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Choropleth Mapping of Lifestyle Diseases in India: Prevalence and Treatment-Seeking Patterns Using NHFS-5 Data

Harsh Kedia

The Shriram Millennium School, Noida, India

harshkedia999@gmail.com

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Abstract

Lifestyle diseases such as asthma, thyroid diseases, heart diseases, cancer, and kidney diseases are caused due to poor diet, stress, physical inactivity, and environmental factors. These non-communicable diseases (NCDs) pose a significant public health challenge as they account for over 60% of all deaths in India. This study aims to geographically map the prevalence and treatment-seeking behaviour related to major lifestyle diseases in Indian states using data from NFHS-5, which will help healthcare stakeholders to obtain actionable insights for resource allocation and disease management. Raw data from the National Family Health Survey-5 (2019–21) was analysed to extract state-wise and district-wise prevalence of asthma, thyroid disorders, heart disease, cancer, and kidney disease. Variables studied also include the percentage of individuals seeking treatment post-diagnosis. Choropleth maps were created to visualize geographic concentration patterns and regional disparities across the country. The analysis reveals significant geographical disparities in the prevalence of NCDs across India. Mizoram consistently emerges as a multi-disease hotspot, ranking among the top five most affected states across all diseases. Kerala is particularly notable for being the most plagued state for both asthma and thyroid disorders. Regional clustering is also observed, with Ladakh and Jammu & Kashmir leading the nation in prevalence for heart disease and cancer. Treatment-seeking behaviour is inconsistent: while some high-burden states like Kerala and Tamil Nadu have robust healthcare engagement, others like Mizoram and Ladakh lag significantly despite severe disease prevalence. This study identifies high burden and low treatment-seeking areas for key lifestyle diseases. Geographically tailored and targeted interventions by policymakers, healthcare companies, and social impact startups could be developed using the study, which are essential for ensuring equitable healthcare and mitigating the growing burden of non-communicable diseases across India.

Keywords: *Epidemiological Mapping, NFHS-5, Lifestyle Diseases, Non-Communicable Diseases (NCDs), Healthcare Resource Allocation*

1. Introduction

Lifestyle diseases occur largely due to one's daily habits and an inappropriate relationship between individuals and their environment (Sharma & Majumdar, 2009). These diseases include, but are not limited to, heart disease, thyroid disease, obesity, type 2 diabetes, hypertension, chronic respiratory diseases like asthma, cancer, chronic kidney disease, and fatty liver disease. Factors ranging from the type of food one consumes to handling stress, hours of sleep, and amount of exercise could determine vulnerability to lifestyle diseases (Darshan, 2020). Lifestyle diseases are also known as non-communicable diseases (NCDs) and are becoming a major public concern. In 2021, at least 43 million people died from non-communicable diseases (NCDs), accounting for 75% of all non-pandemic-related deaths globally (World Health Organization: WHO, 2024). This staggering figure highlights the seriousness of the situation and the urgent need for action to curb the growing impact of NCDs worldwide.

Even in India, more than a tenth of the people in the country have diabetes, 35.5 percent have hypertension, 28.6% have generalized obesity, and 81.2% have dyslipidaemia (abnormal cholesterol/lipid levels). The prevalence of these conditions, except pre-diabetes, is higher in urban areas than in rural areas. However, rural, and urban populations are equally prone to pre-diabetes (Anjana et al., 2023). The fact becomes even worse since 77% of all noncommunicable diseases occur in low- and middle-income countries like India (Noncommunicable Diseases | Knowledge Action Portal on NCDs, n.d.). Government agencies of India have also found a transition happening in the health sector, wherein NCDs are surpassing the burden of communicable diseases like water-borne or vector-borne diseases, TB, HIV, etc. NCDs are estimated to account for around 60% of all deaths nationwide and cause considerable loss in potentially productive years of life (Ministry of Health & Family Welfare-Government of India, n.d.).

From an economic viewpoint, NCDs are devastating. It was estimated that over the period 2011 - 2030, NCDs will cost the global economy more than $30 trillion (Economics of NCDs, 2024). The World Economic Forum (WEF) and Harvard School of Public Health projected that the global economic burden of non-communicable diseases (NCDs) between 2011 and 2030 would be between US$6.7 trillion and US$43.4 trillion (Bloom et al., 2011). In the USA alone, heart diseases and stroke cost $254 billion per year and cause a loss of $168 billion in lost productivity in jobs, and costs from just cardiovascular diseases are projected to hit roughly $2 trillion by 2050 (FaST FaCTs: Health and Economic Costs of Chronic Conditions, 2024). In China and India for the period 2012-2030, for the five main NCDs (cardiovascular disease, cancer, chronic respiratory disease, diabetes, and mental health), the cost will total USD 27.8 trillion for China and USD 6.2 trillion for India (in 2010 USD) (The Economic Impact of Non-communicable Disease in China and India: Estimates, Projections, and Comparisons, 2013/2013). It was also estimated that over the period 2020–2050, in 10 South American countries, the impact of Noncommunicable diseases and mental health conditions (referred to collectively as NMHs) on gross domestic product would amount to $7.3 trillion (Ferranna et al., 2023).

Therefore, it is crucial to identify and map the areas where these lifestyle diseases are prevalent, such as asthma, thyroid disorders, heart diseases, Cancer, and kidney diseases, to curb them and maintain a healthy working population. Public health patterns and inequalities can also be understood, helping the government and/or private sector companies concentrate their efforts according to location-based needs, as significant variation is observed at the state and district levels.

The 2019-2021 National Family Health Survey-5 (NFHS-5), funded by the Government of India, provides information on the population, health, and nutrition of each state and union territory of India. Using a two-stage stratified sampling design and digital data collection methods, like Computer-Assisted Personal Interviewing (CAPI) and GPS verification, high-quality, real-time data were obtained from a sample size of approximately 610,000 households. To date, it remains the gold standard for health data in India and serves as a reliable indicator for various matters (International Institute for Population Sciences & ICF, 2023).

Kulothungan et al. (2024) conducted a very similar study wherein they analysed and created choropleth maps of the prevalence of noncommunicable disease (NCD) risk factors at state and district levels in India using NFHS-5, while examining sociodemographic influences on these risks among males and females. They assessed prevalence estimates of high blood pressure, tobacco use, alcohol consumption, obesity (BMI), raised blood glucose, and cancer screening rates. Their findings revealed that high blood pressure, tobacco use, and alcohol were concentrated in northern and northeastern parts of the country, while obesity and diabetes were more problematic in the south. The study emphasized that such granular, district-level mapping provides actionable insights and supports prioritization of targeted NCD prevention and control strategies.

Rana et al. (2024) conducted a comparative study analysing NFHS-4 (2015-16) and NFHS-5 (2019-21) to see how diabetes mellitus (DM) and hypertension (HTN) are changing across India. Their analysis of 1,637,762 cases revealed significant increases in both conditions. DM prevalence rose from 2.0% to 2.9% in women and 3.2% to 4.2% in men, and HTN increased from 13.2% to 13.5% in women and 18.7% to 21.6% in men. The study identified age as the strongest risk factor, with adults over 50 years showing higher vulnerability to both conditions compared to younger age groups. Other significant correlates included urban residence, higher BMI, alcohol consumption, and wealthier socioeconomic status. These trends signal a growing health burden as the population ages and underscore the need for targeted interventions addressing these metabolic disorders.

Takale et al. (2024) conducted a cross-sectional study analyzing NFHS-5 (2019-21) data to examine the prevalence and determinants of multiple chronic conditions (MCC) among young adults in Indian households. Their analysis of 239,848 adults (men 15-54 years, women 15-49 years) revealed an overall MCC prevalence of 5.5%, with the most common conditions being obesity, substance use, and hypertension. Risk is higher among city dwellers, men, and those from Scheduled Tribe communities, regardless of wealth or education. Unlike most studies that focus mainly on older adults, this research shows that chronic disease risks aren't just a problem for the old; they're already affecting young adults, making it clear that there is a need to act early with practical prevention and support to ensure more young people can lead healthier lives.

This study will focus on creating choropleth maps for asthma, thyroid disease, heart disease, cancer, and kidney disease. In short, Asthma is a condition that causes airways to swell, narrow, and fill with mucus, often making it hard to breathe. Thyroid disease is a medical condition wherein the thyroid gland is not able to produce an ideal number of hormones. Heart disease is a broad term encompassing various conditions affecting the heart and blood vessels. Cancer is uncontrolled cell growth that can affect any part of the body, while chronic kidney disease leads to gradual loss of kidney function, commonly from diabetes or high blood pressure.

Macro-level district data is available with raw data from the NFHS survey, and utilizing it to create choropleth maps, which will help in visualizing and interpreting geographical variations in public health. Choropleth maps are thematic maps where areas are shaded or coloured in proportion to a statistical value such as population density, income level, or disease rates. In terms of this study, the states of India will be shaded in proportion to the prevalence of various diseases. Darker or lighter colours represent higher or lower values, making it easy to visualize regional differences at a glance.

Previous studies have mapped or compared specific non-communicable diseases such as alcohol and tobacco use, raised blood glucose, high blood pressure, diabetes, and hypertension (Kulothungan et al., 2024), and focused on selected regions and demographics. Some have also drawn comparisons between NFHS-4 and NFHS-5 data and targeted a single state, like Maharashtra (Kshirsagar & Ashturkar, 2022), or studied multiple chronic conditions among young adults (Takale et al., 2024). However, there remains a knowledge gap in geographically visualizing and analysing the prevalence of asthma, thyroid disease, heart disease, cancer, and kidney diseases at a macro level across all districts and states in India. This study aims to fill that gap by providing a comprehensive, nationwide mapping of these major lifestyle diseases, offering broader insights to public health stakeholders. It is vital to study the concentration of lifestyle diseases in a country like India, given its diversity with a variety of religions, ethnicities, languages, and cultures from urban, rural, semi-urban, and suburban settings. Variation occurs from locations within India itself since they could have quite different diets, lifestyles, and environments. The findings may also serve as a reference model for other multi-ethnic and geographically diverse nations facing similar public health challenges.

2. Methodology

The primary aim of this study is to geographically map the prevalence of key lifestyle-related non-communicable diseases (NCDs) in India using data from the National Family Health Survey-5 that was conducted in 2019–2021. The objective is to help healthcare companies, policymakers, and other stakeholders better understand where resources are needed most, so they can take meaningful action and improve health outcomes in the places that need it the most. The study focuses on five major NCDs: asthma, thyroid disorders, heart diseases, cancer, and kidney diseases. These were selected since cardiovascular diseases, chronic respiratory diseases, cancers, and diabetes together account for the majority of NCD-related morbidity and mortality in India (Sharma et al., 2024). Whereas kidney and thyroid diseases are included due to their rising (Status of Goitre or Thyroid Disorders in India, n.d.) or expected rise (Varma, 2015) in prevalence, respectively.

The objectives of this study are as follows:

1. Identify the most and least plagued states and districts for each of the five diseases.
2. Determine high-burden regions with low treatment-seeking behaviour.
3. Examine patterns across the five diseases to detect geographic clustering or divergence.
4. Explore why some states/regions have high disease prevalence.
5. Investigate the causes, such as perceived disease severity, healthcare infrastructure gaps, awareness levels, and/or other reasons, behind low treatment-seeking behaviour.

The NFHS-5 dataset responds to questions such as ‘Have you been diagnosed with the given disease?’ and ‘If yes, have you sought treatment?’ The answers to these questions by 636,699 households, covering 724,115 women (aged 19-49) and 101,839 men (aged 19-54), were used to calculate both prevalence and treatment-seeking rates for each disease at the state and district levels. The data spans all 28 states, 8 union territories, and 707 districts, encompassing both urban and rural populations. Using this data, the most and least plagued states were identified, along with the most afflicted districts, and treatment-seeking behaviour was calculated for all states. Choropleth mapping techniques were used to visualize prevalence and treatment data spatially across states, enabling easy identification of disease hotspots and underserved zones. Data tabulations and choropleth maps were created using Microsoft Excel, while Stata was used to extract and filter the relevant variables from the raw NFHS-5 dataset.

3. Results and Discussion

In this section, choropleth maps have been employed to visualize variations in disease prevalence and treatment-seeking behaviour at a state level. Tables identifying the most and least affected states and districts have also been included, as exact percentages of prevalence may be difficult to distinguish from the maps alone. The discussion interprets these findings by exploring possible reasons for state-level variations, identifying geographic patterns and clusters, and linking them to external factors to provide a deeper understanding of regional health challenges.

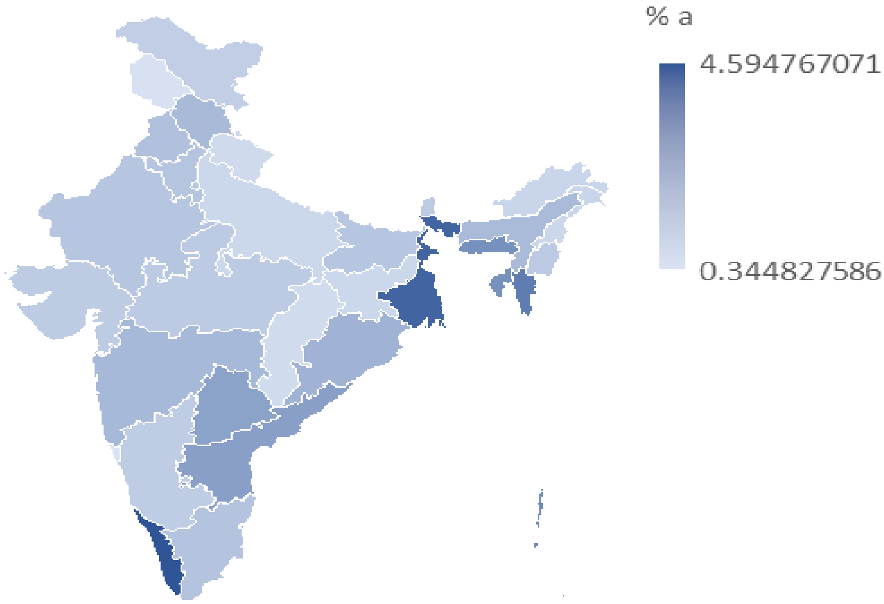

Figure 1.1: State wise Prevalence of Asthma in India (2019-21)

Table 1.1: States with Highest and Lowest Prevalence Rates for Asthma (2019-21)

State	Most Plagued	State	Least Plagued
Kerala	4.59	Goa	0.34
West Bengal	4.13	Jammu & Kashmir	0.41
Mizoram	3.41	Chhattisgarh	0.58
Andaman & Nicobar Islands	3.00	Uttarakhand	0.61
Tripura	2.80	Nagaland	0.70

Table 1.2: Districts with Highest Prevalence Rates for Asthma (2019-21)

District	Most Plagued
Thiruvananthapuram (Kerala)	9.89
Alappuzha (Kerala)	7.15
Kottayam (Kerala)	7.13
Purba Barddhaman (West Bengal)	6.89
Saiha (Mizoram)	6.63

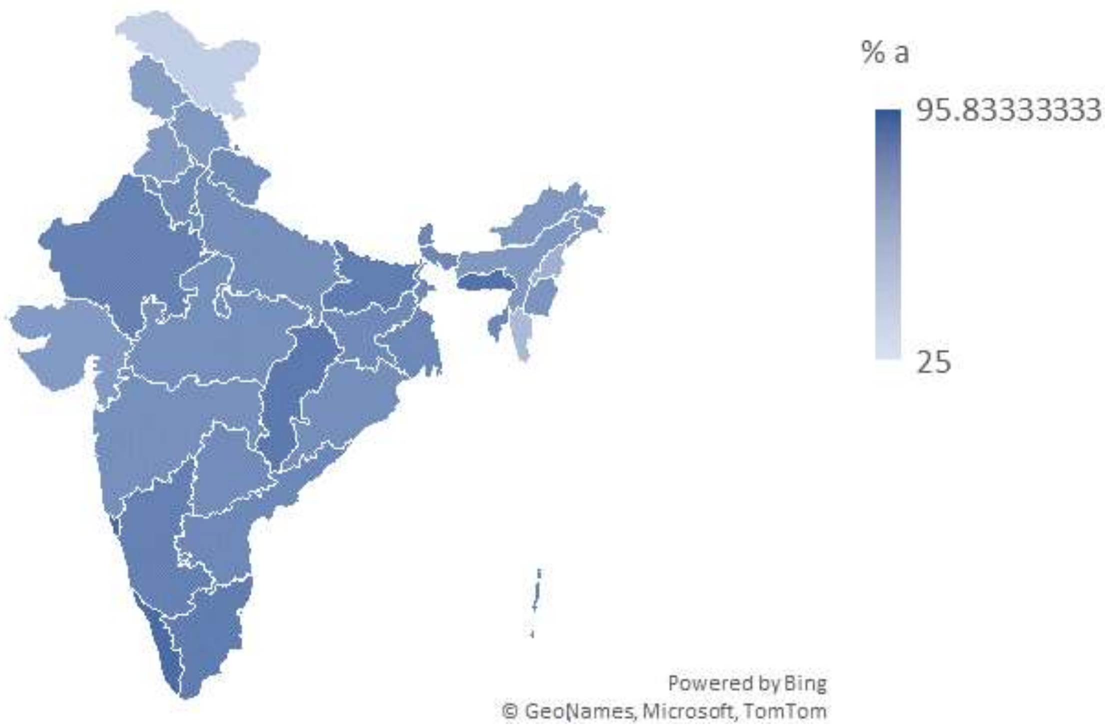

Figure 1.2: State wise Treatment Sought for Asthma in India (2019-21)

The prevalence of asthma in India varies significantly across states. The most plagued state, Kerala, has 4.595% of all respondents who were diagnosed with asthma, whereas the least plagued state is Goa, with only 0.345% of all respondents diagnosed with asthma, as shown in Table 1.1. West Bengal, Mizoram, and Tripura, all of which are among the top five states most affected by asthma, form a geographical cluster as they share borders with Bangladesh, as shown in Figure 1.1. Notably, at the district level, the top 3 most plagued districts (Thiruvananthapuram (9.993%), Alappuzha (7.153%), and Kottayam (7.132%)) all belong to Kerala. When taken together, these three districts exhibit an average prevalence of 8.059% which is nearly double that of the state, as shown in Table 1.2.

Asthma's precise causes remain unclear and may vary from individual to individual. It can develop due to a combination of genetic risk and environmental exposures. Main contributors include a family history of asthma or allergies, early-life respiratory infections, air pollution, tobacco smoke (including second-hand and prenatal exposure), workplace chemicals, and viral infections. Obesity, lower socioeconomic status, and limited healthcare access can also increase both risk and disease severity (American Lung Association, n.d.) (Causes and Triggers | NHLBI, NIH, 2024). Long-term exposure to PM2.5 also increases asthma risk in both children and adults (Ni et al., 2024).

Asthma risk increases with rising humidity, especially among children and people living in developing countries (Gu et al., 2024). This helps explain why asthma is more common in humid, coastal, and densely populated regions of India like Kerala, West Bengal, Mizoram, and the Andaman & Nicobar Islands. It is very interesting to note how Kerala and Goa, despite having similar conditions, for example, both lie on the coast with comparable temperatures and air quality indices but exhibit opposite extremes in asthma prevalence. Kerala leads Indian states with about 1.14 to 1.19 hospital beds per 1,000 people (KPMG et al., 2024), compared to the national average of just 0.79 beds per 1,000 (India's Govt Hospital Bed-population Ratio Dismally Low at 0.79:1,000, 2024), and has 8,525 government hospital beds (2022) and 1,287 government hospitals, serving a population of 36 million (CEICdata.com, 2024), which could result in high detection of asthma patients. However, Goa has an even stronger healthcare infrastructure, with 3,378 government hospital beds for about 1.7 million people, with each bed serving just 671 residents, among the best ratios in the country there the disparity is not due to underreporting in Goa (CEICdata.com, 2023). The main reason behind the issue comes down to Kerala's extremely dense population, with western coastal regions averaging 2,022 persons/km², and a state average of 890/km² (Wikipedia contributors, 2025). This results in crowded living conditions, higher indoor air pollution, and greater allergen exposure. In contrast, Goa's population density is just 394 persons/km² (Goa Population 2025 | Sex Ratio & Literacy Rate 2025, n.d.), nearly half of Kerala's, leading to less crowding and fewer shared indoor environmental risks. Further, Kerala faces air pollution spikes, especially in urban and industrial areas, combined with very high humidity (~97%). Goa's air is similar, but the lower humidity (~76%) makes it less conducive to allergen accumulation. In Kerala, recurring floods, the use of biomass fuels for cooking in some areas, and homes with poor ventilation keep indoor spaces damp and increase exposure to asthma triggers. By comparison, most households in Goa use clean LPG fuel and benefit from better-ventilated homes, making it easier to keep indoor air fresher and healthier.

While asthma prevalence reveals where the disease burden lies, treatment-seeking behaviour shows how well communities respond to it. Figure 1.2 highlights the percentage of asthma patients in each Indian state who sought medical treatment, ranging from 25% to 95.83%. Kerala, with one of the highest asthma prevalence rates, also stands out with high treatment-seeking behaviour. It indicates that asthma is not only well-diagnosed in Kerala but also well-managed, with patients more likely to follow through with medical interventions. In contrast, states like Jammu & Kashmir, Nagaland, and parts of Chhattisgarh show both low prevalence and low treatment rates. This raises concerns about underdiagnosis and limited healthcare access, rather than an actual low disease burden. These regions often face challenges like difficult terrain, a lack of awareness, and fewer respiratory specialists, contributing to low health-seeking behaviour. Other states, such as Andhra Pradesh, Telangana, Maharashtra, and Tamil Nadu, show moderate asthma prevalence alongside relatively high rates of treatment-seeking behaviour. These trends reflect decent urban healthcare infrastructure and growing public awareness, though rural areas in these states may still lag.

Urbanization trends, climate change, and increasing industrialization are expected to worsen the scenario, with the Global Asthma Report 2022 predicting a 15–20% increase in prevalence over the next decade if preventative measures are not adopted. The report also mentioned that efforts such as distributing nearly 80 million subsidized LPG connections and stricter vehicle emission norms have reduced exposure to major triggers like biomass fuel smoke and pollution. These steps, along with free treatment under the Ayushman Bharat Yojana since 2018, have made asthma care more accessible and affordable for low-income families, easing the burden of medical costs (The Global Asthma Report 2022, n.d.).

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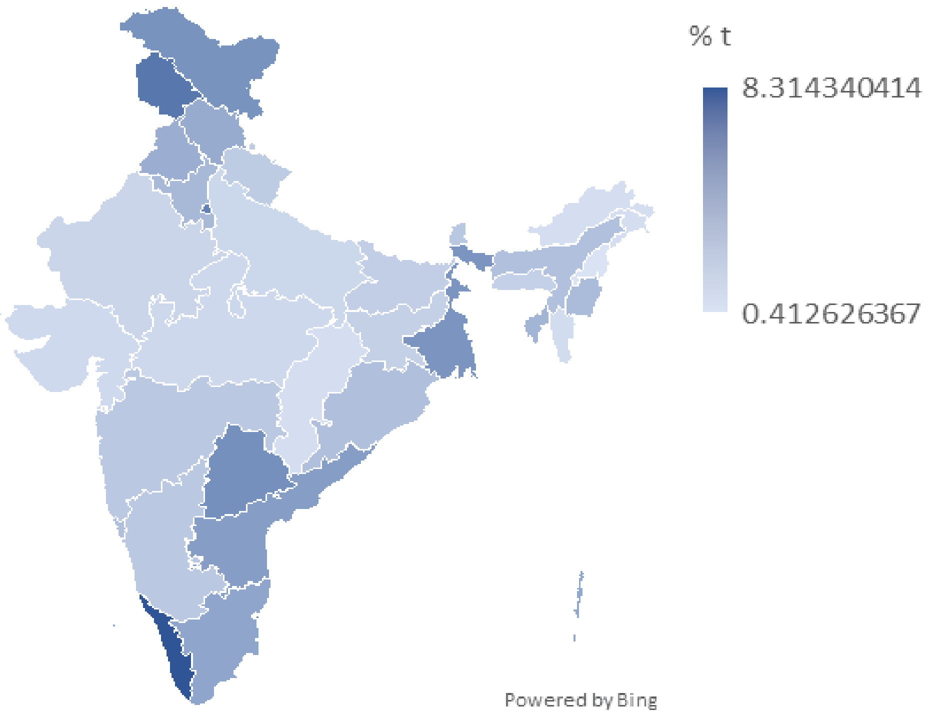

Figure 2.1: State wise Prevalence of Thyroid in India (2019-21)

Table 2.1: States with Highest and Lowest Prevalence Rates for Thyroid (2019-21)

State	Most Plagued	State	Least Plagued
Kerala	8.31	Nagaland	0.41
Chandigarh	6.97	Arunachal Pradesh	0.67
Jammu & kashmir	6.42	Chhattisgarh	0.70
Puducherry	6.08	Mizoram	0.80
NCT of Delhi	5.87	Gujarat	0.94

Table 2.2: Districts with Highest Prevalence Rates for Thyroid (2019-21)

District	Most Plagued
Kollam (Kerala)	13.94
Alappuzha (Kerala)	13.58
Pathanamthitta (Kerala)	13.28
Thiruvananthapuram (Kerala)	12.48
Ernakulam (Kerala)	11.11

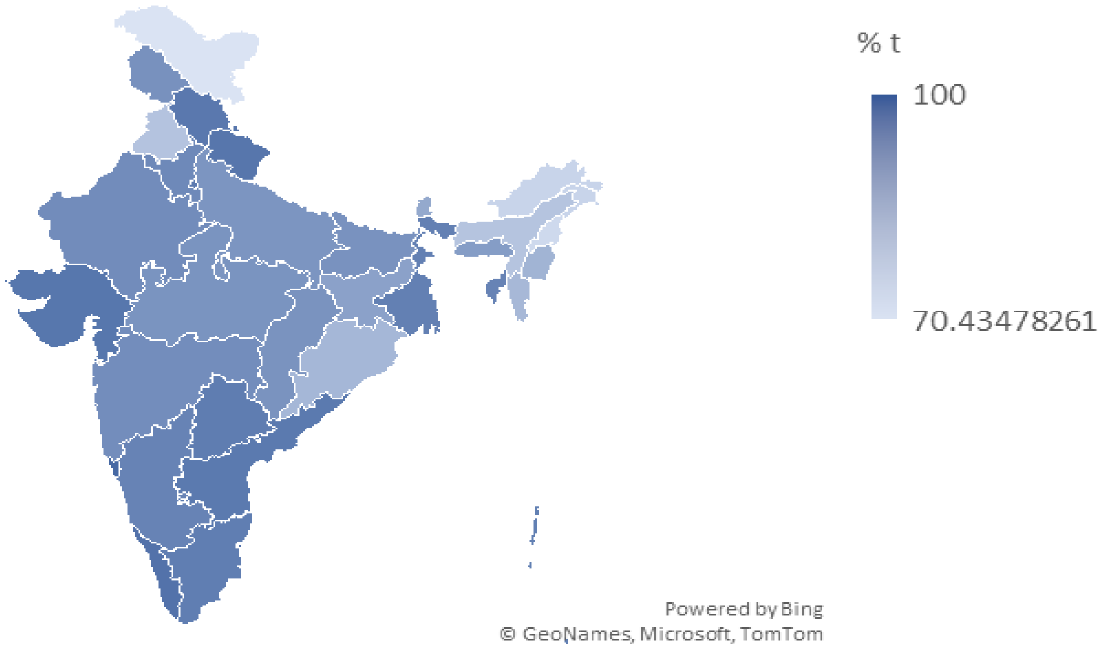

Figure 2.2: State wise Treatment Sought for Thyroid in India (2019-21)

The analysis of thyroid disorder prevalence across Indian states, as shown in Table 2.1, reveals that the national prevalence ranges from a low of 0.41% in Nagaland to a high of 8.31% in Kerala. Other states with notably high prevalence include Chandigarh (6.97%), Jammu & Kashmir (6.42%), and Puducherry (6.08%). On the other hand, states with low prevalence (all below 1%) include Arunachal Pradesh (0.67%), Chhattisgarh (0.70%), and Mizoram (0.79%). At the district level, a very high concentration of thyroid cases is seen in southern Kerala. The five most affected districts, as seen in Table 2.2 (Kollam (13.94%), Alappuzha (13.58%), Pathanamthitta (13.28%), Thiruvananthapuram (12.48%), and Ernakulam (11.11%)), all belong to Kerala, forming a high-burden coastal cluster.

While the exact causes of thyroid disease remain variable and may differ among individuals, it is commonly developed because of a combination of genetic and environmental factors. A family history of thyroid disorders or autoimmune diseases (Panicker, 2011) and ecological contributors, including iodine deficiency or excess, radiation exposure, certain medications, and exposure to chemical contaminants, substantially increase risk (Ferrari et al., 2017). Other risk factors are obesity, female sex, and older age. Viral infections and changes in nutrition or air quality also play roles in triggering or worsening thyroid dysfunction. A deep dive into the reasons behind Kerala's high thyroid prevalence reveals several key observations. Speculative contributors include Kerala's coastal monazite sands, which are rich in thorium and result in naturally elevated background radiation, as well as proximity to nuclear plants. Although the carcinogenic potential of this low-dose radiation is debated and remains unproven, it has been proposed as a risk factor contributing to the high thyroid cancer incidence observed in districts like Thiruvananthapuram and Kollam (Dileep V Kumar, 2020; Singh, 2017; Nair et al., 2008).

Both in Jammu & Kashmir and Kerala, iodine imbalance remains a major determinant of thyroid disease. Iodine deficiency, common in inland and sub-Himalayan hill tracts, predisposes populations to goitre and hypothyroidism (Ganie et al., 2020). In contrast, coastal populations with seafood-rich diets and universal iodised salt are prone to iodine excess, which in genetically susceptible individuals can precipitate autoimmune thyroiditis (Kalarani & Veerabathiran, 2022). India's transition from iodine deficiency to relative sufficiency has therefore created a dual burden of both deficiency-related and excess-related thyroid disorders, with nearly 200 million people still considered at risk (Salt Department-HO, n.d.).

The rise in thyroid incidence in Kerala may reflect overdiagnosis. Kerala's advanced healthcare system, as already discussed while examining asthma prevalence (1.14-1.19 beds/1 000; nationwide 0.79), has enabled intensive thyroid screening programs using high-resolution ultrasonography and fine-needle aspiration cytology. This has led to a surge in detected cases without a parallel increase in mortality. Despite a 93 percent jump in thyroid cancer diagnoses between 2005 and 2014 (Mathew & Mathew, 2017), mortality rates have remained stable at 0.4–0.5 per 100,000 women (Veedu & Mathew, 2018), which implies that many of the newly identified tumours are indolent and would never have caused harm. Data from Kerala's hospital registry further support this pattern, showing that 85.8 percent of thyroid cancers are the papillary subtype, with a significant increase in small, early-stage tumours (T1a and T1b) at diagnosis ($p < 0.001$) (Raghuram et al., 2019). Kerala's pattern closely parallels South Korea's thyroid "epidemic," where nationwide ultrasonography programs drove a 15-fold increase in incidence from 1993 to 2011 without reducing mortality (Veedu & Mathew, 2018).

Figure 2.2 shows that treatment-seeking among thyroid patients in India is consistently high, ranging from approximately 70% to 100%. Kerala, with one of the highest thyroid prevalence rates nationally, records near-universal treatment-seeking, underscoring its advanced healthcare system and strong public health awareness. Jammu & Kashmir, despite a prevalence of 6.8%, shows somewhat lower engagement (70%), likely due to difficult terrain and limited specialist access in the Himalayan regions. Other states such as Gujarat, Tamil Nadu, Uttarakhand, Himachal Pradesh, and West Bengal report treatment rates above 90%, reflecting robust healthcare networks, while parts of northeast India show comparatively lower engagement, around 70–75%. Balanced iodisation requires continuous monitoring to prevent both deficiency and excess across the country. Kerala's case highlights the need for evidence-based screening to avoid overdiagnosis and overtreatment. Meanwhile, innovations like drone-based sample transport in Andhra Pradesh offer scalable solutions for delivering thyroid testing to remote PHCs and should be replicated in other regions (India Today, 2024).

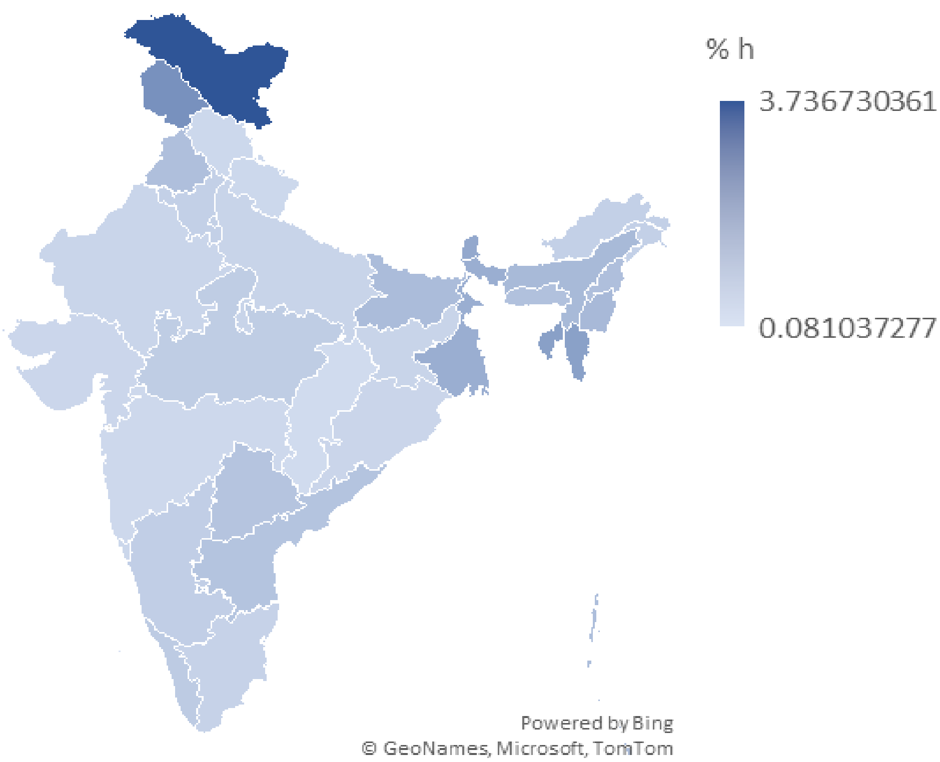

Figure 3.1: State wise Prevalence of Heart Disease in India (2019-21)

Table 3.1: States with Highest and Lowest Prevalence Rates for Heart Disease (2019-21)

State	Most Plagued	State	Least Plagued
Ladakh	3.74	Lakshadweep	0.08
Jammu & Kashmir	2.18	Dadra & Nagar Haveli and Daman & Diu	0.29
Tripura	1.82	Chhattisgarh	0.30
Mizoram	1.79	Maharashtra	0.36
Sikkim	1.59	Himachal Pradesh	0.38

Table 3.2: Districts with Highest Prevalence Rates for Heart Disease (2019-21)

District	Most Plagued
Baramula (Jammu & Kashmir)	4.82
Leh (Ladakh)	4.59
Kupwara (Jammu & Kashmir)	4.06
Sepahijala (Tripura)	3.81
Saiha (Mizoram)	3.71

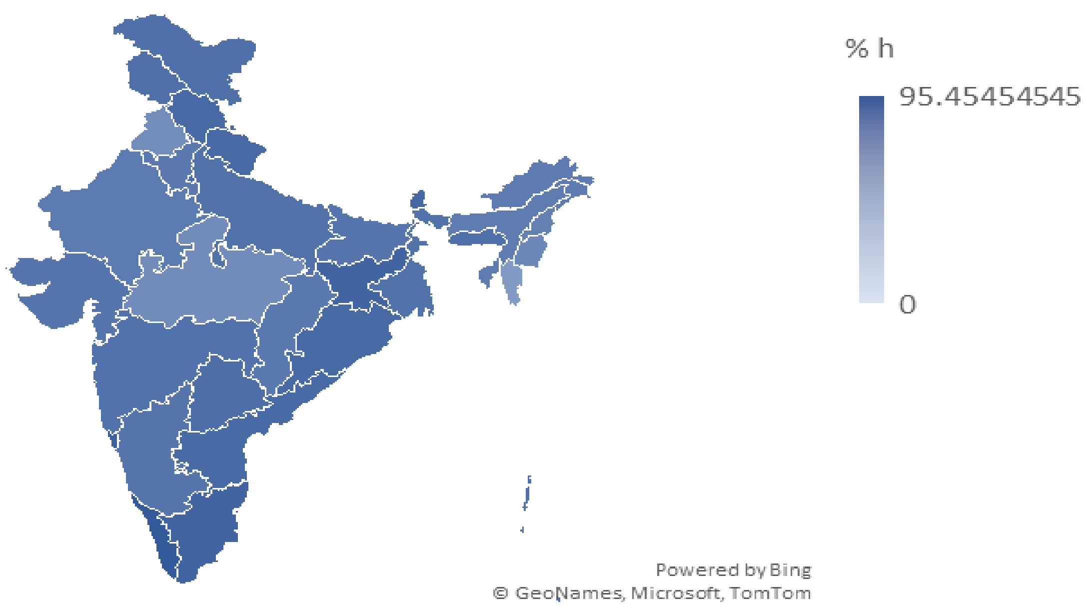

Figure 3.2: State wise Treatment Sought for Heart Disease in India (2019-21)

The analysis of heart disease prevalence across Indian states, as shown in Table 3.1, reveals that national prevalence ranges from a low of 0.08% in Lakshadweep to a high of 3.74% in Ladakh. Other states with notably high prevalence include Jammu & Kashmir (2.18%), Tripura (1.82%), Mizoram (1.79%), and Sikkim (1.59%). States with low prevalence include Dadra & Nagar Haveli & Daman & Diu (0.29%), Chhattisgarh (0.30%), Maharashtra (0.36%), and Himachal Pradesh (0.38%)—a more than 40-fold difference between the extremes. At the district level (Table 3.2), heart disease is highly concentrated in two geographic clusters. The Himalayan cluster comprises Baramulla (4.82%), Leh (4.59%), and Kupwara (4.06%), while the Northeastern cluster includes Sepahijala (3.81%) and Saiha (3.71%).

Heart disease primarily arises from the buildup of fatty deposits in the coronary arteries, leading to narrowed arteries and restricted blood flow to the heart muscle (World Health Organization: WHO, 2025). Key risk factors include smoking, air pollution, high blood pressure, elevated cholesterol and lipoprotein levels, physical inactivity, diabetes, obesity, and family history. Behavioural factors such as unhealthy diet, tobacco use, harmful alcohol consumption, and physical inactivity (Website, 2025), along with psychosocial and socioeconomic determinants including stress, poverty, aging, and genetics (World Health Organization: WHO, 2025), significantly increase the risk of disease.

The high prevalence of cardiovascular disease in Jammu and Kashmir, including Leh, can be explained by altitude, lifestyle changes, air pollution, genes, and limited access to healthcare. The region spans a wide range of elevations from the Chenab River (Wikipedia contributors, 2025b) at 247 meters (810 ft) to Nun Peak (Wikipedia contributors, 2025a) at 7,135 meters (23,409 ft), with Leh situated at an altitude of 3,500 meters. Chronic hypoxia at elevations above 2,500 m forces the body to adapt by producing more red blood cells—a process called polycythaemia. This boosts oxygen transport but also thickens the blood and strains the heart, which accelerates arterial stiffening and plaque buildup, raising risks of hypertension and coronary artery disease. Further, Cold stress, the body's natural response to low temperatures, narrows blood vessels near the skin to conserve heat and maintain core temperature (Marriott & Carlson, 1996), which elevates blood pressure and damages vessel walls. On top of that, prolonged low oxygen also drives excess production of reactive oxygen species—molecules that initially aid adaptation but, in excess, cause inflammation and heart damage. Lifestyle shifts in the Himalayas from traditional diets rich in whole grains and vegetables to refined foods and reduced activity have raised heart disease risk, especially among women and older adults. Indoor air pollution from biomass fuels further damages cardiovascular health, while genetic variations in Western Himalayan groups, unlike protective Tibetan adaptations, increase susceptibility to high blood and lung pressures.

Finally, sparse screening for hypertension, diabetes, and hyperlipidaemia in remote mountain villages means early opportunities for lifestyle changes or treatment are often missed, allowing these diseases to progress before diagnosis (Mallet et al., 2021). In the Northeast regions, forming a cluster, the main drivers of cardiovascular disease are the widespread use of tobacco and alcohol. NFHS-5 data show male smoking prevalence of 56.9% in Tripura and 72.9% in Mizoram; female tobacco use exceeds 50% in several districts (Rai & Bramhankar, 2021). Tobacco, whether smoked, smokeless, or through second-hand exposure, is recognized as a potent precipitant of acute myocardial infarction (Teo et al., 2006). In parallel, the Northeast has the country's highest prevalence of alcohol use, with 22.3% of adults and 35.2% of men reporting current consumption, compared with a national average of 12% (Kalita, 2022). Traditional diets high in smoked meats, oils, and salt, together with AGT and ACE gene polymorphisms that increase salt sensitivity, predispose individuals to hypertension (Eilat-Adar et al., 2012) and hypertensive heart disease, as well in the Northeast.

On the other hand, Lakshadweep's predominantly fish-based diet contributes to high omega-3 fatty acid intake (>2 g/day), primarily EPA and DHA, which have been shown to reduce coronary events via anti-inflammatory and endothelial protective effects substantially. Meta-analyses of data from over 20,000 people show that those with the highest circulating EPA, DHA, and combined EPA + DHA have 22–25% lower risk of coronary heart disease compared to those with lower levels (Innes & Calder, 2020). Dadra & Nagar Haveli and Daman & Diu remain <30% urbanized with >60% of the workforce engaged in agriculture (Census of India, 2011). NFHS-5 (2019–21) further reports obesity prevalence below 15% and hypertension around 11%, significantly lower than national averages. These demographic and lifestyle characteristics align with the observed low burden of cardiovascular disease in the region.

Figure 3.2 shows that treatment-seeking for heart disease in India is generally high due to the disease's severity and fatality. Most individuals with heart disease actively seek treatment, with rates nearing 95% in many regions. The high treatment-seeking behaviour may be a result of effective public health programs such as the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke (NPCDCS) and Ayushman Bharat, which aim to strengthen community-level screening and referral systems for NCDs. Jammu & Kashmir and Leh have high heart disease prevalence with correspondingly high treatment-seeking rates. The Northeastern states also show elevated prevalence and generally good treatment uptake, though Mizoram's rates are slightly lower. Lakshadweep and the union territories of Dadra & Nagar Haveli and Daman & Diu exhibit low prevalence with high treatment-seeking, reflecting effective healthcare services. Madhya Pradesh and Punjab report low to medium prevalence with moderate to high treatment-seeking.

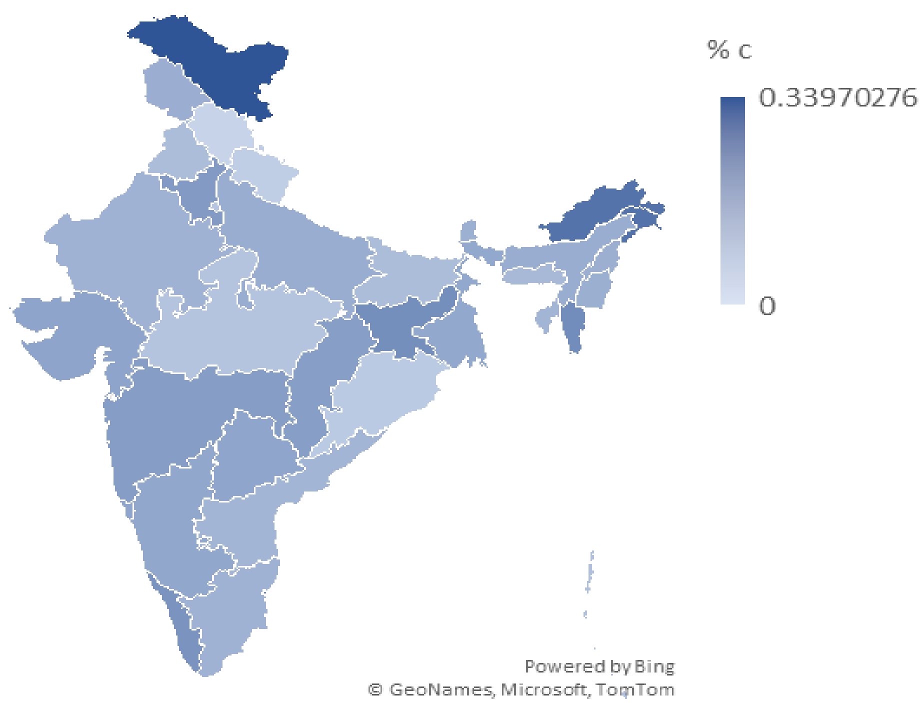

Figure 4.1: State wise Prevalence of Cancer in India (2019-21)

Table 4.1: States with Highest and Lowest Prevalence Rates for Cancer (2019-21)

State	Most Plagued	State	Least Plagued
Ladakh	0.34	Chandigarh	0
Arunachal Pradesh	0.27	Himachal Pradesh	0.04
Puducherry	0.22	Uttarakhand	0.05
Mizoram	0.21	Odisha	0.06
Jharkhand	0.20	NCT of Delhi	0.07

Table 4.2: Districts with Highest Prevalence Rates for Cancer (2019-21)

District	Most Plagued
Kannauj (Uttar Pradesh)	2.20
Gandhinagar (Gujarat)	0.98
Bokaro (Jharkhand)	0.98
Unnao (Uttar Pradesh)	0.89
Bastar (Chhattisgarh)	0.87

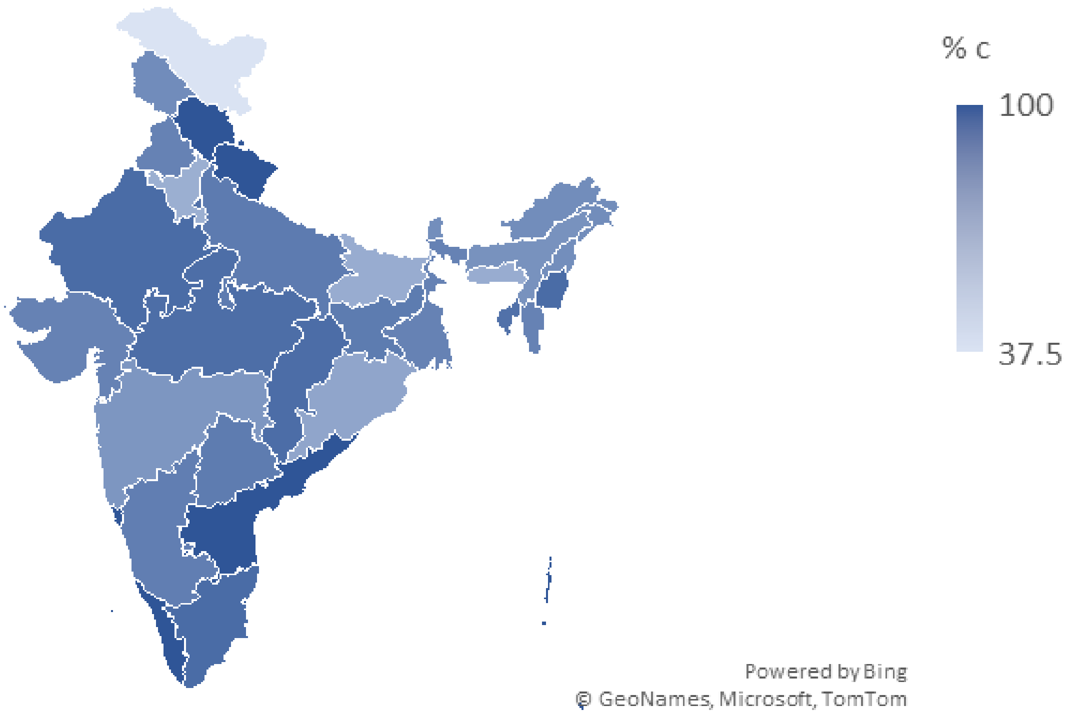

Figure 4.2: State wise Treatment Sought for Cancer in India (2019-21)

The analysis of cancer prevalence across Indian states, as shown in Table 4.1, reveals that at the state level, Ladakh has the highest burden, with a prevalence of 0.34%, followed by Arunachal Pradesh (0.27%), Puducherry (0.22%), Mizoram (0.21%), and Jharkhand (0.20%). In contrast, Chandigarh records 0% prevalence, while states such as Himachal Pradesh (0.039%), Uttarakhand (0.053%), Odisha (0.060%), and Delhi (0.071%) report among the lowest rates. At the district level, the contrast becomes starker. Kannauj in Uttar Pradesh emerges as the most plagued district, reporting an exceptionally high cancer prevalence of 2.20%. Other affected districts include Gandhinagar, Gujarat (0.98%), Bokaro, Jharkhand (0.98%), Unnao, Uttar Pradesh (0.89%), and Bastar, Chhattisgarh (0.87%). These regions do not align directly with the highest-prevalence states, suggesting that cancer in India follows micro-regional clusters rather than broad state-wide trends.

Cancer results from genetic and environmental factors, with risk increasing with age due to accumulated cellular damage. Major risk factors include inherited mutations, family history (Causes of Cancer and Reducing Your Risk, 2025), and chronic conditions such as Lynch syndrome (Website, 2025a). Lifestyle choices such as smoking, alcohol use, obesity, poor diet, inactivity, and excessive sun exposure significantly elevate risk, while environmental factors like air pollution, asbestos, and radiation also contribute. Certain infections (HPV, hepatitis B and C, Helicobacter pylori), hormonal changes, and socioeconomic conditions further influence vulnerability. Notably, nearly one-third of cancer deaths are linked to preventable causes such as tobacco, alcohol, poor diet, and inactivity (World Health Organization: WHO, 2025a).

Ladakh's prevalence (0.34%) is the highest nationally, and may be due to high-altitude conditions, including excessive UV radiation and sedentary lifestyles, which are associated with rising gastrointestinal and skin cancers (Ians, 2018). Traditional diets, particularly salted butter tea ("noon"/ "gurgur"), smoked meats, and reheated foods, can introduce gastric irritants and N-nitroso compounds linked to gastrointestinal cancers (Ladakh, 2022). Further, groundwater analyses (Banerjee & Banerjee, 2024) in Leh reveal that 46–76% of samples exceed safe limits for heavy metals such as chromium and arsenic, while additional studies report uranium levels as high as 95.56 µg/L, well above recommended thresholds. The overall state-level variation across the country is very minimal, ranging only from 0% to 0.34%. This suggests that macro-level factors such as population aging, national lifestyle trends, and widespread carcinogen exposures possibly cause a uniform influence on the prevalence of cancer in India rather than regional environmental clusters alone, as seen in other diseases.

Interestingly, at the district level, cancer prevalence disparities are far more pronounced than at the state level. Bokaro and Bastar are both mining districts, and chronic exposure to heavy metals such as arsenic and chromium from mining activities, along with silica dust and particulate pollution from thermal power plants, has been linked to elevated gastrointestinal and lung cancer rates. Groundwater and soil contamination (Biswal et al., 2016) exceeding safety limits and silicosis among mine workers further exacerbate cancer risks in this region (Khetan & Babu, 2025). In Unnao, industrial emissions from leather tanneries, pesticide-intensive agriculture, and untreated chemical effluents discharged into the Ganga–Yamuna basin correlate strongly with unusually high cancer prevalence (Chitnis, 2017). Similarly, in Gandhinagar (Gujarat), rapid urbanization, industrial emissions, and vehicular pollution have led to deteriorating air quality, with government audit data showing that $PM_{2.5}$, PM_{10}, NO_2, and volatile organics like benzene frequently exceeded recommended safety thresholds across Ahmedabad and Gandhinagar between 2014 and 2021 (Comptroller and Auditor General of India, 2022). These exposures are medically associated with increased risks of lung and bladder cancers.

Treatment-seeking behaviour for cancer in India shows wide variation across states, ranging from 37.5% to nearly 100% as shown in Figure 4.2. States such as Kerala, Telangana, and Goa demonstrate near-universal utilization of cancer care, supported by dense networks of Regional Cancer Centres (e.g., Adyar Cancer Institute, MNJ Institute of Oncology) and robust state-backed insurance schemes such as Arogyasri, Chief Minister Health Insurance, and Ayushman Bharat–PMJAY. In contrast, uptake remains low (40–60%) in states such as Arunachal Pradesh, Mizoram, Jharkhand, Odisha, and Ladakh, due to sparse oncology infrastructure and shortages of specialist doctors. Interestingly, states like Himachal Pradesh, Uttarakhand, and Maharashtra, despite having relatively lower cancer prevalence, report strong treatment uptake, largely due to well-established primary healthcare networks and their proximity to cancer centres.

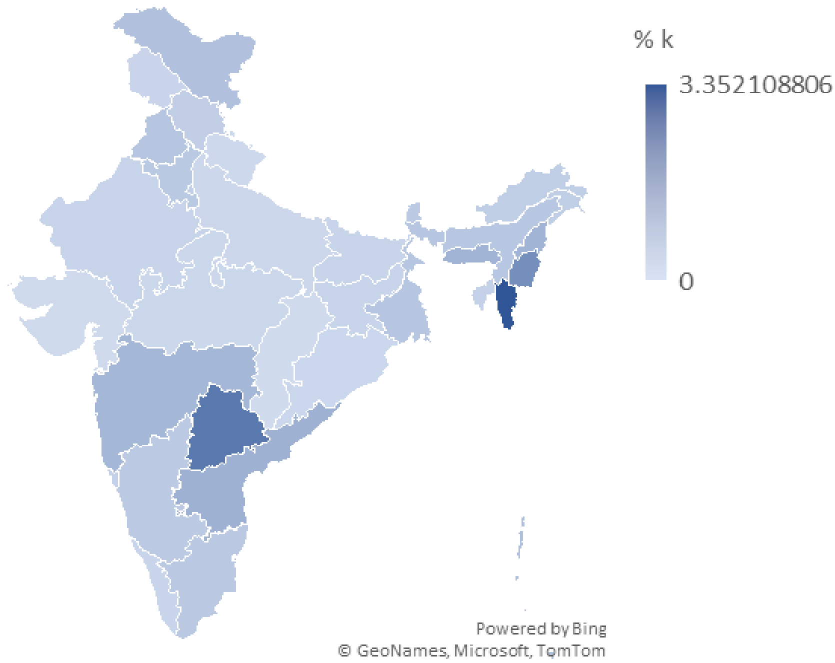

Figure 5.1: State wise Prevalence of Kidney Disease in India (2019-21)

Table 5.1: States with Highest and Lowest Prevalence Rates for Kidney Disease (2019-21)

State	Most Plagued	State	Least Plagued
Mizoram	3.35	Lakshadweep	0
Telangana	2.52	Dadra & Nagar Haveli and Daman & Diu	0.18
Manipur	1.98	Chhattisgarh	0.20
Andhra Pradesh	1.18	Gujarat	0.24
Meghalaya	1.13	Uttarakhand	0.26

Table 5.2: Districts with Highest Prevalence Rates for Kidney Disease (2019-21)

District	Most Plagued
Saiha (Mizoram)	8.20
Aizawl (Mizoram)	6.38
Mahabubabad (Telangana)	5.87
Karimnagar (Telangana)	5.86
Peddapalli (Telangana)	4.65

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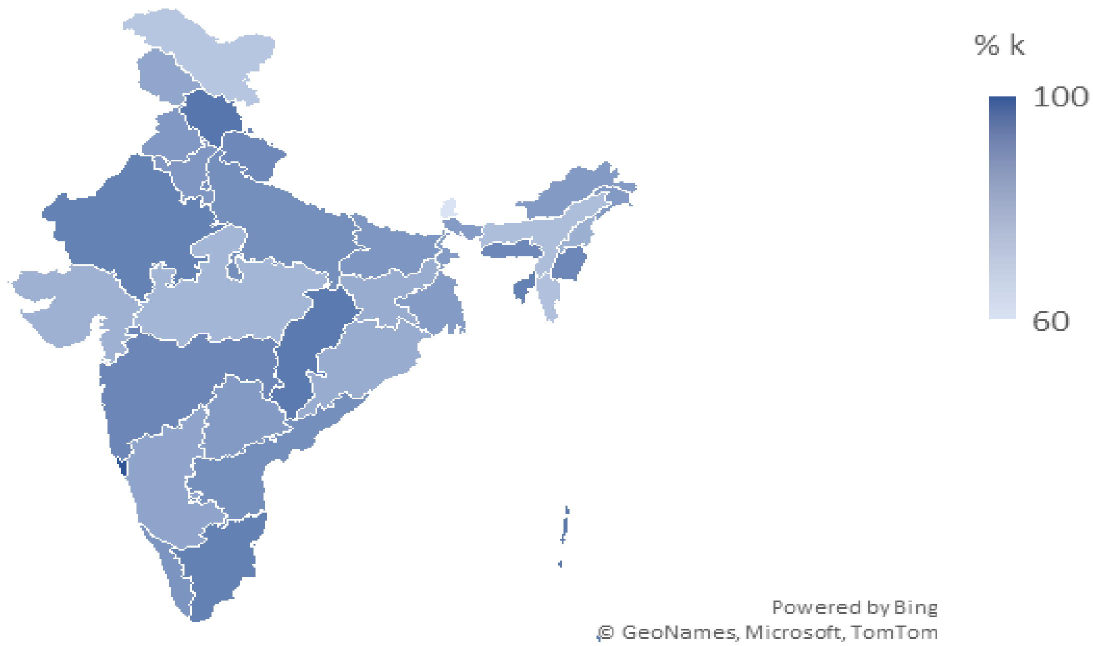

Figure 5.2: State wise Treatment Sought for Kidney Disease in India (2019-21)

Kidney disease in India reveals disparities in both prevalence and access to care. As shown in Figure 5.1 and Table 5.1, Mizoram stands out as the most affected state, with a kidney disease prevalence of 3.35%, followed by Telangana (2.52%), Manipur (1.98%), Andhra Pradesh (1.18%), and Meghalaya (1.13%). These are all states with significant tribal, rural, or agro-ecological populations. On the other end, the least affected states include Lakshadweep (0%), Dadra & Nagar Haveli and Daman & Diu (0.18%), Chhattisgarh (0.20%), Gujarat (0.24%), and Uttarakhand (0.26%).

At the district level, Saiha in Mizoram records an alarming prevalence of 8.20% while Aizawl, also in Mizoram, follows with 6.38%. In Telangana, the districts of Mahabubabad (5.87%), Karimnagar (5.86%), and Peddapalli (4.65%) also exhibit high prevalence of kidney disease. This aligns with the most affected state; therefore, two major high-burden clusters—one in Mizoram and the other in northern Telangana can be seen. Kidney disease results from a mix of genetic, lifestyle, and environmental factors, with risk rising with age due to accumulated kidney damage (Facts About Chronic Kidney Disease, n.d.). Key risk factors include diabetes, high blood pressure, and inherited conditions like polycystic kidney disease (Causes of Chronic Kidney Disease in Adults, 2025). Lifestyle factors such as obesity, smoking, poor diet, high sodium intake, and physical inactivity contribute to kidney damage (Kidney Failure, 2025). Environmental exposures like heavy metals, nephrotoxic drugs, and toxins can also impair kidney function (Environmental Pollution and Kidney Disease, n.d.).

A deep dive into the reasons behind Mizoram's and Northeast India's prevalence of kidney disease reveals several contributing elements unique to this tribal region. Traditional dietary patterns in Mizoram heavily emphasize preserved and smoked foods, contributing to excessive sodium intake (Donoghue et al., 2022). This high-sodium diet creates conditions conducive to hypertension and subsequent kidney damage (A Study of Salt and Fat Consumption Pattern in Regional Indian Diet Among Hypertensive and Dyslipidaemia PaTients - SCRIPT Study, 2016). Delayed diagnosis has also led to an alarming rise in chronic kidney disease (CKD) cases in the Northeast. While the Pradhan Mantri National Dialysis Program (PMNDP) has helped by setting up satellite dialysis units in nearly all 59 districts across the eight Northeastern states, access remains uneven. Many patients are still forced to travel 30 to 150 km for routine haemodialysis (Kalita, 2023). Another factor complicating the management of the disease in the region is the reliance on traditional remedies. Around 30.5% of kidney disease patients in Northeast India use indigenous medicine, with up to 80% among chronic interstitial nephritis cases reporting this. Many remedies contain nephrotoxins like aristolochic acid and heavy metals, which can further damage renal function (Sethi et al., 2024).

Coal mining activities in Meghalaya and Assam generate acid mine drainage (AMD), contaminating water bodies with heavy metals like iron, copper, manganese, zinc, nickel, and lead. Metal concentrations in mine water from Northeast India exceed those found in other Indian mining regions. Zinc and lead show maximum concentrations in Meghalaya's Jaintia coalfield, while nickel peaks in Assam's Makum coalfield (Shylla et al., 2021). For communities relying on these water sources, such contamination directly increases CKD risk. Air pollution from mining and industry further worsens kidney health, as prolonged exposure to PM2.5, sulphur dioxide, and hydrocarbons can damage renal cells and trigger inflammation or glomerulonephritis (Bowe et al., 2017).

Environmental factors converge to create kidney disease risk in the Telangana cluster, particularly in Mahabubabad, Karimnagar, and Peddapalli districts. Water contamination represents a primary concern. 28 of 33 districts exceed the WHO fluoride limit of 1.5 mg/L, making Telangana second in India for fluoride levels (Manda Ravinder Reddy, 2025), and 32 districts record nitrate concentrations above 45 mg/L due to fertilizer runoff (Pulipaka et al., 2025). Additionally, farming communities experience prolonged pesticide exposure, repeated heat stress from manual labour under high temperatures, and dependence on unregulated borewell water. Lakshadweep's predominantly fish-based diet, along with low urbanization and a high agrarian workforce in Dadra & Nagar Haveli and Daman & Diu, contributes to reduced coronary heart disease risk and better kidney health.

Treatment-seeking rates for kidney disease range from 60% to nearly 100%, indicating generally high but uneven care uptake. Mizoram, despite the highest disease burden, has only a 68% treatment-seeking rate, constrained by limited dialysis centres, long travel distances, and few nephrologists. The Pradhan Mantri National Dialysis Programme (PMNDP) now spans 751 districts with 1,721 centers and 12,160 haemodialysis machines, yet tribal and remote areas, especially in the Northeast, remain underserved (Home | Pradhan Mantri National Dialysis Programme, n.d.). Treatment-seeking is high in Himachal Pradesh, Chhattisgarh, and Kerala, nearing 100%, but relatively low in Jammu & Kashmir, northeastern states, Madhya Pradesh, Gujarat, Jharkhand, and Odisha, around 60–70%. Maharashtra, with approximately 90% treatment-seeking, leverages robust public health programs like the Mahatma Jyotiba Phule Jan Arogya Yojana, Maharashtra Diabetes Prevention and Control Program, and Non-Communicable Disease Screening Program to ensure early detection of diabetes and hypertension, preventing the progression of kidney failure.

4. Conclusion

This study aimed to geographically map the burden and treatment-seeking patterns of five major non-communicable lifestyle diseases in India: cardiovascular disease, asthma, thyroid disorders, cancer, and chronic kidney disease, using the NFHS-5 data. The primary goal was to identify disparities in both prevalence and treatment-seeking behaviour, so that healthcare providers, policymakers, and startups can better target underserved areas and deploy resources more effectively. The primary findings reveal substantial regional disparities across India. States such as Kerala and Jammu & Kashmir exhibit particularly high prevalence rates for multiple NCDs. Mizoram uniquely emerges as a multi-disease hotspot ranking among the top five most affected states for 4 out of the 5 diseases analysed in this paper. Ladakh and Jammu & Kashmir show the highest prevalence for heart disease and cancer, respectively. Regional clustering of high NCD burden is evident, with neighbouring states showing similar patterns for some diseases. The possible reasons identified behind this are environmental exposures, dietary habits, healthcare infrastructure, including hospital bed density and specialist access, population density and climate, and the use of traditional medicines.

A crucial insight from this study is the wide variation in treatment-seeking behaviour. Kerala, Tamil Nadu, Chandigarh, Himachal Pradesh, and Maharashtra report high treatment uptake across diseases, while Mizoram, Ladakh, several northeastern states, Bihar, Uttar Pradesh, Jharkhand, and Odisha exhibit lower treatment rates, likely due to limited awareness, inadequate healthcare resources, and cultural factors. Treatment-seeking rates broadly range from as low as 25% to nearly complete coverage, highlighting significant gaps in healthcare accessibility and utilization across the country.

Policymakers at the central and state levels can use the state-wise analysis of NCD prevalence and treatment gaps to allocate resources efficiently, design targeted awareness campaigns, and strengthen healthcare infrastructure in underserved regions. High-burden states like Kerala and Jammu & Kashmir may benefit from comprehensive chronic care management, while states such as Bihar and Uttar Pradesh require focused outreach to improve treatment uptake. Private healthcare providers and health-tech startups can pilot mobile screening, chronic care clinics, and affordable insurance in high-need areas. NGOs and community health workers can implement outreach and behaviour-change initiatives in regions with low awareness and poor access to care using insights from this paper.

Nevertheless, the study is not without limitations. First, the dataset is based on responses collected during 2019–20, which creates a five-year gap. Given that the COVID-19 pandemic occurred soon after and significantly altered patterns of healthcare access and chronic disease management, these findings may not fully reflect the current landscape. NFHS-6 has also been conducted recently, though the data have not been released yet; future research could utilize that dataset to examine post-pandemic shifts in disease burden and treatment access. Second, all data used in the analysis are self-reported, which introduces the possibility of recall bias and underdiagnosis. Lastly, due to the complexity and size of the dataset, this study could not incorporate a deeper stratification by socioeconomic factors such as income, caste, education, and occupation, which should be addressed in future research.

Despite these constraints, this work establishes a foundational framework for geographic epidemiological analysis using public health datasets. It highlights the urgent need for localized data-informed health interventions in India as lifestyle diseases continue to rise. By enabling policymakers, healthcare providers, and innovators to focus resources on areas with the greatest gaps, this study supports more equitable care delivery. Ultimately, it has the potential to significantly reduce preventable NCD burdens and improve health outcomes across the country.

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