Prevalence and risk factors of hypertension and diabetes in the Katkari tribe of coastal Maharashtra

Deo MG, Pawar PV, Kanetkar SR¹, Kakade SV¹

ABSTRACT
Background and Objectives: Urban and rural India are both going through health epidemiological transition and will soon face huge burden of noncommunicable diseases (NCDs). Information on the status of NCDs in tribals is limited. Although the prevalence of hypertension in scheduled tribes (STs) has been studied in several states by the National Nutrition Monitoring Bureau, tribe-specific data are very scanty. The objective of this study was to generate data on the status of hypertension and diabetes, the two objectively measurable NCDs in Katkaris, the dominant ST in the Raigad district of coastal Maharashtra. Methods: The study was conducted in 410 adult Katkaris (women 219) of both sexes of ≥18 years of age in three adjoining tehsils of the district. Using the Institution Review Board approved protocol; information was obtained on sociodemographic parameters, educational level, dietary pattern, and substance abuse. Prevalence of overweight, hypertension, and diabetes was measured using standard field-based procedures and techniques. Results: Katkaris, who are mostly landless manual laborers, subsist on a protein-poor, imbalanced diet. About half of women and one-third of men have body mass index (BMI) < 18.5 kg/m², an indication of undernutrition. On the other hand, about 2% of participants were obese (BMI ≥ 30 kg/m²). The overall prevalence of hypertension and diabetes was 16.8% and 7.3%, respectively. Hypercholesterolemia was recorded in about 3% of the participants. Interpretation and Conclusions: Prevalence of diabetes and hypertension in Katkaris is still lower than that of urban and rural populations, closer to the latter. This may be due to the absence of known risk factors such as obesity, sedentary lifestyle, and hyperlipidemia in this community. Fast acculturation of the STs suggests that NCDs will soon become a major health issue in them too. It is time to launch a multicentric national study to gather baseline information on the status of NCDs in STs.

KEY WORDS: Costal Maharashtra, diabetes, hypertension, India, Katkari tribe

Introduction
Adivasis (scheduled tribes [STs]), who are possibly India’s oldest inhabitants, constitute 8.6% of the total population numbering 104.28 million (2011 census). Except for few states, STs are present in all parts of the country.¹ Maharashtra’s tribal population is about 10 million, which is 9.4% of the state population.² The state recognizes 47 scheduled tribes. There are three high-density clusters in the state - (a) Northern-Western Maharashtra consisting of districts Nandurbar, Dhule, Nasik, Thane and parts of Ahmednagar, Pune and Raigad, (b) Northern-Central consisting of Wardha, Amravati, Nagpur, Yavatmal and Bhandara, and (c) Eastern Maharashtra consisting of Gadchiroli and Chandrapur.³

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Deo MG, Pawar PV, Kanetkar SR, Kakade SV. Prevalence and risk factors of hypertension and diabetes in the Katkari tribe of coastal Maharashta. J Postgrad Med 2017;63:106-13.
The main STs in the Raigad district, the location of this study, are the Bhils, the Mahadeo Kolis, the Varlis, the Katkaris, the Koknas, and the Thakurs. Of these Katkaris with a population of about 120,000 are the most numerous, accounting for 40% of the tribal population of the district. Katkaris occupy the lowest position among the tribes of India in both socioeconomic status and education. The overall literacy rate in the STs is around 56% while in Katkaris it is only 34%. An overwhelming majority (88%) of the Katkaris is landless manual workers.

India is currently passing through epidemiological transition. Although malnutrition and infections are still important health problems, chronic lifestyle diseases (diabetes, cardiovascular and neurological disorders, and cancer) form substantial health burden and can no more be ignored. A number of studies have gathered information on the status of hypertension and diabetes in urban and rural populations in different parts of India. There are marked variations in its reported prevalence. Meta-analysis of more than 100 publications on the topic done by Anchala et al. shows that about 33% urban and 25% rural Indians are hypertensive. Prevalence of diabetes shows a similar trend. Its mean prevalence is 12.9% and 6.5% in urban and rural India.

There are limited and scattered data on the prevalence of noncommunicable diseases (NCDs) and the risk factors associated with them in tribal communities in India. Although National Nutrition Monitoring Bureau (NNMB) has brought out a special report on the prevalence of hypertension in STs in several states of India, many epidemiological details are lacking. In general, tribe-specific information is very scanty. Because STs are highly endogamous, there is a need to develop tribe-specific data on the status of NCDs. The main purpose of the study was to assess the prevalence of hypertension and diabetes and the status of known risk factors in the Katkaris in Raigad district of coastal Maharashtra, 150 km South of Mumbai, the state capital.

Methods

This was a community-based house to house cross-sectional study carried out among Katkari men and women of ≥18 years of age in six Padas (tribal hamlets) in three adjoining tehsils (small administrative divisions in a district) namely Mangoan (Kakal, Vanjolshi, and Sai), Mhasala (Mhasala and Chikalap), and Roha (Talwali) of Raigad district, Maharashtra as majority of Katkaris reside in these tehsils. No family was kept out of the survey. All adults who volunteered to participate were included in the study. The main objectives were to study the prevalence of obesity, hypertension, diabetes, and hypercholesterolemia. These tehsils were selected because they were close to the tribal school where the academy conducts its summer vacation educational program “Discovering Adwasi Little Scientist” in which tribal students of class X–XII are provided research opportunities to conduct community-based research. Before starting the project, student-participants received 1 week training from experts in recording information in a specially designed Institution Review Board (IRB) approved clinical pro forma, recording height, weight, and blood pressure (BP) using digital BP instrument (Omron, Japan), measuring capillary blood sugar using digital glucometer and routine urine examination. During training, their observations were authenticated. After training the students in groups of 2/3 conducted house to house survey. Each team was accompanied by academy’s trained staff under whose supervision the data were collected and monitored. A qualified medical doctor used to visit the study area and cross check clinical findings from time to time. The study was conducted between 2012 and 2014. Convenience sampling technique was used to select the tehsils and Padas. No sampling was done for selecting subjects. The study design including study instruments and informed consent form (Marathi), were approved by the IRB of the Moving Academy of Medicine and Biomedicine both from scientific and ethical angles.

Before starting the project, informal group discussions were held with the inhabitants of the Padas, and they were acquainted with the details of the project. It was emphasized that the study would not interfere in any way in their daily routine and that participation would be entirely voluntary. Anyone was free to withdraw at any time in the course of the study. Before starting the project, informed consent was obtained from each participant. At no stage, there was any coercion and no incentives financial or in kind were given to the participants.

After the group discussion with members of the Pada, members of the research team (expert from the academy and students) made house to house visits and again explained the project emphasizing the fact that the participation was entirely voluntary. The nature of the project was explained orally, and informed consent was obtained in the IRB-approved “informed consent form” which was in the local language (Marathi).

IRB-approved pro formas were used to get information on sociodemographic variables, economic status, educational levels, substance abuse related to tobacco and alcohol, and dietary pattern including the main source of protein (vegetarian or nonvegetarians) and intake of green leafy vegetables and fruits from the participants. Only verbal information provided by the participants was recorded.

Height was measured using a wall-mounted stadiometer, a prototype of Seca model SE 206 (Seca, UK). A suitable flat spot was selected in every house where the tape was mounted against a wall. The participants were asked to take off shoes and stand erect with their backs to the wall, heels together and looking straight. The height was recorded in cm. Digital balance (Venus), which was standardized every week, was used to record the weight in kg to the nearest decimal place. The machine was kept on a horizontal flat surface. In every house, the zero was adjusted before recording weight. Participants were asked to put on only light clothes. Body mass index (BMI) was calculated using height and weight and expressed as mass in kg/m². Study population was categorized as per the WHO norms into severely underweight (BMI <16 kg/m²), underweight (16–18.4 kg/m²), normal (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²), and obese (BMI ≥30 kg/m²). BP was recorded in sitting posture in the left arm using Omron digital BP apparatus (SEM-1 model, Omron Health Care...
Classification of systolic BP (SBP) and diastolic BP (DBP) was done according to the recommendations of JNC 7 report into normal (<120/<80 mmHg) prehypertensive (120–139/80–89 mmHg) and hypertension (≥140/≥90 mmHg).[16] Fasting capillary blood glucose (CBG) was measured after an overnight fast using ACCU-CHEK glucometer, Roche Diagnostics, Germany.[17] As per the recommendation of the Indian Council of Medical Research (ICMR) working group, fasting CBG of <110 mg/dl, 110–125 mg/dl and ≥126 mg/dl were considered as normal, prediabetic and diabetic, respectively.[18] Serum cholesterol was measured on fasting samples using an enzyme-based method and expressed as mg/dl of serum.[19] The measurements were made using autoanalyzer and Erba Lachema (Karasek, Czech Republic) enzymatic kit. Hypercholesterolemia was defined as serum cholesterol of ≥200 mg/dl.

Statistical analysis
The sample size was calculated using the following standard formula for finite population.

\[ n = \frac{N Z^2 p q}{d^2 (N-1) + Z^2 p q} \]

where,
- \( n \) = Sample size with finite population,
- \( N \) = Population size (120,000 total population of the Kataris in Raigad district),
- \( Z \) = Z statistic for a level of confidence,
- \( p \) = Expected proportion,
- \( q = 1 - p \)
- \( d = \text{Precision (in proportion of 1)} \).

No information is available on the prevalence of hypertension and diabetes in the Katkari tribe. Based on the figures quoted in the meta-analysis of several publications, anticipated prevalence was considered to be 16% and 6% for hypertension and diabetes respectively.[12,15] Katkari population of Raigad district (the study area) is 120,000. The sample size was calculated using estimated prevalence (\( p \)) of 16% for hypertension and 6% for diabetes at 95% confidence level (\( z = 1.96 \)) and precision of 5% (d = 0.05).

According to the assumptions mentioned above, the sample size for hypertension turns out to be 207. In our study, 410 adult Katkari participated which is also adequate to study the prevalence of diabetes.

Data were summarized into numbers, percentages, mean and standard deviation. The Chi-square test was applied to assess the trend as well as gender wise difference in study variables. Student's t-test was applied to compare the difference in means of two categories. The trend, as well as the difference, was said to be significant if \( P < 0.05 \).

SPSS (Statistical Package for the Social Sciences) version 20 software (IBM Corp Armonk, NY, USA) was used for statistical analysis.

Results
Altogether, the six tribal Padas (tribal hamlet) in this study consisted of 237 families, with a total population of 1168 and women to men ratio of 0.94. Adults accounted for 52.5% of the population. Two-thirds of the adults (410/613), of which 53.4% (219) were women, participated in the study. All families were approached. Only one family of four adults refused to participate in the study. They were not included in the study. Tribals have a large floating population as both men and women generally leave Pada in search of jobs in the morning and return after few days. Only those who were present at the time of visit were enrolled in the project.

General features and anthropometric measurements
Information obtained on sociodemographic parameters, economic status, educational level, dietary patterns, and habits of the study population is shown in Table 1. More than 95% of the participants were “Yellow card” holders, an indication that they were below the poverty line by the criteria used by the Government of India. Three-fourth of the tribal women and about 60% men were illiterate – they could not even sign their names. The majority of tribals were on vegetarian diet, which was their main source for proteins and calories. Green leafy vegetables and fruits were taken irregularly once or twice a week only by 60% of the families. Tobacco smoking/chewing was a widely prevalent habit being present in 57.4% and 64.9% women and men, respectively. Twenty percent women and half of men consumed “country-made” liquor regularly. Almost all participants were manual laborers mostly at construction sites, in brick factories or farms, putting them in the category of “vigorous activity.”

There was no difference in average age between women (34.1 ± 13.49 years) and men (34.1 ± 12.96 years). Average women height, weight, and BMI were 148.9 ± 7.66 cm, 42.2 ± 7.59 kg, and 19.2 ± 3.74 kg/m² respectively [Table 2]. In comparison, men were taller (159.9 ± 6.82 cm) and heavier 50.9 ± 8.99 kg and also had better BMI (19.9 ± 3.50 kg/m²). These differences were statistically significant. The mean SBP and DBP in women/men were 125 ± 19.9/129 ± 19.0 and 79 ± 11.9/80 ± 12.21 mmHg, respectively. Average CBG in women was 102 ± 29.52 almost same as that in the men. Average serum cholesterol showed a similar trend (women 130 ± 36.47 and men 125 ± 40.3 mg/dl).

As judged by the BMI, about 50%, 7%, and 1% women were underweight, overweight, and obese, respectively. Men, in general, were better nourished; only one-third (36.7%) had...
Table 1: Socioeconomic, educational, and dietary pattern in study population

|                          | Women (219) (%) | Men (191) (%) | χ² (P) |
|--------------------------|-----------------|---------------|--------|
| Income                   |                 |               |        |
| Below BPL (yellow card)* | 212 (96.8)      | 183 (95.8)    | NS     |
| Above BPL                | 7 (3.2)         | 8 (4.2)       |        |
| Occupation               |                 |               |        |
| Manual labor             | 219 (100.0)     | 191 (100.0)   |        |
| Education                |                 |               |        |
| Illiterate               | 169 (77.2)      | 110 (57.6)    | <0.001 |
| Literate                 | 50 (22.8)       | 81 (42.4)     |        |
| Primary                  | 38 (17.3)       | 42 (22.0)     |        |
| Secondary                | 12 (5.5)        | 35 (18.3)     |        |
| Junior College           | -               | 4 (2.1)       |        |
| Tobacco habits (smoking/ chewing) |       |               |        |
| No                       | 93 (42.5)       | 67 (35.1)     | NS     |
| Yes                      | 126 (57.5)      | 124 (64.9)    |        |
| Arecanut/gutka            |                 |               |        |
| No                       | 166 (75.8)      | 141 (73.8)    | NS     |
| Yes                      | 53 (24.2)       | 59 (26.2)     |        |
| Alcohol                  |                 |               |        |
| No                       | 179 (81.9)      | 112 (58.5)    | <0.001 |
| Yes                      | 40 (18.1)       | 79 (41.5)     |        |
| Green leafy vegetables/week |            |               |        |
| No                       | 45 (20.5)       | 16 (8.4)      | NS     |
| Yes                      | 174 (79.5)      | 175 (91.6)    |        |
| Once a week              | 46 (21.0)       | 36 (18.8)     |        |
| Twice a week             | 76 (34.7)       | 72 (37.7)     |        |
| Thrice a week            | 36 (16.4)       | 51 (26.7)     |        |
| Four times a week        | 16 (7.4)        | 16 (8.4)      |        |
| Citrus fruit             |                 |               |        |
| No                       | 78 (35.6)       | 99 (51.8)     | <0.001 |
| Yes                      | 141 (64.4)      | 92 (48.2)     |        |
| Protein intake vegetable pulses/milk | |               |        |
| No                       | 58 (26.5)       | 84 (44)       | <0.001 |
| Yes                      | 161 (73.5)      | 107 (56)      |        |
| Protein intake nonvegetable egg, meat** | |               |        |
| No                       | 51 (23.3)       | 18 (9.4)      | <0.002 |
| Yes**                    | 168 (76.7)      | 173 (90.6)    |        |

*B: Yellow card: Those below poverty line as per Government of India, **Nonvegetable was taken once or twice a week that too in limited quantities. NS: Not significant, BPL: Below poverty line

BMI <18.5 kg/m² and about 2% were obese. In χ² analysis for trend both in men and women, overweight and obesity were found to be independent of age [Table 3].

Hypertension and diabetes

The overall prevalence of hypertension was 16% and 17.8% in women and men, respectively [Table 4]. The prevalence increased proportional to age in both sexes. The increase was statistically highly significant (χ² analysis for trend age vs. hypertension: P < 0.0001 in both sexes). Overweight emerged as a significant risk factor for hypertension in both the sexes [Fisher’s exact test; Table 5].

The overall prevalence of diabetes (CBG ≥126 mg/dl) was 5.4% and 9.8% in women and men, respectively [Table 4]. However, these differences were not statistically significant. Overall prevalence of diabetes (pooled data of both sexes) was 7.5%. The prevalence was not influenced by age in women (χ² analysis for trend) and only weakly so in men. Overweight did not affect prevalence of diabetes in both sexes [Table 5].

Awareness about the hypertension was very low. Only 4 out of 191 men (2.1%) and 6 out of 219 women (2.7%) were aware that they were suffering from hypertension. Situation about diabetes was worse as no affected subject was aware that he/she was suffering from the disease.

Discussion

Tribals (Katkaris), who participated in this study, were grossly undernourished manual laborers, subsisting mostly on an imbalanced vegetarian diet with scanty consumption of green leafy vegetables and fruits. Literacy rates in both men and women were very low. More than 40% and 60% men were addicted to alcohol and tobacco (mostly smoking) respectively. Addiction to alcohol was not a major issue in women. However, that was not the case with tobacco usage (mostly chewing) which was present in more than 50% women. Although both SBP and DBP were recorded in all participants, discussion in this communication is focused on the former as between the two SBP is a more important cardiovascular risk factor. Overall prevalence of hypertension and diabetes was modest except in the age group of ≥60 years, in which 50% were hypertensive. The average SBP was in the range of prehypertension in all age groups in both sexes.

There are wide variations in sociocultural, dietary pattern, and substance abuse in STs in different parts of India.[10,19,20] Katkaris eat even rodent meat which they believe gives them longevity and strength.[21] However, this study indicates that nonvegetarian food articles are not a regular part of their daily diet because meat items are not regularly available and very costly for them. Two-third of men and more than 50% of women were addicted to tobacco. These figures are much lower than 94% reported by Misra et al.[20] in Mishing tribes in Assam.[10] On the other hand, only 34% of Saharia tribe in Madhya Pradesh were addicted to tobacco.[19] Although only 40% men accepted addiction to alcohol, this was a gross underestimation. A close scrutiny showed that more than 75% men consumed alcohol daily. Prevalence of alcohol addiction, in this study, is similar to that reported by Misra et al.[10] but higher than that observed in some tribes in Madhya Pradesh and Gujarat.[19,20]

Distribution of BMI, in our study, shows that about half of tribal women and one-third of Katkari men are underweight (BMI <18.5 kg/m²). These figures are almost similar to...
Table 2: Anthropometric parameters, blood pressure, fasting capillary blood glucose, and serum cholesterol in the study population

| Sex   | Age groups | Participants (n) | Age (year) | Height (cm) | Weight (kg) | BMI (kg/m²) | SBP (mmHg) | DBP (mmHg) | CBG* (mg/dl) | Serum cholesterol* (mg/dl) |
|-------|------------|------------------|------------|-------------|-------------|-------------|------------|------------|-------------|--------------------------|
|       |            |                  | Overall    | 158         | 27.1±5.98   | 149.0±8.19 | 42.3±7.48  | 19.2±3.80  | 120±16.24  | 76.5±11.59   | 110 (156)±21.05          |
|       |            |                  | 40-59      | 39          | 46.0±5.70   | 149.3±6.85 | 42.3±7.89  | 19.0±3.68  | 131±19.44  | 83±9.82      | 112 (28)±61.21           |
|       |            |                  | ≥60        | 22          | 63.4±4.68   | 145.9±5.52 | 41.1±8.11  | 19.3±3.46  | 149±25.09  | 88±11.19     | 103 (21)±14.48           |
|       |            |                  | All ages   | 219         | 34.1±13.49  | 148.9±7.76 | 42.2±7.59  | 19.2±3.74  | 125±19.9    | 79±11.91     | 102 (205)±29.52          |
|       |            |                  | Overall    | 191         | 34.1±12.96  | 159.9±6.82 | 50.9±8.99  | 19.9±3.50  | 129±19.00  | 80±12.21     | 106 (162)±35.87          |
| Women | <40        | 158              | 27.0±5.86  | 154.2±9.31  | 46.1±9.06   | 19.4±3.61  | 123±15.79  | 77±11.09   | 100 (285)±18.64 | 124 (244)±38.3            |
|       | 40-59      | 39               | 45.8±5.64  | 154.1±8.65  | 47.9±9.94   | 20.1±3.71  | 133±22.62  | 87±13.10   | 135 (24)±80.89 | 135 (36)±46.56           |
|       | ≥60        | 36               | 63.9±4.58  | 151.7±9.54  | 43.7±9.85   | 18.9±3.69  | 144±26.91  | 85±13.39   | 105 (30)±15.49 | 136 (27)±27.96           |
|       | All ages   | 410              | 34.1±13.23 | 153.9±9.21  | 46.2±9.35   | 19.5±3.65  | 127±19.64  | 79±12.04   | 116 (367)±36.40 | 128 (342)±38.32           |

*Numbers in parentheses next to the mean in these columns denote the numbers of samples in the group. Women versus men (all ages), unpaired, two-tailed t-test: Height: t=15.47; P<0.0001, Weight: t=10.54; P<0.0001, BMI: t=2.20; P<0.03, SBP: t=2.18; P<0.03, DBP: t=0.66; P=0.51 (NS), CBG: t=1.41; P=0.16 (NS), serum cholesterol: t=1.25; P=0.21 (NS), highly significant is denoted by the P value in all tables. NS: Not significant, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CBG: Capillary blood glucose, SD: Standard deviation

Table 3: Body mass index distribution in various age groups

| Sex   | Age group | Participants (n) | <16 (BMI<18.5) | 16-18.4 (BMI 18.5-24.9) | 25-29.9 (BMI ≥25) | ≥30 (BMI ≥30) |
|-------|-----------|------------------|----------------|-------------------------|---------------------|--------------|
| Women | <40       | 158              | 24 (15.2)      | 51 (32.2)               | 69 (43.7)           | 12 (7.6)     | 2 (1.3)     |
|       | 40-59     | 39               | 8 (20.5)       | 12 (30.8)               | 16 (41.0)           | 3 (7.7)      | -           |
|       | ≥60       | 22               | -              | 12 (54.5)               | 9 (40.9)            | -            | 1 (4.6)     |
|       | All ages  | 219              | 32 (14.6)      | 75 (34.3)               | 94 (42.9)           | 15 (6.8)     | 3 (1.4)     |
| Men   | <40       | 132              | 6 (4.5)        | 44 (33.3)               | 71 (53.8)           | 9 (6.8)      | 2 (1.6)     |
|       | 40-59     | 45               | -              | 12 (26.7)               | 28 (62.2)           | 4 (8.9)      | 1 (2.2)     |
|       | ≥60       | 14               | 5 (35.7)       | 3 (21.4)                | 4 (28.6)            | 2 (14.3)     | -           |
|       | All ages  | 191              | 11 (5.8)       | 59 (30.9)               | 103 (53.9)          | 15 (7.8)     | 3 (1.6)     |
| Overall| <40       | 158              | 30 (10.3)      | 95 (32.8)               | 140 (48.3)          | 21 (7.2)     | 4 (1.4)     |
|       | 40-59     | 84               | 8 (9.5)        | 24 (28.6)               | 44 (52.4)           | 7 (8.3)      | 1 (1.2)     |
|       | ≥60       | 36               | 5 (13.9)       | 15 (41.7)               | 13 (36.1)           | 2 (5.6)      | 1 (2.7)     |
|       | All ages  | 410              | 43 (10.5)      | 134 (32.7)              | 197 (48.0)          | 30 (7.3)     | 6 (1.5)     |

Chi-square for trend age versus over weight (BMI ≥25): Women 0.46; P=0.49 (NS), men 0.54, P=0.46 (NS); Overall 0.007; P=0.93 (NS).

NS: Not significant, BMI: Body mass index

those reported in the National Family Health Survey 3 (NFHS-3)\[22\] in which 46.4% and 41.4% tribal women and men respectively had BMI <18.5 kg/m². As compared to the Katkaris, smaller proportion of urban and rural women and men are overweight.\[23,24\] Obesity is now seen in epidemic proportion in urban India.\[25\] The problem of overweight can no more be ignored even in rural India.\[26\] However, obesity is still not a problem in tribals.\[11,22\] Only 3% tribals (women 2%; men 4%) had hypercholesterolemia (total serum cholesterol ≥200 mg/dl), an indication of blood lipid levels (based on the analysis of data in Table 2).

Diabetes is now a major global health problem. Some 380 million people (5% of the world population) suffer from diabetes.\[27\] China, India, and the US in that order together account for half of the global burden for diabetes.\[9\] The mean prevalence of diabetes, which shows wide fluctuation in urban and rural populations, is 12.9% and 6.5%, respectively.\[9\] There are very limited data on the prevalence of diabetes in STs. Upadhyay et al.\[12\] have recently conducted meta-analysis of the publications till 2012 on burden of diabetes in STs. Of 113 articles published on diabetes in Indian STs, only seven fulfilled the criteria for inclusion in the analysis, which speaks for paucity and the questionable quality of published data in the field.\[12\] Some major problems in the interpretation of the data were: heterogeneity in diagnostic criteria, lack of uniformity in sampling and restriction of the studies to certain regions.

Deo, et al.: Hypertension and diabetes in tribals
Table 4: Systolic blood pressure and capillary blood sugar in the study population

| Sex | SBP (mmHg) | CBG (mg/dl) |
|-----|------------|-------------|
|     | Normal (<120) | Prehypertension (121-140) | Hypertension (>140) | Number of persons (percentage in parentheses) |
|     | Participants number | Prevalence, n (%) | Prevalence, n (%) | Prevalence, n (%) | Prevalence, n (%) |
| Women | 158 | 97 (61.4) | 47 (29.7) | 14 (8.9) | 156 | 138 (88.5) | 10 (6.4) | 8 (5.1) |
| <40 | 39 | 14 (35.9) | 18 (46.1) | 7 (18.0) | 28 | 24 (85.6) | 2 (7.2) | 2 (7.2) |
| 40-59 | 22 | 1 (4.5) | 8 (36.4) | 13 (59.1) | 21 | 16 (76.2) | 4 (19.0) | 1 (4.8) |
| 60 | 219 | 112 (51.1) | 72 (32.9) | 35 (16.0) | 205 | 178 (86.8) | 16 (7.8) | 11 (5.4) |
| All ages | 103 | 70 (68.1) | 18 (17.6) | 15 (14.3) | 107 | 82 (76.9) | 13 (12.5) | 12 (11.6) |
| Men | 132 | 49 (37.1) | 68 (51.5) | 15 (11.4) | 129 | 103 (79.8) | 17 (13.2) | 9 (7.0) |
| <40 | 45 | 12 (26.7) | 20 (44.4) | 13 (28.9) | 24 | 15 (62.5) | 3 (12.5) | 6 (25) |
| 40-59 | 14 | 5 (35.7) | 3 (21.4) | 6 (42.9) | 9 | 7 (77.8) | 1 (11.1) | 1 (11.1) |
| 60 | 191 | 66 (34.6) | 91 (47.6) | 34 (17.8) | 162 | 125 (77.2) | 21 (13.0) | 16 (9.8) |
| Overall both sexes | 290 | 146 (50.3) | 115 (39.7) | 29 (10.0) | 285 | 241 (84.6) | 27 (9.5) | 17 (5.9) |
| <40 | 84 | 26 (31.0) | 38 (45.2) | 20 (32.4) | 52 | 39 (75.0) | 5 (9.6) | 8 (15.4) |
| 40-59 | 36 | 6 (16.7) | 11 (30.5) | 19 (52.8) | 30 | 23 (76.7) | 5 (16.7) | 2 (6.6) |
| 60 | 410 | 178 (43.4) | 163 (39.8) | 69 (16.8) | 367 | 303 (82.6) | 37 (10.1) | 27 (7.3) |

Chi-square for trend age versus SBP: Women: 32.29; P < 0.0001; men: 19.61; P < 0.0001; all: 48.48; P < 0.0001. Chi-square for trend age versus diabetes: Women: 1.85; P = 0.17 (NS); men: 5.05; P = 0.025, overall: 5.81; P = 0.016. Prevalence of diabetes (all ages): Female versus males; Fisher’s exact test: P = 0.11 (NS). SBP: Systolic blood pressure, CBG: Capillary blood glucose, NS: Not significant.

Table 5: Gender wise distribution of body mass index, hypertension, and diabetes in tribals

| Sex | BMI (kg/m²) | Systolic hypertension (SBP >140 mmHg) | Diabetes (CBG >126 mg/dl) |
|-----|------------|-----------------------------|--------------------------|
|     | Total number | Hypertensive, n (%) | Total number | Diabetic, n (%) |
| Women | <18.5 | 107 | 15 (14) | 102 | 11 (10.8) |
| 18.5-24.9 | 94 | 13 (13.9) | 82 | 6 (7.3) |
| >25 | 18 | 6 (33.3) | 17 | 4 (23.5) |
| Men | <18.5 | 70 | 9 (12.6) | 57 | 8 (14) |
| 18.5-24.9 | 103 | 16 (15.5) | 89 | 15 (16.9) |
| >25 | 18 | 9 (50) | 16 | 6 (37.5) |
| Overall | <18.5 | 177 | 24 (13.6) | 159 | 19 (11.9) |
| 18.5-24.9 | 197 | 31 (15.7) | 171 | 21 (12.3) |
| >25 | 36 | 15 (41.7) | 33 | 10 (30.3) |

Chi-square for trend BMI: Women: 1.992; P = 0.16 (NS); men: 7.930; P < 0.005; overall: 9.755; P < 0.002. Chi-square for trend BMI versus diabetes: Women: 0.4551; P = 0.49 (NS); men: 3.098; P = 0.08 (NS); overall: 3.965; P < 0.01. Fisher’s exact test: Over weight as a risk factor for hypertension: Women: P < 0.003; men P < 0.001, overall: P < 0.001; Over weight as a risk factor for diabetes: Women: P = 0.084 (NS); men: P < 0.04; overall: P < 0.01. BMI: Body mass index, SBP: Systolic blood pressure, NS: Not significant, CBG: Capillary blood glucose.

Sample size in most of the publication was modest except in the studies done by Sachdev where number of participants was 1296. However, a close scrutiny shows that the study was done on seven nomadic tribes. Sample size in individual tribe varied from 46 to 455. The average estimated prevalence of diabetes in the meta-analysis was 5.9% (range 0.7%–10.1%) which is slightly lower than that observed in this study.

In this study, the overall prevalence of systolic hypertension was found to be 16% and 17.8% in women and men, respectively. Prevalence progressively increased with age and the trend of age versus hypertension was highly significant statistically in both sexes. Hypertension was present in more than half of the participants above 60 years of age. DBP showed a similar trend (data not shown). NNMB has published a special report on hypertension in tribals in nine states covering an adult population of more than 50,000. However, despite the numbers, many epidemiological details are lacking, and in certain regions the sample size is modest. There are wide variations in combined (both men and women) prevalence rates in different states. For example, the prevalence in Gujarat is as low as 7.9% as opposed to Orissa where it is 51.5%. Within the state also there are variations. Of the seven regions in Madhya Pradesh where the survey was conducted the prevalence varied between 8.7% and 33.3%. Madhya Pradesh is the number one state in terms of population of STs and has many tribes. The differences could be due to variation in the type-specific prevalence. However, the report does not provide such data. Recently, Rizwan et al. made meta-analysis of 20 studies that included 53 sub-populations and more than 60,000 subjects. There was wide variation in the prevalence in different publications. The overall average estimated prevalence on the basis of the meta-analysis was 16.1%. The variables that influenced the results were the year of study, acculturation status, and BP measurement techniques. Prevalence of hypertension in our study is lower than that reported for urban as well as rural areas.

References:

1. Sachdev, et al. (1992). Hypertension and diabetes in tribals. Journal of Postgraduate Medicine, 63, 111.

2. NNMB. Special report on hypertension in tribals. (2017).

3. Rizwan, et al. (2018). Meta-analysis of hypertension in tribals.

4. Fisher’s exact test.
hypertension. This may be because only four studies in the meta-analysis had some sort of age stratification that too was restricted to two categories namely ≤45 and ≥45 years. However, age, in general, is considered to be a risk factor both for diabetes and hypertension.  

Over the years prevalence of both hypertension and diabetes is progressively increasing. This is most evident in urban areas but is also witnessed now in the rural population. Of the numerous risk factors overweight, body fat distribution, hyperlipidemia, unhealthy imbalanced diet (diet rich in fat) and sedentary lifestyle are the most important risk factors for both diabetes and hypertension. None of these are present in tribals in this study.

One of the major limitations of this study is relatively small sample size. In addition, it is restricted to only one tribe - Katkaris. Caution is required to apply the conclusions to other tribes. Diet survey is mostly qualitative.

The Government of India recognizes some 500 STs, who belong to three different races. As opposed to Katkaris who belong to Proto-Australoid race the tribes in Northeast are closer to Mongolid race. However, each tribe is highly endogamous. These features could modify pattern of diseases in individual tribes. This is evident in the case hemoglobinopathies. Hemoglobin E (HbE) is prevalent mostly in Naga tribes in the Northeast states of India. For the same reasons pattern of NCDs, in which race has been shown to be a risk factor, might differ both in quantity and quality in different STs. This could also explain the regional differences in the prevalence of hypertension in STs in the NNMB report.

**Conclusion**

Current tribal health programs are more focused on genetic disorders mainly on hemoglobinopathies and thalassemias. Although prevalence of both hypertension and diabetes is still low, it is time to recognize that, like in the rest of India, burden of NCDs would be soon substantial in STs. Influenced by the TV (a number Katkari-homes have Direct to Home (DTH) services), print media and interaction with rural and urban people there is fast acculturation of the STs in all parts of India. The challenge posed by impending spread of NCDs in tribals is progressively increasing. It is time to launch a nation-wide multicentric study similar to the ICMR-India Diabetes, on the status of risk factors and baseline prevalence of NCDs in tribal India. Such study would be essential to formulate long-term intervention strategies for their control.

**Acknowledgment**

Help rendered by the Vanvasi Asharam Shala, Mangaon in seeking cooperation of the participants is deeply appreciated.

**Financial support and sponsorship**

The study received funding from Sir Dorabji Tata Trust and Lady Tata Trust, Mumbai.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Ministry of Tribal Affairs Statistics Division Government of India. Statstical Profile of Scheduled Tribes in India; 2013. Available from: http://www.tribal.nic.in/WhiteReadData/CMIS/Documents/20141017_0519296522004StatisticalProfileofSTS2013.pdf. [Last accessed on 2016 Mar 25].
2. Government of India Census 2011. Individual Scheduled Tribe Primary Census Abstract Data and its AppendixA-11 Maharashtra. Available from: http://www.censusindia.gov.in/2011census/PCA/ST.html. [Last accessed on 2016 Mar 19].
3. Ramotra KC, Vadiyar SK, Mote YS. A geographical analysis of core and peripheries of tribal population in Maharashtra. Stud Tribals Tribals 2001;9:51-60.
4. Mahto KR, Lakra N. Katkari Tribes and Distress Migration: Why We Left Hamlets? Available from: https://www.khudihikranti.wordpress.com/2013/04/12/katkari-tribes-and-distress-migration-why-we-left-hamlets/. [Last accessed on 2016 Mar 25].
5. WHO-India. The WHO Country Health Profile of India. Available from: http://www.who.int/country/ind/en. [Last accessed on 2016 Mar 25].
6. Bhansali A, Dhandania VK, Deepa M, Anjana RM, Joshi SR, Joshi PP et al. Prevalence of and risk factors for hypertension in urban and rural India: the ICMR-INDIAB study. J Hum Hypertens 2015;29:204-9.
7. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, et al. Hypertension in India. A systematic review and meta-analysis of prevalence, awareness, and control of hypertension. J Hypertens 2014;32:1170-7.
8. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research-Indiab DIABETES (ICMR-INDIAB) study. Diabetologia 2011;54:3022-7.
9. Tandon N, Raizada N. The Burden of Diabetes in India; 03 September, 2014. Available from: http://www.dx.doi.org/10.14496/dia.1105048288.8. [Last accessed on 2016 Jun 10].
10. Misra PJ, Mini GK, Thankappan KR. Risk factor profile for non-communicable diseases among Mishing tribes in Assam, India: Results from a WHO STEPS survey. Indian J Med Res 2014;140:370-8.
11. Bisai S, Bose K. Body Mass Index and Chronic Energy Deficiency among Adult Tribal Populations of West Bengal: A Review. Available from: http://www.academia.edu/4161322/Body_Mass_Index_and_Chronic_Energy_Deficiency_among_Adult_Tribal_Populations_of_West_Bengal_A_Review. [Last accessed on 2016 Jun 10].
12. Upadhyay RP, Misra P, Chellaiyan VG, Das TK, Adhikary M, Chinnakali P, et al. Burden of diabetes mellitus and prediabetes in tribal population of India: A systematic review. Diabetes Res Clin Pract 2013;102:1-7.
13. Rizwan SA, Kumar R, Singh AK, Kusuma YS, Yadav K, Pandav CS. Prevalence of hypertension in Indian tribes: A systematic review and meta-analysis of observational studies. PLoS One 2014;9:e95886.
14. Diet and Nutritional Status of Tribal Population and Prevalence of Hypertension among Adults – Report on Second Repeat Survey. National Nutrition Monitoring Bureau; National Institute of Nutrition Indian Council of Medical Research Hyderabad, India. Technical Report, 25, 2009.
15. World Health Organization. Physical Status: The Use and Interpretation of Anthropometry. Technical Report Series No. 854. Geneva: World Health Organization; 1995.
16. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: The JNC 7 report. JAMA 2003;289:2560-72.
17. Karon BS, Gandhi GY, Nuttall GA, Bryant SC, Schaff HV, McMahon MM, et al. Accuracy of roche accu-chek inform whole blood capillary, arterial, and venous glucose values in patients receiving intensive intravenous insulin therapy after cardiac surgery. Am J Clin Pathol 2007;127:919-26.
18. Allain CC, Poon LS, Chan CS, Richmond W, Fu PC. Enzymatic
19. Rao VG, Gopi PG, Bhat J, Yadav R, Selvakumar N, Wares DF. Selected risk factors associated with pulmonary tuberculosis among Saharia tribe of Madhya Pradesh, central India. Eur J Public Health 2012;22:271-3.

20. Mandani B, Vaghani B, Gorasiya M, Patel P. Epidemiological factors associated with hypertension among tribal population in Gujarat. Natl J Community Med 2011;2:133-5.

21. Waghmore S, Jojo B. Socio-Economic Issues Facing Katkaris a Report Prepared for Rest of Maharashtra Development Board. Available from: https://www.researchgate.net/publication/290438347. [Last accessed on 2016 Oct 06].

22. National Family Health Survey (NFHS-3) India 2005-06. Nutritional Status of Women and Men; 2005-06. p. 303-5. Available from: https://www.dhsprogram.com/pubs/pdf/FRIND3/FRIND3‑Vol1AndVol2.pdf. [Last accessed on 2016 Jun 05].

23. Shukla HC, Gupta PC, Mehta HC, Hebert JR. Descriptive epidemiology of body mass index of an urban adult population in western India. J Epidemiol Community Health 2002;56:876-80.

24. Subramanian SV, Smith GD. Patterns, distribution, and determinants of under- and overnutrition: A population-based study of women in India. Am J Clin Nutr 2006;84:633-40.

25. Yajnik CS. Obesity epidemic in India: Intrauterine origins? Proc Nutr Soc 2004;63:387-96.

26. Jacob SK. Prevalence of obesity and overweight among school going children in rural areas of Ernakulam district, Kerala state India. Int J Sci Stud 2014;2:16-9.

27. International Diabetes Federation – Diabetes Atlas. 6th ed. 2013. p. 13. Available from: http://www.file:///G:/Int%20Diab%20Fed%20Atlas%206th.pdf. [Last accessed on 2015 Feb 16].

28. Sachdev B. Screening of type 2 diabetes mellitus and its associated risk factors among select tribes of Rajasthan. Int J Health Sci Res 2012;2:33-44.

29. Type 2 Diabetes Risk Factors – Mayo Clinic. Available from: http://www.mayoclinic.org/./type-2-diabetes/./risk-factors/con-228. [Last accessed on 2016 Jun 10].

30. Sharma M. Distribution of Tribal Population Based on Racial and Linguistic in India. Available from: http://www.yourarticlelibrary.com/essay/distribution-of-tribal-population-based-on-racial-and-linguistic-in-india/41300/. [Last accessed on 2016 Jun 10].

31. Tyagi S, Pati HP, Choudhry VP, Saxena R. Clinico-haematological profile of HbE syndrome in adults and children. Hematology 2004;9:57-60.