Original Article

# Examining tribal health inequalities around three forested sites in India: Results of a cross-sectional survey

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## Abstract

**Background:** The data available for the health of Scheduled Tribes (ST) in India are often coarse-scale snapshots at district and state levels and fine-scale comparison within and across site is often not possible. In this paper, we examine the health inequalities between the ST and non-ST populations in two forested sites and compare the healthcare parameters for ST populations across three forested sites. **Methods:** We conducted a cross-sectional household survey in three sites in and around three tiger reserves in Karnataka, Madhya Pradesh (MP) and Arunachal Pradesh (AP). In each site, multi-stage sampling and cluster analysis provided a representative sample of households across villages of 859 ST and non-ST households. We examined the sociodemographic and health-related information including self-reported illnesses and healthcare utilisation; from these, we explored the within-site health inequality patterns for the two sites and intersite differences among the ST households of the three sites. **Results:** In Karnataka, the ST and non-ST differences favoured the latter with regard to socio-economic characteristics with no difference in self-reported illness/injuries or healthcare utilisation. In MP, both groups were similar with regard to socio-economic characteristics and healthcare utilisation. AP ST households reported the highest healthcare utilisation, while MP ST households reported the lowest care seeking at hospitals and relied on home networks and health workers. High tobacco consumption was noted among ST groups in all the sites. **Conclusions:** The ST and non-ST inequality patterns at a fine-scale were different between Karnataka and MP. The absence of health inequalities in MP indicates a uniform socio-geographical disadvantage while poor healthcare utilisation by ST people in Karnataka indicates health inequities. The ST households of AP reported the highest utilisation while those of MP reported the lowest. Programmes addressing the health inequalities of STs need to consider site-specific assessments of socio-geographical and health system factors.

**Keywords:** Forests, health inequalities, healthcare access, indigenous health, tiger reserves, tribal health

## Introduction

India's tribal population of 104 million people (the second highest in the world) have poor health indicators as compared to other social categories.[1-4] Mortality among children under five (tribal population: 57.2 deaths under-5 per 1000 live births, others: 38.5), malnutrition (tribal population: 42.3% stunting among children under 5 years, others: 33.9%) and many other health indicators related to healthcare access and immunisation (tribal population: 55.7% full immunisation, others: 71.6%) are worse-off among the tribal populations of India.[3,5-7] In fact, these nation-wide patterns mirror the findings from the largest global study on indigenous populations where tribal populations had worse-off indicators such as infant mortality rate (IMR, 4.5 times higher), maternal

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mortality ratio (3.6 times higher) and proportion of children under-five with stunting (2.4 times higher).[1] While acknowledging the importance of the question of why tribal communities are 'behind everyone, everywhere' with respect to health status and healthcare access, There is a need for more granular analysis of the health of indigenous communities.[1,8]

The term Scheduled Tribes (hereafter ST; derived from Article 342 of the Indian Constitution) is a common identifier for a heterogeneous group of tribal communities in India.[9,10] This constitutional specification of STs aggregates distinct and diverse genetic, ethnic, cultural and social populations.[11,12] This includes 705 notified ST communities, with each Indian State notifying its own ST list. In the general landscape where our study was conducted, the South Indian states had lowest percentages of STs (7% in Karnataka) compared to Central India (21% in Madhya Pradesh) while STs were a majority in Northeast India (69% in Arunachal Pradesh).[13]

The main source of information about the health status of ST population is either from the National Family Health Surveys (NFHS), nationwide surveys across a representative sample of households, or single-tribe prevalence studies.[14,15] The four rounds of NFHS surveys allow for the comparison of ST and other broad social categories.[5,12] The recent NFHS survey (2015–2016) found that STs had the lowest institutional delivery rates (ST: 68%, national average: 80%), lowest full immunisation rates (ST: 56%, national average: 62%), highest stunting (ST: 44%; national average: 38%) and wasting (ST: 45%, national average: 36%) when compared to others.[7] Even in these surveys, there are design constraints for assessing the population health of particular ST communities within a district or state. Furthermore, fine-scale comparisons (for instance, at the district or sub-district level) across tribal communities in different states/regions are not possible.[5,12] Other sources of information on the health of ST population are the national surveys conducted for specific health problems and reports released by the Indian government's Ministry of Health & Family Welfare (Rural Health Statistics, for instance) or Ministry of Tribal Affairs (Statistical Profile of Scheduled Tribes 2010 for instance). These provide snapshots that allow state-level disaggregation of various health-related parameters with limited or nil local-, district- or tribe-level information.[5,10,12,16] The paucity of disaggregated data on the health status and health care utilisation of tribal populations in India is repeatedly stated in different tribal health reports, while noting that even when available, disaggregated data is limited in information and dated.[5,12]

The need for granular ST data is because of social and cultural heterogeneity across ST groups as well as the varying geographical landscapes that they live and depend on.[5,12] A close association with forests is seen across most ST populations. For instance, the Forest Survey of India 2017 revealed that 215 districts with a relatively higher tribal population had an average of 37% forested area when compared with the nationwide forest cover average of 21%.[17] In Northeast India, with large areas under forest cover, STs are a majority in six of the seven states (75–90% in some states).[10] Thus, it is important to understand the healthcare access of STs in relation to the forested landscape they live in, in addition to other social determinants of health.[18] Furthermore, the history of several ST communities is closely aligned with struggles for land rights and access to forest produce to sustain livelihoods; their overarching social effects are linked with overall socio-economic and political disadvantages.[5,19,20] Access to forests for livelihood and secure land tenure differ from one area to another in India, and forest regimes and ST identity in Northeast India are well known to be different from that in Central and South Indian forested areas.[21,22] The National Health Policy 2017 also acknowledges the challenges faced by the ST communities are geographical and infrastructural and calls for situation-specific reforms in health service delivery although it does not convert this into any specific strategy or reform.[23]

In this study, we explored the health of select households in forested landscapes in three states, each in a different region of the country, namely Arunachal Pradesh, Madhya Pradesh and Karnataka. These states significantly vary with respect to their ST populations as evident in Table 1. Arunachal Pradesh has the highest proportion of ST population with relatively better-off indicators with an IMR comparable to the national average; Karnataka, on the other end of the spectrum, has the lowest proportion of ST population with the lowest IMR but relatively poorer social indicators among its ST population [Table 1]. State-level disaggregated data reveal that health inequalities between ST and non-ST vary from state to state with a significant gap in mortality rates among children under-five in Madhya Pradesh as compared to Karnataka [Figure 1].

In this paper, we examine the health inequalities between ST and non-ST population living in the same area in forested landscapes in South and Central India. Furthermore, we compared the various healthcare parameters for ST populations in three forest areas in three regions of India based on the data obtained from a larger collaborative study between public health researchers and ecologists that examined the current and future correlates of forest dependence in four Indian forest areas. The study also focused on collecting select health-related parameters at household level across ST and non-ST communities.[24]

## Methods

### Study setting and design

The study was conducted among communities living around four Indian tiger reserves (a class of Protected Areas with the highest degree of restrictions on human activities) namely Kanha (Madhya Pradesh), Pakke (Arunachal Pradesh), Biligiri Ranganathaswamy Temple (BRT, Karnataka) and Corbett (Uttarakhand). The study received ethical permissions from the Institutional Review Board of the Columbia University.[24] Ethics approval for this study was granted by the Institutional Review Board at Columbia University to NDV

[IRB-AAAR2467] dated 16/02/2017 (valid up to 15/02/2022). In this paper, we examined a subset of data on healthcare parameters from households identified using multi-stage cluster sampling in three of its sites excluding Corbett [Figure 2]. The ST communities living around these three sites are mainly the *Gonds* and *Baigas* around Kanha, the *Nyishis*, *Akas* and *Puroiks* around Pakke (six other STs live in the area but in smaller numbers) and *Soligas* in and around BRT. The non-ST communities in these sites were *Pawar*, *Marar*, *Lodhi* and *Yadavs* around Kanha, temporary migrant populations from outside the state in Pakke albeit in small numbers, and *Dalits*, *Upparas*, *Lingayats*, and *Brahmins* around BRT.

These tiger reserves span different management histories and residents use these forests in different ways. Kanha is one of India's oldest tiger reserves (declared in 1974) while Pakke and BRT were declared as tiger reserves in 2002 and 2011, respectively. The three sites vary in the history and intensity of relocation efforts.[25] The ST population in all the three study sites rely to varying extent on the extraction of non-timber forest products in addition to firewood and livestock grazing, albeit with important local differences in access to forests for ST. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 which recognises land and occupation rights has been implemented to a greater extent in BRT (compared to other sites) where 25 *gram sabhas* (a unit of local level governance) received community forest rights.[26] These sites have diverse socio-economic and cultural settings, with differing relationships between communities and forests, and policies and practices with respect to forest access and management. A detailed summary for each study site and its implications on conservation efforts is published elsewhere.[24]

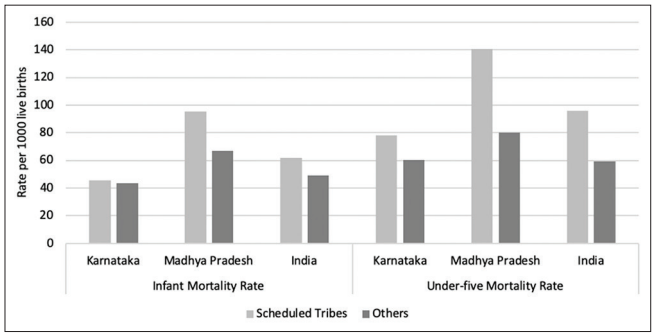


**Figure 1:** Health inequalities between ST and other populations in Karnataka and Madhya Pradesh with national figures (NFHS 2005-06) 12

The study design was cross-sectional, and we examined the socio-demographic and healthcare-related data for 859 households from the three sites (BRT: 329, Kanha: 322 and Pakke: 208). Our sampling frame for STs is comprised of 41% of households in BRT, 70% in Kanha and 95% in Pakke. For each site, we selected villages (from the 2011 Census of India) using a cluster analysis (with distance to tiger reserve boundary, forest, road, town or city) from five clusters (>75% of the variance was captured by the cluster analysis). After the pilot, we added new villages that were not on our initial map and/or replaced villages from the same cluster that could not be found. Using a random start point in the village, we sampled 8 to 12 households per village where we walked in different cardinal directions in order to sample three to four households in each direction. In smaller villages, we sampled nearly all households and while this may have resulted in clustering within a village, we expect that within-site across village bias would be minimised with our differing random start point for each village. Our households were represented by various demographic profiles that spanned different tribes, education levels, land-holding sizes, household occupations [Table 2].

## Data collection

Prior to the survey, we conducted field visits to each site to establish field teams and develop the questionnaire through small pilots. Approval was sought from local community

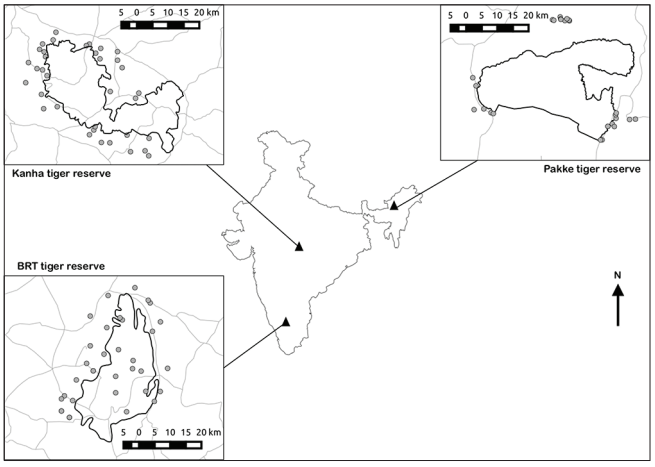


**Figure 2:** The three study sites, each in a different region of the country, showing the studied villages in which the 859 study households were located

**Table 1: A profile of ST population indicators in the three study states (Arunachal Pradesh, Karnataka and Madhya Pradesh) compared with national averages[5,12]**

| States | ST population proportion | Education till secondary school | Households using clean cooking fuel^ | Infant Mortality Rate^^ | Sources for treatment seeking | |
|---|---|---|---|---|---|---|
| | | | | | Public | Private |
| Arunachal Pradesh | 69% | 34.5% | 23.9% | 67.6 | 96.5 | 2.5 |
| Karnataka | 7% | 24.5% | 14.3% | 45.8 | 47.2 | 51.8 |
| Madhya Pradesh | 21% | 14.2% | 3.6% | 95.6 | 59.9 | 38.8 |
| India | 9% | 21.9% | 9.5% | 62.1 | 77.3 | 20.2 |
| Source | Census 2011 | NSSO 68th 2011-12 | Census 2011 | NFHS 3 2005-06 | DLHS 2007-08 | |

^Clean cooking fuel includes PNG/LPG, electricity, biogas ^^infant deaths per 1000 live births

representatives at each site to undertake the study. The survey was conducted in three languages (Hindi, Assamese and Kannada), each corresponding to the most widely spoken language in that site. Subsequently, we conducted training sessions for data collectors and finally data collection was completed between December 2016 and September 2017. We conducted household surveys using a structured questionnaire with visual aids following verbal informed consent at each household. The questionnaire collected information on various themes of which those related to health were: (1) the nature of healthcare utilisation and illnesses: self-reported illnesses, the point of first-care, treatment of minor ailments, hospitalisation, maternal care and preferences for health services; and (2) how these behaviours and preferences are related to the socio-demographic characteristics and tribal and non-tribal affiliations. Data on the consumption of tobacco and alcohol were collected for the past week, minor ailments for the past month and hospitalisation for the past year. We interviewed either the household head or any adult who was willing to speak on behalf of the household following verbal consent (51% were females). Our interviews typically lasted 40–60 minutes. Data was entered into a spreadsheet at each site and all three data spreadsheets were checked for errors and merged to create a master dataset. Further details of data collection along with the questionnaire with variables are published elsewhere.[24]

In each site, the researchers coordinated with local community representatives to inform them of the research and sought permissions to pursue this research. In all three sites, the members of local communities were involved in piloting the tools and were the primary respondents of the survey. The data collection teams in the three sites comprised of researchers and members from the local communities, who were trained in administering the survey tools.

## Data analysis

We used Program R (R Core Team 2017) for cluster analysis and SPSS statistics (version 23) for data analyses. We classified the households into ST and non-ST categories, and analysed the household and health-related characteristics across these two categories within each site for BRT and Kanha only (BRT ST: 136 non-ST: 193, Kanha ST: 225 non-ST: 97). In Pakke, due to the low proportion of non-ST household presence, only the ST household data was included (only 10 non-ST households were identified and not included due to the low number). Comparisons of the ST households were conducted across the three sites: BRT, Kanha and Pakke (BRT: 136, Kanha: 225 and Pakke: 208). The results of the study are presented in this order. We estimated bootstrapped means and 95% Confidence Intervals (CI, based on 1000 bootstrap iterations). We inferred significance in differences when CIs were non-overlapping.

# Results

## Health inequalities within the site BRT and Kanha

The pattern of inequality between ST and non-ST households varied between BRT and Kanha. We report below the specific differences.

In BRT, the ST households (41% of total households in the site) firewood more (ST: 71% and non-ST: 34%), less wealthy (ST: 2.9 and non-ST: 5.1 average asset count per household), less likely to have toilets in their houses (ST: 36% and non-ST: 61%) and had higher overall tobacco use (ST: 64% and non-ST: 34.7%) compared to non-STs (Table 2; all differences based on non-overlapping CIs). However, relatively lesser BRT ST households reported spending > 50% income on food (ST: 75%

**Table 2: Socio-economic and socio-political characteristics of ST and non-ST households within BRT and Kanha and for ST alone in Pakke *(Proportion of households (unless otherwise indicated) with 95% CI indicated in parentheses, significant findings indicated by*with 95% CI not overlapping)***

| Household characteristics ST | BRT | | Kanha | | Pakke |
|---|---|---|---|---|---|
| | Non-ST | ST | Non-ST | ST | |
| No. of households studied (within-site proportion) | 136 (41%) | 193 (59%) | 225 (70%) | 97 (30%) | 208 |
| Average household size | 3.9 (3.6-4.2) | 4.4 (4-4.7) | 5 (4.8-5.3) | 5 (4.6-5.3) | 6.4 (6.1-6.8) |
| Average no. of dependents# | 1.3 (1.2-1.5) | 1.6 (1.4-1.8) | 1.8 (1.6-1.9) | 1.9 (1.7-2.2) | 4 (3.7-4.3) |
| Firewood only as cooking fuel | 71% (63-78)* | 34% (27-40)* | 89% (85-93) | 82% (74-90) | 34% (27-40) |
| Water-source at or near home | 54% (45-62) | 68% (61-76) | 3% (1-5) | 4% (2-7) | 76% (71-83) |
| Toilet present in house | 36% (28-44)* | 61% (55-68)* | 38% (32-44) | 47% (38-58) | 82% (76-87) |
| Average asset count per household^ | 2.9 (2.7-3.3)* | 5.1 (4.9-5.5)* | 2.6 (2.4-2.8) | 2.7 (2.3-3) | 5.2 (4.9-5.5) |
| Substance use in past week by any household member — Tobacco (in any form) | 64% (56-72)* | 35% (28-41)* | 89% (85-93)* | 73.% (64-82)* | 67% (60-73) |
| Substance use in past week by any household member — Alcohol | 26% (19-33) | 26% (20-33) | 53% (47-60) | 41% (31-51) | 38% (31-45) |
| At least one member migrated for work in past three months | 13% (7-19) | 8% (5-13) | 42% (36-48) | 36% (26-46) | 61% (54-68) |
| Spend >50% income on food | 75% (68-82)* | 88% (83-92)* | 72% (66-78) | 68% (59-77) | 37% (31-44) |
| Average no. of income setbacks in past year^^ | 3.5 (3.2-3.9) | 3.1 (2.9-3.3) | 5.4 (5.2-5.5) | 5 (4.7-5.3) | 5.4 (5.1-5.7) |
| Average no. of schemes utilised in past year^^^ | 2.5 (2.3-2.7) | 2.4 (2.2-2.6) | 2.3 (2.2-2.4) | 2.2 (2-2.4) | 4.1 (4-4.2) |
| Participation in village or higher politics by any member | 42% (34-50)* | 18% (12-23)* | 3% (1-5) | 8% (3-14) | 24% (19-30) |

non-income earning household members ^Sum of 18 different assets for each household including different livestock ^^15 income setbacks were assessed including environmental, social or other relevant setbacks ^^^9 government schemes including ration card, various pensions, Rashtriya Swasthya Bima Yojana [22]

and non-ST: 88% households) and reported higher political participation (ST: 42%, non-ST: 18%) when compared to non-STs (Table 2; all differences based on non-overlapping CIs). Overall, the ST and non-ST differences in BRT (unlike in Kanha; see below) were in favour of non-ST communities.

Despite differences in various household characteristics, there were no differences in BRT between the ST and non-ST households for self-reporting minor ailments, infectious diseases or serious injuries. Only reporting of non-communicable disease (NCD) was higher among non-STs than that of the ST households (11% and 3%, respectively, with non-overlapping 95% CIs) [Table 3]. Healthcare utilisation was similar for both groups of households. The first point of care for minor ailments was either the health worker (46% ST 44% non-ST) or hospital (36% ST 43% non-ST), with half (46% ST 60% non-ST) approaching the primary health centre for care eventually [Table 3]. Most hospitalisations among the ST households (58%) were in public hospitals as compared to the private hospitals in case of the non-ST households (73%), though this was not statistically significant.

In Kanha, the ST households (70% of all households in the site) appeared to be similar to non-ST households in terms of all studied household characteristics including household size, firewood dependence, average asset count per households to name a few, except for tobacco use [Table 2]. The ST households in Kanha reported significantly higher tobacco use as compared to the non-STs (ST: 89%, non-ST: 73% with non-overlapping CIs). The Kanha ST and non-ST households were similar with respect to self-reported minor ailments and hospitalisations in the past year as well. We find that care-seeking at hospitals was never the first choice in case of minor ailments for both ST and non-ST, and eventually both tend to seek care at public hospitals for hospitalisations too. The absence of significant inequalities between the ST and non-ST households in Kanha is in contrast to BRT, although absolute health and household parameters indicate a more uniform disadvantage across the ST and non-ST households across Kanha.

## Variations in healthcare parameters of ST households across the three sites BRT, Kanha and Pakke

From the literature review, we expected ST households to vary significantly between sites, but the patterns seen in the results are significantly different. Pakke ST households had a larger household size (average 6.4 Pakke vs 3.9 BRT 5 Kanha) with more dependents (average 4 Pakke vs 1.3 BRT 1.8 Kanha) and higher migration (61% Pakke vs 13% BRT 42% Kanha). However, they had better-off indicators for most household characteristics when compared with ST households at BRT and Kanha. For instance, most Pakke ST households reported a toilet at home (82% Pakke vs 36% BRT 38% Kanha), water-source at or near home (76% Pakke vs 54% BRT 3% Kanha) with low firewood dependence (34% Pakke vs 71% BRT and 89% Kanha), high average asset count (5.2 Pakke vs 2.9 BRT 2.6 Kanha) and lowest reports of spending >50% income on food (37% Pakke vs 75% BRT 72% Kanha) when compared to BRT and Kanha ST households.

Kanha, on the other hand, reported the highest firewood dependence (mentioned earlier), poorest availability of water-source at or near home with highest reported alcohol (53% Kanha vs 26% BRT 38% Pakke) and tobacco consumption (89% Kanha vs 64% BRT 67% Pakke) when compared to BRT and Pakke ST households [Table 2].The BRT ST households were at the middle

**Table 3: Health-related characteristics and healthcare utilisation of ST and non-ST households within BRT and Kanha and for ST alone in Pakke *(Proportion of households (unless otherwise indicated) with 95% CI indicated in parentheses, significant findings indicated by*with 95% CI not overlapping)***

| Health related characteristics ST | | BRT | | Kanha | | Pakke |
|---|---|---|---|---|---|---|
| | | Non-ST | ST | Non-ST | ST | |
| Minor ailments reported in past month | | 51% (42-59) | 40% (33-47) | 19% (14-24) | 10% (5-17) | 34% (28-41) |
| First point of care for minor ailment | Home/friends | 17% (9-26) | 13% (6-21) | 67% (53-81) | 40% (9-75) | 10% (4-17) |
| | Health worker | 46% (34-58) | 44% (33-56) | 33% (19-47) | 60% (25-91) | 0 |
| | Hospital | 36% (25-48) | 43% (31-53) | 0 | 0 | 90% (83-97) |
| Type of hospital eventually visited for minor ailment[$] | Primary health centre (public) | 46% (34-59) | 60% (48-71) | 7% (0-16) | 20% (0-50) | 31% (21-42) |
| | Other public hospital | 4% (0-10) | 17% (9-25) | 19% (8-30) | 50% (17-80) | 44% (32-55) |
| | Private hospital | 38% (26-50) | 18% (10-28) | 7% (0-16) | 0 | 25% (16-36) |
| | Did not visit hospital | 12% (5-19) | 4% (0-8) | 67% (54-81) | 30% (0-63) | 0 |
| Infectious diseases reported in past year (malaria/tuberculosis) | | 9% (4-14) | 5% (2-8) | 5% (2-8) | 6% (2-11) | 12% (8-17) |
| NCDs reported in past year (diabetes mellitus/hypertension/cancer) | | 3% (1-6)* | 11% (7-16)* | 0.9% (0-2) | 0 | 6% (3-10) |
| Serious injury (including snake bite) | | 1% (0-3) | 2% (1-4) | 1% (0-3) | 0 | 1% (0-3) |
| Household with a childbirth in past year | | 12% (7-17) | 6% (3-10) | 7% (4-10) | 9% (4-16) | 7% (4-10) |
| Hospital admission(s) reported in past year | | 24% (17-32) | 23% (18-29) | 10% (6-14) | 14% (8-22) | 33% (26-39) |
| Type of hospital utilised for admission[$$] | Public health centre | 58% (39-74) | 27% (14-40) | 82% (64-96) | 53% (29-80) | 54% (42-66) |
| | Private health centre | 42% (26-61) | 73% (61-86) | 18% (4-36) | 47% (20-71) | 42% (30-54) |

[$]Details for 1 non-ST household in BRT not available [$$]Not available for 3 ST households in Pakke

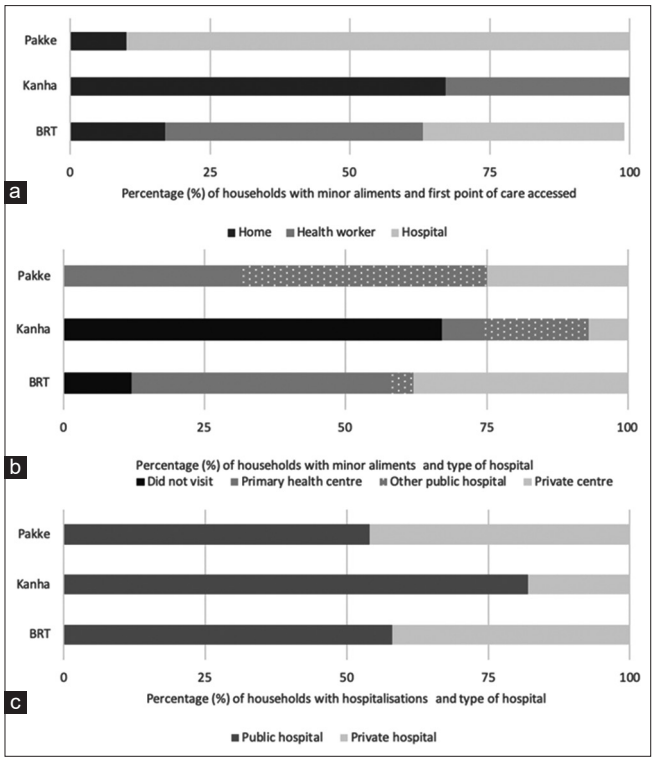


**Figure 3:** Variations in healthcare utilisation among ST households in three sites: BRT, Kanha and Pakke (a) The first point of care for minor ailments, (b) Type of hospital eventually visited for minor ailments and (c) Type of hospital utilised for admissions

of this spectrum though for a few household characteristics, they were comparable to Kanha ST households; for instance, the presence of toilet in house (36% BRT 38% Kanha), average asset count (2.9 BRT 2.6 Kanha) and relatively higher proportions of spending >50% income on food (75% BRT 72% Kanha).

With respect to the healthcare-related characteristics of the ST households in the three sites, differences were noted for self-reporting of minor ailments, hospitalisations and healthcare utilisation [Table 3]. The highest self-reporting of minor ailments was seen among BRT ST households (51%) and lowest in Kanha (19%). The first point of care for BRT households was a health worker closely followed by hospital (46% and 36%). In Kanha however, home remedies were the first choice (67%) with none going to a hospital while the opposite was seen in Pakke with 90% of households with minor ailments approaching hospitals immediately. In Kanha 67% with minor ailments never went to any hospital [Table 3, Figure 3], and for those who did make it to hospitals in the other sites, 75% Pakke and 50% BRT went to public hospitals. Coming to hospitalisations, the lowest was reported among Kanha ST households (10% Kanha vs 24% BRT 33% Pakke) and 82% of them went to public hospitals. More than half of BRT and Pakke hospitalisations were reported at public hospitals too (58% and 54% respectively) [Figure 3].

## Discussion

There are few studies that examine the ST and non-ST inequalities in a given landscape.[27-30] Rather, most studies (such as those based on NFHS data) allow for ST and non-ST comparisons at state or higher levels (up to districts from NFHS-4 onwards).[4,31] By sampling in particular forested landscapes, our study enabled a finer scale comparison within sites at a local level. This allowed us to examine if national- and state-level ST and non-ST differences persist at such scales as well, given that both ST and non-ST communities that we sampled face comparable geographical and social disadvantages associated with living in or around forests. The persistence of ST and non-ST differences in our samples could help deepen our understanding of the drivers of ST inequalities. The picture of inequalities when examined at a finer scale were significantly different than those reported by NFHS surveys and contrast between the ST and non-ST inequality patterns in BRT and Kanha is striking. In the latter site, the geographical and social disadvantages and their healthcare utilisation appeared to be distributed across the households irrespective of ST status, indicating the factors beyond ST identity driving overall socio-economic and health indicators.

The inter-site differences in the socio-demographic and health-related characteristics of ST households highlight the variation in ST populations in relation to local context and state health systems; this has also been seen for antenatal care services in other studies.[32] In terms of overall state-level ST health indicators, the IMR for Karnataka ST population is better-off (45.8 per 1000 live births), followed by Arunachal Pradesh (67.6 per 1000 live births) and Madhya Pradesh (95.6 per 1000 live births) with a similar pattern for several other health outcomes [Table 1]. However, when we compare health services' infrastructure and human resources in ST areas as per Rural Health Statistics 2014–2015, we find a mixed picture.[16] Arunachal Pradesh reports adequate numbers of subcentres and Primary Health Centres (PHCs) with 43% shortage of female health workers in subcentres and only 13% doctor vacancies in PHCs; Madhya Pradesh needs to increase its subcentres by 38% but has female health workers in excess with only 10% doctor vacancies at PHC; Karnataka, however, needs to increase its subcentres by 72% with 25% female health workers shortage and 40% doctor vacancies in PHCs.[16] In our study, accessing the health services was highest in Pakke and lowest in Kanha despite having comparable services in place as per state-level information [Figure 3]. Access to health services was relatively low for BRT in comparison with Pakke reconfirming that services in tribal areas are lacking in Karnataka despite having a better-off health services distribution among the three states.[33] Hence, with widespread improvements in the availability of health services infrastructure through the National Health Mission in states like Karnataka, efforts to address tribal health inequalities at district and sub-district level need to focus on the fine-scale patterns of healthcare access to ST communities in the state.

The high prevalence of tobacco and alcohol consumption among tribal populations is documented in many reports and studies and this has also been linked to other co-morbidities including tuberculosis among tribal populations.[5,10,12,34,35] In our study also,

we found this to be significantly higher among ST households in BRT and Kanha when compared to non-ST. It must be noted that in Kanha the prevalence was high for both groups as compared to other sites with the highest prevalence across all sites reported in Kanha ST households (89%). In addition, the relatively high prevalence of alcohol consumption (53% ST and 41% non-ST) was noted in the site. Excess consumption of tobacco and alcohol's contribution to increased mortality is known and at this high prevalence, their contribution to the adverse health in the form of Tuberculosis, other NCDs and perhaps excess mortality can be inferred though these need to be studied to recognise their impact on these communities.[34-37] This has implications for the current gap in primary health care services in tribal areas which do not offer adequate cessation services for tobacco, alcohol and other addictions. Furthermore, PHC services and health workers catering to tribal populations may need more context-specific capacity-building on socio-cultural and technical aspects, and linkages to appropriate tertiary care centres and medical colleges to address the primary and secondary prevention and health promotion needs in these areas.

The health parameters chosen in the study were a subset of a larger research study and were limited in their scope by covering only self-reported conditions and utilisation of health services, as a proxy for overall healthcare access, and is not expected to be a comprehensive assessment of population health of these communities. Yet, in the lack of fine-scale data on tribal health, this provides an insight into within-group differentials and extent of variation across sites. Increasing the number of indicators, covering more sites and incorporating historical and qualitative inquiries on specific sites using social science or theory-driven inquiry could improve the potential for theorizing the drivers of inequalities among populations in and around forest areas.[38,39]

Overall, our study revealed patterns of inequalities at different sites but there is a need to explain the fine-scale drivers of inequalities taking into account the local socio-economic and health system factors, including the geographical and environmental factors related to living in and around protected forest areas. The contrast between the inequality patterns in Kanha and BRT highlight the importance of studying state and local health system factors in explaining tribal health inequities, possibly using implementation research and participatory health policy and systems research methods.[40] For a state like Karnataka, the poor healthcare utilisation of ST in BRT indicates health inequalities within the state and/or the contribution of local environmental factors that differentially affect tribal communities. The pattern seen in Kanha though appears to be a function of overall health services and system performance in the state and wider geographical/landscape level factors, it seems to affect both ST and non-ST communities.

## Key Message

- Most information on health inequalities of tribal communities in India is available only at district/state levels or through single-tribe prevalence surveys.
- The study examines the differences in the socio-demographic and health-related indicators of tribal and nearby non-tribal populations that share similar geographical disadvantages in three sites across India.
- The nature of health inequalities faced by tribal communities varies from one site to another. In some regions/sites, the nearby non-tribal communities too may be similarly disadvantaged with respect to health, necessitating site/context-specific policy and programs, in addition to national and state-wide programs.
- There is an urgent need to adapt primary healthcare services catering to tribal populations with context-specific tobacco and alcohol cessation services, primary and secondary prevention, and health promotion services

## List of abbreviations

*Listed in alphabetical order*

BRT – Biligiri Ranganathaswamy Temple

CI – Confidence Interval

IMR – Infant Mortality Rate

NFHS – National Family Health Surveys

NSSO – National Sample Survey Organisation

NCD – Non-Communicable Disease

PHC – Primary Health Centre

ST – Scheduled Tribe

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## Conflicts of interest

There are no conflicts of interest.

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