Comparison of the Prevalence of Type 2 Diabetes Mellitus in Asian Indians Living in the United States and India: Does Location Matter?

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Abstract

Introduction: Type 2 diabetes mellitus (T2DM) has affected many people worldwide. One population that is greatly affected by T2DM is the Asian Indian population. The relative effects of genetics and environment on the development of diabetes in adults are not completely understood. **Objectives:** We conducted an analysis to determine if location, through the environment and different diets, affects T2DM inheritance in Asian Indians. We hypothesised that the prevalence of T2DM depended on location. **Materials and Methods:** We analysed previously collected data on T2DM in the individual states of India and the U.S. and used this information to compare the prevalence of T2DM in Asian Indians living in these two countries. **Results:** A total of 1,117,465,226 individuals were surveyed in India. Of these, 108,295,674 individuals had T2DM. Similarly, of the 1,704,846 individuals in the US, 298,107 had T2DM. The prevalence of T2DM was 17.49% in Asian Indians living in the US compared to 9.69% for Indians living in India ($P < 0.00001$). In individuals with similar genetic backgrounds, environmental factors significantly influence the development of T2DM.

Keywords: Asian Indians, prevalence, T2DM

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a disease that hinders the human body's ability to regulate and use blood glucose and results in a high amount of blood glucose in the bloodstream. The high amount of glucose is due to one or both of two main reasons: the pancreas does not produce enough insulin, a hormone that regulates the blood glucose movement, and/or the cells do not take in as much blood glucose because they don't react to insulin as well.[1]

T2DM is believed to be genetically inherited because of its strong link to family history and lineage.[1] T2DM can occur during childhood or adulthood but is usually found in older adults. Many genetic mutations have been known to contribute to T2DM. These mutations occur during DNA replication when errors in the DNA are made and are not corrected in time.[2]

T2DM does not have a known cure, but exercise, a healthy diet, and losing weight, as well as diabetes medications and insulin treatment, will help maintain blood glucose.[1] Usually, one of the first medications prescribed to a patient with diabetes is metformin. This medication helps lower the production of glucose by the liver and boosts the body's ability to react to insulin, allowing it to use insulin more easily and regulate the blood glucose level.[3]

A recent NHANES analysis showed that the prevalence of diabetes in the United States varied by race/ethnicity. The prevalence was lowest among non-Hispanic whites and highest among Hispanic adults. Among non-Hispanic Asian adults, the prevalence was highest among South Asians.[4] However,

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the causes of these differences are not well understood, and neither are the effects of the environment on the modulation of genetic background and subsequent development of T2DM.[5] Hence we undertook this study to compare the prevalence of T2DM among Asian Indians living in the United States with their counterparts living in India.

MATERIALS AND METHODS

Data were collected from pre-existing surveys that measured the burden of T2DM in both the United States and India. The Annual Health Survey (AHS) and the District-Level Household Survey #4 (DLHS-4) were population-based health surveys conducted in India to create high-grade health data. The DLHS-4 survey was conducted per district in the more populated Indian states, while the AHS was conducted in the less populated states. All Indian states were covered other than Gujarat, Kashmir, and Jammu. The surveys specifically targeted adults aged 18 or older. Both surveys had bilingual questionnaires in the local language and English, and they were sent out to households through a computer system called Computer Assisted Personal Interviewing. Also, the local health facilities were given printed questionnaires about the local residents. The household surveys had questions asking about the health of the members in the household, socioeconomic status, and various diseases that the members had faced.[6]

The Behavioral Risk Factor Surveillance System (BRFSS) surveys were health-related telephone surveys that accumulated data about each U.S. state and its population's health and health problems. They collected surveys from randomly selected adults aged 18 years or older. The households and interviewees were randomly chosen from blocks of potential phone numbers in a given area to ensure the data was as generalisable as possible to represent the state.[7-12]

The AHS and DLHS-4 received permission from the institutional review board of the Harvard T. H. Chan School of Public Health, and the BRFSS survey was conducted by the Centers for Disease Control. This project used publicly available, non-identifiable information from those datasets and hence did not need ethics committee approval.[6-12]

RESULTS

Data from India
The AHS and DLHS-4 surveys included 1,117,465,226 individuals, of which 108,295,674 (9.69%) had prevalent DM. The prevalence ranged from 5.65% in Telangana to 25.00% in Kerala [Figure 1 and Table 1].

Data from the United States
The BRFSS survey included 1,704,846 individuals, of which 298,107 (17.49%) had prevalent DM. The prevalence ranged from 7.00% in Texas to 29.03% in California [Figure 1 and Table 2].

Table 1: India raw data

India	No. of type 2 diabetics	No. of people (N)	Prevalence of diabetes
Uttar Pradesh	12,967,821	199,812,341	6.49%
Maharashtra	14,721,038	112,374,333	13.10%
Bihar	6,308,426	104,099,452	6.06%
West Bengal	14,786,731	91,276,115	16.20%
Madhya Pradesh	4,277,719	72,626,809	5.89%
Tamil Nadu	9,559,481	72,147,030	13.25%
Rajasthan	4,613,310	68,548,437	6.73%
Karnataka	6,170,625	61,095,297	10.10%
Andhra Pradesh	4,114,899	49,577,103	8.30%
Odisha	2,892,023	41,974,219	6.89%
Telangana	1,977,707	35,003,674	5.65%
Kerala	8,351,515	33,406,061	25.00%
Jharkhand	2,084,850	32,988,134	6.32%
Assam	2,324,815	31,205,576	7.45%
Punjab	3,911,811	27,743,338	14.10%
Chhattisgarh	2,283,740	25,545,198	8.94%
Haryana	3,688,638	25,351,462	14.55%
Uttarakhand	771,601	10,086,292	7.65%
Himachal Pradesh	1,163,550	6,864,602	16.95%
Tripura	205,739	3,673,917	5.60%
Meghalaya	213,616	2,966,889	7.20%
Manipur	209,487	2,570,390	8.15%
Nagaland	231,485	1,978,502	11.70%
Goa	155,335	1,458,545	10.65%
Arunachal Pradesh	121,076	1,383,727	8.75%
Mizoram	92,165	1,097,206	8.40%
Sikkim	96,471	610,577	15.80%
Total	108,295,674	1,117,465,226	9.69%

Table 2: U.S. raw data

US	No. of type 2 diabetics	No. of people (N)	Prevalence of diabetes
California	153,313	528,120	29.03%
New York	44,158	313,620	14.08%
New Jersey	44,131	292,256	15.10%
Texas	17,219	245,981	7.00%
Hawaii	271	2,201	12.31%
Maryland	9,565	79,051	12.10%
Michigan	15,504	77,132	20.10%
Washington	5,196	61,124	8.50%
Connecticut	3,203	46,415	6.90%
Arizona	3,028	36,047	8.40%
Wisconsin	2,519	22,899	11.00%
Total	298,107	1,704,846	17.49%

Interpretation of Processed Data
When the raw data were compared using the χ^2 test, the differences were highly statistically significant with a P-value of <0.00001.

Impact of Uncertainty
There is a possibility of uncertainty in estimating the prevalence of T2DM since individuals may not know that they have T2DM.
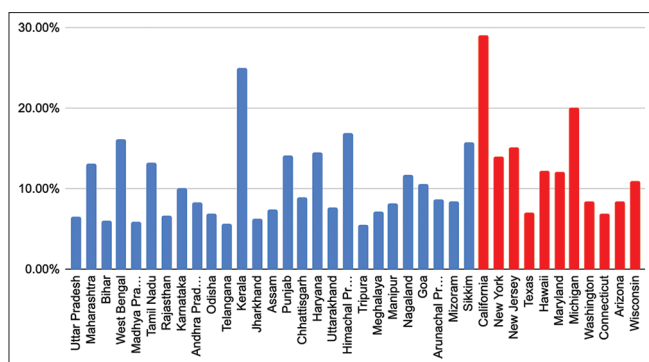
Figure 1: Prevalence (%) of T2DM in the Indian states (blue) versus U.S. states (red)

However, this uncertainty is likely similar in all the databases, so the results are valid. There cannot be any measurement uncertainty because a survey was sent to each household and then sent back to the surveyors. The only possible uncertainties could be that the surveyors miscounted someone as having type 2 diabetes when they weren't or miscounted someone as not having type 2 diabetes when they were. The people taking the survey could have lied because they did not want their health status in the survey. This is unlikely because the people taking the survey could have just chosen not to do the survey, and the surveyors would ignore those households.

DISCUSSION

We observed that Asian Indians living in the US have a higher prevalence of T2DM than those living in India. There is a prevalence rate of 9.69% for T2DM for Asian Indians living in India and a prevalence rate of 17.49% for Asian Indians living in the U.S. Our numbers are similar to those found by a recent National Health and Nutrition Examination Surveys, which found a prevalence of diabetes among South Asians of 23.3%.[4]

While there are many factors at play when it comes to T2DM, we did not study any of them specifically. However, the surveys had a large sample size, indicating that the other factors would be between the two groups, and the main differences would be attributable to geographical differences with relevant changes in lifestyle-related factors. Although when it comes to location, one major cause of diabetes is diet.[1] The American diet is centred around large quantities of red meat, processed and pre-packaged foods, and many sugary sweets.[13] The Asian Indian diet, on the other hand, is centred around a multitude of natural spices and various vegetables.[14] These spices are unlike the various harmful sugars used in the U.S. Since sugary foods are easier to digest, they can also cause a spike in blood glucose. Although Asian Indians eat a lot of their native diet, they do assimilate some American food into their diets, and the main ones are sugary foods. As a result, it is possible that Asian Indians in the U.S. are eating more sugary foods than Asian Indians in India. This is likely to increase their blood glucose amount, and since Asian Indians are more likely to be resistant to insulin, they are more likely

to develop T2DM.[14] This specific factor should be studied further in future studies.

Another possible factor could be the activity levels because, in India, Asian Indians are more likely to bike or walk to their destinations than in the U.S. It is well established that exercise is known to delay T2DM.[1] This analysis did not account for activity levels due to the nature of the data collected in those surveys.

Limitations

This analysis has some limitations. The BRFSS surveys did not always have information about the Asian Indian populations in some U.S. states,[7] hence some U.S. states grouped the entire Asian population as Asian Indians and used that statistic in their calculations. One possibility is that it may be because there aren't many Asian Indians living in those states. This could have resulted in spuriously low prevalence for Asian Indians because the T2DM prevalence rates could be much lower in some Asian ethnicities who aren't very susceptible to the disease.

Another limitation is the fact that the sample could be bigger. While India's side of the study had a reasonable sample size, as can be seen from Table 1, the Asian Indian population in the U.S. was underrepresented, as can be seen from Table 2. This could have caused the prevalence rate of T2DM among individuals of Indian origin in the United States to be closer and farther away from India's prevalence rate. This probably wouldn't change the results by much, as previous studies have shown that Asians were more likely to report perceived risk for the development of diabetes.[15] This would potentially skew the results towards a greater difference in T2DM between Indians living in the US and those in India. However, despite this, a major strength of this study was the fact that the surveys were official surveys conducted in both countries.

In summary, Asian Indians living in the United States are much more likely to develop T2DM than their counterparts living in India, despite having a similar genetic background. Further studies need to evaluate the exact causes for this increase, which will lead to efforts to decrease this disease burden.

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Conflicts of interest
There are no conflicts of interest.

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