REPORT ON
GUT MICROBIAL GENOMIC STUDY AMONG THE PVTGs OF INDIA
2023-2024
PART-A (FIELD REPORT)

Anthropological Survey of India
Ministry of Culture
Government of India

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Preface

The study of human health and well-being has expanded far beyond conventional approaches, embracing a deeper understanding of the intricate relationships between human biology and environmental factors. In this context, the exploration of the human gut microbiome has become a critical area of research, especially for populations like the Particularly Vulnerable Tribal Groups (PVTGs) in India. These communities, with their distinct cultural practices, traditional diets, and unique living environments, offer a valuable perspective on human health and microbial diversity.

The Anthropological Survey of India initiated a national study titled "Gut Microbial Genomic Study among the PVTGs of India," in the Financial Year 2023-2024 with a clear mandate to complete the project in a period of three years covering about 40-45 PVTGs from all parts of the country. The project is expected to generate a comprehensive report on the gut microbiome diversity among six distinct PVTG communities across India. By examining the microbial composition in relation to dietary practices, socio-economic conditions, and health behaviors, this research seeks to provide insights into the impact of acculturation of the tribal communities on microbial diversity and the broader implications for public health.

The Anthropological Survey of India, through this initiative, has aimed to bridge the gap in existing knowledge about the gut microbiome of PVTGs. The findings of this research will offer a unique glimpse into the resilience of traditional lifestyles and their potential influence on microbial health. The first phase of this project covers six PVTGs: the Chenchu, Savara, Kolam, Kathodi, Lodha, and Birhor tribes, with detailed ethnographic and demographic data. The report is being prepared in three parts. The current report is Part I of the final report. This contains a brief context and coverage of the study, besides the findings of the data relating to field survey conducted among the six communities for necessary meta data.

This study not only contributes to the broader understanding and the effects of rapid lifestyle changes but also holds potential for shaping public health strategies tailored to these vulnerable populations. It is our hope that this report serves as a foundation for further research and interventions aimed at improving health outcomes, preserving traditional knowledge, and ensuring the well-being of India's diverse tribal communities.

Anthropological Survey of India
Ministry of Culture
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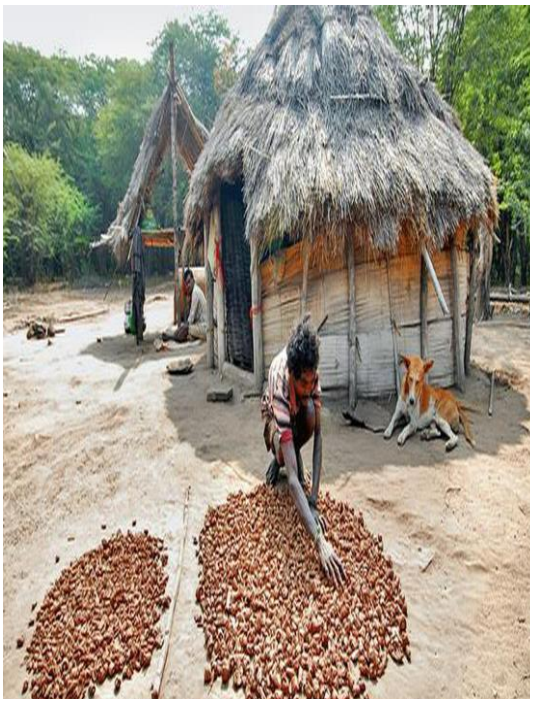
Research Team
Anthropological Survey of India

INTRODUCTION

The human gut microbiome, a complex ecosystem of microorganisms residing in the gastrointestinal tract, has emerged as a critical factor influencing health and disease. This intricate community plays essential roles in nutrient metabolism, immune function, and protection against pathogens (Turnbaugh et al., 2007). Recent advances in sequencing technologies have enabled detailed characterization of gut microbial communities, revealing their diversity and functional potential.

The study of gut microbiomes among Particularly Vulnerable Tribal Groups (PVTGs) in India is of special interest, as these populations often maintain traditional lifestyles and dietary practices that may influence their microbial profiles. Understanding the unique characteristics of PVTG gut microbiomes can provide valuable insights into human-microbe coevolution and the impacts of modernization on microbial diversity. Several factors influence the gut microbiome composition among PVTGs, including access to basic amenities, livelihoods and general economic conditions, personal and community hygiene, food habits and dietary practices, environmental exposures, and reduced exposure to antibiotics and processed foods (Rampelli et al., 2015; Gupta et al., 2017).



Limited access to clean water, sanitation facilities, and healthcare can significantly impact the microbial communities in the gut. Occupational exposures and socioeconomic status can affect diet quality and environmental interactions, thereby influencing the microbiome. Hygiene practices, often influenced by cultural norms and available resources, further shape the microbial ecosystem (Schnorr et al., 2014).

Traditional diets of PVTGs, often rich in plant-based foods and fermented products, can promote diverse and beneficial gut microbial communities (Clemente et al., 2015). Close contact with nature and traditional living conditions may expose PVTGs to a wider array of environmental microbes (Gomez et al., 2016), while limited access to modern healthcare and

processed foods may preserve certain beneficial microbes that have been lost in industrialized societies (Martínez et al., 2015).

The geographical location and seasonal changes can also significantly impact the gut microbiome of PVTGs. Studies on Himalayan populations have shown distinct microbial compositions influenced by altitude and seasonal dietary shifts (Jha et al., 2018). Moreover, many PVTGs rely on traditional medicine, often involving plant-based remedies, which may influence gut microbiome composition and function (Patel et al., 2019).

While environmental factors play a crucial role, host genetics also contribute to shaping the gut microbiome. Studies on Indian populations have revealed genetic variants associated with microbiome composition (Dhakan et al., 2019). Additionally, vertical transmission of microbes from mother to child and traditional birthing practices among PVTGs may contribute to unique early-life microbiome establishment (Kumar et al., 2020).

As some PVTG members involuntarily or voluntarily migrate to other geographical locations and get acculturated or assimilated into the so called mainstream societies, there is high likelihood of changes in the gut microbiome Studying the changes in their gut microbiome in such instances can provide insights into the effects of lifestyle transitions (Taneja, 2018). This aspect is particularly relevant as it may reveal how rapidly the gut microbiome adapts to new environmental conditions and dietary habits.

Studying the gut microbiomes of PVTGs can reveal beneficial microbes or microbial functions that have been diminished in industrialized populations. This knowledge could potentially inform strategies to address health disparities and improve overall health outcomes in both tribal and non-tribal communities. Furthermore, understanding the complex interplay between traditional lifestyles, environmental factors, and the gut microbiome may provide valuable insights for developing targeted interventions to promote health and prevent disease in diverse populations.

The study of gut microbiomes among PVTGs in India offers a unique opportunity to explore the intricate relationships between traditional lifestyles, environmental factors, and microbial communities. This research not only contributes to our understanding of human-microbe coevolution but also has the potential to inform public health strategies and personalized medicine approaches in an increasingly interconnected world. Given the unique lifestyles and dietary practices of PVTGs, studying their gut microbiomes could provide valuable insights into human-microbe interactions and potentially inform strategies for improving health outcomes in these vulnerable populations. However, there is currently a lack of comprehensive data on the gut microbial profiles of PVTGs in India.

To address this knowledge gap, the Anthropological Survey of India has initiated a national project titled "Gut Microbial Genomic Study among the PVTGs of India." This study aims to

characterize the gut microbiome diversity and investigate the relationship between gut microbial composition, dietary practices, and variations of microbes among select PVTGs. By elucidating the gut microbial profiles of these understudied populations in conjunction with detailed ethnographic data, this research seeks to contribute to the broader understanding of human microbiome variation and its implications for health and disease. The findings may also inform culturally appropriate interventions to improve health outcomes among PVTGs while respecting their traditional knowledge systems and practices.

The current study of AnSI:

The first phase of research study was undertaken on six PVTGs namely the Chenchu of Telangana, the Savara of Andhra Pradesh, the Kolam and the Kathodi of Maharashtra, the Lodha of West Bengal and Birhor of Jharkhand. The study specifically focussed to explore the gut microbiome diversity and its association with socio-demographic and economic factors, personal and community hygiene, food habits and dietary practices and access to and utilization of biomedicine. The six PVTGs included in this study represent diverse geographical, and ecological backgrounds, cultures and dietary practices.

The present report focuses on general introduction, socio-cultural profiles of the studied PVTGs, findings related to the survey on socio-demographic characteristics, and anthropometry of sample population in all the six PVTGs. This part of the report is expected to serve as background and context to the Part II of the report relating to the project that contains findings of genetic analysis of the faecal samples more specifically the taxonomic and functional analysis of microbiota.

ABOUT THE COMMUNITIES

The Chenchus of Telengana:

The Chenchu inhabit the Nallamalla hills in Andhra Pradesh and Telangana. In Telangana, they are spread over primarily in two mandals in the Nagarkurnool district. In Andhra Pradesh, Chenchus are seen in Kurnool, Prakasam and Guntur districts. A significant number of them live in all the other districts of Andhra Pradesh too. They are also seen in Karnataka, and Odisha.

In Telangana and Andhra Pradesh, they speak Telugu with some variance. As of August 2024, the Chenchu are a tribe in southern India that numbered about 65,000. The majority of Chenchus reside in Telangana and Andhra Pradesh, especially in the Nallamala jungle. 64,227 Chenchus were counted in five districts—two in Telangana and three in Andhra Pradesh—during the 2011 census. There were 32,196 men and 32,031 women, making up the child sex ratio of 988/1000. Overall, 40.6% of people were literate, with 47.3% of men and 34% of women being literate.
Their kinship is loosely structured into exogamous 'intiperu' groups. Thokala, Nimmala, Erra, Signla, Maindla are the major clans of the Chenchu. They live in nuclear families though the number of compound families is significant. The average family size is approximately 4.5. For all practical purposes husband and wife are partners with equal rights, and this equality of status means that the family may live with either the husband's or the wife's descent group. Each such group holds hereditary rights to a tract of land, and within its boundaries its members are free to hunt and collect edible roots and tubers. The Chenchus are characterized by a strong sense of independence and personal freedom. None of them feels bound to any particular locality, and the ability to move from one group to the other allows men and women to choose the companions with whom they wish to share their daily lives.

Marriage rules are based on the exogamy of patrilineal clans. As long as they observe the rules of clan exogamy young people are free to marry whomsoever they wish. Spouses can separate without any formality, but the abduction of a woman still living with her husband is disapproved of as immoral. The cross cousin and uncle-niece marriages are preferred, though there are traces of partners from the other Chenchu villages.

Their traditional occupation was honey collection and hunting. More recently, they have started to make finished products of bamboo and sell them in the towns nearby. Contribution to their family income from wage labour is also found to be very significant.

They follow ancestral worship and also have many gods and goddesses of whom 'intidevatha is the most important. But their religion is influenced by Hinduism. They worship Hindu gods and goddesses like Sri Rama, Siva, and Mallikarjuna swami. The worship of these gods is considered essential. The influence of Sufi durgah (a Muslim religious sect) and Christianity are also part of their religious beliefs.

Their political organization comprises of a traditional council headed by the 'peddamanchi'. The institution of statutory Panchayat headed by duly elected sarpanch also plays a prominent role in this regard.

A recent study on Health Status of Particularly Vulnerable Tribals (PvTGs) in Telangana (Sharma 2019) revealed the following in regard to the health of Chenchus. Eyesight seems to be a major health issue for many PvTGs across the districts. About one fourth have reported some problem or the other in regard to the eye. It should be of grave concern that almost half of the Chenchu respondents were identified with some eye problem. Night blindness is very frequently reported by the Chenchus in Nagarkurnool district. A greater percentage of respondents in Nagarkurnool and Adilabad were identified to have Photophobia. Chenchus majorly displayed the signs of Hyperthyroidism. This may be due to poor nutrition and lack of iodine in their diet. Almost four percent of them reported goitre. In particular, more than twenty percent of the Chenchus reported spoon-shaped nails, which is a clear indication of anaemia. The spoon shaped nails were observed in case of respondents of all age groups including the age groups of 0-5 years and 6-10 years.

In case of the Chenchu, the mortality rates for both males and females is not only high, but the male mortality is almost double the rate observed for the females. These differences need an in-depth examination. The higher male mortality rate among the Chenchu could be related to occupational injuries and also higher incidence of T.B among the men in their community. Tuberculosis is the major cause of death of the PvTGs in the state. One fourth of the total 102 deaths were reported to be due to Tuberculosis. Of these 25 out of 102 cases of T.B deaths, 40% are contributed by the deaths among the Chenchu.

Morbidity among the Chenchu:

Data on major morbidity (illness for more than 10 years and/or involving inpatient treatment) for a reference period of one year) was obtained as part of a research sponsored by the Department of Tribal Welfare, government of Telangana in the year 2019 (Sharma, 2019). The study revealed that Chenchus suffered from Typhoid, Dengue, Malaria, Chikungunya and other fevers frequently.

Back pain/knee pain/Joint pains	14	9.0
TB/Chest pain/Blood vomiting	48	30.9
Eye problems (other than night blindness and photophobia)	2	1.2
Asthma/breathing problems	7	4.5
BP/Sugar/Weakness	7	4.5
Accidents/Fractures	0	0.0
Fevers/Cough	32	20.6
Typhoid/Dengue/Malaria/ Chikungunya	15	9.6
Mental illness	2	1.3
Stomach pain	16	10.4
Paralysis/Parkinson/Fits	5	3.2
Cancers	5	3.2

Jaundice	0	0.00
Skin ailments	2	1.3
Toothache	0	0.00
Leprosy	0	0.00
Others	0	0.00
Total	155	100

Since their early times, the Chenchus have lived in the forests of Nallamalai, considering it to be their home, and have hunted and gathered food. The tribal families were provided the facility of housing in colonies outside the reserved forest and occasionally inside the forests too with the intention of improving their living conditions and for protecting the forests, animals, and environment. Harvested forest products by Chenchus for human consumption include honey, tubers, roots, wild gooseberries, nanari gadda, mahua flowers, and more. Non-timber products that are sold for cash include Madanagadda, a root that is processed into tea powder for a pleasant scent. Girijana Cooperative Corporation (GCC), which is managed by the state government, purchases the root and takes up marketing.

Additionally, honey is gathered from the forest in the winter and sold to GCC, which packs and sells it to other companies or to private consumers. Bee comb wax, which is produced from them, is also marketed. The weekly markets also feature the collection and sale of items like madupaku (betel) leaves, nannari root, and madipi ginjalu (sal tree seeds). In the region, there are two distinct agricultural seasons: Rabi (Yasangi) is cultivated during October to March, and Kharif (Vanakalam) is extends from June to September. Major crops cultivated are red gramme (pigeon pea), toor dal, groundnut (palli), maize (mokka jonna) and, cotton (patti) in the areas outside the forest, and Jowar (jonna) by the families in the areas inside the forest.

They have access to tamarind, mangoes, papaya, mosambi, amla, wild bananas, oranges, and custard apples, among other fruits. Mushrooms, chintachiguru pappu (tamarind leaf with dal), curd rice with mango or mango pickle, and other seasonal dishes are eaten with meals. Additionally consumed were leafy vegetables such as spinach (palak), gongura, bachala kura, guntaku kura, tota kura, etc. They eat Mellakura, Nimenakilu, Pullarika, Mundalakura, and other varieties during the winter.Soup made with tamarind, or chintapulusu, is a staple during the rainy season. They eat fermented foods like ganjiannam (occasionally consumed in the summer) and ragi ambali (every day). Tobacco use is also common among the Chenchus; Most of the men folk consume *bidi* 1-2 packets daily. Both men and women were observed chewing *khaini and paan.*

The Savaras of Andhra Pradesh:

The Savara[1] live in several states in western and central India, with three-quarters of their population concentrated in the states of Andhra Pradesh and Odisha. The Koraput and Ganjam districts of Odisha and Srikakulam and Vizianagaram districts of Andhra Pradesh

[1] The Savara are also referred to as Saora or Sora, the term Savara has been used as it is spelt that way in the area under study. Other scholars who have studied this tribe in the state of Andhra Pradesh (erstwhile Madras presidency during British rule) also called them Savara, which is also used by the Government of Andhra Pradesh under the list of Scheduled Tribes (ST)

have the largest concentration of Savara population in these two states. Referred to as Savara, Sabara, or Saura, the Savara have had an enduring presence in classical Indian literature and mythology. Elwin argues that Sabara may denote earlier inhabitants of the forest in general or a larger group than the present-day Savara. Epics like Mahabharata contain passages that allude to the origin and nature of the Savara among other tribes (Elwin, 1955, p.p. 10-33; Sharma, 1992). Most of the prominent works among the Savara are based on Odisha, particularly Koraput and Ganjam; the works on the Savara of Andhra Pradesh remain relatively fewer. Notable among them are the works of Suryanaryana (1978) and Sharma (1992).

The population of the Savara in the State of Andhra Pradesh according to the 2011 census is around 137613 and accounts for 5.02% of the total tribal population of the State. Their population in the districts of Srikakulam and Vizianagaram is 76.04% and 22.73%, respectively out of their total population in the State. Savaras have their own language which belongs to the Kol Munda group of Austro-Asiatic family. Grieson (1906) holds that it is closely related to Kharia and Juang, although it differs from them in some important characteristics.

The absence of any named clans or lineages, their complex religious life, their exclusive practice of shifting cultivation and the practice of polygamy were the distinct cultural characteristics of this tribe. Their identity as Savara is firstly rooted in their distinct language and secondly in the religion that they followed (Elwin 1955; Krishna Rao, 1972). However, one can notice a significant change now in the socio-cultural life of the Savara. The shift in their religious belief system to *Akshara Brahma (*under the reform movement of Savara religion) and Christianity and the move towards horticulture, especially cashew cultivation are the notable changes (Gopika J, 2018; Sharma 2019).

Traditionally, the Savara of Seethampeta Block depended upon shifting cultivation (*podu*) for meeting most of their food needs, while food gathering supplemented what was produced in their *podu* fields. A large number of tubers, nuts, fruits and vegetables growing in the wild are gathered. The crops cultivated under *podu* depended on soil fertility. Prior to taking up cashew plantation, the Savara cultivated red gram or mixed crops of millets and cereals (6-9 varieties) in the *podu* lands. The millets cultivated are barnyard millet (*oodalu)*, pearl millet (*gantilu*), fox tail millet *(korralu)*, little millet (*samalu*), green sorgam *(jonnalu),* finger millets (*ragulu).* Black horse gram (*nalla ulavalu),* red gram *(kandulu),* cow pea *(bobbarlu)* are also widely cultivated for self-consumption. Finger millets and barnyard millets used to be the most important of the staple cereals. They eat millets either in the form of cooked solid cereals or prepare thin gruel with broken cereal or flour to add along with chillies, salt in the vegetable curry.

Apart from seasonal vegetables like spiny gourd, brinjal, bottle guard, broad beans, raw banana, ladies' finger, cluster beans, radish, drumstick, elephant foot yam, tapioca, pumpkin, ash gourd, cucumber, they frequently consume *Taabang* (bamboo shoots); *Urung batti* (Bamboo Mushrooms). Among the tubers, 'uladumpa' is special item for the Savara. *Dula dumpa, Doldumpa, puli dumpalu, chilagada dumpalu* are some of the tubers consumed less frequently these days. A variety of wild roots are collected in the winter season for cooking

in different ways. *Pondi* Teegalu *(Vond rayelu),* Donde *teegalu (Marsa*), Kasa Teegalu, (Tulba), *Palloru Theegalu* (Pare), *Gone Teegalu (Margidi), Arika Theega (Cacio*) are some of the roots listed by scholars. The greens that are cooked frequently include: Pumpkin leaves, drumstick leaves, *bitter guard leaves (kakaara), konda regu* sour spinach *(gongura), and* amaranthus *(thotakura)*

Currently many Savara families own cashew plantations. The tender cashew is cooked as vegetable during the season as delicacy. Two of the traditional dietery practices for which the Savara are known for are *jeedi ambali* - meal prepared with the mango kernel *(jeedi)* and cuisine with tamarind seed powder. Both mangoes and tamarind are abundaently avialable in the forest. So, during the season they collect the kernel and tamarind seed in the season. They are dried in the sun and then powdered for future use. These two items constitute a sort of resilience to face hunger. Till free supply of rice, many of the Savara families survived on this mango seed powder for about 2 to 3 months in year, especially during July and August months.

They consume a variety of fruits available in their backyards or in forest. The most frequently consumed fruits are, custard apple, mango, papaya, soursop (*ramaphal*), Indian black berry, Indian plum, jack fruit, and amla are collected from forest. Pine apple, cashew apple and banana are abundantly consumed during the season as they are cultivated by them.

Meet constitutes almost 30% to 40% of their diet on an average. Meat of domesticated animals like pigs, goat, buffalo, oxen besides the chicken is very frequently consumed. As these animals and birds are sacrificial animals, the meat consumption is high on that account. It is very common among the Savara families to sundry the meet of buffaloes and oxen for consumption in lean periods. Meat of wild animals like mountain goat, hare, mountain lizard, wild pigs is also occasionally available. Similarly, they trap birds like *adavi kodi* (forest fowl), and quail for meat.

One significant aspect of the Savara dietary practice is that they were not consuming milk till recently. They don't milch their domesticated animals as they consider mother's milk belongs

to her offspring alone. Only recently, they started buying tetra pack milk and milk powder from outside for tea. As noted by other scholars (Prasad, 1985), earlier, the consumption of jaggery, tamarind and chilli is very high among the Savara.

Liquor is an inseparable part of Savara life. There are two types of liquor that are currently consumed by the Savara mostly: One made from *ippa puvvu* (flowers of Madhuca longifolia) known as "*Mogga Saara*" and other one extracted from *Jeeluga chettu* (palm tree) is called '*Jeeluga kallu'.* It has both ritual and cultural significance. Consumption is socially accepted and so men are initiated into liquor as early as 14 years or so. Though the unmarried females do not consume liquor, many women aged above 30 years consume on par with men. It is said that the liquor is but necessary for the hard work they need to do for the shifting cultivation. Apart from these drinks, certain beers prepared by fermenting choked cereals like trice', 'Ragi' and 'Sama' used to be popular at one time, but has decreased now. These beers are believed to have curative properties and cooling effect and so are taken occasionally by the members suffering from chronic diseases. While fermented mango-juice is another popular drink, the drink prepared from marking nut is also not so unpopular. The fleshy fruits of the marking nut are sun dried and soaked in water and the resultant syrup is fermented to distil liquor.

Only in the recent past Savara have taken up horticulture and settled agriculture owing to the initiatives of the Government of Andhra Pradesh (Sharma 2019). One significant change in the dietary practices of the Savara society relates to changes in staple food. Rice is now their staple food due to supply of rice through the public distribution system and also the introduction of cash crops in their fields. Many Savara families in Seethampeta Block today cultivate cash crops like pine apple, bananas, turmeric and ginger. The cash economy is also enabling them to buy rice if necessary. Further, the attendance of Savara boys and girls to residential schools of the government too brought changes in the food habits. There is a gradual shift to spicy and oily food; shift from cooked food to pan frying and deep frying. Consumption of milk and milk products and refined sugar is a latest introduction into Savara food culture.

The health and educational status of the Savaras in the State is far from satisfactory. The studies among the Savara show the popularity of the ethnomedical specialists for health care. The herbalists among the Savara are admired even today though there is some decline in the role of magico-religious healing. A recent survey conducted in the three P.H.C. areas of Seethampeta ITDA area enumerated 231 TMPs. Out of them, 135 have specialized in one specific illness; 88 have specialized in treating 2- 3 illnesses, and the rest eight treated all kinds of illnesses. The local health tradition shows varied treatment practices with medical knowledge of plants, animals and minerals. The decline in magico-religious healing is due to the fact that many a Savara in this district has more recently changed their religious faiths to *Akshara Brahma (*under the reform movement of Savara religion) and Christianity (Gopika, 2018). The recent acceptance of biomedicine and the dependence on unqualified Less acculturated Medical Practitioners for biomedicine surely increased the use of antibiotics among the Savara.

Survey of major morbidity:

A survey of major morbidity suffered by the Savara was conducted as part of an ICMR research project among the Savara of Seethampeta ITDA area in 2019-2022. (Sharma, 2023) For the purpose of this survey any illness that lasted for more than 10 days was operationally defined as major morbidity. A total of 524 members in a survey of 15098 population reported a major morbidity of more than 10 days. Approximately 34 members out of every 1000 thus reported to have suffered from a major morbidity. The details of the habitations, number of households and population surveyed in three PHC areas is as follows:

P.H.C	No. of habitations	No. of households	Total Savara population
Donumbai	23	623	3992
Kusumi	44	1386	8043
Marripadu	26	601	3063
Total	113	2610	15098

Disease categories					
Cancer	Gynaec. related	Kidney stones	Stomach disorders	Fever	**524**
5	16	4	26	12	
Dengue	Paralysis	Skin related	Typhoid	Chicken pox	
8	8	16	46	5	
Malaria	T. B	Jaundice	Others/Undiagnosed		
196	43	46	93		

Kolam of Maharashtra:

The Kolam tribes are an indigenous community primarily found in the Vidarbha region of Maharashtra. They have been recognized as a PVTG by the Government of India. Their mother tongue is Kolami, a part of the Dravidian language family (Deogaonkar et.al., 2005). However, due to their interaction with other communities, many also speak Marathi. Generally, they prefer to stay away from the other population of the area; as such, they stay in segregated settlements called Pods *(*Deogaonkar et al., 2003*)* They believe their race originated from the Pandavas of the Great Mahabharat and call themselves Pandav-Vanshi. Hence, they have a high sense of status and prestige as against other tribes and consider themselves ethnically related to the Pandavas.

As per the 2001 census, the Kolam population in Maharashtra was 1, 73,646, which increased to 1, 94,671 in 2011. One of Maharashtra's three Particularly Vulnerable Tribal Groups (PVTGs) is the Kolam Adivasi community. They also reside in Telangana, Madhya Pradesh, Chhattisgarh, and Andhra Pradesh.

In the Maharashtra state's districts of Yavatmal, Chandrapur, and Nanded, Kolams are found. They are mostly Dravidian in origin, and their language, Kolami, has no script. According to their oral histores, they were originally from the Kolammal hills in South India. Later, they moved to Maharashtra's Vidarbha and Marathwada areas, as well as neighbouring states like Telangana.

Kolams are very conscious and proud of their socio-cultural traditions and follow all their rituals meticulously. Despite the influence of Christianity and Buddhism in Yavatmal and Chandrapur districts, there are very few conversions among the Kolams. They stay true to their Kolami religion (Deogaonkar et al., 2003).

The population of the Kolam in Maharashtra was 43,555 in 1961. Since then, their population has gradually increased to 56,061 in 1971, 118,073 in 1981, 1,47,843 in 1991, and 1,73,646 in 2001. The Kolam population in Maharashtra further increased to 1,94,671 in 2011. The drastic change was observed between 1971 to 1981, when it went from 28.71 percent to 110.61 percent. The sudden increase is believed to be due to immigration, as Kolam in Maharashtra was declared PVTG much earlier. (Raviprasad et al., 2016)

R. V. Russell and Hirarlal stated that the Kolam tribe is akin to the Gonds which aligns with Mr. Hislop's view, and that the Kolams retain some very primitive customs (Mohanty, 2004). In Maharashtra, the Kolam tribe is divided into a number of exogamous clans, which also act as surnames. Some of them are- Tekam, Kumraker, Siley, Wagdhare, Kodape, Meshram, Junghare, etc. (Deogaonkar and Baxi et al., 2004) These clans form basic social units, and marriage within a clan is prohibited (Mohanty 2004). The Kolam society is patriarchal, and they practice monogamous marriage, which is mainly arranged. Cross-cousin marriage is also permitted in their community. Joint families used to be the foundation of the Kolam community. However, the majority of Kolams today are part of nuclear Families.

The Kolam in Maharashtra state are mostly cultivators. Their way of life revolves around agriculture, hunting, and gathering and is firmly anchored in the natural world. Traditionally,

they practiced shifting cultivation, locally known as *podu*, and have historically relied on the forests for their subsistence. With restrictions by forest laws on shifting cultivation, their primary occupation has changed to settled agriculture or agricultural labor (Deogaonkar et al., 2004). However, very few of them possess agricultural land, so many people depend upon agricultural labour for daily wage. They also practice hunting occasionally in nearby forests and collect forest produce.

The Kolam tribe's food and dietary practices reflect their closeness to the environment. They consume both vegetarian as well as non- vegetarian food. Their diet primarily consists of millets like sorghum (jowar) and pearl millet (bajra), along with rice and wheat. They also eat the meat from animals including pigs and beef occasionally. Kolams consume the flesh of almost any animals such as rats, tigers, snakes, squirrels, except dogs, donkeys, and jackals. Some vegetables they eat are ambadi, math, kumbha and other seasonal vegetables like cabbages, brinjals, and roots like carrots and radishes. They also eat a variety of roots and tubers, leaves, and flowers available in the forest. Liquor consumption is very common among the Kolam people, mainly country liquor.

The Kolam tribes have a rich tradition of healing practices deeply rooted in their cultural and spiritual beliefs. They have been using plants, leaves, roots, etc., along with magico-religious healing for hundreds of years. Traditional healers who have acquired therapeutic knowledge either through family traditions or by undergoing training under another healer utilize a wide array of forest plants, weeds, flowers, seeds, and bark in their traditional treatments. Most preparations are administered orally or applied directly to affected areas. According to Kolam tribe customs, the role of the healer is considered a service to God, and they are not allowed to accept any form of remuneration (Singh 2024)

The major diseases prevailing among the Kolam of Maharashtra state include cases of malaria, tuberculosis, leprosy, pneumonia, water-borne diseases, and skin diseases (Singh 2024). They also face several health challenges, which are often exacerbated by their marginalized status, poor living conditions, and limited access to healthcare.

Like many other indigenous communities, the Kolam tribes of Maharashtra have undergone significant changes over the years. Various factors, including increased interaction with mainstream society, economic pressures, environmental challenges, and government policies have driven these changes. Of the many changes observed, some major changes are noted in the following. Traditionally, they were dependent on subsistence agriculture, hunting and gathering. However, the Kolam of Maharashtra have seemingly absorbed the culture of nearby communities, and have now shifted to wage labour (Deogaonkar et al., 2004). The reason for this is the loss of access to forests due to government restrictions, which have reduced their ability to sustain themselves in traditional ways. Another change is the increased consumption of processed and packaged food, gradually moving away from their traditional reliance on domestically grown and foraged food. Reduced forest resources and the easy availability of processed foods in nearby local markets have influenced this change. This has further led to a shift from the traditional nutrient-rich diet.

Kathodi of Maharashtra:

The Kathodi tribe, also known as Katkari, is one of the tribal groups from Maharashtra state. They reside mainly in the hilly tracts of the Western Ghats. They are among the three Particularly Vulnerable Tribes of Maharashtra. They were given the vulnerability status from their history of being nomadic and forest-dwelling people as listed by the British Raj under the Criminal Tribes Act of 1871, which is a stigma to date (Acharya 2020). They speak the Katkari language, a dialect of the Konkani language family. However, they also speak Marathi while talking to Marathi-speaking people. The name is derived from the Marathi word 'Kath,' i.e., 'catechu', and 'kari,' i.e., 'to make.' Thus 'Katkari' means making of catechu (Sreenath, 2016). On account of A.N. Weling, the Katkaris were landless people who mostly relied on hunting, making charcoal, and gathering forest products. They had no set sedentary occupation.

In the Bombay Gazetter Thana (vol. XIII), they were described as the poorest and least hopeful, 'a drunken lot,' 'given to thieving' and unwilling to work except when forced by hunger. They resided in compact and clustered huts which are made of mud-dabbed walls (karvi) with a peaked roof thatched with palm leaves and supported by bamboo columns (Sreenath 2016)

The population of the Katkari tribes in Maharshtra was 1,35,839 in 1961. It steadily increased from 1,46,785 in 1971 to 1,74,602 in 1981 to 2,02,203 in 1991. The number further increased to 2,35,022 in 2001. Iin 2011 census, 2,85,334 persons were returned as Katkari in Maharashtra. The rate of increase in population size is more or less similar to other communities. In Maharashtra, the Katkari people are predominantly found in Raigadh and Thane districts. They are also found in Pune, Satara, Nashik, and Ratnagiri districts.
Pardhi, has described that the katkaris have a patriarchal system. They do not follow joint family structure and prefer nuclear family model (Pardhi 2024).

The traditional occupation of the Katkari was forest-based, i.e., making and selling of catechu from the Khair tree. Other livelihood sources included the making and sale of charcoal, firewood, and various forest products, along with freshwater fishing, hunting, upland agriculture, and agricultural labour (Heredia and Srivastava 1994). The Katkaris have intimate knowledge of the plant life. However, with restrictions by the government on cutting trees, their major source of livelihood of making catechu had a sharp decline. Also, restrictions on shifting cultivation have affected their forest-based livelihoods. As such they started to migrate to look for settlement and employment. They are mostly landless workers now, as very few of them have land. Agricultural labour is now the main source of their income (Sreenath et al., 2016). Some have become bonded labourers working in the brick kilns and charcoal units (Heredia and Srivastava 1994).

The Katkari people's diet includes both vegetarian and non-vegetarian items. The staple diet of the Katkari people is maize, jowar or nagli. They also consume rice and dal. During the rainy season, they eat the green leaves of Karadai (Carthamus tinctorius). Liquor locally brewed from *mahua* flowers is also part of their consumption. Both men and women smoke beedi and chew tobacco. A majority are dependent on seasonal forest products. The Katkaris

supposedly find them delicious and healthy owing to their medicinal properties. Some forest produce they collect are – pearl millet, moringa, guava, cowpea, vilayati imli, jamun, etc. (Bose 2020)

Kulkarni, in his study, observed that the traditional association of Katkaris with the deep forests has helped in conserving medicinal plants and retaining their ethnomedicinal knowledge. He found the use of plants and plant parts, as well as animals, as remedies for various ailments. Various parts of plants such as bark, leaves, roots, wood, seeds, flowers, carpel, fruits, bulb, sticky oozes, latex were prevalently used as remedies. The Katkaris also reportedly used different animals, their products and parts like stomach, scales, adipose, tissue, excreta, milk, etc., commonly.

From a survey in 1997-98, the incidence of cholera, jaundice, dysentery, malaria, and measles were recorded among the Katkari community. Skin infections and infestations were also commonly found among them. In 2001, Kate reported an incidence of 5.9% of sickle cell trait carrier among the Katkari people. Sahu, in his study, found that the rate of anemic children in the Katkari community was higher than the state average, along with the prominent occurrence of chronic malnutrition. Malnourishment in women is also alarming (Kulkarni 2011).

The Katkaris, like most of the tribes of Maharashtra and largely India, have undergone significant changes due to government interventions, their interaction with the mainstream communities, and the gradual deforestation. One main change is seen in their occupational pattern. From their traditional economy mainly based on forest produce, which was making katha and gathering and selling produce from forests, they now earn their livelihood mainly as agricultural labourers. They also engage in daily wage labour activities, among which bricklaying is predominant. This shift is caused by changes in forest laws, Government policies, and the deterioration of forests (Pattnaik 2004). Sinha, in his study, has revealed that the Katkari tribe is poverty-ridden and marginalized owing to their original source of livelihood being compromised and requiring government initiatives to ensure suitable livelihoods (9).

Birhor of Jharkhand:

Birhors are a tiny indigenous tribal community residing mainly in the eastern Indian states of Jharkhand, Odisha, Chhattisgarh West Bengal, and Bihar (Census of India 2011). The name “Birhor” is derived from two words, "Bir" signifies Forest, and “Hor” represents man i.e. they are the people who stay in forest areas (Singh 2014). In India, they were included in the category of PVTGs. The Birhor population is small. They are a Scheduled Tribe of Jharkhand and the population is approximately ten thousand (Census of India, 2011). They are found in several districts of Hazaribagh, Gumla, and Ranchi in Jharkhand; and Chhattisgarh, Odisha, W.B., & Bihar (Minz, 2015). Birhors usually reside in deep-forested areas, and their settlements are known as "tandas" (Singh & Others 2014). As per the 2011 census the total population of Birhors in India is 17,241, out of which about 62% are settled in Jharkhand. However, the figure is doubtful as their population in Jharkhand is not more than 7,514.

Birhor society is a close-knit network of social relations closely knit with their traditional norms and values (Prasad, 2013), living in small clan-based groups, and having a social hierarchy (Roy, 2012). They practice monogamy and arrange their marriages within the community (Minz, 2015). Birhor is a part of the Munda subgroup of the Austroasiatic language family. But, presently, many of them speak local languages for increased contact with neighboring communities (Singh, 2014). They practice animism, which involves the worship of natural elements, spirits, and ancestors. Also, they celebrate many festivals and rituals that are rooted to their cultural identity (Prasad, 2013). Traditionally, the Birhor were semi-nomadic, relying on hunting and gathering in the forests for their livelihood (Roy, 2012). They hunted small animals, collected wild fruits, roots, and honey, and practiced basic shifting cultivation (Ministry of Tribal Affairs, 2016). However, due to deforestation and the reduction of forest resources, they have had to adapt to new ways of making a living. Nowadays, many Birhors are involved in bamboo craft-making, such as weaving baskets and making ropes, which they sell in local markets (Singh, 2014). Some have also turned to agriculture, wage labor, and seasonal migration to cities for work (Minz, 2015).

The traditional diet of the Birhor community is largely based on forest foods (Prasad, 2013). They eat various wild fruits, roots, tubers, honey, and meat from hunting small animals like rabbits, squirrels, and birds (Roy, 2012). As forest resources have declined, their diet has shifted to include more agricultural products like rice, pulses, and vegetables (Ministry of Tribal Affairs, 2016). Due to their economic situation, their diet is often simple and lacks variety, mainly consisting of staple grains and whatever seasonal produce is available (Singh, 2014). Limited access to market goods also affects their nutrition (Prasad, 2013).

The Birhor community heavily relies on traditional healing methods because they have limited access to modern healthcare services (Minz, 2015). They use a wide range of medicinal plants, herbs, and roots from the forests to treat various health problems (Prasad, 2013). The Birhor community faces several health challenges, the main reason is their poor socio-economic conditions and lack of access to healthcare facilities (Ministry of Tribal Affairs, 2016). Common health problems consist mainly of malnutrition, anemia, respiratory infections, tuberculosis, gastrointestinal diseases, and skin infections (Prasad, 2013). Poor sanitation, lack of clean drinking water, and inadequate nutrition are the leading causes of these issues (Roy, 2012). Child mortality and maternal health are significant concerns as well(Minz, 2015).

The Birhors have undergone significant changes over the past few decades. Various government programs intended to resettle the Birhors and provide them with education, healthcare, and job opportunities have brought significant changes to their lifestyle and economic activities (Ministry of Tribal Affairs, 2016). The increasing interaction with the neighboring communities has led to cultural assimilation, with them adopting new customs, languages, and ways of life (Roy, 2012). Economic difficulties have caused many young ones in the community to migrate for jobs, leading to a gradual shift to wage labor and others (Minz, 2015). Improved, but still limited, access to education and healthcare services has led to change in health-seeking behaviors, and awareness levels, influencing a gradual shift toward more settled ways of life (Singh, 2014).

Lodha of West Bengal:

As per 2001 census, Lodhas numbered 84,966 and formed 1.9 per cent of the scheduled tribe population of West Bengal. They had a literacy rate of 34.8 per cent. As per the 2011 census, the Lodhas population is 108,707 and 9,785 in West Bengal and Odisha respectively.
A slice of flesh bearing their ancestor's name is referred to as "Lodha." Because of its background, the community continues to experience social marginalisation and stigma. In 1871, the tribe was considered criminal. By 1900, they were considered ex-criminals. In 1956, the Act classified them as persistent offenders. In 1952, they were designated as a "denotified community." In 1971, they were further classed as a Primitive Tribal Group. Since 2006, they have been a part of the Particularly Vulnerable Tribal Group (PVTG).

Since October 1956, the "Lodha" have been recognised by the state of West Bengal as a Scheduled Tribe (ST). They were transported from Odisha during British rule to clear the forests, and ever since, they have lived in the "Jungle Mahal" forest areas (the area along the western border of the former Paschim Medinipur district). There was a mixed population of Lodha, Santals, and Mahato living in both of the investigated settlements. In the settlement of Parashia, there were 72 dwellings, housing 593 people.
A community of Mundari speakers (an Austronesian language family) makes up the Lodha. They have a dialect made up of terms from Mundari that are twisted versions of Bengali and Odisha.

The Lodha community mainly lives in the eastern Indian states of West Bengal and Odisha. Traditionally, the Lodhas mainly lived in forests, hunting and gathering, and did small-scale farming (Census of India, 2011). Over time, the Lodhas have faced many challenges, i.e. losing their traditional ways of living caused by deforestation and laws that restrict hunting (Sinha, 2012). The Indian government has introduced various programs to help improve their socio-economic conditions (Ministry of Tribal Affairs, 2015). But still, many Lodhas live in poverty and have limited access to education, healthcare, and job opportunities (Basu, 2013). The Lodhas have a diverse social structure, which is characterized by a clan-based organization (Chakraborty, 2016). Their society is patriarchal, with decision-making powers to the male elders (Sinha, 2012). They practice an array of rituals and customs linked to animistic beliefs, i.e. worshiping various natural elements and deities (Roy, 2010). The Lodhas have their very own dialect, which is a mixture of Bengali and Odia languages, though many of them now speak the regional languages fluently due to the increased interaction with broader community (Basu, 2013).

Historically, the Lodha community was characterized by their practice of Hunting and Gathering, for their survival (Chakraborty, 2016). As time went by, for the depletion of forest resources, they transitioned to alternative forms of livelihood, encompassing agriculture, wage labour, and artisanal crafts (Ministry of Tribal Affairs, 2015). A part of the Lodha population participates in seasonal migration to most acculturated areas for employment (Basu, 2013).

Hunting and gathering is the Lodha people's traditional way of life. They still rely on daily labour, harvesting, and selling a variety of forest products to support their subsistence

economy. For consumption, they gather various tubers (forest potatoes, yams, paan potatoes, chun potatoes, bangla potatoes), fruits, green vegetables, etc. Gathered and sold for money are things like honey, sal leaf, firewood, medicinal plants, roots, tree bark, cocoons (tusser), wax, lac, etc. The majority of the community members are involved in the harvesting of sal leaves, which they then sell to mahajans (traders) for Rs. 60 per thousand leaves. Some of them use the sal tree to make wooden khatiya (beds), which they sell for Rs. 200. Both the male and the female members work as agricultural labourers in the fields, earning a sum of Rs. 300 each day. They also raise pigs, chickens, ducks, goats, buffaloes, and other animals. For entertainment, they domesticate titir (partridge) and tia pakhi (parrot).

Their main meal is rice. They regularly consume several kinds of saag. They eat a lot of yams and tubers known locally as "khaam alu," "chun alu," "paan alu," "bangla alu," etc. Once or twice a month, they eat meat. The majority of the items added to their daily diet are chicken, fish (geto), snails/mollusks, tiny crabs, edible clams (gerigugli), snapper (freshwater turtles), dried fish (taroyal, paata), dried prawns (kuchochingri/kadachingri), mutton, etc. They don't consume beef. Depending on what is available, people occasionally eat pig. Pork, dried fish, and mutton are typically purchased from the market located outside of the settlement. Using nets and traps, they independently capture small fish, prawns, edible clams (gerigugli), snapper (freshwater turtles), and other organisms from streams and bodies of water. Daily mahua liquor consumption occurs throughout the Lodha community. The majority of them make this mahua at home on their own. The ladies in the weekly haat sell excess of this alcoholic beverage. A portion of them also eat handia made from rice. It is noted that drinking alcohol is a component of their eating routine. Men and women both chew tobacco and sip country spirits and betel leaves. Men enjoy smoking cigarettes and bidis.

The Lodha tribe faces several health challenges, mainly for their socioeconomic status and lifestyle (Ministry of Tribal Affairs, 2015). Common health hazards include malnutrition, gastrointestinal diseases, skin infections, respiratory infections, and vector-borne diseases like malaria (Basu, 2013). Limited access to healthcare facilities, poor sanitation, and lack of awareness about modern medical practices have deteriorated their health conditions (Sinha, 2012). Child mortality rates and maternal health issues are also are of concern (Chakraborty, 2016).

Over past many years, the Lodha community went through significant social, economic, and cultural changes. Deforestation and laws restricting hunting and gathering have forced them to give up their traditional ways of living (Roy, 2010). The need to find work has led many Lodhas to move to most acculturated settlements, where they have replaced their traditional occupations to more modern ones (Basu, 2013). Living and having interaction with more non-tribal communities has led to a weakening of their traditional customs and the adaptation of new cultural practices (Sinha, 2012). Improved, but limited, access to education and healthcare has changed their health behaviors and resulted in increasing awareness (Chakraborty, 2016). While these changes have brought some benefits, they have also led to the loss of the Lodhas' traditional culture and practices, creating a complex balance between adapting to new ways and maintaining their heritage (Basu, 2013).

Material and Methods

The present study covered six PVTGs of India. Various health measurements (height, weight, waist, and hip circumference), body composition (RMR, Visceral fat, Skeletal Muscles, Fat Mass, Percentage of Body Fat), Blood pressure, Blood sugar, and haemoglobin levels were recorded to assess their current health status. The population covered for faecal samples were surveyed for socio- demographic information, health and hygiene behaviours, morbidity and preferred treatment practices, etc., in addition to dietary data. Dietary information was obtained through Food Frequency (FFQ) method, and nutritional values were calculated using established guidelines.

Anthropometric Variables:

Height: During taking HT measurement, subject were asked to stand on a flat surface as straight as possible, heels together, so that, weight of the participants was distributed evenly on both the feet, and the head was positioned in Frankfort Horizontal Plane. The arms hang freely by the side of the trunk, with the palms facing the thighs. The subjects were asked to places the heel together, and medial border of the feet were at angle of about 60 degree. If the subject has knock knees, the feet are separated in contact but not overlapping. The participants were asked to inhale deeply and maintain a fully erect position without altering the load on the heels. The movable horizontal arm of the anthropometer was bought down on the most superior point of the head with sufficient pressure to compress the hair. The measurement was recorded to the nearest 0.1 cm.

WT: During WT measurement participant was asked to take off her shoes and then stand still over the center of the platform of the weighing machine with the body weight evenly distributed between both feet. WT was measured to the nearest 0.1 kg MUAC: During MUAC measurement each participant was requested to stand erect with the arm hanging freely at sides of the trunk and with the palms facing the thighs. To locate the midpoint, the subjects elbow was flexed to 90 degree with the palm facing superiorly. The lateral tip of the acromion by palpating laterally along the superior surface of the spinous process of the scapula was traced by standing behind the subject and a small mark was made. Next a small mark point on the acromial process was also located and marked. After that an inelastic tape was placed touching the two points around the arm without compressing the soft tissue. Another measurement at tensed condition was also recorded. The circumference was recorded to the nearest 0.1 cm. WC: During WC measurement each participants were asked to stand erect with the abdomen relaxed, the arms at sides and the feet together. An inelastic tape around the participant was placed, in a horizontal plane, at the level of the natural waist, which was narrowest part of the torso, as seen from the anterior aspect. The measurement was taken at the normal expiration, without the tape compressing the skin. It was recorded to the nearest 0.1 cm.

HC: For HC the procedure was same as those to be followed for the waist circumference, but here measurement was recorded squatting at the left side of the participant so that the level of maximum extension of the buttock was visible clearly. An inelastic tape was placed around the buttock in a horizontal plane at this level without compressing the skin. It was recorded to the nearest 0.1 cm.

Blood pressure Resting systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured on the left hand of each participant in sitting position, after 5 minutes of without changing posture, following standard techniques (Weiner and Lourie, 1981). Blood pressure was measured using OMRON blood pressure monitor [MODEL: M2 (HEM-442C-C1)] following instruction manual at left upper arm of every participant. Each participant was measured twice with 10 minute gape and average value was used for analysis. During the measurement each participants were advised to avoid any kind of substance like, smoking, chewing tobacco, alcohol and also were not engage in any heavy loaded work or exercise for 31 at least before 30 minutes prior to the recording. The arm (left) was supported comfortably at vertical level of the 4th intercostal space at the sternum (heart level) at an angle of between 0 degree to 45 degree from the trunk. The cuff was applied closely to the upper arm, with its lower border about an inch (2.5 cm) above the elbow. The pulse rate was also measured at the time of taking blood pressure using OMRON blood pressure monitor [MODEL: M2 (HEM442C-C1)]. The validity of OMRON blood pressure monitor was checked by using adult calf with mercury sphygmomanometer (Doctor 079) and stethoscope (Chancellor) and blood pressure was measured following the standard technique (Weiner and Lourie, 1981). For the purpose same individuals were measured using both OMRON blood pressure monitor and using adult calf with mercury sphygmomanometer and stethoscope. Statistical analysis revealed no significant ($p>0.05$) differences in these two types of instruments reading. For accuracy same procedure was followed after every two to three months during the whole period of data collection.

Technical error of measurements Technical error of measurements (TEM) was calculated for the anthropometric variables (Ulijaszek, 1994) and the values were between 0.08-0.61. 2.11 Classification of blood pressure Hypertension was classified and defined (SBP ≥140 mmHg and/ or DBP ≥ 90 mmHg) in accordance with the Seventh Report of the Joint National Committee (JNC-7) recommendation (Chobanian et al., 2003). Table 2.11.1: Classification of blood pressure Classification* Range Normal (SBP < 120 and DBP < 80) mmHg Pre Hypertensive (SBP = 120-139 or DBP = 80-89) mmHg Stage 1 Hypertension (SBP = 140-159 or DBP = 90-99) mmHg Stage 2 Hypertension (SBP ≥160 or DBP ≥100) mmHg *JNC7; Chobanian et al., 2003 32 2.12 Mean arterial pressure (MAP) Mean arterial pressure (MAP) is the average pressure in the participants‟ arteries during one cardiac cycle. MAP considered as an indicator of perfusion to vital organs (Sainas et al., 2016). The mean arterial pressure (MAP) was calculated using the following equation: MAP = [(2 x diastolic) + systolic]/3 (Guedes-Martins et al., 2015).

Biochemical variables

Random Blood Glucose

The random blood glucose level was measured using glucometer (One Touch Select Plus Simple). A lancet was loaded into the lancet device according to the manufacturer's instructions and the depth setting was adjusted depending on the type of the participant's skin. A test strip was then fully inserted into the glucometer. The meter automatically turns on when the strip is inserted. The selected finger was cleaned with an alcohol swab. Then the lancet was used to prick the fingertip (typically the middle or ring finger is used) and gentle pressure was applied to encourage blood flow. The edge of the test strip was touched to the blood droplet, ensuring that an adequate blood was absorbed by the strip. The glucometer then displays the reading on the screen after few seconds. The used lancets, test strips and the alcohol swap were disposed of safely according to biomedical disposal protocols.

Haemoglobin: For the estimation of haemoglobin level, the procedure of drawing blood through finger prick and recording the reading was same as followed for the estimation of random blood glucose, except that a portable haemoglobinometer (Mission Hb) was used. Loading the strip and the blood sample was done according to the device's loading instructions.

Inclusion and Exclusion Criteria:

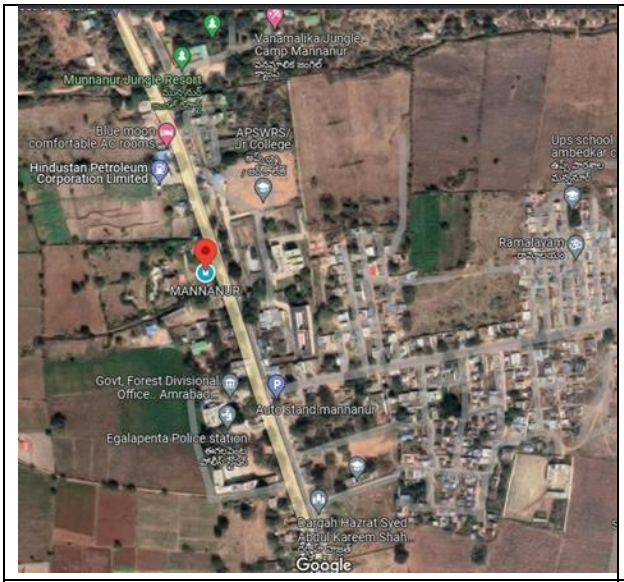
Inclusion	Exclusion
BMI *(Asia Pacific, WHO, 2000)*	
Within Normal Range (18.5-22.9)	Underweight, Overweight and Obese
WHR (WHO, 1989)	
Within Normal Range (Male - <0.95, Female - <0.85)	(Male - >0.95, Female - >0.85)
Hemoglobin	
Normal Range (Female – 12.1 – 15.1gm/dl) Male – 13.8 – 17.2 gm/dl)	Anaemic
Blood Pressure (JNC VII)	
Normal Prescribed Values (SBP - ≤120mmHg, DBP - ≤80mmHg)	Hypertensive and Hypotensive
Medications	
No modern medications (chemical drugs) in the last 90 days	In the last 90 days
Diseases (30 days reporting)	
Absence	Presence
Other Physiological Conditions	
	• Pregnant and Lactating Women • Women who have experienced miscarriage or foetal wastage in last one month. • Individuals experiencing Constipation and diarrhoea

Studied villages:

Chenchu:

The field work was conducted among the Chenchus of Telangana state. Both most acculturated and less acculturated localities were visited in order to identify individuals suitable for sample collection for the study and for collecting food and diet related information. The Chenchu territory comes in the mandal- Amrabad, district Nagar kurnool of Telangana state.

The most acculturated village sites visited during the field work are Mannanur village (16°22'23.5"N 78°45'25.9"E), Macharam village (16°22'40.3"N 78°47'35.7"E) and Macharam colony (16°22'30.9"N 78°47'40.7"E).



MANNANUR

MACHARAM

MACHARAM COLONY

Map 2: Chenchu Households in Most acculturated Area

The less acculturated sites located in the core area of Amrabad tiger reserve (ATR) are- SangadiGundala (16°08'43.6"N 78°40'56.1"E), Medimalkala (16°05'47.1"N 78°47'27.4"E), Bhaurapur (16°06'35.2"N 78°45'17.4"E), Pulaipalli (16°04'42.9"N 78°47'19.7"E).

SANGADI GUNDALA

MEDIMALKALA

BHAURAPUR

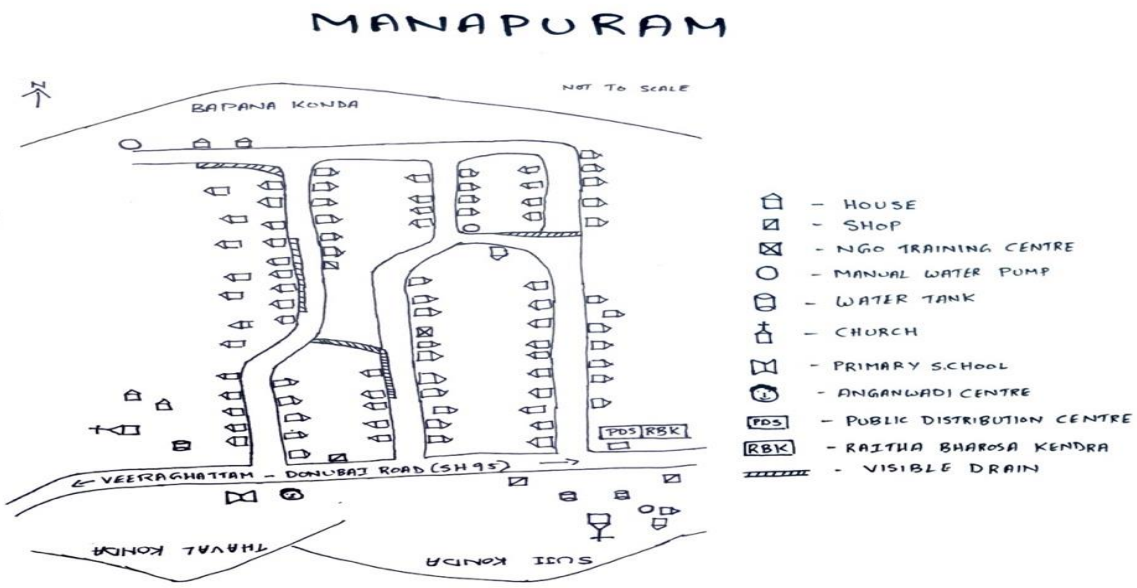
PULAIPALLI

Map 2: Chenchu Households in Less acculturated Area

Savara:

The present study is conducted in both most acculturated and less acculturated villages of Seetampeta Mandal of Palakonda divison. Seetampeta mandal is located at 18˚41'33.1188" N latitude and 83˚49'0.4908" E longitude.

Maanapuram is the village with most acculturated setup where the samples are collected. The village is surrounded by three mountains as soodhi Konda in the east, bapana Konda in the west and thabelu Konda in the north. The names soodi Konda and bapana konda were given based on the shape of the mountain. The name bapana Konda is given because the villagers believe that the Gods and Goddesses live in this mountain do not take non-vegetarian i.e., sacrifice of hen, goat etc are strictly prohibited. The people have the right to access the resources of these mountains and they do shifting cultivation on these mountains. They also consume natural resources of these mountains which include fire-wood, tubers, roots, herbs (for medicinal purpose) etc



Kolam:

For the shake of present study Kolam are studied in two different locations viz. most acculturated (Bhari village: located at 20.3875°N and 78.1985°E) and less acculturated (Warpod and Pachpod village: located at 19.9886°N and 78.6700°E), areas of Yavatmal district of Maharshtra.

Map 1. Kolam household in Bhari village (most acculturated setup).

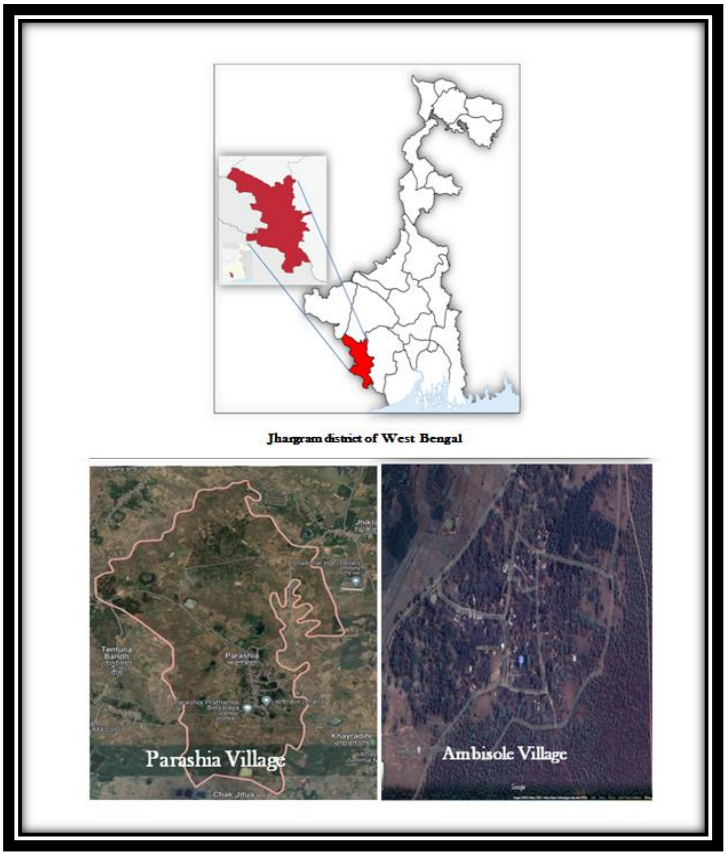
Map 2. Kolam household in Pachpod village (less acculturated setup)

Kathodi:

Katkaris are located primarily in Raigad and in parts of Palghar, Ratnagiri and Thane districts of Maharashtra as well as in some places of Gujarat. For the sake of present study Katkaris are studied in two different locations viz. most acculturated (Karambeli village) and less acculturated (Tilore and Karli village), areas of Pen Taluka, Raigarh district of Maharshtra. It can be seen from Table 1 that they are sparsely populated in the studied villages.

Lodha:

Most of the Lodha villages were located in forest lands. They live in small huts having mud walls and thatched roof made of straws or palm/kend leaves. On the basis of discussion with the administrative heads of each district and with a scholar who had worked among the Lodha for the past 15 years, along with field visits by the pilot survey team, Parashia village (23˚54'36.9" N latitude and 87˚20'55.3" E longitude) is identified for study and Ambisole village (22˚02'19.6" N latitude and 87˚06'32.1" E longitude) suitable for sample collection for the present study (Fig 1). Both these villages come under Nayagram block of Jhargram district. The villages were visited for a continuous period of nine days to screen the individuals based on inclusion and exclusion criteria as delineated in the section on 'Methodology' for sample collection. Altogether, data on socio-demographic, health status, sanitation, hygiene, personal habits, dietary pattern is taken, and fecal samples were collected for the present human gut microbiome research.



Birhor:

The present study was conducted in the Urban and Rural habitations of the tribe in the districts - Hazaribagh and Ranchi. The urban habitations were located at Katkamsandi Block in Hazaribagh district. Following villages were studied in the urban setup:

i. Birhor Colony, Dhengura (23°56′23.0″N 85° 19'50.5"E)
ii. Birhor Colony, Khandsar (24°03′07.9″N 85° 16'15.8"E)

The rural locations were:

i. Birhor Colony, Jhargo (22°57'13.0″N 85°46′57.4°E)
ii. Birhor Colony, Chipibandh dih (22°58'50.4″N 85°41′02.5°E)
iii. Birhor Colony, Amanburu (23°28' 17.6″N 85°56′ 45.2"E)

RESULTS

Table 1: Age and Sex Distribution:

Community	Settlement	Mean Age ± SD	Age Range
Chenchu	Most acculturated	33±4.88	26-43
	Less acculturated	30.57±7.95	22-45
Savara	Most acculturated	30.27±5.92	20-43
	Less acculturated	30.85±5.29	24-40
Kolam	Most acculturated	26.82±5.80	20-38
	Less acculturated	29.48±5.80	21-40
Kathodi	Most acculturated	29.14±6.59	20-39
	Less acculturated	28.37±7.64	20-58
Lodha	Most acculturated	30.16±9.10	18-45
	Less acculturated	27.29±7.34	18-42
Birhor	Most acculturated	31.09±8.81	18-43
	Less acculturated	28.95±9.09	18-43

As per the criteria for the present study, the studied cohort had similar ranges of age. In the Chenchu community, the mean age is 33 years and 30.57 years, respectively. The Savara community's mean age is 30.27 years for both settings, which is comparable. Within the Kolam community, the average age of less acculturated areas is 29.48 years, while the average age of most acculturated areas is 26.82 years. The Kathodi community's mean age is comparable, with an most acculturated mean age of 29.14 years and a less acculturated mean age of 28.37 years. In the Lodha community, the mean age of the most acculturated population is 30.16 years, while the mean age of the less acculturated population is 27.29 years. The most acculturated Chenchu community has the highest mean age among all the communities, at 33 years old, with an age range of 26 to 43.

Predominantly, the majority of families across the studied communities are nuclear families, the highest percentage is found among the most acculturated Chenchu (90%) and less acculturated Birhor (90.5%) communities. These are more common in the most acculturated Lodha community (42.86%) and forest dwelling Kolam community (30.8%). The Kolam community is the only group with a notable percentage of broken families (5.10%) in the most remote areas. Small family sizes are less common, with the highest proportion seen in the most acculturated Lodha community (33.33%) and deep forest dwelling Birhor community (38.1%). This is the most common family size across all communities, with the Kathodi community showing the highest prevalence in less acculturated areas (82.60%). Larger families are rare but do exist, particularly in the less acculturated Birhor (9.5%) and

remotely inhabiting Chenchu (5.3%) communities. The table indicates that nuclear families are the most common structure among these PVTGs, with a majority of families consisting of 4-8 members. The presence of joint or extended families is less frequent, but notable in certain communities like the most acculturated Lodha. Broken families are exceptionally rare, except in the less acculturated Kolam community.

Table No. 2 Family Details:

Family Type				
Community	**R/T**	**Nuclear (%)**	**Joint/Extended (%)**	**Broken (%)**
Chenchu	Most acculturated	90.00	10.00	0
	Less acculturated	89.50	10.50	0
Savara	Most acculturated	65.90	34.10	0
	Less acculturated	71.40	28.60	0
Kolam	Most acculturated	75.00	25.00	0
	Less acculturated	64.10	30.80	5.10
Kathodi	Most acculturated	67.40	32.60	0
	Less acculturated	78.30	21.70	0
Lodha	Most acculturated	57.14	42.86	0
	Less acculturated	73.68	26.32	0
Birhor	Most acculturated	76.2	23.8	0
	Less acculturated	90.5	9.5	0
Family Size				
Community	**R/T**	**1-3 (%)**	**4-8 (%)**	**Above (%)**
Chenchu	Most acculturated	25.00	75.00	0
	Less acculturated	26.30	68.40	5.30
Savara	Most acculturated	9.80	85.40	0
	Less acculturated	9.10	86.40	4.50
Kolam	Most acculturated	17.20	82.80	0
	Less acculturated	7.70	89.70	2.90
Kathodi	Most acculturated	2.30	95.30	2.30
	Less acculturated	17.40	82.60	0
Lodha	Most acculturated	33.33	66.67	0
	Less acculturated	21.05	78.95	0
Birhor	Most acculturated	33.3	66.7	0
	Less acculturated	38.1	52.4	9.5

Migration from less acculturated to most acculturated areas and the adoption of modern practices can influence the gut microbiome composition among PVTGs. Changes in diet, lifestyle, and exposure to different environments play a significant role in these microbial shifts.

Table 3: Migration Details

Migration Details			
Community	**R/T**	**Yes (%)**	**No (%)**
Chenchu	Most acculturated	30.00	70.00
	Less acculturated	15.80	84.20
Savara	Most acculturated	17.10	82.90
	Less acculturated	40.90	59.10
Kolam	Most acculturated	14.30	85.70
	Less acculturated	10.30	89.70
Kathodi	Most acculturated	2.30	97.60
	Less acculturated	6.50	93.50
Lodha	Most acculturated	0	100.00
	Less acculturated	0	100.00
Birhor	Most acculturated	23.8	76.2
	Less acculturated	23.8	76.2
Travelled in last 6 months			
Community	**R/T**	**Yes (%)**	**No (%)**
Chenchu	Most acculturated	30.00	70.00
	Less acculturated	36.80	63.20
Savara	Most acculturated	7.30	92.70
	Less acculturated	13.60	86.40
Kolam	Most acculturated	37.90	62.10
	Less acculturated	5.10	94.90
Kathodi	Most acculturated	20.50	79.50
	Less acculturated	13.00	87.00
Lodha	Most acculturated	15.79	84.21
	Less acculturated	0	100.00
Birhor	Most acculturated	14.3	85.7
	Less acculturated	19.8	81.0

This analysis highlights varying migration patterns across different communities, influenced by factors such as economic opportunities, and possibly access to resources. A higher percentage of migration is observed in most acculturated areas (30%) compared to less acculturated areas (15.8%). Contrary to the Chenchu, the Savara community shows a higher migration rate in less acculturated areas (40.9%) compared to most acculturated areas (17.1%). The migration rates in the Kolam community are relatively low, with slightly higher migration in most acculturated areas (14.3%) compared to forest areas (10.3%). The Kathodi community has the lowest migration rates among all the communities, with more migration occurring in less acculturated areas (6.5%) compared to most acculturated areas (2.3%). The Lodha community shows no migration, with 100% of both most acculturated and less acculturated populations not migrating. The Birhor community exhibits an equal percentage of migration in both the two studied groups (23.8%). The Savara and Kathodi communities show higher migration rates in less acculturated areas compared to most acculturated areas.

The Chenchu and Kolam communities exhibit lower migration rates in forest aeas. The Lodha community does not show any migration activity. The Birhor community displays a balanced migration pattern with equal rates in both the studied areas.

The gut microbiota is influenced by various environmental factors, including the type of housing in which individuals live. Most acculturatedization, sanitation, household materials, and the presence of pets are some factors that could differ between house types and potentially affect gut microbiota composition.

Table 4: House Type

House Type					
Community	**R/T**	**Kaccha (%)**	**Semi-pucca (%)**	**Pucca (%)**	**Others (%)**
Chenchu	Most acculturated	35.00	0	65.00	0
	Less acculturated	63.20	15.80	0	21.10
Savara	Most acculturated	0	17.00	0	83.00
	Less acculturated	100.00	0	0	0
Kolam	Most acculturated	42.90	10.70	46.40	0
	Less acculturated	92.30	5.30	2.60	0
Kathodi	Most acculturated	56.80	9.10	34.10	0
	Less acculturated	69.60	4.30	26.10	0
Lodha	Most acculturated	0	81.00	19.00	0
	Less acculturated	0	78.90	21.10	0
Birhor	Most acculturated	0	19	81	0
	Less acculturated	0	85.7	14.3	0

The Chenchu and Kolam communities have a significant proportion of pucca houses in most acculturated areas, with 65% and 46.4%, respectively. The Savara community in most acculturated areas mostly lives in houses categorized under "Others" (83%), which might include temporary or non-standard housing structures. The Birhor community has a high percentage of pucca houses (81%). Kaccha houses are predominant in less acculturated areas for the Savara (100%), Kolam (92.3%), and Kathodi (69.6%) communities. The Chenchu community residing in deep forest areas has a notable proportion of kaccha houses (63.2%) and a significant percentage of houses classified under "Others" (21.1%). The Lodha community predominantly lives in semi-pucca houses in both studied areas (78.9% and 81% respectively). The analysis reveals that the majority of PVTG communities, especially in remote and inaccessible areas, live in kaccha houses, indicating a lack of durable housing. In contrast, most acculturated areas show a more significant presence of pucca and semi-pucca houses, reflecting better infrastructure and access to resources. The Savara community stands out with a high proportion of "Other" types of housing in most acculturated areas, suggesting non-traditional or temporary housing structures.

Table 5: Basic Facilities to Health

Basic Health Facilities							
Community	**R/T**	**Sub Centre**	**PHC (%)**	**CHC (%)**	**Private Hospital(%)**	**Local Doctor (%)**	**Others(%)**
Chenchu	Most acculturated	55.00	5.00	40.00	0	0	0
	Less acculturated	57.90	36.80	5.30	0	0	0
Savara	Most acculturated	9.80	0	0	4.90	46.30	34.10
	Less acculturated	9.50	0	0	9.50	23.80	57.10
Kolam	Most acculturated	10.30	65.50	3.40	17.40	0	3.40
	Less acculturated	0	97.40	2.60	0	0	0
Kathodi	Most acculturated	31.80	15.90	0	6.80	0	45.40
	Less acculturated	26.10	37.00	2.20	10.90	0	23.90
Lodha	Most acculturated	57.14	0	31.10	0	0	4.76
	Less acculturated	15.79	10.53	36.84	0	0	36.83
Birhor	Most acculturated	9.5	47.6	0	0	38.1	4.8
	Less acculturated	4.8	23.8	0	47.6	9.5	14.3

The majority of the Chenchu population in both areas rely on sub-centres and PHCs for health care, with less acculturated areas showing higher dependence on PHCs. Savara communities in both settings have limited access to formal health care facilities, with a significant portion relying on local doctors and other unregulated sources of care. The Kolam community, particularly in forest areas, heavily depends on PHCs, indicating good coverage of primary health care services. Kathodi communities in less acculturated areas have better access to PHCs, while most acculturated areas see a higher reliance on non-formal health facilities. The Lodha community, particularly in less acculturated areas, depends on CHCs and other non-formal health services. The Birhor community residing in forest areas largely relies on private hospitals, contrasting with most acculturated areas where PHCs and local doctors are more prevalent. The analysis highlights the varied access to health facilities among the PVTGs, with some communities relying heavily on sub-centres and PHCs, while others depend more on local doctors or other sources. The data suggests a need for improved healthcare infrastructure, particularly in remote and forest areas where access to formal healthcare services is limited.

Table 6: Access to Education:

Access to education involves an interdisciplinary approach that can explore how educational access might influence gut health, and vice versa, through various socio-economic, nutritional, and lifestyle factors. Access to education encompasses the availability, affordability, and quality of educational opportunities for individuals, particularly in low-income and marginalized communities. It is a critical determinant of socio-economic status, health literacy, and overall well-being. Education improves health literacy, enabling individuals to make informed decisions about their diet, lifestyle, and healthcare, all of which

influence gut health. Access to education is closely tied to socio-economic status. Better-educated individuals often have higher incomes, which allows for better access to healthy food, healthcare, and information about maintaining gut health. Understanding the relationship between gut microbiota and access to education can provide valuable insights into how educational disparities influence health.

Access to Education				
Community	**R/T**	**School (%)**	**College (%)**	**Both (%)**
Chenchu	Most acculturated	45.00	0	55.00
	Less acculturated	10.50	0	89.50
Savara	Most acculturated	100.00	0	0
	Less acculturated	100.00	0	0
Kolam	Most acculturated	100.00	0	0
	Less acculturated	100.00	0	0
Kathodi	Most acculturated	100.00	0	0
	Less acculturated	100.00	0	0
Lodha	Most acculturated	100.00	0	0
	Less acculturated	100.00	0	0
Birhor	Most acculturated	90.5	0	9.5
	Less acculturated	100	0	0

In the most acculturated areas of the Chenchu, 45% have access to school education, while 55% have access to both school and higher education (college). In the less acculturated areas, 10.5% have access to school education, and a significant 89.5% have access to both school and higher education. Both the studied groups in these communities have 100% access to school education. None of these communities have access to college education, either in the studied areas, indicating a potential gap in higher education facilities. In the most acculturated area, 90.5% have access to school education, and 9.5% have access to both school and higher education. In the less acculturated area, 100% have access to school education, with no access to higher education. Access to school education is high across all the communities, particularly in most acculturated areas. However, in some less acculturated areas like the Chenchu community, the access to both school and higher education is more prevalent. The access to college education is limited across all the communities, with only the Chenchu and Birhor communities showing any percentage (most acculturated) of access to both school and higher education. This analysis highlights the disparity in access to higher education among these PVTGs, suggesting a need for targeted interventions to improve educational opportunities, particularly in less acculturated areas.

Of the six communities, Chenchu is the only one having access to both less acculturated (89.50%) and most acculturated (55%) education and higher education. Only schools are available to the other four communities, which are Savara, Kolam, Kathodi, and Lodha.

1. COOKING AND DRINKING PRACTICES

Table 7: Drinking Water

The relationship between gut microbiota and access to clean drinking water is a crucial area of study in understanding public health, nutrition, and disease prevention. Access to clean drinking water is directly linked to the composition and health of gut microbiota. Exposure to harmful pathogens, heavy metals, and other contaminants through unsafe drinking water can disrupt the gut microbiota, leading to dysbiosis (an imbalance in the gut microbial community). This can contribute to gastrointestinal diseases, infections, and chronic conditions. Chlorination, filtration, and other water treatment processes can affect the microbial content of water. While these processes are essential for eliminating pathogens, they may also impact beneficial microbes that could influence gut health. Contaminants in water, such as antibiotics and antimicrobial agents, can promote the development of antibiotic-resistant bacteria in the gut microbiota, which can lead to harder-to-treat infections. Studies have shown that individuals in less acculturated areas with limited access to clean water often have a more diverse gut microbiota, but they are also more prone to harboring harmful pathogens. In contrast, most acculturated populations with better water quality may have less microbial diversity but lower incidences of waterborne diseases. Research has demonstrated that improving access to clean water can positively affect gut microbiota composition. For instance, providing clean water in communities with previously contaminated water supplies has been shown to reduce the prevalence of waterborne pathogens and improve overall gut health.

Access to Drinking Water (%)							
Categories	**R/T**	**Chenchu**	**Savara**	**Kolam**	**Kathodi**	**Lodha**	**Birhor**
Tubewell	Most acculturated	30.00	0	0	0	**0**	**14.3**
	Less acculturated	57.90	0	0	0	**0**	**42.9**
Stream	Most acculturated	0	70.70	0	0	**0**	**0**
	Less acculturated	10.50	0	0	2.20	**0**	**0**
Pond	Most acculturated	0	0	0	0	**0**	**0**
	Less acculturated	10.50	0	0	0	**5.26**	**0**
Well	Most acculturated	0	0	0	13.60	**0**	**0**
	Less acculturated	0	0	41.00	73.90	**63.16**	**0**
Hand pump	Most acculturated	0	0	3.40	0	**0**	**23.8**

	Less acculturated	0	0	0	0	**0**	**0**
Government tap water	Most acculturated	55.00	29.30	62.10	79.50	**100.00**	**61.9**
	Less acculturated	15.80	77.30	41.00	17.50	**21.05**	**57.1**
None	Most acculturated	0	0	3.50	2.30	**0**	**0**
	Less acculturated	0	22.70	0	0	**0**	**0**
Others	Most acculturated	15.00	0	0	4.50	**0**	**0**
	Less acculturated	0	0	18.00	6.50	**10.52**	**0**
Improved Water Sources (%)							
Piped water into dwelling/yard/plot	Most acculturated	10.00	9.80	0	22.50	4.76	38.1
	Less acculturated	26.30	59	0	4.30	0	38.1
Public tap	Most acculturated	35.00	0	25.00	72.50	95.24	4.8
	Less acculturated	26.30	0	71.80	56.50	47.37	4.8
Sandpipe	Most acculturated	0	70.70	0	0	0	0
	Less acculturated	0	0	0	0	0	0
Tube well or Borehole	Most acculturated	15.00	19.50	3.60	0	0	23.8
	Less acculturated	21.10	40.90	0	0	10.53	42.8
Protected dug well	Most acculturated	0	0	46.40	0	0	0
	Less acculturated	5.30	0	0	4.30	31.58	0
Protected spring	Most acculturated	0	0	0	0	0	0
	Less acculturated	5.30	0	0	0	0	0
Rainwater	Most acculturated	0	0	0	0	0	0
	Less acculturated	15.80	0	0	0	0	0
Community RO plant	Most acculturated	25.00	0	0	0	0	0

	Less acculturated	0	0	0	0	0	0
Others	Most acculturated	0	0	25.00	5.00	0	0
	Less acculturated	0	0	28.20	34.80	10.52	0
Unimproved Water Sources (%)							
Surface water	Most acculturated	5.00	100.00	0	0	0	23.8
	Less acculturated	15.80	100.00	0	0	0	0
Unprotected dug well	Most acculturated	75.00	0	0	47.70	100.00	0
	Less acculturated	57.90	0	0	76.10	94.74	4.8
Unprotected spring	Most acculturated	0	0	0	0	0	0
	Less acculturated	0	0	0	0	0	14.3
Cart with small tank	Most acculturated	0	0	0	0	0	0
	Less acculturated	5.30	0	2.60	0	0	0
Tanker truck	Most acculturated	0	0	0	0	0	0
	Less acculturated	8.90	0	0	0	0	0
Others	Most acculturated	20.00	0	13.80	52.20	0	0
	Less acculturated	12.10	0	5.10	23.90	5.26	0
None	Most acculturated	0	0	86.20	0	0	0
	Less acculturated	0	0	92.30	0	0	28.6
Condition of Drinking Water (%)							
Boil	Most acculturated	10.00	0	0	6.80	0	0
	Less acculturated	10.50	0	5.10	4.40	0	0
Use ceramic	Most acculturated	0	0	0	0	0	0
	Less acculturated	0	0	0	2.20	0	0
Sand	Most acculturated	0	0	0	0	0	0

	Less acculturated	0	0	0	0	0	0
Other water filters	Most acculturated	0	0	0	0	0	0
	Less acculturated	0	0	5.10	4.40	0	0
Electronic purifier	Most acculturated	15.00	0	0	0	0	0
	Less acculturated	0	0	0	0	0	0
No treatment	Most acculturated	65.00	100.00	86.20	93.20	100.00	100
	Less acculturated	89.50	100.00	89.80	88.90	89.47	100
Others	Most acculturated	10.00	0	13.80	0	0	0
	Less acculturated	0	0	0	0	10.53	0
Storage Pot (%)							
Steel	Most acculturated	60.00	95.10	67.90	90.90	80.95	23.8
	Less acculturated	100.00	100.00	76.90	100.00	31.58	23.8
Earthen	Most acculturated	0	4.90	0	0	0	19.0
	Less acculturated	0	0	2.60	0	0	66.7
Copper	Most acculturated	0	0	0	0	0	0
	Less acculturated	0	0	0	0	0	0
Bronze	Most acculturated	0	0	0	0	0	0
	Less acculturated	0	0	0	0	0	0
Others	Most acculturated	40.00	0	32.10	9.10	19.05	57.1
	Less acculturated	0	0	20.50	0	68.42	9.5

The analysis reveals that many PVTGs rely on a mix of government tap water, wells, and unimproved sources like surface water and unprotected dug wells. There is limited use of water treatment methods, and steel pots are the most common storage method. The data highlights the need for improved access to safe drinking water and education on water treatment practices. Among the Chenchus, 55% of the most acculturated rely on government tap water, with 30% using tubewells and among the less acculturated, 57.9% use tubewells, and 15.8% depend on government tap water. 70.7% of the most acculturated Savara

community use streams, and 29.3% rely on government tap water and 77.3% of the forest dwelling group depend on government tap water. 62.1% use government tap water, with some reliance on wells and hand pumps in the most acculturated set up and 41% rely equally on wells and government tap water in the less acculturated set up. 79.5% depend on government tap water among the kathodi and 73.9% use wells, with 17.5% relying on government tap water. The Lodhas (100%) rely on government tap water in most acculturated set up and 63.16% use wells, with some use of ponds inside the forest areas. 61.9% Birhors in most acculturated set up use government tap water, with 23.8% using hand pumps and 57.1% use government tap water, and 42.9% use tubewells in less acculturated setting.

Among the Chenchu's most acculturated setting, 35% use public taps, 10% have piped water into their dwelling, whilst 26.3% have piped water, and 26.3% use public taps in less acculturated setting. On the other hand in the Savara community, 70.7% of the most acculturated dwellers use sandpipes and 59% of the less acculturated have piped water into dwellings. Similarly, 46.4% of most acculturated Kolams use protected dug wells, and 25% use public taps, whilst 71.8% of the less acculturated Kolams use public taps. In the Chenchu most acculturated area, community RO plants (25%) and public taps (35%) are the primary sources of improved water. In contrast, public taps (26.30%) and piped water entering homes (26.30%) are the main sources of water in less acculturated areas. In the Savara community, piped water into homes is the primary source for less acculturated residents (59%), while the majority of most acculturated residents (70.70%) use sandpipes. In the Kolam community, public taps (71.80%) supply improved water to less acculturated areas and protected dug wells (46.40%) supply water to most acculturated areas. In the Kathodi community, public taps are available for both less acculturated (56.50%) and most acculturated (72.50%) regions. In the same way, public taps serve as the primary source in both less acculturated (47.37%) and most acculturated (95.24%) portions of the Lodha community.

In the Chenchu community, unprotected dug wells account for the majority of unimproved water sources (57.9% of less acculturated and 75% of most acculturated water sources). Surface water is the primary source in the Savara community, accounting for 100% of the most acculturated and 100% of the less acculturated areas. The only sources for the Kolam community are carts with tiny tanks (2.60%), Others (5.10%), and Others (13.80%) for most acculturated regions. In the Kathodi community, unprotected dug wells account for 47.70% of less acculturated sources and Other sources (52.20%) for most acculturated sources. Similarly, the primary source for the Lodha community is an unprotected well that is 94.74% in less acculturated areas and 100% in most acculturated areas.

In all the studied areas, the majority of residents lacked access to treated drinking water. In the Chenchu neighbourhood, just 10% of most acculturated residents boil their water, compared to 10.5% of less acculturated residents, while 15% of most acculturated residents use electronic purifiers. No one cleans the drinking water for the Savara village. Just 13.8% of Kolam community members live in most acculturated areas while 5.1% of those in less acculturated areas boil their water and another 5.1% use alternative water filters. In Kathodi,

just 6.8% of most acculturated residents boil their water, whereas 4.40 percent of less acculturated residents use ceramic filters, 4.40 percent boil water, and 4.40 percent use other water filters.

In all the communities, steel is the most widely utilised material for storage pots. In Chenchu community, steel is used by 60% of most acculturated residents and by all less acculturated residents. Likewise, the Savara community uses steel throughout 100% of its less acculturated and 95.10% of its most acculturated areas. In contrast, the Kolam community has a significantly lower percentage of steel users—67.90% of most acculturated residents and 76.90% of less acculturated residents—than other towns. In the Kathodi community, 100% of less acculturated residents and 90.9% of most acculturated residents use steel. 68.42% of less acculturated residents in the Lodha community utilise different materials, while just 31.58% use steel, in contrast to other communities. Nonetheless, 80.95% of the most acculturated Lodha community uses steel.

The study of gut microbiota in relation to access to drinking water is essential for understanding the broader impacts of water quality on human health. Ensuring access to clean drinking water not only prevents waterborne diseases but also supports a healthy gut microbiome, which is critical for overall well-being.

Table 8: Cooking

Studies have shown that people living in less acculturated areas, where cooking is often done with traditional methods and locally sourced ingredients, tend to have more diverse gut microbiota compared to those in most acculturated settings where processed foods and modern cooking methods are prevalent. Economic status influences access to different cooking environments and methods. For example, reliance on wood or coal for cooking in low-income settings may expose individuals to higher levels of indoor air pollution, affecting gut and overall health. Comparing gut microbiota in populations with different cooking environments (e.g., most acculturated vs. less acculturated, traditional vs. modern kitchens) can shed light on how cooking practices influence gut health. Introducing changes in cooking environments, such as improving ventilation or switching to cleaner cooking fuels, and observing the impact on gut microbiota can provide insights into mitigating negative effects. Examining how traditional cooking practices in different cultures contribute to gut health can highlight beneficial practices that could be adapted or preserved. Understanding how cooking practices and environments influence gut microbiota can inform strategies to promote healthier diets and improve overall well-being, particularly in contexts where poor air quality and hygiene in cooking places pose risks to health.

Cooking Place					
Community	**R/T**	**In the house (separate room) (%)**	**In the house (no separate room) (%)**	**Separate building (%)**	**Others (%)**
Chenchu	Most acculturated	65.00	35.00	5.00	0
	Less acculturated	0	94.70	5.30	0

Savara	Most acculturated	39.00	34.10	24.40	2.40
	Less acculturated	38.10	14.30	33.33	14.30
Kolam	Most acculturated	93.10	6.90	0	0
	Less acculturated	84.60	12.80	2.60	0
Kathodi	Most acculturated	79.50	20.50	0	0
	Less acculturated	67.40	23.90	9.00	8.70
Lodha	Most acculturated	0	28.57	0	71.43
	Less acculturated	10.53	21.05	0	52.63
Birhor	Most acculturated	9.5	33.3	57.1	0
	Less acculturated	14.3	71.4	9.5	4.8
Mode of Cooking					
Community	**R/T**	**Stove (%) (LPG/kerosene/ electric)**	**Chullah (%)**	**Open fire (%)**	**Others (%)**
Chenchu	Most acculturated	100.00	0	0	0
	Less acculturated	0	84.20	15.80	0
Savara	Most acculturated	4.90	68.30	4.90	22.00
	Less acculturated	9.50	28.60	23.80	38.10
Kolam	Most acculturated	20.70	0	0	79.30
	Less acculturated	0	97.40	0	2.60
Kathodi	Most acculturated	6.80	70.50	0	22.70
	Less acculturated	0	78.30	0	21.70
Lodha	Most acculturated	0	100.00	0	0
	Less acculturated	0	100.00	0	0
Birhor	Most acculturated	9.5	85.7	0	4.8

	Less acculturated	0	100	0	0
Utensils Used for Cooking					
Community	**R/T**	**Earthen Pot (%)**	**Aluminum (%)**	**Steel (%)**	**Others (%)**
Chenchu	Most acculturated	5.00	45.00	35.00	15.00
	Less acculturated	0	68.40	31.60	0
Savara	Most acculturated	0	65.90	12.20	22.00
	Less acculturated	0	61.90	14.30	23.80
Kolam	Most acculturated	0	42.90	28.60	28.60
	Less acculturated	26.00	66.70	17.90	12.80
Kathodi	Most acculturated	0	53.50	2.30	44.20
	Less acculturated	0	65.20	2.20	32.60
Lodha	Most acculturated	0	100.00	0	0
	Less acculturated	0	57.89	10.53	31.57
Birhor	Most acculturated	0	57.1	4.8	38.1
	Less acculturated	0	52.4	4.8	42.9

In Chenchu, the majority of most acculturated residents cook in a separate room in the home (65%), whilst the majority of less acculturated residents cook in the home without a separate room (94.70%). In the Savara community, the majority of families residing in forest areas cook in a separate building outside (33.33%) and within the house (38.10%), while most acculturated residents cook inside the house in a separate room (39%) and without a separate room (34.10%) in a similar manner. The majority of Kolam community members, irrespective of the habitation area prepare meals in a separate room inside their homes.

A similar situation exists in the Kathodi village, where 79.50% of most acculturated and 67.40% of less acculturated residents cook in a separate room within their homes. Nonetheless, the bulk of cooks in the Lodha community are in the less acculturated (52.63%) and most acculturated (71.43%) sectors. 28.57% of them are most acculturated and 21.05% are less acculturated, although few of them cook in-house without a separate space.

In the Chenchu hamlet, stoves are used by all most acculturated residents for cooking. In a less acculturated area, 84.20% of the population cooks in chulah. In the Savara community,

the majority of most acculturated utilise Chullah, whereas the majority of less acculturated cook mostly over open fire (23.80%), Chullah (28.60%), and Others (38.10%). In the Kolam community, only 20.70% of most acculturated residents utilise stoves, while 79.30% use other sources; in less acculturated areas, chullah is generally used (97.40%). Likewise, in the Kathodi community, churlah is the primary cooking method in both less acculturated (78.30%) and most acculturated (70.50%) areas. Chullah was utilised by all members of the Lodha community, both less acculturated and most acculturated.

The most common type of cooking utensil is aluminium. In Chenchu community, the most acculturated population uses 45% aluminium and 35% steel, whereas the majority of the less acculturated population (68.30%) uses aluminium. In the Savara community, aluminium is used by over half of the most acculturated (65.90%) and less acculturated (61.90%) populations. In the Kolam community, the majority of less acculturated residents use aluminium (66.70%), while most acculturated residents use steel (28.60%), aluminium (42.90%), and other materials (28.60%). Similarly, in Kathodi, roughly half of the less acculturated (65.20%) and most acculturated (53.50%) populations utilise aluminium. In the Lodha community, aluminium is used by all most acculturated residents and by 57.89% of less acculturated residents.

The majority of the tribes tend to cook in a separate room within their homes, and they predominantly use stoves (LPG/kerosene/electric) or chullah for cooking. Aluminum is the most commonly used material for cooking utensils.

In the forest areas, cooking usually happens inside the house without a separate room or in a separate building outdoors. The chullah is the primary mode of cooking, and aluminum remains the most common material for cooking utensils.This analysis highlights the traditional practices and materials used by these communities, with a clear distinction between most acculturated and less acculturated settings in terms of cooking environments and tools used.

Table 9: Drainage Facility

The quality of drainage systems and sanitation facilities in a community can significantly impact gut health. Poor drainage and inadequate sanitation can lead to contamination of water and food sources, increasing exposure to harmful pathogens that can disrupt the gut microbiome. Drainage systems can harbor a variety of environmental microbes, including those that may influence the gut microbiome. These include bacteria that could either be beneficial or harmful, depending on the conditions of the environment. Understanding the link between drainage, sanitation, and gut health can lead to improved public health strategies, particularly in underdeveloped areas. Ensuring clean water and proper waste management can reduce the incidence of gut-related illnesses. The study of the gut microbiome is crucial for understanding its role in health and disease, and environmental factors, including drainage and sanitation, play a significant role in shaping the gut microbiome. Improving environmental conditions, particularly in areas with poor drainage, can help maintain a healthy gut microbiome and prevent disease.

Drainage Facility			
Community	**R/T**	**Yes (%)**	**No (%)**
Chenchu	Most acculturated	45.00	55.00
	Less acculturated	10.50	89.50
Savara	Most acculturated	24.40	75.60
	Less acculturated	72.70	22.70
Kolam	Most acculturated	24.10	75.90
	Less acculturated	0	100.00
Kathodi	Most acculturated	2.40	97.60
	Less acculturated	4.30	95.70
Lodha	Most acculturated	0	100.00
	Less acculturated	0	100.00

The Chenchu community has the highest percentage (45%) of closed drainage facilities in most acculturated areas. The Birhor community lacks closed drainage facilities entirely in most acculturated settings. Open drainage is most prevalent among the Kolam community (60%) in most acculturated areas, followed by Savara (50%). A significant portion of the Lodha and Birhor communities (60%) in most acculturated areas have no drainage facilities. None of the communities have closed drainage facilities in less acculturated areas. The Chenchu community has the highest percentage (40%) of open drainage facilities in less acculturated areas, while the Kolam and Birhor communities have the lowest (20%). The Kolam and Birhor communities have the highest percentage (80%) of households with no drainage facilities in less acculturated areas. This analysis highlights the disparities in access to drainage facilities between most acculturated and less acculturated areas across different tribal communities, with less acculturated areas particularly lacking in closed drainage systems. The people's health could be vulnerable if there are inadequate drainage systems.

Table 10: Cleaning Practices

Cleaning of Water Storage Utensils						
Community	**R/T**	**Daily (%)**	**2-3 days/week(%)**	**Once in a week (%)**	**Fortnightly (%)**	**Others (%)**
Chenchu	Most acculturated	95.00	0	0	0	5.00
	Less acculturated	36.80	42.10	0	0	21.10
Savara	Most acculturated	97.50	0	0	0	2.40
	Less acculturated	86.40	13.60	0	0	0

Kolam	Most acculturated	68.00	20.00	12.00	0	0
	Less acculturated	69.20	30.80	0	0	0
Kathodi	Most acculturated	84.10	15.90	0	0	0
	Less acculturated	93.50	6.50	0	0	0
Lodha	Most acculturated	100.00	0	0	0	0
	Less acculturated	100.00	0	0	0	0
Birhor	Most acculturated	85.7	14.3	0	0	0
	Less acculturated	85.7	9.5	4.8	0	0

The most common source of drinking water for most acculturated areas, especially in the Kathodi (79.50%) and Lodha (100%) communities. However, forest dwelling groups like the Kolam (41%) and Kathodi (17.50%) still rely on government tap water but to a lesser extent. These are more commonly used in less acculturated areas, such as the Kolam (41%) and Lodha (63.16%) communities, indicating limited access to piped water. The majority of the communities do not treat their drinking water, with the Kolam community showing the lowest treatment rates. Some most acculturated areas, like the Chenchu, use electronic purifiers (15%). Steel is the predominant material for water storage across most communities, both most acculturated and less acculturated. However, in the Lodha community, alternative materials are more frequently used in less acculturated areas (68.42%) compared to most acculturated ones (19.05%). Common in most communities, particularly among the most acculturated Kolam (93.10%) and Kathodi (79.50%). In less acculturated areas, many still cook in separate buildings or outdoors, especially in the Savara community (33.33%). Most acculturated areas like the Chenchu community fully utilize stoves, while less acculturated areas predominantly use traditional methods like chullah, especially in the Kolam (97.40%) and Lodha (100%) communities. These are the primary materials used for cooking utensils. Most acculturated Chenchu communities favor aluminum (45%) and steel (35%), while less acculturated communities lean more towards aluminum (68.40%). This analysis indicates that traditional practices still dominate in less acculturated areas, with limited adoption of modern amenities like treated water and advanced cooking methods. The reliance on natural resources such as wells and open fires is significant, especially in less acculturated communities, which may have implications for health and hygiene.

Table 11: Material for Cleaning of Utensils

Ash is a widely used material for cleaning utensils, particularly in less acculturated areas. The Savara community in less acculturated areas has the highest usage of ash (85.70%). The Birhor community also shows high usage in less acculturated areas (90.50%). Soap is more commonly used in most acculturated areas across all communities. The Kolam community in

most acculturated areas shows the highest usage of soap (96.60%). In contrast, less acculturated areas of all communities generally show lower usage of soap. None of the communities reported using mud or other materials for cleaning utensils in either most acculturated or less acculturated areas. The use of materials for cleaning utensils shows a clear distinction between most acculturated and less acculturated areas. Most acculturated populations tend to use soap more frequently, while forest dwelling populations rely more on traditional materials like ash. This pattern reflects the availability and cultural practices within these communities.

Materials for Cleaning Utensils								
Community	**R/T**	**Soap**	**Tamarind**	**Coal**	**Ash**	**Mud**	**Water**	**Others**
Chenchu	Most acculturated	90.00	5.00	0	0	0	0	5.00
	Less acculturated	73.80	0	0	10.60	0	0	10.60
Savara	Most acculturated	58.20	0	0	19.40	0	0	0
	Less acculturated	50.0	0	9.10	31.70	0	0	0
Kolam	Most acculturated	62.00	0	0	0	34.60	3.40	0
	Less acculturated	53.60	0	0	0	19.50	12.20	14.70
Kathodi	Most acculturated	86.40	0	0	0	6.60	4.50	0
	Less acculturated	78.30	0	0	8.70	15.50	0	0
Lodha	Most acculturated	100.00	0	0	0	0	0	0
	Less acculturated	89.47	0	0	0	10.53	0	0
Lodha	Most acculturated							
	Less acculturated							

Table 12: Cleaning of Rooms

The cleanliness of living environments, including homes, hospitals, and workplaces, affects the types and quantities of microbes that inhabit these spaces. Regular cleaning practices, such as using disinfectants, can significantly reduce microbial load, including potentially harmful pathogens. There is growing interest in how environmental cleanliness influences the human microbiome, including the gut microbiome. For instance, excessive sterilization of environments might reduce exposure to beneficial microbes, potentially affecting the development of the immune system, especially in children. There is growing interest in how environmental cleanliness influences the human microbiome, including the gut microbiome. For instance, excessive sterilization of environments might reduce exposure to beneficial microbes, potentially affecting the development of the immune system, especially in children. There is growing interest in how environmental cleanliness influences the human

microbiome, including the gut microbiome. For instance, excessive sterilization of environments might reduce exposure to beneficial microbes, potentially affecting the development of the immune system, especially in children. while gut microbial studies primarily focus on understanding the complex interactions within the gut microbiome and its effects on health, the cleanliness of rooms and the broader environment plays a significant role in shaping these microbial communities.

Cleaning of Rooms					
Community	**R/T**	**Daily**	**2-3 days in a week/Once in a week**	**Fortnightly**	**Others**
Chenchu	Most acculturated	40.00	35.00	25.00	0
	Less acculturated	15.80	36.80	42.10	5.30
Savara	Most acculturated	53.70	22.0	24.40	0
	Less acculturated	63.60	13.60	18.20	0
Kolam	Most acculturated	77.80	18.50	3.70	0
	Less acculturated	66.70	33.30	0	0
Kathodi	Most acculturated	81.80	18.20	0	0
	Less acculturated	73.90	26.10	0	0
Lodha	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0
Birhor	Most acculturated	81.0	29.0	0	0
	Less acculturated	71.4	28.6	0	0

The hygiene practices among these communities vary widely, with some communities showing higher standards due to better access to resources and others relying on traditional methods. Practices are often influenced by the availability of water and cleaning materials. Most of the communities live in kachha (mud) houses, with some in semi-pucca or pucca houses, which impacts their cleaning methods. The condition of homes, such as the presence of separate cooking areas and the type of flooring, also influences how often and how thoroughly rooms are cleaned. Cultural beliefs play a role in cleaning practices, particularly in handling waste and maintaining personal space. Rituals and norms might dictate the frequency and methods of cleaning different parts of the house, especially in places where the kitchen is separate or cooking is done outside. Access to clean water is a major challenge, directly affecting how often and effectively rooms can be cleaned. Some communities may struggle with consistent cleaning due to lack of resources, leading to compromised hygiene. High reliance on traditional methods for cleaning, with limited use of modern cleaning agents. Similar traditional practices, with variability depending on proximity to most

acculturated centers. Likely similar to the Chenchu and Savara, with influences from local practices and available resources. Some integration of modern practices, especially in more most acculturated areas. Likely to have mixed practices depending on their level of interaction with non-tribal populations and access to modern amenities. Cleaning practices among these PVTGs are closely tied to their living conditions, cultural norms, and access to resources. While some communities might have more structured approaches, others may face significant challenges due to environmental and economic constraints.

Table 13: Cleaning of Household

Cleaning of Household					
Community	**R/T**	**Daily**	**2-3 days in a week**	**Once in a week**	**Fortnightly**
Chenchu	Most acculturated	5.00	20.00	35.00	40.00
	Less acculturated	5.30	31.60	26.30	36.80
Savara	Most acculturated	48.80	24.40	4.90	22.00
	Less acculturated	63.60	4.50	18.20	13.60
Kolam	Most acculturated	65.40	19.20	15.40	0
	Less acculturated	66.70	33.30	0	0
Kathodi	Most acculturated	70.50	20.50	9.10	0
	Less acculturated	65.90	29.50	4.50	0
Lodha	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0

The analysis of household cleaning, particularly in terms of cooking practices and utensil use, shows significant variation among the PVTGs. Most acculturated areas tend to have more modern cooking arrangements like separate rooms and stoves, while less acculturated areas rely heavily on traditional methods such as cooking in the open or using Chullah. Aluminum utensils are the most common across all communities, but the use of earthen pots and other materials is also noted, especially in less acculturated areas.

In Table number 13 regarding the sanitation practices of households, it is evident that within the most acculturated population of the Chenchu community, approximately 35% engage in weekly household cleaning, while around 40% clean their households on a fortnightly basis. As for the less acculturated population, roughly 32% perform weekly household cleaning, and about 37% engage in such activities fortnightly. Within the most acculturated population of the Savara community, approximately 49% partake in daily household cleaning, with around 25% doing so for 2-3 days per week. The majority of the forest dwelling population, accounting for 63.60%, engage in daily household cleaning practices. Moreover, the predominant practice among the Kolam community is daily household cleaning, with rates

of 65.40% in most acculturated areas and 66.70% in less acculturated areas. Similarly, the Kathodi community also exhibits a preference for daily household cleaning, with rates of 70.50% in most acculturated areas and 65.90% in less acculturated areas. The entire sub groups of the studied population of the Lodha community is observed to engage in daily household cleaning practices.

Table 14: Cleaning Method

Cleaning Method					
Community	**R/T**	**Dry Cleaning**	**Wet Cleaning with Mopping**	**Others**	**Multiple Mode**
Chenchu	Most acculturated	20.00	0.00	0	0
	Less acculturated	0	100.00	0	0
Savara	Most acculturated	17.10	53.70	9.80	0
	Less acculturated	21.10	72.70	5.30	0
Kolam	Most acculturated	0	60.70	7.200	32.10
	Less acculturated	33.33	0	48.70	18.00
Kathodi	Most acculturated	2.30	20.50	45.50	31.80
	Less acculturated	6.80	11.40	54.50	27.30
Lodha	Most acculturated	0	0	0	100.00
	Less acculturated	26.32	36.84	0	36.84
Birhor	Most acculturated	47.6	52.5	0	0
	Less acculturated	9.5	90.5	0	0

In Table No. 14, it is evident that a significant proportion of the two studied subgroup of population belonging to the Chenchu community engage in wet cleaning through the utilization of the mopping technique. The prevailing practice among the Savara community reveals that approximately 53.70% of most acculturated individuals and 72.70% of less acculturated individuals resort to wet mopping. Similarly, the majority of most acculturated residents in the Kolam community, accounting for 60.70%, opt for wet mopping. Conversely, within the less acculturated population of the Kolam community, around 33% adopt dry cleaning procedures, while approximately 49% employ alternative methods. Notably, a substantial portion of the less acculturated demographic, constituting 55%, and roughly 46% of most acculturated inhabitants in the Kathodi community, resort to alternative methods. Moreover, about 32% of most acculturated residents in the Kathodi community utilize multiple cleaning techniques, reflecting a pattern akin to the entirety of the most acculturated population. Furthermore, roughly 37% of the forest dwelling population in the Lodha community engage in wet mopping practices. In summary, wet mopping and the utilization of diverse cleaning methods are predominantly favoured for room sanitation.

Table 15: Place of Disposing Garbage

The table titled "Place of Disposing Garbage" provides detailed data on how different communities handle garbage disposal, distinguishing between most acculturated and less acculturated settings. Overall, the data highlights significant variations in garbage disposal practices across different communities, with a general trend of less acculturated populations tending to dispose of garbage at specific places outside their houses, while most acculturated populations show more variability. From Table 15, it is evident that more than 90% of the Chenchu community opts to dispose of their waste in a specific location outside their

residences. Similarly, a majority of the less acculturated population in Kolam (73%), Lodha (85.71%), and Kathodi (55.80%) habitually discard their garbage in various random spots outside their homes. Approximately 48% of most acculturated residents in Kolam follow the same practice of disposing of waste in random locations, while an equal percentage choose a designated spot outside for waste disposal. Moreover, more than half of the less acculturated inhabitants in Kathodi (51%) prefer a specific outdoor area for garbage disposal. Lastly, over 53% of the less acculturated population in Lodha exhibit a preference for discarding their waste in random locations.

Place of Disposing Garbage				
Community	**R/T**	**Anywhere outside house**	**Particular place outside house**	**Others**
Chenchu	Most acculturated	10.00	90.00	0
	Less acculturated	5.30	94.70	0
Savara	Most acculturated	56.10	34.10	9.80
	Less acculturated	53.80	46.20	0
Kolam	Most acculturated	48.10	48.10	3.80
	Less acculturated	73.00	27.00	0
Kathodi	Most acculturated	55.80	44.20	0
	Less acculturated	48.80	51.20	0
Lodha	Most acculturated	85.71	14.29	0
	Less acculturated	52.63	47.37	0
Birhor	Most acculturated	76.2	23.8	0
	Less acculturated	57.1	42.9	0

Table 16: Type of Latrine

Type of Latrine						
Community	**R/T**	**Kaccha**	**Pucca**	**Thatched**	**Pit**	**Open**
Chenchu	Most acculturated	15.00	30.00	20.00	35.00	0
	Less acculturated	10.50	42.10	21.10	26.30	0
Savara	Most acculturated	7.30	12.20	9.80	0	71.20
	Less acculturated	12.50	12.50	31.30	0	43.80
Kolam	Most acculturated	14.80	66.70	0	0	18.50

	Less acculturated	23.10	7.70	0	0	69.20
Kathodi	Most acculturated	25.60	27.90	0	0	46.50
	Less acculturated	15.60	8.90	0	2.20	73.30
Lodha	Most acculturated	14.29	33.33	0	0	52.38
	Less acculturated	15.79	10.53	0	0	73.68
Birhor	Most acculturated	0	28.6	0	0	71.4
	Less acculturated	0	19.0	0	0	81.0

Most acculturated Kolam community has the highest percentage (66.7%) of pucca latrine usage. In less acculturated areas, the Chenchu community leads with 42.1%. Less acculturated Kolam community has the highest use of kaccha latrines at 23.1%. The Savara community shows significant usage of thatched latrines, particularly in forest areas (31.3%). Most acculturated Chenchu communities favour pit latrines, with 35% usage.

Table: 17 Source of Water in Toilet

Source of Water in Toilet					
Community	**R/T**	**Piped**	**Tubewell**	**From Outside**	**Others**
Chenchu	Most acculturated	0	30.00	70.00	0
	Less acculturated	0	10.50	89.50	0
Savara	Most acculturated	7.50	12.50	80.00	0
	Less acculturated	13.30	20.00	66.70	0
Kolam	Most acculturated	66.70	0	33.33	0
	Less acculturated	11.11	88.90	0	0
Kathodi	Most acculturated	28.60	0	71.40	0
	Less acculturated	17.50	0	80.00	2.50
Lodha	Most acculturated	14.29	0	28.57	57.14
	Less acculturated	5.26	0	15.79	78.95
Birhor	Most acculturated	47.6	0	19.0	33.3
	Less acculturated	47.6	9.5	28.6	14.3

Open defecation is prevalent in many communities, especially in the less acculturated Kathodi (73.3%) and Lodha (73.7%) communities, and most acculturated Savara (71.2%) and Birhor (71.4%) communities. This data underscores the disparities in sanitation infrastructure across different tribal communities, with open defecation remaining a significant issue in many areas, particularly less acculturated settings.

Government Tap Water is the predominant source in most acculturated areas for most communities, particularly the Lodha community, where it is used exclusively in most acculturated settings. Wells and Tubewells are more common in forest areas, particularly among the Kathodi, Kolam, and Chenchu communities. The Savara community uniquely relies heavily on streams in most acculturated areas, while shifting to government tap water in less acculturated regions. This table summarizes the primary sources of water used across different communities, highlighting the variation between most acculturated and less acculturated areas.

Table:18 Place of Defecation

The place of defecation, whether it is in open fields, unimproved latrines, or improved sanitation facilities, has direct implications for hygiene and exposure to pathogens. Open defecation and inadequate sanitation facilities can lead to environmental contamination, increasing the risk of exposure to pathogenic microorganisms. This exposure can, in turn, affect the gut microbiota by introducing harmful bacteria or disrupting the microbial balance. The place of defecation can influence the types of microorganisms to which individuals are exposed. For example, those practicing open defecation may be more exposed to soil-transmitted helminths and bacteria, which can alter the gut microbiota.

Place of Defecation				
Community	**R/T**	**Open**	**Latrine**	**Others**
Chenchu	Most acculturated	25.00	75.00	0
	Less acculturated	94.70	5.30	0
Savara	Most acculturated	95.10	4.90	0
	Less acculturated	90.90	4.50	4.50
Kolam	Most acculturated	57.10	42.90	0
	Less acculturated	100.00	0	0
Kathodi	Most acculturated	76.70	23.30	0
	Less acculturated	88.60	11.40	0
Lodha	Most acculturated	61.90	33.33	4.76
	Less acculturated	89.47	10.53	0
Birhor	Most acculturated	71.4	23.8	4.8
	Less acculturated	95.2	4.8	0

The hygiene hypothesis suggests that lack of exposure to diverse microorganisms, as a result of improved sanitation and hygiene, might reduce the diversity of gut microbiota, potentially leading to immune-related disorders. Research comparing less acculturated populations, who might practice open defecation, with most acculturated populations using improved sanitation, has shown differences in gut microbial diversity. Less acculturated populations often have more diverse microbiomes, which is thought to be beneficial, although they may also have higher exposure to pathogens. The place of defecation and associated sanitation practices are critical factors influencing gut microbiota. Improving sanitation can lead to

better health outcomes by reducing exposure to pathogens, but it also has implications for microbial diversity, which plays a crucial role in maintaining a healthy gut.

Open defecation among the Chenchu community is highly prevalent in less acculturated areas (94.70%) compared to most acculturated areas (25.00%). And among the Savaras, both the studied areas exhibit high rates of open defecation, with most acculturated areas slightly higher (95.10% vs. 90.90%). Forest areas of the Kolams show a complete dependence on open defecation (100.00%), whereas most acculturated areas have a significant but lower rate (57.10%). The practice of open defecation is prevalent, especially in less acculturated areas of the Kathodi (88.60%), though less so in most acculturated areas (76.70%). It is noted among the Lodhas, open defecation is prevalent in both most acculturated (61.90%) and less acculturated (89.47%) areas, with some use of latrines in most acculturated settings. High open defecation rates in less acculturated of the Birhor (95.2%) and most acculturated (71.4%) areas, with minimal use of latrines. This data underscores the significant challenges in sanitation infrastructure, especially in less acculturated regions, and highlights the need for targeted interventions to improve latrine access and reduce open defecation rates.

Table:19 Mode of Cleaning after Toilet

Mode of Cleaning After Toilet					
Community	**R/T**	**With Water**	**With Leaves**	**Applying Cow dunk**	**Applying Mud**
Chenchu	Most acculturated	90.00	10.00	0	0
	Less acculturated	100.00	0	0	0
Savara	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0
Kolam	Most acculturated	100.00	0	0	0
	Less acculturated	92.30	7.70	0	0
Kathodi	Most acculturated	97.70	2.30	0	0
	Less acculturated	95.6	4.40	0	0
Lodha	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0
Birhor	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0

The data clearly shows that the majority of people across all communities, both in the studied settings, predominantly use water for cleaning after toilet use. The use of leaves as a cleaning method is minimal, with the Chenchu (Most acculturated) showing a 10% usage, and Kolam (Less acculturated) showing a 7.7% usage. None of the communities reported using cow

dung or mud as a cleaning method after toilet use. This analysis indicates a strong preference for water as a cleaning method, which is a positive indicator of hygiene practices across these communities.

Table:20 Material Used for Washing Hands after Defecation

Material Used for Washing Hands after defecation					
Community	**R/T**	**Water and Soap**	**Water and Ash**	**Soil/Water only**	**Others**
Chenchu	Most acculturated	85.00	0	15.00	0
	Less acculturated	26.30	63.20	10.50	0
Savara	Most acculturated	46.30	0	51.20	2.40
	Less acculturated	31.80	0	63.60	4.50
Kolam	Most acculturated	81.80	18.20	0	0
	Less acculturated	50.00	0	47.20	2.80
Kathodi	Most acculturated	48.80	0	48.80	2.30
	Less acculturated	71.40	0	23.80	4.80
Lodha	Most acculturated	95.24	4.76	0	0
	Less acculturated	63.16	0	21.05	15.79
Birhor	Most acculturated	76.2	0	14.3	9.5
	Less acculturated	47.6	0	33.3	4.8

A significant difference between the two sub groups residing in different areas is evident among the Chenchus. While 85% of most acculturated residents use water and soap, the less acculturated population predominantly uses water and ash (63.2%). The majority of both most acculturated and less acculturated Savara residents use soil and water only. Kolam Most acculturated residents prefer water and soap, while less acculturated areas are almost evenly split between water/soap and soil/water. A large proportion of less acculturated residents of the Kathodi community (71.4%) use water and soap, while most acculturated residents are equally divided between using soap or soil/water. Lodha most acculturated residents almost exclusively use water and soap (95.24%), but less acculturated residents have a more varied approach with some using soil/water or other materials. Birhor's preference for water and soap in most acculturated areas, but less acculturated residents show more varied practices. These findings suggest that there is a significant variation in handwashing practices between most acculturated and less acculturated settings within each community, with less acculturated areas more likely to use traditional or less hygienic materials such as soil and ash.

Table:21 Bathing Practice

Bathing Practice in Winter					
Community	**R/T**	**Daily**	**2-3 days/week**	**Once/week**	**Fortnightly**
Chenchu	Most acculturated	60.00	40.00	0	0
	Less acculturated	5.30	68.40	15.80	5.30
Savara	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0
Kolam	Most acculturated	96.40	3.60	0	0
	Less acculturated	97.40	2.60	0	0
Kathodi	Most acculturated	100.00	0	0	0
	Less acculturated	97.80	2.20	0	0
Lodha	Most acculturated	100.00	0	0	0
	Less acculturated	89.47	10.53	0	0
Birhor	Most acculturated	42.9	52.4	4.8	0
	Less acculturated	38.1	61.9	0	0

In the provided bathing practice table, it is evident that the majority of most acculturated individuals belonging to the Chenchu community engage in daily showering routines during both winter and summer seasons. Conversely, a significant contrast is observed among less acculturated community members, who limit their showering frequency to 2 to 3 days per week regardless of the season. Similarly, among the other four Particularly Vulnerable Tribal Groups (PVTG) communities, as well as the most acculturated and less acculturated populations within those communities, daily showering is the prevalent practice for both winter and summer periods.

Table:22 Bathing Place

In the studied communities, most acculturated areas generally have better access to structured bathing facilities, such as indoor bathing areas with government tap water. Forest dwellers often rely on open areas or natural water sources, indicating lesser access to proper hygiene facilities. Communities like the Savara and Kolam show a clear divide between most acculturated and less acculturated practices, with most acculturated settings having better hygiene infrastructure.

Bathing Place						
Community	**R/T**	**Bathroom**	**Tube Well**	**Pond**	**Stream**	**Others**
Chenchu	Most acculturated	85.00	0	0	0	15.00
	Less acculturated	15.80	0	31.60	0	52.60
Savara	Most acculturated	46.30	4.90	7.30	26.80	0
	Less acculturated	57.10	4.80	0	38.10	0
Kolam	Most acculturated	95.00	0	5.00	0	0
	Less acculturated	20.50	0	0	0	79.50
Kathodi	Most acculturated	43.90	0	2.40	2.40	51.20
	Less acculturated	21.10	0	2.60	0	80.40
Lodha	Most acculturated	0	9.52	90.48	0	0
	Less acculturated	5.26	0	94.74	0	0
Birhor	Most acculturated	19.0	4.8	57.1	4.8	14.3
	Less acculturated	9.5	9.5	57.1	0	23.8

Access to clean water varies significantly, with many less acculturated areas depending on streams, wells, or unprotected sources which might affect the overall hygiene practices and health. The above analysis indicates that while some most acculturated communities have better access to clean water and indoor bathing facilities, less acculturated communities often struggle with limited access, potentially affecting their overall hygiene and health outcomes.

Bathing Practice in Other Seasons					
Community	**R/T**	**Daily**	**2-3 days/week**	**Once/week**	**Fortnightly**
Chenchu	Most acculturated	60.00	40.00	0	0
	Less acculturated	5.30	68.40	15.80	5.30
Savara	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0

Kolam	Most acculturated	92.90	7.10	0	0
	Less acculturated	100.00	0	0	0
Kathodi	Most acculturated	100.00	0	0	0
	Less acculturated	95.70	4.30	0	0
Lodha	Most acculturated	95.24	4.76	0	0
	Less acculturated	89.47	10.53	0	0
Birhor	Most acculturated	61.9	38.1	0	0
	Less acculturated	90.5	9.5	0	0

Table: 23 Use of Soap During Bathing

Use of Soap During Bathing					
Community	**R/T**	**Daily**	**2-3 days/week**	**Once/week**	**Fortnightly**
Chenchu	Most acculturated	100.00	0	0	0
	Less acculturated	21.10	26.30	15.80	36.90
Savara	Most acculturated	100.00	0	0	0
	Less acculturated	100.00	0	0	0
Kolam	Most acculturated	70.40	25.60	0	3.70
	Less acculturated	81.10	16.20	2.70	0
Kathodi	Most acculturated	87.80	12.20	0	0
	Less acculturated	87.50	12.50	0	0
Lodha	Most acculturated	80.95	4.76	14.76	0
	Less acculturated	57.89	31.58	10.53	0
Birhor	Most acculturated	61.9	19.0	9.5	9.5
	Less acculturated	14.3	71.4	14.3	0

Table 23 illustrates the utilization of soap in the bathing practices among the majority of individuals from four distinct communities namely Savara, Kolam, Kathodi, and Lodha, as well as the entire most acculturated populace of the Chenchu community, exhibit a regular use of soap during their daily bathing routines. Conversely, the less acculturated inhabitants

of the Chenchu community predominantly opt for a bi-weekly or 2 to 3 times a week frequency in employing soap during bathing.

Table: 24 Mode of Brushing Teeth

Mode of Brushing Teeth						
Community	**R/T**	**Toothpaste and Brush**	**Tooth Powder and Brush**	**Twigs of Plants**	**With Ash and Sand**	**Others**
Chenchu	Most acculturated	60.00	0	30.00	5.00	5.00
	Less acculturated	78.90	0	21.10	0	0
Savara	Most acculturated	14.60	0	58.50	26.80	0
	Less acculturated	28.60	0	47.60	23.80	0
Kolam	Most acculturated	50.00	0	4.50	0	45.50
	Less acculturated	48.60	2.90	31.40	8.60	8.50
Kathodi	Most acculturated	97.70	0	0	0	2.30
	Less acculturated	97.70	0	0	0	2.30
Lodha	Most acculturated	9.52	0	90.48	0	0
	Less acculturated	21.05	0	73.68	0	5.26
Birhor	Most acculturated	14.3	0	85.7	0	0
	Less acculturated	14.3	4.8	76.2	0	0

In Table 24 for the mode of brushing teeth, the majority of both the most acculturated and less acculturated populations of Chenchu, Kolam, and Kathodi communities use toothpaste and brush. Most of the Savara and Lodha people use twigs of plants.

Table: 25 Use of Footwear

Research on the connection between footwear use and gut bacteria is fascinating, especially in light of the ways that lifestyle choices affect the microbiome. The microbiome of the environment, such as soil and surfaces, can interact with human microbiota. Footwear can act as a barrier between feet and these environmental microbiomes or as a vector, introducing new microbes into the household environment. People who walk barefoot are exposed to dirt and other natural surfaces, which may have an impact on the microbial communities on their skin and potentially even their digestive tract due to the spread of bacteria from hands and mouth. Footwear could either limit or promote exposure to environmental microbes. For instance, regularly wearing shoes could reduce contact with certain beneficial soil microbes, potentially impacting gut health indirectly by altering immune responses. Outdoor footwear has the ability to bring microorganisms indoors,

where they may alter the home microbiome and then, through environmental exposure, the gut microbiota. Comparing the gut microbiota of individuals who frequently walk barefoot with those who wear shoes most of the time could reveal differences potentially linked to microbial exposure. Studying populations with varying footwear habits due to cultural practices (e.g., some less acculturated vs. most acculturated communities) could provide insights into how environmental exposure through feet affects the gut microbiome. This hypothesis suggests that reduced exposure to environmental microbes due to modern hygiene practices, including wearing shoes, may contribute to the development of autoimmune diseases. Exploring this in the context of gut microbiota could be valuable. Some studies have examined how microbes are transferred between surfaces and humans, suggesting that footwear might play a role in this process. Understanding this could help link footwear use to gut microbial diversity. Many factors influence the gut flora, therefore it's difficult to pinpoint the consequences of wearing shoes explicitly. While the direct relationship between gut microbiota and footwear use remains an underexplored area, the hypothesis that footwear could influence the gut microbiome through environmental exposure or restriction is a fascinating avenue for future research. This area would benefit from interdisciplinary studies combining microbiology, environmental science, and anthropology.

Use of Footwear				
Community	**R/T**	**Yes**	**No**	**Habitually**
Chenchu	Most acculturated	55.00	40.00	5.00
	Less acculturated	47.40	31.60	21.10
Savara	Most acculturated	97.60	2.40	0
	Less acculturated	95.50	4.50	0
Kolam	Most acculturated	96.30	3.70	0
	Less acculturated	73.70	15.80	10.50
Kathodi	Most acculturated	93.20	4.50	2.30
	Less acculturated	93.30	0	6.70
Lodha	Most acculturated	85.71	4.76	9.52
	Less acculturated	73.68	0	26.32
Birhor	Most acculturated	81.0	0	19.0
	Less acculturated	85.7	0	14.3

In the above-given table no. 25, regarding the use of footwear, it is evident that the majority of all the communities use footwear. This change from their traditionally not using footwear is very good as it helps in maintaining their personal hygiene.

Table: 26 Personal Habits

The relationship between gut microbiota and lifestyle factors such as smoking, chewing tobacco, and alcohol consumption is a growing area of research. These factors are known to influence the composition and function of gut microbiota, which in turn can affect overall health. Smoking has been associated with dysbiosis, a condition characterized by an imbalance in the microbial community. Smokers typically have a lower diversity of gut bacteria, which is often linked to various gastrointestinal and systemic diseases. Studies have shown that smoking can decrease beneficial bacteria such as *Bifidobacterium* and *Lactobacillus*, while increasing the abundance of harmful bacteria like *Proteobacteria*. This shift can contribute to increased inflammation and a higher risk of diseases such as inflammatory bowel disease (IBD) and colorectal cancer. Smoking-induced dysbiosis may promote inflammation in the gut, potentially exacerbating conditions like Crohn's disease and ulcerative colitis. Research specifically focusing on the effects of chewing tobacco on gut microbiota is limited. However, it is known that tobacco contains a variety of harmful substances that could negatively impact the gut microbiome. Since chewing tobacco directly affects the oral microbiota, which is closely linked to gut microbiota, it is plausible that changes in the oral microbiome due to tobacco chewing could lead to alterations in the gut microbiome. Potential effects include reduced diversity and an increase in pathogenic bacteria. Alcohol consumption, especially chronic and excessive intake, is known to alter gut microbiota composition. Alcohol can reduce the levels of beneficial bacteria like *Firmicutes* and *Bacteroidetes*, while promoting the growth of harmful bacteria such as *Proteobacteria* and *Actinobacteria*. Alcohol can increase intestinal permeability, commonly referred to as "leaky gut." This condition allows harmful substances, including bacteria and toxins, to pass from the gut into the bloodstream, leading to systemic inflammation and an increased risk of liver diseases such as alcoholic liver disease (ALD). Alcohol metabolism by gut microbes can lead to the production of harmful metabolites, such as acetaldehyde, which can damage the gut lining and contribute to carcinogenesis. When smoking, chewing tobacco, and alcohol consumption are combined, their negative effects on the gut microbiota can be amplified. The combined exposure may lead to a more pronounced dysbiosis, increasing the risk of gastrointestinal disorders and systemic diseases. The combination of these factors can exacerbate the inflammatory response in the gut, further disrupting the microbial balance and leading to chronic health issues. The disruption of gut microbiota by these factors is linked to metabolic disorders such as obesity, diabetes, and metabolic syndrome. The relationship between gut microbiota and smoking, chewing tobacco, and alcohol consumption highlights the complex interactions between lifestyle factors and microbial health. Disruptions to the gut microbiota caused by these behaviours can lead to significant health issues, emphasizing the importance of maintaining a balanced lifestyle for gut health.

	Personal Habit				
Community	**R/T**		**Smoking**	**Chewing**	**Drinking**
Chenchu	Most acculturated	Yes	15.00	30.00	55.00
		No	85.00	70.00	45.00
	Less acculturated	Yes	26.30	10.50	89.50
		No	73.70	89.50	10.50
Savara	Most acculturated	Yes	0	9.60	24.40
		No	100.00	90.40	75.60
	Less acculturated	Yes	0	28.60	54.50
		No	100.00	31.40	45.50
Kolam	Most acculturated	Yes	3.40	48.80	17.20
		No	96.60	51.20	82.80
	Less acculturated	Yes	2.60	48.80	5.10
		No	97.40	51.20	94.90
Kathodi	Most acculturated	Yes	4.50	9.10	22.80
		No	95.50	90.90	77.20
	Less acculturated	Yes	0	28.20	12.90
		No	100.00	71.80	87.10
Lodha	Most acculturated	Yes	38.09	66.67	76.19
		No	61.90	33.33	23.80
	Less acculturated	Yes	42.10	78.94	63.16
		No	57.89	21.05	36.84
Birhor	Most acculturated	Yes	0	23.8	61.9
		No	100	76.2	38.1
	Less acculturated	Yes	9.5	19.0	61.9
		No	90.5	81.0	38.1

From the above given table 26 of personal habits, it is seen that, in the case of smoking Habits; generally, populations residing in forest areas tend to have higher smoking rates compared to most acculturated populations across all communities except Savara and Kathodi, where smoking is almost negligible or absent in most acculturated areas. Among less acculturated populations, Lodha shows notably higher smoking rates (42.10%) compared to other communities. In the case of the Chewing Habits; it varies widely across communities and between most acculturated and less acculturated areas. Lodha of forest areas stands out with very high rates of chewing (78.94%), while most acculturated areas of Savara and Kathodi show much lower rates. Lastly, in the case of Drinking Habits; it also shows variability, with most acculturated areas generally having higher rates of drinking compared to less acculturated areas. Lodha of most acculturated areas shows particularly high rates of drinking (76.19%), contrasting with Savara most acculturated areas where drinking rates are much lower (24.40%).

Most acculturated areas tend to have higher rates of smoking and drinking compared to less acculturated areas across most communities. Chewing habits are more varied but often show higher prevalence in less acculturated areas. Lodha appears to have higher overall rates of smoking, chewing, and drinking compared to other communities, especially in less acculturated area. Savara shows very low rates of smoking in both most acculturated and less acculturated areas, and relatively lower rates of drinking compared to other

communities. These variations could be influenced by cultural practices, economic factors, and accessibility to substances.

Anthropometric Parameters

The human gut microbiome, a complex community of trillions of microorganisms, plays a crucial role in various physiological processes, including digestion, immune function, and even mental health. Recent research has begun to explore the relationship between the gut microbiome and anthropometry—the measurement and analysis of the human body's physical dimensions. Understanding how gut microbial composition correlates with body metrics such as height, weight, body mass index (BMI), and body composition can provide insights into health and disease prevention. Studies have shown that individuals with obesity often exhibit a less diverse gut microbiome, with a higher ratio of Firmicutes to Bacteroidetes. This imbalance is thought to contribute to increased energy harvest from food, leading to weight gain. Research suggests that certain gut bacteria are associated with lean body mass, while others are linked to higher body fat percentage. Dietary patterns significantly influence the gut microbiome, which in turn affects anthropometric outcomes. Diets rich in fiber, for instance, promote the growth of beneficial gut bacteria that are associated with healthy body weight and reduced adiposity. The gut microbiome can affect metabolic processes, including the regulation of fat storage and energy expenditure, potentially influencing anthropometric measures like waist circumference and BMI. The intersection of gut microbiome research and anthropometry offers a promising avenue for understanding the complex relationships between diet, microbiota, and physical health. By exploring these connections, this study aims to contribute to personalized health interventions and enhance our understanding of the role of gut microbiota in shaping anthropometric traits.

Anthropometric Parameters							
Variables	**R/T**	**Chenchu**	**Savara**	**Kolam**	**Kathodi**	**Lodha**	**Birhor**
SBP	**MA**	120.35±9.57	114.65±11.88	123.00+12.50	122.98 ± 16.70	125.74±9.26	124.76±12.18
	LA	119.47±19.53	101.45±26.77	123.00+12.50	122.67 ± 17.89	121.10±10.7	124.44±16.40
DBP	**MA**	80.40±7.26	98.48±14.78	84.85+9.88	80.88 ± 13.25	83.68±7.00	85.71±10.40
	LA	80.58±10.33	73.66±8.64	79.05+9.97	81.59 ± 13.72	80.19±5.94	84.66±6.64
Pulse Rate	**MA**	81.15±19.51	75.10±14.90	76.13+27.52	80.78 ± 10.67	83.74±13.76	79.71±13.85
	LA	88.11±10.67	70.52±10.46	79.44+12.93	78.87 ± 13.83	86.33±9.54	83.66±16.20
Haemoglobin	**MA**	12.79±2.16	11.43±3.66	15.18+4.07	12.31 ± 2.21	11.91±1.92	12.37±3.35
	LA	11.39±1.19	12.91±2.29	13.73+3.47	11.78 ± 2.11	11.80±2.23	15.10±16.31
Ran. Blood Glucose	**MA**	103.85±31.52	75.97±23.42	97.24+12.80	112.45 ± 32.14	101.05±29.9	120.33±38.04
	LA	102.79±22.78	81.76±10.01	101.86+16.07	104.18 ± 24.69	97.90±27.95	110.47±26.78
Oxygen Saturation	**MA**	98.60±0.75	96.07±5.48	98.22+1.77	98.62 ± 1.56	97.37±3.71	97.19±2.65
	LA	98.63±0.60	97.14±2.43	95.80+16.03	98.80 ± 0.58	98.33±1.28	98.44±0.9
Height	**MA**	161.55±7.12	157.46±9.18	155.82+8.50	159.04 ± 9.22	153.85±7.40	152.20±10.02
	LA	159.20±8.28	156.77±9.63	161.15+9.20	158.39 ± 8.19	157.76±5.84	152.69±6.74
Weight	**MA**	58.35±8.76	54.75±10.45	66.06+8.30	52.38 ± 10.28	45.67±8.28	44.91±5.96
	LA	51.30±9.23	58.57±12.10	69.12+8.60	50.40 ± 11.20	48.62±7.30	47.79±6.83
BMI	**MA**	22.35±2.29	24.22±5.13	20.00+2.78	20.47 ± 3.50	19.13±2.35	19.30±1.80
	LA	19.95±2.43	23.91±4.65	20.06+3.15	19.41 ± 2.62	19.51±2.55	20.29±2.49
Hip Circumference	**MA**	88.72±5.30	88.10±6.92	83.33+6.80	85.17 ± 8.50	77.13±5.34	78.78±5.13
	LA	84.10±5.98	90.00±9.26	85.70+8.05	81.34 ± 5.97	80.26±6.29	80.70±3.82
Waist Circumference	**MA**	77.50±6.28	77.29±8.97	66.06+8.30	71.51 ± 9.64	67.12±7.51	68.20±5.95
	LA	70.89±7.91	78.85±9.68	69.12+8.50	68.28 ± 7.59	70.98±9.53	72.02±6.03
WHR	**MA**	0.85±0.05	0.87±.05	0.79+0.80	0.83 ± 0.07	0.87±0.06	0.86±0.05

	LA	0.84±0.05	0.87±.04	0.80+0.05	0.84 ± 0.06	0.88±0.06	0.88±0.05
Body Fat	**MA**	25.27±7.31	25.21±6.71	21.88+6.70	21.34 ± 9.20	19.34±5.37	18.86±7.92
	LA	21.24±6.95	27.21±8.50	20.59+9.65	19.14 ± 6.87	21.41±8.39	21.77±6.95
Visceral Fat	**MA**	5.75±2.55	5.21±3.17	3.25+2.50	4.05 ±3.07	3.00±2.24	2.33±1.23
	LA	3.58±2.54	7.23±5.18	3.39+2.94	3.15 ± 2.22	2.90±1.97	3.76±2.14
Skeletal Muscle	**MA**	31.17±4.12	30.90±4.69	31.90+3.94	32.67 ± 5.90	33.53±4.37	32.63±6.90
	LA	34.12±5.50	29.67±4.88	32.18+5.47	34.15 ± 5.40	32.44±5.43	33.12±5.11
Resting Metabolism	**MA**	1347.75 ±201.87	1285.70 ±215.00	1186.53 +187.79	1239.77 ± 191.64	-	1130.52± 156.32
	LA	1257.79± 206.98	1336.76± 212.60	1150+ 445.71	1232.47 ± 202.73	-	1184.52± 161.67

MA: Most acculturated; LA: least acculturated

Both the studied sub groups mean SBPs of Chenchu, Kolam, Kathodi and Lodha are in normal range. For Lodha, both are slightly low. For DBP, the mean values in both most acculturated areas and less acculturated areas of Chenchu, Kolam, Kathodi, and Lodha are in the normal range. While most acculturated DBP of Lodha is Hypertensive I, and for less acculturated DBP it is low. The pulse rates for all communities are normal. The mean random blood sugar level in both less acculturated and most acculturated areas of all communities are in the normal range. The mean BMIs of both most acculturated and less acculturated areas of the Savara community are in an overweight category. The remaining other communities are within the normal range. In all populations, the average waist-to-hip ratio is within the moderate range. Most acculturated Savara individuals have the highest average BMI, indicating a potential trend towards overweight status in most acculturated settings. Most communities have WHR values in the moderate range, indicating balanced body fat distribution. Most acculturated populations generally have higher body fat percentages than less acculturated ones, with some exceptions like Savara, where less acculturated body fat is higher. Less acculturated Chenchu individuals have higher skeletal muscle percentages and resting metabolism, suggesting greater physical activity levels compared to their most acculturated counterparts.

Table: Dietary intake

Diet and gut microbial research are important fields of study that investigate the intricate connection between dietary practices and the human gut microbiota. Trillions of bacteria, viruses, fungi, and protozoa make up the gut microbiome, which is essential to human health and affects immunity, metabolism, digestion, and even mental health. The makeup of the gut microbiome varies greatly from person to person and is impacted by a number of variables, including environment, genetics, and most crucially, nutrition. A more varied and healthier microbiome is linked to diets high in fat, sugar, and processed foods, whereas diets high in fibre, fruits, vegetables, and fermented foods can cause dysbiosis, or an imbalance in the gut microbiota. Beneficial bacteria like Lactobacillus and Bifidobacteria flourish on diets rich in

dietary fibre. These microorganisms generate butyrate and other short-chain fatty acids (SCFAs), which are beneficial to gut health and have anti-inflammatory qualities. Probiotics are live bacteria found in foods like yoghurt, kefir, sauerkraut, and kimchi that can support the maintenance or restoration of the balance of gut flora. Diets heavy in carbohydrates and saturated fats can decrease the diversity of microbes and encourage the growth of dangerous bacteria, which can aggravate illnesses including type 2 diabetes, obesity, and inflammatory bowel disease (IBD). Certain gut microbial patterns may be linked to metabolic diseases and obesity, according to research. Changing one's diet to include more good bacteria can help control or even avoid certain illnesses. The gut-brain axis connects the gut microbiome to mental health. Research suggests that dietary modifications to the gut microbiota may affect mood and behaviour, which may have an effect on disorders including anxiety and depression. A strong immune system is dependent on a healthy gut microbiota. Microbial diversity-promoting diets can strengthen immune responses and lower the incidence of autoimmune disorders. Dietary ingredients that are indigestible but encourage the growth of good bacteria. Inulin, oligosaccharides, and resistant starches found in foods like onions, garlic, bananas, and whole grains are a few examples. A blend of prebiotics and probiotics intended to increase the colonisation and survival of good bacteria in the stomach. Studies are investigating how the gut microbiome can be used to develop personalized medical treatments, particularly in the context of diet-related diseases.

Community Name	Intake	Place of Residence	Carbohydrates (%)	Plant protein (%)	Animal protein (%)
CHENCHUU	Frequent	Most acculturated	31.92	37.50	24.38
		Less acculturated	30.78	36.88	25.66
	Infrequent	Most acculturated	52.69	40.00	48.83
		Less acculturated	56.45	46.10	54.00
	Never	Most acculturated	15.38	22.50	26.88
		Less acculturated	12.56	17.10	20.40
SAVARA	Frequent	Most acculturated	31.62	37.00	27.00
		Less acculturated	39.06	33.63	35.29
	Infrequent	Most acculturated	60.67	45.25	71.31
		Less acculturated	50.77	58.35	64.73
	Never	Most acculturated	7.57	17.73	1.54
		Less acculturated	10.13	8.08	0.00
KOLAM	Frequent	Most acculturated	36.85	50.00	41.89
		Less acculturated	20.65	20.53	26.03
	Infrequent	Most acculturated	15.04	23.25	5.39
		Less acculturated	18.10	20.52	35.51
	Never	Most acculturated	47.94	27.60	52.87
		Less acculturated	61.37	58.95	38.46
KATKARI	Frequent	Most acculturated	29.38	29.55	32.48
		Less acculturated	31.54	40.23	32.63
	Infrequent	Most acculturated	20.17	28.43	30.82
		Less acculturated	16.55	18.50	19.57
	Never	Most acculturated	50.39	42.05	36.70
		Less acculturated	51.90	41.08	47.80

LODHA	Frequent	Most acculturated	21.72	22.62	40.82
		Less acculturated	19.98	32.89	37.60
	Infrequent	Most acculturated	7.25	7.14	3.40
		Less acculturated	14.35	2.63	5.26
	Never	Most acculturated	70.99	69.05	55.78
		Less acculturated	65.55	64.48	57.14
BIRHOR	Frequent	Most acculturated	27.96	26.20	24.50
		Less acculturated	27.88	29.35	31.30
	Infrequent	Most acculturated	20.02	11.90	31.30
		Less acculturated	18.66	7.13	21.09
	Never	Most acculturated	52.26	61.90	44.23
		Less acculturated	53.47	63.40	47.64

Community Name	Intake	Place of Residence	Fat (%)	Probiotics (%)	Alcohol (%)	Carbonated drink (%)	Non-carbonated drinks (%)
CHENCHUU	Frequent	Most acculturated	34.29	75.00	10.00	0.00	0.00
		Less acculturated	33.83	73.70	15.80	0.00	0.00
	Infrequent	Most acculturated	52.14	15.00	75.00	0.00	0.00
		Less acculturated	57.96	5.30	68.40	0.00	0.00
	Never	Most acculturated	13.57	10.00	15.00	100	100
		Less acculturated	11.29	5.30	15.80	100	100
SAVARA	Frequent	Most acculturated	35.40	46.20	33.30	0.00	0.00
		Less acculturated	38.02	37.90	43.80	0.00	0.00
	Infrequent	Most acculturated	51.17	53.90	38.90	0.00	0.00
		Less acculturated	61.03	55.60	56.30	0.00	0.00
	Never	Most acculturated	13.38	0.00	27.80	100	100
		Less acculturated	0.98	5.60	0.00	100	100
KOLAM	Frequent	Most acculturated	20.08	69.00	6.90	2.60	3.40
		Less acculturated	3.00	0.00	0.00	0.00	0.00
	Infrequent	Most acculturated	23.55	13.80	3.40	38.50	27.60
		Less acculturated	20.08	12.80	2.60	25.10	10.30
	Never	Most acculturated	56.32	17.20	89.70	59.00	69.00
		Less acculturated	76.92	87.20	97.40	75.90	89.70
KATKARI	Frequent	Most acculturated	14.00	13.60	0.00	6.80	6.80

		Less acculturated	16.30	26.10	1.10	0.00	14.10
	Infrequent	Most acculturated	32.58	40.90	0.00	45.50	5.70
		Less acculturated	24.65	32.60	1.10	26.30	10.85
	Never	Most acculturated	53.40	45.40	100	47.70	87.50
		Less acculturated	59.08	41.30	97.80	73.90	75.00
LODHA	Frequent	Most acculturated	0.79	0.00	68.75	0.00	0.00
		Less acculturated	4.39	0.00	75.00	0.00	0.00
	Infrequent	Most acculturated	3.97	0.00	31.25	0.00	0.00
		Less acculturated	10.53	0.00	25.00	0.00	5.26
	Never	Most acculturated	95.24	100	0.00	100	100
		Less acculturated	85.09	100	0.00	100	94.74
BIRHOR	Frequent	Most acculturated	12.70	14.30	19.00	28.60	14.30
		Less acculturated	10.32	4.80	9.50	4.80	14.25
	Infrequent	Most acculturated	23.80	19.00	0.00	14.30	9.55
		Less acculturated	13.48	9.50	4.80	23.80	4.80
	Never	Most acculturated	63.48	66.70	81.00	57.10	76.20
		Less acculturated	76.18	85.70	85.70	71.40	81.00

The Chenchu reside in the forests of Nallamalai, Telangana and predominantly depend on forest products like honey, tubers, roots, and fruits (e.g., mango, tamarind, wild bananas). They consume seasonal dishes and fermented foods such as ganjiannam and ragi ambali. Leafy vegetables are also a significant part of their diet. Practices include cultivating red gram, groundnut, maize, cotton, and jowar. Tamarind water is commonly consumed, especially during the rainy season.

The Savaras residing in the Eastern Ghats of Andhra Pradesh and Odisha relies on shifting cultivation with millets and forest produce. Recent shifts include rice becoming the staple food due to government programs and public distribution systems. Their main diet includes red beef, pork, chicken, and mutton, with a decline in red meat consumption. Traditional drinks include jeelugu kallu and mahua liquor.

The Kolam of Maharashtra districts of Yavatmal, Chandrapur, and Nanded. Jowar, rice, and vegetables form the core diet, with occasional meat consumption like chicken and eggs. Non-vegetarian food is typically consumed once a week. Primarily settled farmers growing cotton, oil seeds, lentils, wheat, and gram.

The Kathodi (Katkari) of Maharashtra consumes rice and wheat, with occasional pulses like urad, tur, and moong. Fish, eggs, goat, chicken, and pork are also consumed. Limited fruit consumption, tea instead of milk, and homemade spirits from mahuva flower.

The Lodha of West Bengal depends mainly rice and tubers, with occasional meat consumption including chicken, fish, and pork. Involves gathering and selling forest products like honey, sal leaves, and firewood.

Many PVTGs are experiencing dietary changes due to government programs promoting settled agriculture and the introduction of cash crops. As some members migrate to most acculturated areas, they experience changes in their gut microbiome due to new environmental conditions and dietary habits. Despite modernization, traditional dietary practices, and knowledge of medicinal plants remain prevalent. Traditional diets rich in plant-based foods and limited exposure to processed foods help maintain diverse and beneficial gut microbiomes among PVTGs. The study includes health measurements like blood pressure, blood sugar, and body composition to assess the current health status of individuals.

The Anthropological Survey of India has initiated a study to characterize gut microbiome diversity among PVTGs and its relationship with dietary practices. Understanding the gut microbiome can inform strategies to improve health outcomes and address disparities in tribal and non-tribal communities. The report emphasizes the importance of preserving traditional dietary practices and understanding the impacts of modernization on the gut microbiome for developing effective health interventions.
Regarding the dietary intake of Chenchu, Savara, Kolam, Katkari, and Lodha, the intake rate has been classified into three categories – frequent, infrequent, and never. Frequent intake implies people who have them every day or twice a week, and infrequent intake implies having them once a month or yearly.

In Chenchu community, the rate of intake is higher in the infrequent category for Carbohydrates at 52.69% most acculturated population and 56.45% less acculturated population, Plant protein at 40% and 46.10% for the two sub groups respectively, Animal protein at 48% of most acculturated people and 54% less acculturated people, Fat with 52.14% Most acculturated and 57.96% less acculturated, and Alcohol with 75% most acculturated population and 68.40% less acculturated population. In the case of probiotics, 75% of most acculturated people and 73.70% of less acculturated people consume frequently. Among the other nutrients consumed regularly, plant protein has the highest percentage, with 37.50% of most acculturated and 36.88% of less acculturated populations.
For the Savara community, the most dietary intake for all nutrients is seen in the infrequent category. Carbohydrates is consumed infrequently by 60.77% most acculturated and 50.77 less acculturated. In plant protein, 45% of most acculturated and 58.35% of less acculturated consumes it infrequently. Similar cases are seen in animal protein (71.31% & 64.73%), fat (51.17% & 61.03%), probiotics (53.90% & 55.60%), and alcohol (38.90% & 56.30%). In nutrients consumed frequently, the highest is probiotics (46.20%) for the most acculturated population and carbohydrates (39.06%) for the less acculturated Savara population.

The majority of the Kolam population never consumes carbohydrates in both most acculturated (47.94%) and less acculturated (61.37%) areas. For plant protein, most of the most acculturated population (50%) consumes frequently while most of the less acculturated population (58.95%) never consumes. Similarly, for probiotics, most most acculturated have it frequently (69%), and most less acculturated never have it (87.20%). No one from less acculturated area consume probiotics regularly. In the case of animal protein (52.87% & 38.46%) and fat (56.32% & 76.92%) also, most people never consumed them in both most acculturated and less acculturated areas. Also, most of the people from the Kolam community do not drink alcohol.

In Katkari community, the highest percentage is in the never category for all the dietary components. Only 29.38% of most acculturated people and 31.54% of less acculturated people frequently have carbohydrates. For plant protein, 29.55% of most acculturated people and 40.23% of less acculturated people have frequently. Similar range is seen in animal protein, with 32.48% most acculturated and 32.63% less acculturated having frequently. Very few percent of people have fat regularly, i.e., only 14% most acculturated and 16.3% less acculturated. More less acculturated people (26.10%) have probiotics frequently than most acculturated people (13.60%). None of the most acculturated people drink alcohol, and the percentage of drinkers from less acculturated is also very low. More people drink carbonated and non-carbonated drinks in most acculturated areas than less acculturated areas.

Most people of the Lodha community do not eat carbohydrates, protein, and fat, as the highest percentage is observed in the never category. The dietary component consumed frequently is animal protein, with 40.82% in most acculturated areas and 37.60% in less acculturated areas. The percentage of people having carbohydrates frequently is somewhat similar in the most acculturated areas (21.72%) and the less acculturated areas (19.98%). However, for people with frequent plant protein intake, it is more in less acculturated areas (32.89%) than in most acculturated areas (22.62). In the Lodha community, very few people consume fat. And the number of less acculturated people who have it regularly is almost negligible, i.e., only 0.79%. None of the people from the most acculturated and less acculturated areas have probiotics. The number of people who drink frequently is the highest, with 68.75% for most acculturated people and 75% for less acculturated people. There is no non-drinker in the community.

On comparing between the five communities, the Chenchu and Savara communities have less percentage of people who never have carbohydrates. However, in the case of Kolam, Katkari, and Lodha, almost half of the people never eat carbohydrates in the most acculturated and less acculturated areas of all three communities. Similarly, for plant protein, the Chenchu and Savara communities have very few people who never eat it. However, for the Kolam community, while half of the most acculturated people had plant protein frequently, more than half of the less acculturated people never had plant protein. In the Katkari and Lodha communities, almost half of the people never have plant protein in both the less acculturated and most acculturated areas.

The Savara community majorly consumes animal protein. They are the only community in which only 1.54% of most acculturated people never have animal protein and none from less acculturated areas. While the Lodha community, more than half the community never had animal protein. The Kolam, Katkari, and Lodha communities have very few numbers consuming fat regularly. Especially in the Lodha community, where almost all the people never consume fat. The Savaras are major fat consumers, having only very few people who never eat fat.

The Chenchus are the only people who have probiotics regularly. The majority of the population, both in the most acculturated and less acculturated areas, eat probiotics frequently. In the Savara community, the number of people who have never had probiotics in both most acculturated and less acculturated areas is very low. However, in the Kolam community, there is a stark difference in the less acculturated and most acculturated areas having probiotics; more than half the most acculturated people have probiotics, but none of the less acculturated areas have probiotics regularly, even though most less acculturated people never had probiotics. For Katkari, even though not many people consume probiotics regularly, the percentage of people who have never had them is less than half the population. No one from the Lodha community consumes probiotics.

The Lodha community has the highest number of people who drink frequently among all the communities. More than half the people drink regularly, and the remaining population drinks infrequently. In the Katkari and Kolam communities, the majority of the population never drinks. Savara community has more percentage of people who drinks frequently among all the communities. Kolam and Katkari have few people who do non-frequently drink carbonated and non-carbonated drinks.

The Lodha community has the highest number of people who drink frequently among all the communities. More than half the people drink regularly, and the remaining population drinks infrequently. In the Katkari and Kolam communities, the majority of the population never drinks. Savara community has more percentage of people who drinks frequently among all the communities. Kolam and Katkari have few people who do non-frequently drink carbonated and non-carbonated drinks. The entirety of the Birhor community, encompassing both most acculturated and less acculturated demographics, consistently abstains from the consumption of fats, probiotics, and alcoholic beverages, as well as both carbonated and non-carbonated drinks.

Table: Dietary intake

Community Name	Intake	Place of Residence	Carbohydrates (%)	Plant protein (%)	Animal protein (%)
CHENCHU	Consuming	More Acculturated	84.61	77.50	73.21
		Less Acculturated	87.23	82.98	79.66
	Non-consuming	More Acculturated	15.38	22.50	26.88
		Less Acculturated	12.56	17.10	20.40
SAVARA	Consuming	More Acculturated	92.29	82.25	86.57
		Less Acculturated	89.84	91.98	100

	Non-consuming	More Acculturated	7.57	17.73	13.38
		Less Acculturated	10.13	8.08	0.00
KOLAM	Consuming	More Acculturated	51.89	73.25	47.28
		Less Acculturated	38.73	41.05	61.54
	Non-consuming	More Acculturated	47.94	27.60	52.87
		Less Acculturated	61.37	58.95	38.46
KATKARI	Consuming	More Acculturated	49.55	57.98	63.30
		Less Acculturated	48.09	58.73	52.20
	Non-consuming	More Acculturated	50.39	42.05	36.70
		Less Acculturated	51.90	41.08	47.80
LODHA	Consuming	More Acculturated	29.01	30.95	44.22
		Less Acculturated	34.45	35.52	42.86
	Non-consuming	More Acculturated	70.99	69.05	55.78
		Less Acculturated	65.55	64.48	57.14
BIRHOR	Consuming	More Acculturated	47.98	38.10	55.80
		Less Acculturated	46.54	36.48	52.39
	Non-consuming	More Acculturated	52.26	61.90	44.22
		Less Acculturated	53.47	63.40	47.64

Community Name	Intake	Place of Residence	Fat (%)	Probiotics (%)	Alcohol (%)	Carbonated drink (%)	Non-carbonated drinks (%)
CHENCHU	Consuming	More Acculturated	86.43	90.00	85.00	0.00	0.00
		Less Acculturated	91.79	79.00	84.20	0.00	0.00
	Non-consuming	More Acculturated	13.57	10.00	15.00	100	100
		Less Acculturated	11.29	5.30	15.80	100	100
SAVARA	Consuming	More Acculturated	86.57	100	72.20	0.00	0.00
		Less Acculturated	99.05	93.50	100	0.00	0.00
	Non-consuming	More Acculturated	13.38	0.00	27.8	100	100
		Less Acculturated	0.98	5.60	0.00	100	100
KOLAM	Consuming	More Acculturated	43.63	82.80	10.30	41.00	31.00
		Less Acculturated	23.08	12.80	2.60	25.10	10.30
	Non-consuming	More Acculturated	56.32	17.20	89.70	59.00	69.00
		Less Acculturated	76.92	87.20	97.40	75.90	89.70

KATKARI	Consuming	More Acculturated	46.58	54.50	0.00	52.30	12.50
		Less Acculturated	40.95	58.70	2.20	26.30	24.95
	Non-consuming	More Acculturated	53.40	45.40	100	47.70	87.50
		Less Acculturated	59.08	41.30	97.80	73.90	75.00
LODHA	Consuming	More Acculturated	4.76	0.00	100	0.00	0.00
		Less Acculturated	14.91	0.00	100	0.00	5.26
	Non-consuming	More Acculturated	95.24	100	0.00	100	100
		Less Acculturated	85.09	100	0.00	100	94.74
BIRHOR	Consuming	More Acculturated	36.50	33.30	19.00	42.90	23.84
		Less Acculturated	23.80	14.30	14.30	28.60	19.05
	Non-consuming	More Acculturated	63.48	66.70	81.00	57.10	76.20
		Less Acculturated	76.18	85.70	85.70	71.40	81.00

The Chenchu and Savara communities are the highest consumers of carbohydrates, plant protein, animal protein, fat and probiotics. The most acculturated Chenchu community has the highest consumption in probiotics and forest dwelling Chenchu has highest consumption in fat. For Savara, all the most acculturated people consume probiotics while all less acculturated people consume animal protein. Similar to Savara, Kolam also the highest for most acculturated in probiotics and highest for forest dwellers in animal protein. On the contrary to both communities, Katkari has the highest consumption of most acculturated people in animal protein; for less acculturated people it is probiotics and plant protein. The highest consumption for both less acculturated and most acculturated areas of Lodha community is animal protein dependent community. This community also has cent percent of drinkers. The only community where no one from both the studied areas consume probiotics are the Lodhas.

INDICES

Sanitation Index:

		Chenchu	Savara	Kolam	Kathodi	Lodha	Birhor
Sanitation	More Acculturated	18	16.5	13	15.03	15.08	15.7
	Less Acculturated	15.03	13.1	16	16	15.3	14.6

Unsatisfactory: 4-10; Satisfactory: 11-17; Highly satisfactory: 18-23

The above table reflects the sanitation conditions in different tribal areas, indicating that the Chenchu community (more acculturated) has the highest score of 18 (highly satisfactory), while less acculturated areas generally show lower satisfaction in terms of sanitation, which is consistent across different communities.

Personal Hygiene Index

		Chenchu	Savara	Kolam	Kathodi	Lodha	Birhor
Personal Hygeine	More Acculturated	**28.15**	**25.6**	**22.6**	**25.8**	**23.6**	**23.09**
	Less Acculturated	**19.2**	**24.5**	**25.89**	**26.2**	**23.3**	**21.3**

Unsatisfactory: 6-14; Satisfactory: 15-22; Highly satisfactory: 23-30

The personal hygiene score is another important indicator. Communities like Chenchu, Savara, and Kathodi score relatively higher in more acculturated regions compared to their less acculturated counterparts.

The Sanitation Index in the report tracks the adequacy of sanitation conditions (e.g., access to clean water, toilets, and waste management) in different tribal communities. Communities with a higher Sanitation Index, such as the Chenchu, demonstrate better hygiene practices, which can impact the composition and diversity of the gut microbiome. Better sanitation often limits exposure to harmful pathogens, which might otherwise lead to dysbiosis (imbalance in the gut microbiota). On the other hand, poor sanitation, as seen in some less acculturated communities with a lower Sanitation Index, can lead to a higher risk of gastrointestinal infections, which negatively impact the gut microbiome's balance, reducing microbial diversity and increasing susceptibility to diseases. Communities with lower sanitation standards might experience higher exposure to environmental microbes, which could either enrich the gut microbiome or, in contrast, introduce pathogens that disrupt its equilibrium. The report suggests that poor sanitation could lead to harmful microbial communities in the gut due to frequent infections. Good sanitation practices help protect the gut by reducing harmful pathogen exposure. The study finds that tribal groups with higher Sanitation Index scores (like the Chenchu in acculturated regions) also show improved gut health and a balanced gut microbiome, indicating that adequate hygiene supports a healthy microbial environment. The Sanitation Index plays a crucial role in determining the health and diversity of the gut microbiome in tribal communities. While higher sanitation levels generally promote better gut health by limiting pathogen exposure, poor sanitation can compromise the gut microbiota, leading to health issues. Therefore, improving sanitation infrastructure in less acculturated areas is critical for enhancing overall community health.

DISCUSSION

The study highlights the diversity and unique characteristics of the gut microbiomes of PVTGs, influenced by their traditional lifestyles and diets. It emphasizes the importance of understanding these microbial communities to develop culturally appropriate health interventions and improve health outcomes for these vulnerable populations. The research aims to fill the knowledge gap regarding the gut microbial profiles of PVTGs in India and their implications for health and disease.

The report provides a comprehensive overview of the gut microbiome studies conducted among Particularly Vulnerable Tribal Groups (PVTGs) in India. It explores the unique characteristics of the gut microbiomes of six PVTGs: Chenchu, Savara, Kolam, Kathodi, Birhor and Lodha. The human gut microbiome is a complex ecosystem of microorganisms in the gastrointestinal tract, playing essential roles in nutrient metabolism, immune function, and pathogen protection. These groups maintain traditional lifestyles and diets, providing unique insights into human-microbe coevolution and the impacts of modernization on microbial diversity. Traditional diets rich in plant-based foods and fermented products promote diverse gut microbiomes. Close contact with nature and limited access to modern healthcare and processed foods preserve beneficial microbes. Geographical location, seasonal changes, host genetics, and traditional medicine practices influence gut microbiome composition. Changes in lifestyle and migration to most acculturated areas impact gut microbiomes, offering insights into microbial adaptation to new environments. The study aims to characterize gut microbiome diversity among PVTGs, investigate relationships between microbiome composition and dietary practices, and explore microbial variations across communities. Understanding these factors can inform health strategies and interventions for both tribal and non-tribal populations, contributing to personalized medicine approaches.

The Chenchus located in Telangana, known for hunting and gathering, with diets including forest products, tubers, and fermented foods. The Savaras inhabit Andhra Pradesh and Odisha, practice shifting cultivation, with diets of millets, forest produce, and occasional meat. The Kolams found in Maharashtra, engage in agriculture, with diets consisting of millets, pulses, and local vegetables. The Kathodi of Maharashtra Also known as Katkari, reside in Maharashtra, rely on agriculture and wage labor, with diets of rice, lentils, and occasionally meat. The Lodhas of West Bengal, practice hunting and gathering, with diets including rice, forest products, and occasional meat.

Anthropometric measurements, blood pressure, blood sugar, and hemoglobin levels were recorded to assess health status. Illumina deep metagenomic sequencing was used to study the genetic composition and functional potential of gut microorganisms.

Traditional diets rich in plant-based foods and limited access to antibiotics and processed foods contribute to diverse gut microbiomes. Hygiene practices, access to clean water, and socioeconomic conditions influence microbial composition. Access to healthcare and

educational facilities varies across communities, impacting health outcomes and microbial diversity.

The study of gut microbiomes among PVTGs provides valuable insights into the interplay between traditional lifestyles, environmental factors, and microbial communities. It highlights the potential for using this knowledge to improve health outcomes and develop culturally appropriate interventions for these vulnerable populations. This summary encapsulates the main themes and findings presented in the document, providing an overview of the research on the gut microbiomes of India's PVTGs.

The gut microbiome is described as a complex ecosystem of microorganisms that reside in the gastrointestinal tract, playing crucial roles in nutrient metabolism, immune function, and protection against pathogens. The study of gut microbiomes among PVTGs is emphasized because these populations maintain traditional lifestyles and dietary practices that can influence their microbial profiles. This can provide insights into human-microbe coevolution and the effects of modernization on microbial diversity. Several factors affecting the gut microbiome among PVTGs are outlined, including access to basic amenities, livelihoods, economic conditions, hygiene practices, dietary habits, environmental exposures, and reduced exposure to antibiotics and processed foods. The traditional diets of PVTGs, often rich in plant-based foods and fermented products, are noted for promoting diverse and beneficial gut microbial communities. The impact of geographical location, seasonal changes, and host genetics on the gut microbiome is discussed. These factors contribute to the distinct microbial compositions observed in different PVTG communities. The study explores how migration to most acculturated areas and adoption of modern practices may affect the gut microbiome of PVTG members, offering insights into the rapid adaptation of the microbiome to new conditions. The Anthropological Survey of India has initiated a national project to study gut microbial diversity among PVTGs, aiming to understand the relationship between microbial composition, dietary practices, and health. By characterizing gut microbial profiles and ethnographic data, the research aims to contribute to a broader understanding of human microbiome variation and its health implications. The findings could inform strategies to improve health outcomes while respecting traditional knowledge systems and practices.
Understanding the relationship between diet and the gut microbiome can lead to more effective dietary guidelines for maintaining gut health and preventing disease. While dietary sources of probiotics and prebiotics are preferred, supplements can be used to support gut health, particularly in individuals with specific health conditions or those on restrictive diets. The relationship between gut microbiota and food is a fast developing field that has important implications for maintaining health and preventing disease. More individualised food advice based on a person’s microbiota will probably become standard procedure in boosting general health as research advances.

The primary goal of the study was to explore the gut microbial diversity in the context of the socio-cultural and environmental factors unique to these PVTGs. The research also aimed to understand the relationship between the gut microbiome and health behaviors, such as sanitation, diet, and hygiene. The study combined ethnographic data collection with biomedical analysis, including anthropometry, dietary surveys, and fecal sample collection

for microbial genomic analysis. Variables like height, weight, body composition, blood pressure, and random blood glucose levels were recorded. Socio-demographic data on health and hygiene behaviors were also collected.

The report emphasizes the association between sanitation practices and the gut microbiome. Communities with better access to sanitation facilities, such as the Chenchu, exhibited healthier microbial diversity compared to those in less acculturated settings. Traditional diets rich in plant-based foods and fermented products were found to foster beneficial gut microbes. These diets, in conjunction with limited exposure to processed foods and antibiotics, contributed to a more resilient gut microbiome in these PVTGs. The report discusses the effects of acculturation and migration on gut microbiomes, noting that communities adopting more modern lifestyles and diets exhibit a decrease in microbial diversity. This shift is linked to increased consumption of processed foods and exposure to modern medical practices, including antibiotics. The gut microbiome is linked to a range of health outcomes, from metabolic function to immune response. The report suggests that preserving traditional diets and improving sanitation infrastructure could enhance microbial health, which in turn could help address health disparities in these tribal communities.

Detailed socio-cultural profiles of the six PVTGs are provided, highlighting their traditional livelihoods, kinship structures, religious practices, and interactions with the environment. The report explores how these factors play a role in shaping the health behaviors and dietary practices that influence the gut microbiome. The findings offer potential pathways for developing health interventions that respect traditional knowledge systems while addressing the challenges posed by modernization.

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