

Original Research Article

Cross-sectional study of demographic and health status of the scheduled tribe population in selected panchayat areas of Kallakurichi district, Tamil Nadu

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ABSTRACT

Background: Scheduled Tribes (STs) in rural areas often face economic deprivation, social marginalization, and limited access to essential services such as healthcare, education, employment, and income-generating opportunities. This community-based study assessed demographic data and NCD risk factors among STs in Kalrayan Hills, Kallakurichi District, Tamil Nadu.

Methods: The study was conducted from 1st June 2021 to 31st March 2022 in four ST-dominant regions, data on health-related demographics, the prevalence of NCDs, and associated risk factors were collected through door-to-door visits. The information was gathered via face-to-face interviews with respondents using a pre-designed survey format.

Results: Among 4,363 ST adults, 3.69% had hypertension, 2.20% diabetes, and 2.10% osteoarthritis. Nutritional assessments showed 2.15% were undernourished, and 2.5% overweight. Among newly diagnosed participants, 30.16% of females and 24.36% of males had hypertension. Diabetes was found in 6.07% of males and 8.14% of females aged 31 and above. Osteoarthritis was prevalent in 5.5% of males and 8.7% of females. Additionally, 46.6% followed a non-vegetarian diet, while 2.06% had alcohol addiction, and 4.95% were addicted to smoking.

Conclusions: Poor infrastructure and addiction issues contribute to health risks. The study emphasizes the need for improved healthcare access, early screening, and health education initiatives to promote NCD prevention and management in tribal communities.

Keywords: Cross-sectional study, Health disparities, Household survey, Non-communicable diseases, Public health intervention, Socio-demographic profile, Tribal health

INTRODUCTION

India is home to a diverse range of ethnic groups, with its tribal population standing at 10.43 crore, or 8.6% of the total population, according to the 2011 Census. Of this, 89.97% live in rural areas and 10.03% in urban areas.¹ In Tamil Nadu, the Scheduled Tribe (ST) population is 7,94,697, constituting 1.1% of the state's total population, with 85% residing in rural areas¹. The 36 STs notified in

Tamil Nadu by the Scheduled Castes and Scheduled Tribes Order (Amendment) Act, 1976, face significant economic and social marginalization, with limited access to health, education, and employment. Literacy rates for ST men and women in Tamil Nadu are 54.3% and 46.8%, respectively, lower than the national averages.^{2,3}

NCDs, such as diabetes and hypertension, are prevalent in southern India, with risk factors like overweight and

physical inactivity being more common in urban areas, while rural areas see higher rates of smokeless tobacco use and alcohol consumption.^{4,5} The Kalvarayan Hills taluk, part of Kallakurichi district since its bifurcation from Villupuram in 2019, is predominantly inhabited by the 'Malayali tribe'.⁶⁻⁸ This study profiles NCDs, socio-economic factors, and health risks in the region to inform effective planning and interventions for improving the health and living standards of the ST community.

The study's primary objective was profiling non-communicable diseases (NCDs) and health status in the ST population, profiling of Socio-demographic determinants and risk factors of NCDs among in selected Panchayat and villages of Kalrayan Hills Block, Kallakurichi district, and Tamil Nadu.

METHODS

This observational and community-based cross-sectional survey study was conducted from 1st June 2021 to 31st March 2022 after ethical approval of Dr. Achanta Lakshmipathi Regional Ayurveda Research Institute, Chennai. The study focused on the population from four selected Panchayat villages Vanjikuzhi, Serapattu, Kilakadu, and Innadu among the 15 ST dominated panchayat areas in the Kalrayan Hills Block of Kallakurichi District, Tamil Nadu. These villages were chosen based on the blocks outlined in the Performance Audit of the Tribal Sub-Plan Report (No. 33 of 2015) by the Comptroller and Auditor General (CAG) of India.⁹ Participants were recruited from selected areas, specifically targeting ST community members who voluntarily participated. A household survey identified ST individuals, forming the study's sampling frame. Non-ST residents were excluded. Health and demographic data for children under 18 were collected with parental assistance. As an observational study, data were collected and documented using a close-ended questionnaire. Descriptive data were presented as numbers and percentages, while continuous data were expressed as mean (SD).

The data for the following variables were collected using a structured questionnaire: 1) Village/Area Information: Details of the surveyed locations. 2) Demographic and Housing Conditions: Includes caste, tribe, religion, housing type, family size, ventilation, drinking water source, toilet facilities, drainage, and the number of children, women, and elderly per household. 3) General and Health Information (18+ Years): Covers personal and health aspects such as name, gender, age, marital status, education, occupation, addictions, NCDs, menstrual history (for women), diet, nutrition, lifestyle, and obesity status. 4) Quantitative Variables: Includes height, weight, blood pressure, hemoglobin, blood sugar, family size, healthcare visit frequency, age at first marriage,

individual ages, and the male-female distribution in the survey.

Study procedure

The CCRAS-ALRARI Chennai implemented a health survey in a selected ST-dominated area after briefing key local authorities, including the District Adi-Dravider Welfare Officer (ADWO), VAO, Sarpanch, Gram Panchayat members, and other officials, obtaining their approval. Weekly visits were conducted over a year to systematically survey households using standardized forms, capturing socio-demographic details, health behaviors, medical history, and current health conditions through structured face-to-face interviews. Anthropometric measurements were taken following standard procedures height using an anthropometric rod (MCP 20-210 cm) and weight using a calibrated digital weighing scale (S.cure). Health screening included blood pressure measurement with a sphygmomanometer and Omron automatic device, and blood tests for anemia and diabetes mellitus using the 'Kernel Multi Check GCU Hb' meter. Oral informed consent was obtained before testing. The project team underwent extensive training, and regular supervision ensured data accuracy. Selection bias was minimized by verifying participants' caste through government-issued ID cards, while standardized procedures helped maintain data consistency. However, convenience sampling posed a limitation, affecting generalizability. Data were collected using a close-ended questionnaire, with descriptive data presented as numbers and percentages and continuous data expressed as mean (SD). The sample size was calculated using
$$n = \frac{(Z^2 \alpha/2) * (p)(1-p)}{e^2}$$
 for a 50% NCD prevalence and 2% margin of error, yielding 2,401. With a design effect of 2 and a 20% non-response rate, the final target was approximately 5,800.

RESULTS

During the study period, 6,082 individuals from the ST population were surveyed across 1,407 households over 112 visits. Data on demographics and health were collected using a structured questionnaire from these participants, comprising 4,363 adults and 1,719 children. 100% participants belonged to the 'Malayali' tribe and the Hindu community.

NCDs and health status

The survey assessed the prevalence of non-communicable diseases (NCDs) such as hypertension, diabetes mellitus, cancer, stroke, COPD/asthma, and osteoarthritis among 4,363 adults. The findings revealed that 2.2% had been diagnosed with and were living with diabetes mellitus, 3.69% with hypertension (HTN), and 2.1% with osteoarthritis (Table 1).

Table 1: Prevalence of non-communicable diseases among the study population.

Disease condition	HTN/CVD	Diabetes	OA	Cancer, stroke, COPD/asthma	None	Total
Male	116	44	39	00	2027	2226
%	2.66	1.01	0.89	00	46.46	51.02
Female	45	52	53	00	1987	2137
%	1.03	1.19	1.21	00	45.54	48.98
Total	161	96	92	00	4014	4363
%	3.69	2.20	2.11	00	92.00	100

Table 2: An overview of the nutritional status, blood pressure levels, hemoglobin levels, and blood sugar levels among males and females in the surveyed population.

Category	Male (N)	Male (%)	Female (N)	Female (%)	Total (N)	Total (%)
Nutrition and obesity status						
Underweight	29	0.66	65	1.49	94	2.16
Normal (18.5-24.9)	2134	48.91	2026	46.44	4160	95.35
Overweight (25-29.9)	60	1.38	40	0.92	100	2.29
Obesity I (30-34.9)	1	0.02	1	0.02	2	0.05
Obesity II (35-39.9)	2	0.05	5	0.11	7	0.16
Blood Pressure (BP) levels						
Condition (<120/<80)	242	16.93	274	19.17	516	36.10
Condition (120-139/80-89)	301	21.06	270	18.90	571	39.96
Condition (140-159/90-99)	130	9.10	78	5.46	208	14.56
Condition ($\geq$ 160/ $\geq$ 100)	62	4.34	72	5.04	134	9.38
Hemoglobin (Hb) status						
Hb $\geq$ 13 (Male) / $\geq$ 12 (Female)	313	28.69	389	35.66	702	64.35
Hb 11-12.9 (Male) / 11-11.9 (Female)	49	4.49	89	8.16	138	12.64
Hb 8-10.9	57	5.22	191	17.51	248	22.73
Hb <8	0	0.00	3	0.27	3	0.27
Random Blood Sugar (RBS) levels						
Blood sugar level (<140)	286	36.95	378	48.84	664	43.02
Blood sugar level (140-199)	36	4.65	54	6.98	90	5.75
Blood sugar level ($\geq$ 200)	11	1.42	9	1.16	20	1.27

In addition to the health survey, data on nutritional status, blood pressure, hemoglobin levels, and random peripheral capillary blood sugar levels were collected from consenting adults and analysed. Nutritional status was assessed using BMI classifications, revealing that the majority of participants had a normal BMI. However, 2.15% were found to be undernourished, while 2.6% were classified as overweight or obese. The analysis of health data for 1,429 adults highlighted critical concerns related to blood pressure and anemia. A substantial 39.96% of the population was categorized as pre-hypertensive, indicating an elevated risk of progressing to hypertension if preventive measures are not taken. Furthermore, 24% were identified as hypertensive, with 14.56% in Grade 1 hypertension and 9.38% in Grade 2 hypertension. Anemia was another major concern, particularly among women. Among 1,091 Scheduled Tribe individuals aged 18 years and above, 17.51% of females had hemoglobin levels between 8 and 10.9 g/dl, indicating a significant prevalence of anemia. Regarding diabetes, among individuals aged 31 years and above, 4.65% of males and

6.98% of females were classified with Grade 1 diabetes, having blood sugar levels between 140 and 199 mg/dL. Additionally, 1.42% of males and 1.16% of females were identified with Grade 2 diabetes, with blood sugar levels exceeding 200 mg/dl (Table 2).

Amongst 2137 adult females surveyed, 63.92% have regular menstruation, 2.01% have primary amenorrhea, 32.99% have reached natural menopause, and 45.11% experience dysmenorrhea (Table 3).

Of the 1,719 ST children (<18 years), 76.44% are attending school, and 2.90% exhibit signs of pica. Respiratory infections affect 6.98% of the population, while 5.00% suffer from skin infections, and a small percentage are affected by gastrointestinal (GIT) infections. Among the girl children, 19.92% have reached menarche, 19.54% experience regular menstruation, and 20.81% of girls aged 11-18 years have not yet attained menarche (Table 4). In terms of malnutrition, 8.5% of male children and 9.4% of female children are classified as undernourished (Table 5).

Table 3: Menstrual history of participating population.

Menstrual history	Above 18-30 years N (%)	31-40 years N (%)	41 years & above N (%)	Total	N (%)
Menstruation					
Primary amenorrhea	31 (1.45)	11 (0.51)	1 (0.05)	43	2.01
Regular	776 (36.31)	438 (20.50)	152 (7.11)	1366	63.92
Irregular	5 (0.23)	17 (0.80)	1 (0.05)	23	1.08
Natural menopause	6 (0.28)	62 (2.90)	637 (29.81)	705	32.99
Menstrual pain					
Painless	0	0	0	0	0
Pain starts even before menstruation & relieved once bleeding starts	85 (3.98)	172 (8.05)	168 (7.86)	425	19.89
Pain begins with menstrual flow	397 (18.58)	299 (13.99)	268 (12.54)	964	45.11

Table 4: School attendance, dietary habits, health conditions, and menarche status of children (≤18 years). (total number of children surveyed-1719; male children- 936 & female children-783).

Variables	0-10 years, N (%)	11 to 18 years, N (%)	Total number	N (%)
Education (school going)				
Yes	749 (43.57)	565 (32.87)	1314	(76.44)
No	249 (14.49)	156 (9.08)	405	(23.56)
History of Pica				
Yes	46 (2.67)	4 (0.23)	50	(2.90)
No	952 (55.39)	717 (41.71)	1669	(97.10)
Recurrent infection (for RTI and GI more than 3 episodes in last 6 months; for skin infection-any infective lesion in last 6 months)				
Respiratory tract infections	85 (4.94)	35 (2.03)	120	(6.98)
Gastrointestinal tract infections	3 (0.17)	0	3	(0.17)
Skin infections	39 (2.26)	47 (2.73)	86	(5.00)
None	871 (50.66)	639 (37.17)	1510	(87.84)
Diet				
Vegetarian	368 (21.41)	7 (0.40)	375	(21.81)
Non-vegetarian	630 (36.64)	714 (41.53)	1344	(78.18)
Use of health supplements				
Iron Supplement	1 (0.05)	0	1	(0.05)
Multivitamin-multi-mineral/general health tonics	81 (4.71)	60 (3.49)	141	(8.20)
None	916 (53.28)	661 (38.45)	1577	(91.74)
Menstrual history				
Menarche				
Menarche attained	0	156 (19.92)	156	(19.92)
No	464 (59.25)	163 (20.81)	627	(80.08)
Pattern				
Menstrual periods regular	0	153 (19.54)	153	(19.54)
Menstrual periods irregular	0	3 (0.38)	3	(0.38)
Pain during menstruation				
Painless	0	0	0	0
Yes, starts even before menstruation and relieved once bleeding starts	0	105 (13.41)	105	(13.41)
Yes, begins with menstrual flow	0	51 (6.51)	51	(6.51)

Table 5: IAP Grading girls and boys body mass index charts: (0-18 years).

Weight Status	Normal	Underweight	Overweight	Total
Boys	712	147	77	936
%	76.10	15.71	8.23	100
Girls	580	162	41	783
%	74.18	20.69	5.23	100
Total	1292	309	118	1719
%	75.18	17.98	6.84	100

Table 6: Distribution of marital and education status among study participants.

Category	Male	%	Female	%	Total	%
Marital status						
Married	1618	37.08	1567	35.92	3185	73.00
Unmarried	567	13.00	281	6.44	848	19.44
Widower/widow	22	0.50	288	0.44	310	0.94
Divorce/separate	19	0.44	1	0.02	20	0.46
Educational status						
Illiterate (adult)	669	15.33	948	21.73	1617	37.06
Primary school (upto 5th)	207	4.74	263	6.03	470	10.77
Middle school (upto 8th)	275	6.30	239	5.38	514	11.68
High school (upto 10th)	319	7.31	253	5.80	572	13.11
Intermediate (12th/diploma)	418	9.58	210	4.81	628	14.43
Graduate & above	338	7.75	224	5.13	562	12.88

Table 7: Dietary habits and addictions among study participants.

	Number	%
Diet		
Non-vegetarian (average 3-4 times a week)	2037	46.6
Pure vegetarian	0	0.0
Fruits consumption (average 3-4 times a week)	322	7.3
Green vegetables consumption (average 3-4 times a week)	815	18.6
Addiction		
Tobacco (snuff)	2	0.045
Alcohol	90	2.06
Smoking	216	4.95
None	4055	92.9

Table 8: Occupational status among study participants.

Occupation status	Govt. employee	Non-govt. employee	Self-employed	Non-paid	Student	Home maker	Unemployed (able to work)	Unemployed (unable to work)	Total
Male	9	217	1404	0	298	0	160	120	2208
%	0.21	4.94	32.18	0	6.83	0	3.67	2.75	50.63
Female	3	30	116	3	196	1753	17	30	2148
%	0.07	0.69	2.66	0.07	4.49	40.18	0.39	0.85	49.37
Total	12	247	1520	3	494	1753	177	150	4356
%	0.28	5.63	34.84	0.07	11.32	40.18	4.06	3.60	100

Demographic data and general information

Out of the 4363 Scheduled Tribe adults surveyed, a notable 73% are married, while 19.44% remain unmarried. Education levels reveal that 37.06% of the

population is illiterate, with higher illiteracy rates among females compared to males (Table 6).

Dietary habits indicate that all participants are non-vegetarian, among them 46.6% consume in average 3-4 times a week, but 7.3% used to consume fruits in average,

and 18.6% people used to take green vegetables in average. Smoking and alcohol are general addictions (Table 7).

In terms of occupation, only 0.28% holds government positions, with a significant portion being self-employed

34.84% or homemakers 40.18% (Table 8). Housing conditions reveal that 60% of households live in pucca houses, though 33.12% lack adequate ventilation. Most households do not purify water, and 54.87% use open fields for toilets. Cooking methods vary, with 63.97% using LPG and 36.03% relying on wood (Table 9).

Table 9: Housing, sanitation, and utility facilities of surveyed households (n=1407).

Information	Items	Number	% out of house surveyed
Type of house	Pukka	838	59.56
	Semi Pukka	290	20.61
	Kutchha	279	19.83
Ventilation	Adequate	941	66.88
	Non adequate	466	33.12
Drinking water source	House tap	975	69.30
	Public tap/ community plant	429	30.49
	Tube well or borehole or well	2	0.14
	Tanker supply	1	0.07
Drinking water purification	Boil	3	0.21
	Add bleach/chlorine	8	0.57
	None	1394	99.08
Toilet facilities	Inside house	11	0.78
	Outside house	623	44.28
	Open field	772	54.87
	Public toilets	1	0.07
	Insecticide/treated nets	2	0.14
	Coils	1394	99.08
	Vaporizer	1	0.07
	None	10	0.71
Drainage facility	Open/surface drainage	612	43.50
	Closed/covered drainage system	134	9.52
	Indiscriminate disposal in the open	661	46.98
Fuel for cooking	LPG	900	63.97
	Biogas	0	0
	Wood coal/cow dung cake	507	36.03

DISCUSSION

Healthcare in the state has improved significantly over the last few decades with more people having increased access to medical care services.¹⁰ Separate schemes are implemented for the welfare of the SC/ST community in various sectors like education, health, employment, housing etc.,¹¹ Survey studies can bring information of the health influencing demography-related factors and thus have their unique way to contribute in adopting preventive strategies.¹² Only about 12% of people with hypertension in India have their blood pressure under control.¹³ The National Health Family Survey 5 (NFHS-5) reported the prevalence of hypertension in 24% men and 21% women.¹⁴ A study by Radhakrishnan et al among the tribal population of Salem district shows the prevalence of hypertension to be 31.6%.¹⁵ The prevalence of 7.8% diabetes and 26.2% hypertension is showing in two different studies in rural Tamil Nadu.^{16,17} The overall prevalence of anemia in a rural setting among a group of adolescent girls was 48.63%, which reflects upon the

burden of anemia attending a tertiary care hospital.¹⁸ High prevalence rates of anemia among women in rural Tamil Nadu have been consistently reported in various studies.^{19,20} The prevalence of Osteoarthritis in rural population of Kancheepuram District was 27.2% based on ACR clinical criteria.²¹ This cross-sectional study of the Scheduled Tribe (ST) population in the Kalrayan Hills Block, Kallakurichi District, Tamil Nadu, provides a comprehensive snapshot of the health status, prevalence of non-communicable diseases (NCDs), and socio-demographic factors influencing health outcomes. The findings highlight significant health challenges and infrastructure issues that impact this community's overall well-being.

Prevalence of non-communicable diseases

The study revealed a notable prevalence of NCDs among the surveyed adults. 3.69% hypertension and 2.2% diabetes mellitus were identified as significant health concerns; consistent with global trends of increasing

NCDs. Osteoarthritis was present in 2.1% of the population, reflecting the burden of musculoskeletal conditions. These findings align with the broader epidemiological patterns observed in similar populations but underscore the need for targeted interventions. The high percentage of pre-hypertension (39.96%) and hypertension (24%) points to an urgent need for hypertension management and prevention programs. The prevalence of anemia among females (17.51% with hemoglobin levels between 8 and 10.9 g/dL) is particularly concerning, suggesting a need for nutritional interventions and iron supplementation.

Nutritional status and risk factors

Tamil Nadu, show higher obesity rates compared to the national average, with Tamil Nadu experiencing a notable 9.5% increase in obesity from NFHS-4 to NFHS-5.²² The prevalence of under nourishment among children in rural area of Tamil Nadu was higher among male children (76.9%) than female children (56.3%) and was statistically significant.²³ Nutritional assessments indicated that while most participants had a normal BMI, 2.15% were undernourished, and 2.6% were classified as overweight or obese. In children, 17.9% were underweight and 6.7% were overweight. This nutritional profile highlights broader issues of limited access to a balanced diet, exacerbated by inadequate consumption of fruits (7.3%) and green vegetables (18.6%). These dietary patterns deviate from the World Health Organization's recommendations, which advocate for a balanced intake of diverse food groups, including ample fruits and vegetables, to ensure optimal nutrition and health.²⁴

The Tamil Nadu Tobacco Survey (2015-2016), conducted by the Adyar Cancer Institute, highlights that 0.2% of women in the state are tobacco smokers, while 0.4% use smokeless tobacco.²⁵ This data (4.96% smokers & alcohol 2.06%) highlight the presence of tobacco-related issues like respiratory tract infection (*Swasa & Kasa etc.*) within the population, the prevalence of smoking and alcohol use as common addictions further exacerbates health risks, contributing to the incidence of NCDs and complicating their management. These behaviors are critical areas for public health intervention, particularly in promoting cessation programs and healthier lifestyle choices.

Achieving menstrual health is crucial for upholding the equality, rights, and dignity of individuals who menstruate.²⁶ Tamil Nadu's strong commitment to menstrual hygiene management shows that state efforts can drive significant improvements.²⁷ Despite this, 45.11% of women experience dysmenorrhea and 2.01% report primary amenorrhea, highlighting ongoing issues. Additionally, 20.81% of female children aged 11-18 have not yet attained menarche, potentially due to nutritional deficiencies and dietary imbalances.

Socio-demographic insights

Socio-demographic data reveal that a significant portion 73% of the population was married, and educational attainment is low, with 37.06% of adults being illiterate. This educational deficit is particularly pronounced among females, which could impact health literacy and access to healthcare services. Low literacy levels are associated with poorer health outcomes and limited understanding of disease prevention and management. Employment data show that a majority are self-employed (34.84%) or homemakers (40.18%), with minimal representation in government positions (0.28%). The lack of formal employment opportunities may contribute to the socio-economic barriers impacting health.

Housing and environmental conditions

Housing conditions reflect significant infrastructural deficiencies. While 60% of households live in pukka houses, 33.12% lack adequate ventilation, and many households do not purify their drinking water. The reliance on open fields for sanitation (54.87%) and varied cooking methods (63.97% use LPG, 36.03% use wood) highlight critical areas for improvement. Inadequate housing and sanitation facilities contribute to environmental health risks, including respiratory, skin and gastrointestinal issues in that area.

Children's health and development

Many population-based studies have found a low level of serum iron/ferritin (and other micronutrients) among patients with pica.²⁸⁻³⁰ The underlying cause of pica in these children has to be identified and treated accordingly. The survey also sheds light on the health status of children. With 76.44% of children attending school, the focus should be on improving educational and nutritional outcomes. The prevalence of pica (2.90%) and undernutrition among children (8.5% of males and 9.4% of females) necessitates targeted nutritional interventions and health education programs for both children and their families.

A significant limitation of this study is its cross-sectional design, which captures data at a single point in time. This design restricts our ability to establish temporal relationships between cause and effect, thereby limiting our understanding of how health conditions develop or change over time. Specifically, cross-sectional studies can identify associations between variables but cannot determine the directionality of these relationships.

CONCLUSION

This study underscores the urgent need for targeted public health interventions to address the high burden of non-communicable diseases among the ST population in Kalrayan Hills. Poor infrastructure, unhealthy lifestyles, and addiction-related risks contribute to undiagnosed and

unmanaged health conditions, further worsened by limited healthcare access and low awareness. Strengthening healthcare facilities, improving sanitation, promoting balanced nutrition, and implementing early screening and health education programs are essential to improving health outcomes in these communities.

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