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# Lifestyle Factors in Diabetes Management: Insights from the Kerala Paradox for the Indian Diaspora

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## ABSTRACT

With an estimated 101 million people living with diabetes, India ranks second in the world for the highest number of cases. In particular, Kerala, a state in southern India, faces what is known as the "Kerala Paradox", where strong socio-economic indicators fail to translate into lower levels of lifestyle-related diseases. As a result, Kerala has one of the highest diabetes prevalence rates in the country, ranking among the top three. This research paper aims to thoroughly analyse the Kerala Paradox and explore the factors contributing to it. It then extends the analysis through primary data to assess whether these lifestyle factors also influence the prevalence of diabetes in the Delhi NCR region. The latter half of the paper builds on findings from the literature review and primary research to evaluate the implications for diabetes management across the Indian diaspora.

***Key Words:*** *India, Kerala paradox, Diabetes, Lifestyle factors, Physical activity, Dietary habits, Diabetes Management*

## INTRODUCTION

In 2019, WHO reported that around 77 million people in India were living with diabetes - accounting for 1 in 7 of all adults living with diabetes worldwide - with numbers expected to worsen to more than 130 million by 2045. Only two years later, in 2021, a study by Anjana et al. (2023), published in the credible Lancet journal, reported much higher figures suggesting that a large percentage of the population, i.e. 11.4% or 101 million people, are struggling with diabetes, while 136 million have prediabetes with high chances of developing the disease in the coming years. Beyond national numbers, however, the state-specific data published is of interest. The survey forming the base of the Lancet report included an extensive sample size of 1,13,043 people across all 28 states, two union territories, and the national capital region of Delhi. The results showed that the prevalence of diabetes was highest in Goa (26.4%), Puducherry (26.3%) and Kerala (25.5%). This supports the previous evidence that has suggested that the southern states witness a higher burden of diabetes.

Of the states with the highest prevalence of diabetes, Kerala proves to be a fascinating study as it is a state that otherwise boasts fantastic socio-economic progress on the fronts of and in the form of education, high life expectancy, and access to state-of-the-art medical care. One would, therefore, expect this to translate to a lower prevalence of chronic metabolic diseases such as diabetes. This sheds light on what is known as the Kerala Paradox, i.e. “the unexpectedly and paradoxically high prevalence of lifestyle diseases - heart disease, diabetes, high blood pressure, and obesity resulting in very high mortality and morbidity from CAD” in a state which is otherwise credited by the likes of Amartya Sen for the greater state involvement enabling religious

diversity, well-performing human capital indices, and strong and widespread welfare measures.

Understanding the factors contributing to this paradox is essential as it can enable better state-based management, a more thorough analysis of the diabetes situation in other Indian states, and more effective disease management across the country. In light of the aforementioned, this research paper aims to answer the following research question: "To what extent do the lifestyle and cultural factors underlying the Kerala paradox influence the prevalence of diabetes in Delhi, NCR, and what insights can be drawn for the Indian diaspora?"

## LITERATURE REVIEW

As mentioned in the introduction, Kerala has long distinguished itself from other Indian states due to its strong socio-economic indicators. For instance, the literacy rate is around 96.2%, the highest in the country, and the least literate district in the state also surpasses the national average for literacy rates (PTI, 2020). Furthermore, it has been reported that Kerala does well on other development indicators, with many being on par with some developed countries and above the average of developing nations. As per the economic theory, many would assume this to translate into a healthier population - one that prevents a high prevalence of lifestyle diseases such as diabetes. The Kerala Paradox, however, proves differently, with several explanations for why this puzzling situation arises.

Firstly, Kerala is a state in the southern part of India, and much of the previously published literature indicates that these states have a high prevalence of diabetes. In 1964, for example, one of the first studies was conducted in the south at Vellore. This hospital-based study included 63,356 individuals, with results supporting a diabetes prevalence rate of 2.5% (Vaishnava et al., 1964). Later, in 1966, a study by Rao et al. (1966) reported a high prevalence of 4.1% and showed early signs of the looming diabetes epidemic in Hyderabad. More recent studies, such as that by Anjana et al. (2017) and Geldsetzer et al. (2018), have also found a difference in the prevalence of diabetes between the states. Additionally, in 2020, Biradar et al. conducted an interesting study that set out to understand the contrasting situation in Bihar - a state in the eastern part of India - and Kerala. Their results showed that "for almost all categories of background characteristics, the prevalence of diabetes for both women and men are much higher (some cases more than double) in Kerala compared to Bihar. For instance, in Bihar and Kerala, for those who are less than 30 years old, the prevalence is 2.5% and 2.8% for women, and for men, the corresponding prevalence is 4.0% and 7.6% respectively".

Figure 1 illustrates the overall and area-wise weighted prevalence of diabetes and prediabetes.

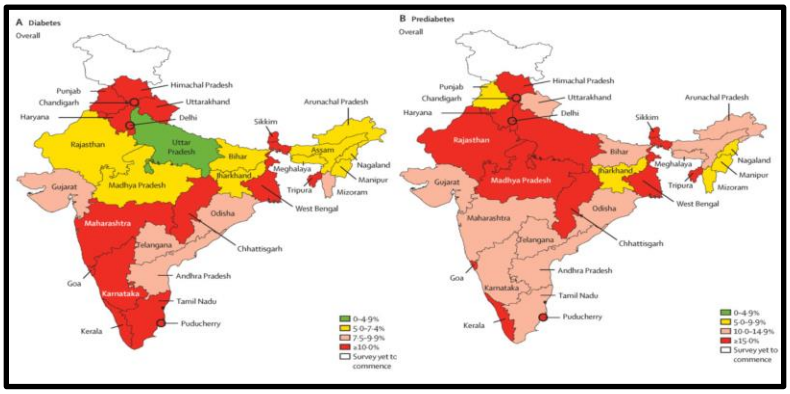


*Figure 1 - Overall and area-wise weighted prevalence of diabetes and prediabetes. [Source: Anjana et al., 2023]*

The explanation for southern states witnessing higher rates of diabetes may be in the distribution of several risk factors associated with non-communicable diseases, such as hypertension, obesity, and dyslipidemia (abnormal levels of cholesterol or triglycerides) - all of which are strongly linked to diabetes. The study published in the Lancet, for example, shows that generalised obesity is more prevalent in the south, followed by the northern and eastern regions and hypercholesterolaemia and high LDL cholesterol "showed wide interstate and inter-regional variability, with the highest prevalence in the northern region, Kerala, and Goa" (Anjana et al., 2023). The rate of obesity in Kerala is one of the highest in India. In 2009, a high prevalence of overweight or obesity (25%) was documented in a study conducted on non-communicable risk factors among adults in Kerala (Thankappan et al., 2010). Later, as per a study conducted by Vijayakumar et al. (2019) based on participants from Kerala who were followed over ten years to study the incidence of type 2 diabetes and prediabetes, it was found that "prevalence of overweight or obesity is quite high (46%) in this cohort with nearly 70% of participants having central obesity based on Asian Indian cut off."

Several lifestyle-related habits can explain the high prevalence of obesity in Kerala and, consequently, diabetes. Global studies have shown a strong association between dietary habits and their impact on health. A strong reliance on processed foods, eating at fast food or quick service restaurants, particularly, has been studied for health outcomes, including being overweight and obese. For instance, a study by Fraser et al. (2012) shows a direct connection between fast food consumption, increased BMI, and higher obesity rates. This could significantly be a result of the changing food culture in Kerala, where a significant percentage of food expenditure is on served processed food, packaged processed food, and beverages (Karunakaran et al., 2021). Furthermore, a meat-heavy diet can also trigger diabetes. In a study led by researchers at Mumbai's International Institute for Population Sciences, "a 74% state-level correlation between diabetes prevalence and consumption of meat, fish, and eggs has been found." It was reported that among the states in the country, the per capita intake of non-vegetarian food was the lowest in the northern states of Rajasthan and Haryana but the highest in Kerala and West Bengal (Singh, 2019).

Another lifestyle factor beyond diet that can contribute to obesity and eventual diabetes is a lack of physical activity. Results from a cross-sectional study conducted to assess the level of physical activity among 240 residents aged between 15 and 65 years in Kulappuram, a village in north Kerala, noted that a "low level of physical activity was seen in 65.8% of the study participants. The average duration of moderate to vigorous intensity physical activity per day in different domains such as work, travel, and recreation were 40.5, 10.1, and 12.7 minutes, respectively. The average duration of sedentary activities was 284.3 minutes per day" (Aslesh et al., 2015). A big reason for the lack of physical activity in the population in Kerala may be attributed to the type of jobs that people are taking on. For instance, a report suggests that "many people are opting for IT and IT-related jobs which involve spending a better part of the day in front of digital devices. This has lessened the time people spend outdoors" (Raja, 2017). Additionally, lack of time for exercise, constant work pressure, and irregular eating habits have led to diminished physical activity. This trend is even more concerning because it extends to children and students. "Children do not get time to go out and play due to exams and private tuitions coupled with the ensuing stress. The little free time they get is spent on digital devices," says Indian Academy of Paediatrics (IAP) Kerala chapter state president Dr M. N. Venkateswaran (Raja,

2017). This is evidenced by results from a recent local survey that found that nearly 20% of the 800 students assessed suffered from obesity.

Apart from lifestyle habits, even environmental factors play a crucial role in interacting with genetic predispositions and triggering the onset of diabetes. One significant environmental factor is air pollution. As seen in Fig 2, research has shown a positive association between air pollution and the risk of developing type 2 diabetes. Particulate matter (PM) and other air pollutants can induce inflammation, oxidative stress, and insulin resistance, all of which contribute to the development of diabetes (Zorena et al., 2022). The situation in Kerala is quite dire, with the current PM2.5 concentration being 1.6 times above the recommended limit given by the WHO's 24-hour air quality guidelines. Urban areas in Kerala, such as Kochi and Thiruvananthapuram, are experiencing particularly increased levels of air pollution due to waste burning, fire events, road works, and vehicular pollution. In Kochi, "according to the 2023 World Air Quality Report from IQAir, Eloor and Vyttila had average PM2.5 levels of 29.5µg/m3 to 35 µg/m3 in the last year, 5-7 times above the safe levels. According to the WHO air quality guidelines, the annual average concentrations of PM2.5 should not exceed 5µg/m3" (Nambudiri, 2024).

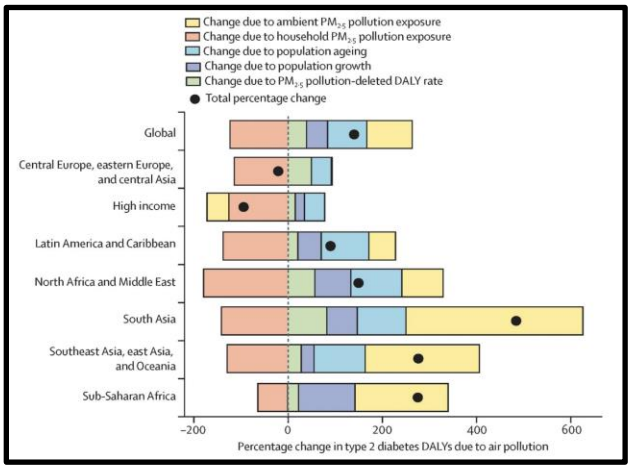


*Figure 2 - Drivers of trends in type 2 diabetes DALYs attributable to air pollution in GBD super-regions and globally, 1990–2019. Source: GBD 2019 Diabetes and Air Pollution Collaborators (Ref: 18)*

Apart from pollution, another environmental factor that could contribute to the high prevalence of diabetes in Kerala is the state's topography and altitude. Studies by Singh et al. (2016) and Vijayakumar et al. (2019) have observed that spatial location and altitude play a role in the risk of developing diabetes. This is relevant to Kerala as it is located on the west coast, with 50% of its geographical area comprising highlands, largely due to the Western Ghats. The Western Ghats are also responsible for the numerous peaks found in the state, with more than 50 peaks reaching above 5,000 feet (around 1,500 meters) above sea level. The highest peak, Anamudi, is located in the Idukki district and stands at 2,695 meters (8,841 feet). A recent district-level study found a higher prevalence of 140-160 mg/dl blood glucose in the Idukki district (Biradar & Singh, 2020).

## METHODOLOGY

Lifestyle factors that contribute to diabetes can be altered, while environmental factors typically cannot. Therefore, by understanding

the various lifestyle factors influencing the paradox in Kerala, this research paper aimed to explore whether similar factors are present in the Indian diaspora, specifically through an analysis of Delhi, NCR. This was enabled by an analysis of the primary research gathered using a survey. Of the 150 respondents, 70% of the sample were individuals above the age of 45- a key factor as the likelihood of developing diabetes increases if an individual is aged 45 or older.

## FINDINGS AND DISCUSSION

With regard to dietary habits, approximately 81.3% of the respondents reported adhering to a 'traditional Indian diet,' as seen in Fig 3, defined as "locally sourced fruits, vegetables, whole grains, dairy, idli/dosa/rice/fulka, and fish." This underscores the enduring cultural influence on food choices. However, 28 respondents reported consuming a more 'Westernized diet,' which included processed foods, refined carbohydrates, and sugary beverages. Thus, the sample population appears to focus more on traditional Indian foods rather than shifting predominantly toward a Westernized diet. Although there is no specific data to indicate the percentage of the population in Kerala that prefers traditional Indian foods over Westernized ones, we could infer that the consumption of traditional Indian foods is still evident in both states. Still, Kerala has witnessed a greater transformation, shifting from a focus on a traditional diet to one that is more reliant on fast food.

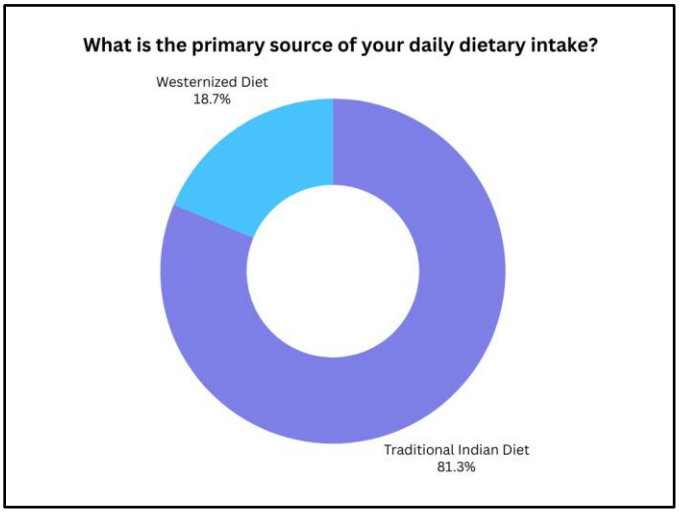


*Figure 3*

The responses were slightly more varied when asked about their physical activity levels. As seen in Fig 4, while 24% of the respondents reported being 'active,' engaging in physical activity 5-6 times a week, a significant portion, approximately 42.7%, reported having a 'moderately active lifestyle,' involving intentional physical activity at least 3-4 times a week. The remaining 33.3% of respondents reported leading a 'sedentary lifestyle,' exercising only 0-2 times a week. This is a concerning finding, as sedentary behaviours have been linked to an increased risk of diabetes. When further questioned about the reasons for such behaviour, around 52% of respondents indicated that their occupation requires them to sit for extended periods. This aligns with the situation in Kerala, as analysed in the literature review, where decreasing physical activity is being reported, largely due to the rise of IT-related jobs that require professionals to be seated for long periods.

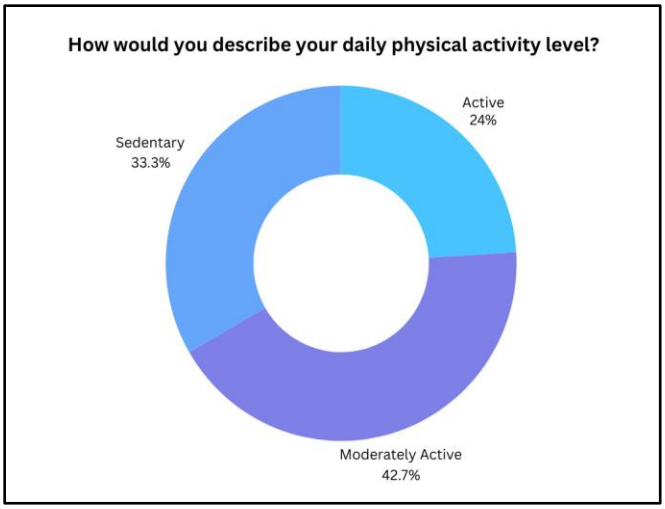


*Figure 4*

Moreover, many people reported a lack of time to engage in regular exercise. For instance, when asked if they had ever participated in any community-based exercise programs or workplace wellness initiatives, 56% of the Delhi NCR survey respondents answered 'no', as seen in Fig 5. This suggests that, even when opportunities to exercise are available, many individuals cannot take advantage of them due to other commitments.

Finally, to gauge an understanding of the awareness and health-seeking behaviors of the sample population in Delhi NCR, participants were first asked if they had attended any diabetes awareness campaigns or educational programs in their community. A concerning 78% (around 117 participants out of 150) responded 'no' – evident in Fig 6. However, when asked how likely they were to seek medical advice promptly if facing health concerns, a significant 54% of respondents answered 'very likely' – as seen in Fig 7.

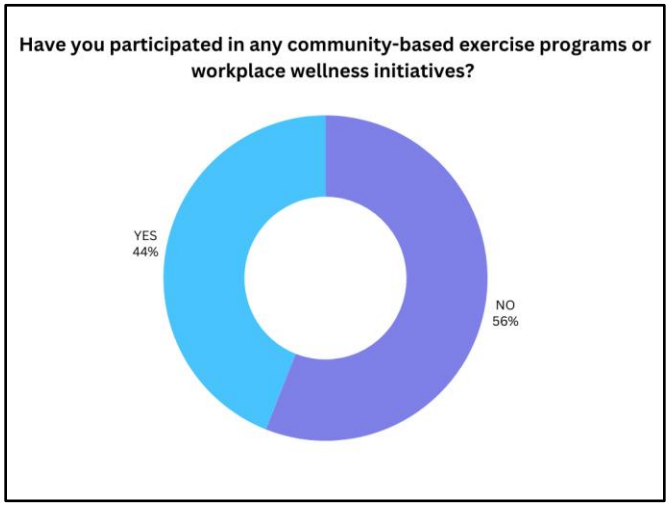


*Figure 5*

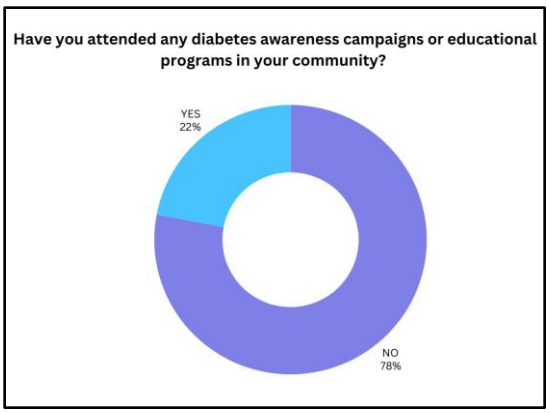


*Figure 6*

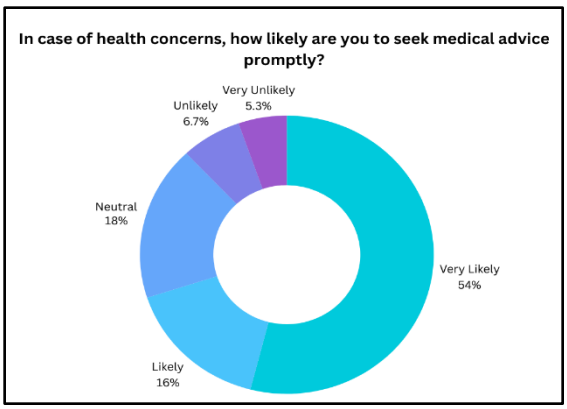


*Figure 7*

This creates some confusion, as participants seem keen on seeking medical advice promptly but are likely not engaging with programs or educating themselves on what the medical signs of concern may even be regarding diabetes. This gap could lead to situations where many miss the opportunity to seek medical advice when diabetic symptoms first appear or recognise them too late.

**Implications for the Management of Diabetes in the Indian Diaspora**

The literature review and primary research findings uncover some valuable insights. While there are some similarities in the lifestyle factors triggering diabetes in Kerala and Delhi, NCR, fundamental differences do exist, with different factors having different weightage effects depending on the state. One important takeaway, therefore, is that lifestyle factors may need to be assessed for their individual impacts to formulate appropriate state-specific strategies to combat diabetes. Regarding dietary preferences, for example, some Indian states still have a large population of individuals strictly abiding by a vegetarian diet. Haryana, for example, has the highest share of vegetarians in India, with nearly 80% of women and more than 56% of men reportedly never consuming meat here (Chauhan, 2024). In some other states, however, the population consumes a predominately non-vegetarian diet rich in food with high fat and cholesterol content. With meat consumption being a risk factor for diabetes, strategies to curb the consumption of such foods may be more effective in the latter states than those where the population is primarily vegetarian. That being said, strategies in this realm may be influenced by real-life policies implemented globally, such as "Meatless Mondays," - a campaign exercised in countries such as the US to reduce meat consumption by encouraging people to go vegetarian one day a week for their personal health (Conzachi, 2021).

Furthermore, when considering physical activity, there is some consensus that the Indian population, on the whole, is not very active. For instance, data published in a study by Podder et al. (2020) reported that “20% and 37% of the population in India are not active or mildly active, respectively, and thus 57% of the surveyed population do not meet the physical activity regimen recommended by the World Health Organization. This puts a large Indian population at risk of developing various non-communicable diseases (NCDs)”. Diving deeper into the trends of activity across India, the report suggests that “central (30%) and south zones (29%) had the highest prevalence of physical inactivity. In comparison, the northwest zone (14%) had the lowest prevalence. The south zone also had the highest prevalence (43%) of mildly inactive people”. It is a known fact that those who are

pre-diabetic or have been diagnosed with diabetes are required to strictly adhere to physical activity or exercise regimes in order to prevent further complications. The study by Podder et al. (2020) also found that, surprisingly, "28% and 42% of people who were aware of being diabetic fall into no activity and mild activity category, respectively". This not only reiterates the need for and importance of state-level intervention to prevent and tackle diabetes after comprehensively understanding the relevant lifestyle factors but also underscores the importance of encouraging the population to participate in education and awareness programmes related to diabetes - something which much of the population is currently not doing.

## CONCLUSION

This research paper aimed to comprehensively analyse the Kerala Paradox to uncover the lifestyle and cultural factors influencing the alarming rates of diabetes in Kerala. By exploring these factors - specifically dietary habits and physical activity - the paper sought to understand how they also impact the prevalence of diabetes among the Indian diaspora, with a focus on Delhi, NCR.

As highlighted in the literature review, Kerala presents a fascinating case study characterised by strong socio-economic indicators that do not correlate with low levels of lifestyle-related diseases, particularly diabetes. The high prevalence of diabetes in Kerala can be attributed to various lifestyle and environmental factors. Notably, a shift towards fast and processed foods and reduced physical activity appear to be significant contributors to the disease. In examining the context of Delhi, NCR, some variations in the severity and implications of these lifestyle factors were observed. For instance, the sample population predominantly adhered to a traditional Indian diet rather than a Westernized one, and a substantial portion engaged in active or moderately active lifestyles. However, sedentary behaviour remains prevalent among some individuals, representing a considerable risk factor for diabetes. Thus, it can be concluded that the lifestyle and cultural factors underlying the Kerala Paradox do influence the prevalence of diabetes in Delhi, NCR, albeit to a varying extent.

The insights drawn from this analysis suggest that effective diabetes management strategies for the Indian diaspora must consider state-specific variations in lifestyle factors. A comprehensive understanding of these regional differences is essential to develop targeted interventions. Beyond state-specific strategies, however, there is also an undeniable need for a nationwide effort to enhance education and awareness about diabetes, ensuring that the population is better equipped to manage and prevent the disease.

### *Declaration by Author*

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