beverage was also asked. Physical activity was classified as sedentary and active on the basis of their routine activities. Participants with predominantly sedentary routine were considered sedentary while participants with predominantly standing, walking or physically strenuous routines were categorized as active.

All of them were screened for diabetes via random blood glucose levels using Accuchek Glucometer. Based on RBS, a sugar level of ≥200 mg/dl was considered as diabetic, between

![Figure 1: Map of Bihar showing West Champaran block](image-url)
140 mg/dl and 200 mg/dl was considered to be prediabetic, and <140 mg/dl was considered as normal. Along with random blood sugar (RBS), their blood pressure and body mass index (BMI) were also recorded. Three measurements of blood pressure at five-minute intervals in the sitting position were taken using a mercury sphygmomanometer. Hypertension was categorized based on JNC 7 classification. Persons with systolic blood pressure below 120 mmHg and diastolic blood pressure below 80 mmHg were taken as normal. Hypertension or high BP is defined as the mean systolic blood pressure (SBP) being ≥140 mmHg and/or diastolic blood pressure (DBP) being ≥90 mmHg, that is, includes hypertension grade I and grade II.

Weight was recorded using a spring balance calibrated to an accuracy of 0.1 kg. Height was measured using a sliding stadiometer calibrated to an accuracy of 0.1 mm. BMI was categorized as per Asian guidelines. Overweight was defined as BMI measuring 23–24.9 kg/m² and obesity was defined as BMI measuring 25 kg/m² and above. High BMI levels included overweight and obesity categories.

Statistical analysis
The data analysis was done using statistical software R. Frequency and percentage were calculated for demographic parameters and risk behaviour parameters related to CVDs. To find the association of hypertension and diabetes with various risk factors, Pearson’s Chi-squared test was applied. One way ANOVA and Student’s t test were used to study association for continuous variables. The statistical significance was evaluated at 5% level of significance.

Results
The present study included 252 participants, which comprised of 147 females (58.3%) and 105 males (41.7%). Around 46% of participants belonged to 50–59 years age group and about 41% belonged to lower socioeconomic class. Around 30% of the study participants were smokers and 39% were habitual of chewing tobacco while only 12% of individuals were habitual of alcohol intake. About half of the population were not involved in active physical activities (49.2%). The prevalence of hypertension was 32.5% while 43.5% of the tribal population were pre-hypertensive. The prevalence of hypertension was slightly more among males (35.2%) in comparison to females (30.6%). The prevalence of diabetes was 4.8% (9.5% in male, 1.4% in female) while 11% people had impaired glucose levels. Around 21% of the population were either overweight or obese while around 17% population were underweight.

The mean systolic BP of the entire population was 131.36 mmHg while the mean diastolic BP was 82.86 mmHg. As the age group increases the mean systolic and diastolic blood pressure also increased and the association was statistically significant. The mean RBS value of population was 123.68 gm/dl. It was higher among males (133.96 mg/dl) than females (116.40 mg/dl) and the association was statistically significant ($P = 0.02$). As the age group increased, the mean RBS value also increased ($P < 0.001$).

As the age increased, the prevalence of hypertension also increased significantly ($P < 0.001$). Prevalence of hypertension was significantly higher among smokers compared to non-smokers ($P = 0.007$) and also among overweight/obese persons (43.4%) in comparison to normal (32.5%) and underweight persons (19%) ($P = 0.042$). We have not found any significant association between gender, marital status, socioeconomic status, tobacco chewing, alcohol consumption and physical activities with the status of hypertension.

Elevated blood glucose level was more common among males (9.5%) than in females (1.4%), and the association was significant ($P = 0.003$). As the age increased, the prevalence of diabetes also increased significantly ($P = 0.012$). The raised blood glucose level was also significantly associated with smoking ($P = 0.03$) and tobacco chewing ($P < 0.001$). We have not found any significant association between marital status, alcohol consumption, physical activities and BMI with status of diabetes.
Table 1: Distribution of sociodemographic profile and risk factors of CVDs among study participants (n=252)

| Variables                  | Frequency | Percentage (%) |
|----------------------------|-----------|----------------|
| Gender                     |           |                |
| Male                       | 105       | 41.7           |
| Female                     | 147       | 58.3           |
| Age (Mean±SD)              |           |                |
| Male                       | 46.7±12.5 |                |
| Female                     | 44.3±11.2 |                |
| Total                      | 45.3±11.7 |                |
| Age group                  |           |                |
| 20-29                      | 24        | 9.5            |
| 30-39                      | 50        | 19.8           |
| 40-49                      | 63        | 25.0           |
| 50-59                      | 115       | 45.6           |
| Education                  |           |                |
| Illiterate                 | 157       | 62.3           |
| Literate                   | 95        | 19.8           |
| Smoking status             |           |                |
| Non-smoker                 | 176       | 69.8           |
| Smoker                     | 76        | 30.2           |
| Tobacco chewing            |           |                |
| Tobacco non-chewer         | 152       | 60.3           |
| Tobacco chewer             | 100       | 39.7           |
| Alcoholism                 |           |                |
| Non-alcoholic              | 221       | 87.6           |
| Alcoholic                  | 47        | 12.4           |
| Physical activity          |           |                |
| Sedentary                  | 124       | 49.2           |
| Active                     | 128       | 50.8           |
| Blood pressure category    |           |                |
| Normal                     | 55        | 21.9           |
| Pre-hypertension           | 115       | 45.6           |
| Hypertension grade I       | 54        | 21.4           |
| Hypertension grade II      | 28        | 11.1           |
| Random blood glucose level |           |                |
| Normal                     | 212       | 84.1           |
| Impaired glucose           | 28        | 11.1           |
| Diabetes                   | 12        | 4.8            |
| Body mass index            |           |                |
| Underweight                | 42        | 16.7           |
| Normal                     | 157       | 62.3           |
| Overweight/Obese           | 53        | 21.0           |

Discussion

The lifestyle pattern of a tribal population is also changing with time as they are coming in contact with the general population. Health assessment of tribal communities is required time-to-time to see the pattern of chronic diseases among them. In the present study, around 21% of the population were either overweight or obese. A tribe of western India showed prevalence of overweight and obesity to be 10.9% and 15.8%, respectively.[14] Another study among Nicobareses showed 37% to be overweight/obese.[15] 70% of individuals were taking tobacco in the form of smoking while 60% of individuals were taking tobacco in the form of chewing. A study done on Katkaris tribe of costal Maharashtra reported that tobacco smoking/chewing was a widely prevalent habit being present in 57.4% and 64.9% women and men, respectively.[11] In present study, only 12% of individuals reported that they were habitual of alcohol intake, although it is a common practice among tribal population. The probable reason for this may be due to prohibition of alcohol consumption in Bihar, making the participants hesitant in disclosing their real status regarding alcohol consumption.

Nowadays, hypertension has become a major health concern in developing nations and an important modifiable risk factor for cardiovascular diseases. The present study reported a higher prevalence of hypertension as 32.5% (35.2% among males while 30.6% among females). The prevalence of hypertension among the tribal population was reported to be as low as 16% to as high of 51% from different parts of India.[15–17] A 2015 multicentric study conducted in nine states reported the prevalence of hypertension as 27.1% and 26.4% among tribal men and women, respectively.[18] Studies have revealed acculturation as being one of the reasons for increased hypertension among tribals.[7,19] Tribes that were adjudged to be acculturated and to have risk factors (like prevalent consumption of increased salt, smoking, etc.) displayed a higher prevalence.

Prevalence of hypertension increased significantly with age; a similar observation was reported in other studies[19,20,21] as age is considered as a non-modifiable risk factor for hypertension. The prevalence of pre-hypertension in our study was 45.6%. Such a higher percentage of population are at an increased risk of becoming hypertensive. Increasing age, cigarette smoking, and obesity are significantly associated with hypertension. Hypertension was significantly associated with age, higher BMI, waist to hip ratio, and sedentary life style in different studies.[22–24] In another study, smoking, which is a modifiable risk factor for hypertension, was significantly associated with it.[25]

The present study showed a prevalence of 4.8% of raised sugar level with 9.5% in males and 1.4% in females. A study on Rang Bhotia tribe of Uttarakhand showed 6.9% prevalence of raised blood sugar.[26] A meta-analysis of seven studies on tribal populations revealed the prevalence of diabetes to be 5.9%.[27] A study done by M G Deo et al.[11] in Katkari tribe of coastal Maharashtra reported a prevalence of 7.3% of diabetes. Sathiyanarayanan et al.[28] in their study in Vellore district reported a 3.8% prevalence of diabetes on the basis of RBS. Diabetes was found to increase with increasing age and tobacco consumption either in smoking form or in chewing form. Age is also an independent risk factor for diabetes. It is also associated with other unhealthy practices like smoking and tobacco chewing.[29]

The higher magnitude of risk factors of CVDs in our study supports the concept of “shift from early adopters to late adopters” given by Howson et al.[29] which explains that the burden of CVDs shifts from richer sections of the society to the poorer sections, and risk behaviors shift from “early adopters” to “late adopters”. Identifying those at highest risk
The presence of various cardiovascular diseases risk factors in a large portion of the Tharu tribal population is a matter of concern. The high prevalence of hypertension, pre-hypertension, diabetes, and obesity necessitate initiation of appropriate medical and social interventions including health education activities to promote chronic disease awareness and emphasize preventive measures among this tribal population. This would be useful for the prevention and control of cardiovascular morbidity and mortality in the community.

Contributions

All authors were involved in study design, carrying out the study, literature search, drafting of the manuscript and critically reviewing it for intellectual content. All authors have seen and approved the final draft.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.
Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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