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**Original Research Article**

# Lifestyle and socio-economic disparities in the prevalence of diabetes among the elderly population (aged 60+) in India: a decomposition analysis using longitudinal aging study in India data

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## ABSTRACT

**Background:** This study aimed to determine the prevalence of self-reported diabetes by sex and investigate the socio-economic, demographic, and lifestyle risk factors associated with diabetes. Additionally, it aimed to understand the coexistence of diabetes with other morbid conditions.
**Methods:** The study design used in this research is a cross-sectional study design. This study utilized data from the longitudinal aging study in India (LASI), a nationally representative survey of older adults. The sample included 15,098 males and 16,366 females aged 60 years and above.
**Results:** The prevalence of diabetes in India varies by state, zone, and rural/urban areas. Kerala has the highest prevalence among both men (33%) and women (28.5%). Urban areas have a higher prevalence (20%) compared to rural areas (8.5%). Hypertension and cancer are strongly associated with diabetes. Other morbid conditions like heart disease, high cholesterol, and vision problems also show significant links with diabetes.
**Conclusions:** Diabetes in India is a significant health concern, with variations across regions and associations with comorbidities like hypertension, cancer, heart disease, high cholesterol, and vision problems. To address this, comprehensive preventive measures and health promotion campaigns are needed, targeting high-risk groups and improving healthcare access. Early detection, effective management, and promoting healthy lifestyles are crucial for diabetes prevention and control in India.

**Keywords:** Diabetes, Prevalence, Comorbidities, Healthy Ageing, Elderly

## INTRODUCTION

India is currently undergoing remarkable demographic changes, characterized by increasing longevity and declining fertility rates.[1] This demographic transition has led to a substantial growth in the population of individuals aged 60 years and above, often referred to as the elderly population.[2] Additionally, there has been a significant global increase in the proportion of older individuals, with projections suggesting that the population aged 60 years and above will reach 2 billion by 2050.[3-5] Non-communicable diseases (NCDs), including diabetes mellitus (DM), are typically prevalent among individuals aged 55 years or older in developed countries.[6,7] However, in India, the onset of NCDs, such as diabetes, occurs at a younger age, often before the age of 45.[8-11] The elderly population is particularly vulnerable to NCDs, including diabetes, due to age-related physiological changes and an increased susceptibility to metabolic disorders. Diabetes mellitus is a chronic metabolic disease characterized by elevated blood glucose levels.[12-14] Type 2 diabetes, which occurs when the body does not produce enough insulin or becomes resistant to its effects, is the most common form of diabetes in adults.[13,15] Globally, in 2019, an estimated 463 million people were living with diabetes, and within India, the burden of diabetes is substantial, with approximately 77 million individuals affected.[16-18] The prevalence of diabetes varies significantly not only

between countries but also within countries. In India, a review of several studies indicates that the prevalence of diabetes ranges from 7.5% to 24%, with a higher prevalence observed among individuals of higher wealth status.[19,20] Age is a crucial factor influencing the prevalence of diabetes, with multiple studies demonstrating a gradual increase in diabetes with advancing age.[21] However, diabetes is also influenced by various socioeconomic, demographic, and lifestyle factors, in addition to biological factors.[22]

A survey conducted in Gujarat highlighted obesity, lack of physical activity, and a sedentary lifestyle as risk factors associated with diabetes.[23] Furthermore, several studies have found a positive correlation between male gender, body mass index (BMI), increased waist-hip ratio, and diabetes.[24-26] In a study conducted in Delhi, obesity, hypertension (25.9%), and diabetes (19.1%) were found to be the most common comorbidities.[27] Another study identified elderly age group, obesity, and a family history of diabetes as strong factors associated with comorbid diabetes and hypertension.[28]

The diabetes epidemic is primarily attributed to the epidemiological transformation caused by changes in food habits and decreased physical activity.[29] Non-modifiable risk factors such as age, ethnicity, and family history have also been prospectively associated with diabetes mellitus.[30] Complications related to diabetes, such as kidney disease, neuropathy, and blindness, pose a significant economic burden on the healthcare system.[25] Diabetes also increases the risk of serious health complications, including high blood pressure, stroke, and cardiovascular diseases.[25,26,31,32]

Studies have consistently shown that a lack of physical activity is strongly associated with diabetes, reinforcing the belief that genetics provide the predisposition while lifestyle factors trigger the disease.[33] With the adoption of a western lifestyle and the effects of urbanization, diabetes mellitus is on the rise among the elderly globally.[34] Consequently, they are at a higher risk of developing heart diseases, which poses a significant challenge for healthcare, particularly with the increasing aging population in India.[35] Understanding and identifying the high-risk group for diabetes is crucial for targeted prevention and intervention efforts.[36,37]

A report by World Health Organisation on global report diabetes revealed that the high prevalence of diabetes among the elderly population in India calls for urgent attention and focused interventions.[38] The early onset of diabetes and its increasing prevalence in younger age groups highlight the need for preventive measures and improved management strategies.[32] Effective control of diabetes is crucial to prevent complications and reduce the burden on the healthcare system.[19] Understanding the specific challenges faced by the elderly population in managing diabetes, such as comorbidities and age-related factors, is essential for developing targeted interventions and ensuring better health outcomes for this vulnerable group.[30] While numerous studies have been conducted in India, they have primarily been limited to regional, state, or community levels due to the diversity of the Indian population.[26,27,32] Additionally, most studies have focused on the adult population, with limited research that can be generalized to the entire elderly population of India. However, the recent longitudinal aging study in India (LASI) provides valuable data at the state level, covering a significant number of elderly individuals.[39] Therefore, the present study aims to examine the prevalence of diabetes among the elderly population, identify associated risk factors, and explore the burden of comorbidities. By utilizing data from LASI, this study will contribute to a more comprehensive understanding of diabetes among the elderly population in India, addressing the gaps in existing research and providing valuable insights for targeted interventions and healthcare planning.

## METHODS

### *Dataset used in the study*

This study utilized data from the first wave of the LASI conducted in 2017-2018.[39] LASI is a collaborative effort by Harvard TH Chan School of Public Health, the International Institute for Population Sciences, and the University of Southern California.[40] The survey aims to gather essential information about the well-being of older adults in India, including their physical, social, and cognitive aspects. The survey employed a multistage stratified cluster sample design for rural and urban areas.[41] Its standardized design allows for valuable insights and international comparisons. For more detailed information on the sample design, survey instruments, fieldwork, data collection, processing, and response rates, please refer to the LASI report on their website.[42] The participants in this study were comprised of 15,098 males and 16,366 females aged 60 years and above in India. However, it is important to note that the subset of individuals with overweight, high-risk waist circumference, and waist-to-hip ratio may differ from the total sample, as some older adults did not provide consent for these measurements. Prior consent was obtained from the respondents by the survey agencies responsible for data collection during the field survey.

### *Variable description*

*Outcome variable*

The variable of interest in this study was the presence or absence of diabetes, which was represented as a binary outcome (yes/no).

*Independent variable*

The study incorporates specific socioeconomic and demographic variables to elucidate the disparities in diabetes between rural and urban areas among older individuals. The independent variables considered in the

analysis include age categories (60-69 years; 70+), marital status (currently married; never married; divorced/separated/deserted), education level (no education; below primary; primary; secondary; higher), religion (Hindu; Muslim; others), current employment status (yes; no), history of using smokeless tobacco (yes; no), and history of alcohol consumption (yes; no).

***Statical analysis***

In the LASI study, to evaluate inequalities in diabetes, the concentration index (CI) is employed. The CI calculation requires a measure of socioeconomic status, which is achieved through the creation of a wealth index using multiple correspondence analysis (MCA).[43] The wealth index incorporates various household and living condition indicators, such as housing type, water and sanitation services, and ownership of thirteen household assets.

In the LASI study, the CI is calculated to measure inequalities in diabetes. The CI formula used in this study is derived from the concentration curve (CC) and can be expressed as given where CI represents the concentration index, cov (h, r) is the covariance between the diabetes variable (h) and the ranking of the wealth index (r), and μ is the mean of the diabetes measure.

$$CI = 2 \times cov\ (h, r)/\mu$$

The CI is derived from the concentration curve (CC), which plots the cumulative percentage of diabetes against the cumulative percentage of the population ranked by the wealth index. It is calculated as twice the area between the CC and the 45-degree line. A CI value of zero indicates no socioeconomic-related health inequality, implying an equal distribution of diabetes across the population. Positive and negative CI values indicate concentration among the wealthier and poorer populations, respectively. In the LASI study, the CI is computed as twice the covariance between the diabetes variable and the ranking of the wealth index, divided by the mean of the diabetes measure (μ). As the diabetes variable is binary, a normalization process is applied using the Erreygers corrected concentration index,(44) expressed as "E(h)=b."

In the formula E(h) represents the Erreygers corrected concentration index, and “b” is a coefficient that quantifies the extent of inequality.

*Decomposing burden of diabetes*

In the study, the burden of diabetes is decomposed using a mathematical expression. This decomposition helps in understanding the relative importance of various determinants in explaining the burden of diabetes and identifying the key drivers of inequality.[45]

The mathematical expression used for decomposing the burden of diabetes is derived from the concept of the CI. The mathematical expression for decomposing the burden of diabetes can be derived as follows:

$$CI = (1/\mu) \times \Sigma[cov(Xi, Yi) \times \beta i]$$

In this expression, CI represents the concentration index, which measures the extent of inequality in diabetes, μ represents the mean of the health measure, which is diabetes prevalence, Σ denotes the summation of all contributing factors, cov (Xi, Yi) represents the covariance between each determinant (Xi) and the health measure (Yi), indicating the degree of association between the determinant and diabetes, and βi denotes the elasticity of each determinant with respect to diabetes, indicating the sensitivity of diabetes to changes in that determinant.

By calculating the covariance between each determinant and diabetes, and multiplying it by the corresponding elasticity, we obtain the contribution of each determinant to the overall inequality measure. The summation of these contributions provides a comprehensive understanding of the factors driving the burden of diabetes and the extent to which each determinant contributes to socioeconomic disparities.[46]

*Bivariate and multivariate analysis*

In this study, bivariate and multivariate statistical analyses were performed using SPSS 16 software. The researchers estimated the prevalence of diabetes among older men and women in all states and Union Territories of India, considering their sex and place of residence. Multivariate binary logistic regression was used to calculate the odds ratio of lifestyle behaviours in relation to the occurrence of diabetes. Initially, the analysis was conducted without controlling for socio-demographic factors, and later it was adjusted for these factors. Furthermore, the chi-square test was employed to assess the association between diabetes and other comorbid conditions.

The expression for logistic regression can be represented as follows where logit(p) is the natural logarithm of the odds of the occurrence of diabetes, β0, β1, β2, ..., βn are the coefficients corresponding to each independent variable (X1, X2, ..., Xn), and X1, X2, ..., Xn are the predictor variables, including lifestyle behaviours, socio-demographic factors, or any other relevant variables.

$$logit(p) = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots + \beta nXn$$

The logistic regression model estimates the relationship between the predictor variables and the probability of having diabetes. The coefficients (β) quantify the magnitude and direction of the association between each independent variable and the likelihood of diabetes occurrence.

By examining the significance and magnitude of these coefficients, one can assess the impact of different factors on the odds of having diabetes.

## RESULTS

Table 1 presents the prevalence of diabetes among men and women, categorized by place of residence (rural and urban), and organized by different states and zones in India. The overall prevalence of diabetes in India is 12.5% among men, the prevalence is 13%, while among women, it is 12%. Diabetes prevalence is higher in urban areas (20%) compared to rural areas (8.5%). Kerala has the highest prevalence of diabetes among both men (33%) and women (28.5%), followed by Chandigarh (22%), Delhi (19.5%), and Goa (24%). Meghalaya has the lowest prevalence among men (2.5%), while Manipur has the lowest prevalence among women (0.5%). Mizoram (7.5%) and Arunachal Pradesh (7%) also have relatively lower prevalence rates. The South zone has the highest prevalence (20.5%), followed by the West zone (13.5%), the North zone (11.5%), and the Northeast zone with the lowest prevalence (8%).

Table 2 shows a significant link between hypertension and diabetes, with around 30.6% of men and 25.1% of women with hypertension also having diabetes. The table also reveals a connection between cancer and diabetes, with approximately 20.3% of men and 21.2% of women with cancer being diabetic. Additionally, various health conditions such as lung disease, heart disease, stroke, bone/joint disease, physical/mental impairment, neurological/psychiatric disease, high cholesterol, hearing problems, and vision problems are associated with a higher prevalence of diabetes in both men and women. Heart disease and high cholesterol show particularly strong associations with diabetes.

The findings from Table 3 reveal several associations between socio-demographic factors and the likelihood of diabetes among the elderly population in rural and urban areas of India. In rural areas, individuals aged 70 and above had slightly lower odds of diabetes (OR: 0.89, 95% CI: 0.78-1.01) compared to those aged 60-69, while in urban areas, individuals in the same age group had significantly higher odds (OR: 1.23, 95% CI: 1.09-1.38). Females exhibited higher odds of diabetes compared to males, with an odds ratio of 1.35 (95% CI: 1.22-1.49) in rural areas and 1.18 (95% CI: 1.07-1.31) in urban areas. Education was associated with higher odds of diabetes, with increasing levels of education showing higher odds ratios. In rural areas, individuals with below primary education had an odds ratio of 1.29 (95% CI: 1.10-1.50), while those with primary education had an odds ratio of 1.50 (95% CI: 1.28-1.76). Similar trends were observed in urban areas, although the effect sizes were slightly smaller. Religion was also associated with the odds of diabetes, with Muslims having higher odds than Hindus in urban areas (OR: 1.20, 95% CI: 1.09-1.32). Non-poor individuals had higher odds of diabetes in both rural (OR: 1.28, 95% CI: 1.15-1.42) and urban areas (OR: 1.12, 95% CI: 1.01-1.25) compared to the poor. In terms of working status, individuals not currently working had slightly higher odds of diabetes in both rural (OR: 1.15, 95% CI: 1.04-1.27) and urban areas (OR: 1.18, 95% CI: 1.06-1.31). Chewing tobacco was associated with higher odds of diabetes in urban areas (OR: 1.23, 95% CI: 1.10-1.38), while alcohol consumption showed a similar association in urban areas (OR: 1.19, 95% CI: 1.06-1.34). These findings highlight the importance of considering socio-demographic factors and lifestyle behaviours in understanding the likelihood of diabetes among the elderly population in India.

The analysis presented in Table 4 highlights the factors contributing to the disparity in diabetes prevalence among elderly individuals in urban and rural areas of India. Education emerges as the primary driver, making a substantial contribution of 52.02%. This underscores the importance of addressing educational inequalities in reducing the disparity. Chewing tobacco also exhibits a considerable impact, contributing 18.89% to the disparity. Sex, currently working, and marital status are associated with the observed disparity to a lesser extent. Factors such as age, religion, wealth, and alcohol consumption show non-significant associations.

**Table 1: Prevalence of diabetes among elderly (60+) men and women in states/UTs of India: LASI wave 1, 2017-18.**

| State | Sample size (n) | Men (%) | Women (%) | Total (%) | Rural (%) | Urban (%) | Total (%) |
|---|---|---|---|---|---|---|---|
| **North** | 11966 | 12.25 | 10.95 | 11.75 | 7.95 | 17.95 | 11.5 |
| **Chandigarh** | 932 | 20.5 | 23 | 22 | 0 | 22.5 | 22 |
| **Delhi** | 1171 | 21 | 18 | 19.5 | 5 | 20 | 19 |
| **Haryana** | 1757 | 9 | 7.5 | 9 | 6.5 | 13.5 | 8.8 |
| **Himachal Pradesh** | 1255 | 11.5 | 14.5 | 13.75 | 13 | 20.5 | 13.3 |
| **Jammu and Kashmir** | 1486 | 6.5 | 10.75 | 8.75 | 5.5 | 14 | 7.9 |
| **Punjab** | 1972 | 12.75 | 18.5 | 17.5 | 13 | 25 | 17 |
| **Rajasthan** | 2131 | 11.75 | 6.75 | 9 | 7 | 14.5 | 8.5 |
| **Uttarakhand** | 1262 | 10.75 | 8.75 | 10.25 | 7 | 18 | 9.8 |
| **Central** | 8907 | 8.75 | 6.5 | 7.5 | 6 | 14.5 | 7.4 |
| **Chhattisgarh** | 1901 | 8.5 | 6 | 7.5 | 4 | 16 | 7.3 |
| **Madhya Pradesh** | 2717 | 7.5 | 5.5 | 6.5 | 3.5 | 11.5 | 6.4 |

Continued.

| State | Sample size (n) | Men (%) | Women (%) | Total (%) | Rural (%) | Urban (%) | Total (%) |
|---|---|---|---|---|---|---|---|
| **Uttar Pradesh** | 4289 | 8.5 | 6 | 7 | 6 | 14 | 7.8 |
| **East** | 11580 | 10.5 | 9 | 9.75 | 6.5 | 20 | 9.6 |
| **Bihar** | 3297 | 8 | 7.5 | 7.75 | 6 | 15 | 7.9 |
| **Jharkhand** | 2228 | 11.5 | 7.5 | 9.75 | 6.5 | 20 | 10 |
| **Odisha** | 2621 | 10 | 6.5 | 8.25 | 6 | 18.5 | 8.3 |
| **West Bengal** | 3434 | 10 | 10 | 11 | 6.5 | 20.5 | 11.7 |
| **Northeast** | 8513 | 9 | 7 | 8 | 6.5 | 13.5 | 7.8 |
| **Arunachal Pradesh** | 982 | 9.5 | 5.5 | 7 | 7.5 | 4 | 7 |
| **Assam** | 2019 | 9 | 6.5 | 76.5 | 6.5 | 13 | 76 |
| **Manipur** | 1251 | 14.5 | 0.5 | 10.5 | 7.5 | 14.5 | 10.1 |
| **Meghalaya** | 886 | 2.5 | 4.5 | 3.75 | 2.5 | 38 | 39 |
| **Mizoram** | 1129 | 7.5 | 7.5 | 9 | 3.5 | 13.5 | 8.9 |
| **Nagaland** | 1202 | 5.5 | 8.5 | 8 | 5.5 | 12.5 | 7.8 |
| **Tripura** | 1044 | 10.5 | 8 | 9.5 | 7.5 | 14.5 | 9.5 |
| **West** | 8894 | 14.5 | 13 | 13.5 | 9.5 | 19.5 | 13.4 |
| **Dadra and Nagar Haveli** | 989 | 10.5 | 8 | 9.5 | 5.5 | 14 | 10 |
| **Daman and Diu** | 903 | 23.5 | 13.5 | 18.5 | 14.5 | 19.5 | 18.2 |
| **Goa** | 1265 | 24.5 | 22 | 24 | 19.5 | 25.5 | 23.8 |
| **Gujarat** | 2145 | 13.5 | 14.5 | 13.5 | 9.5 | 18.5 | 13.2 |
| **Maharashtra** | 3592 | 14.5 | 12.5 | 13.5 | 9.5 | 18.5 | 13.3 |
| **South** | 15702 | 20.5 | 20.5 | 20.5 | 14.5 | 28 | 20.2 |
| **Andaman and Nicobar** | 1113 | 14.5 | 21.5 | 21.5 | 16.5 | 30 | 21.2 |
| **Andhra Pradesh** | 2399 | 20 | 17.5 | 19.25 | 15 | 29.5 | 19.3 |
| **Karnataka** | 2083 | 17.5 | 26.5 | 16.75 | 8.75 | 31.5 | 17 |
| **Kerala** | 2300 | 33 | 28.5 | 29 | 27.5 | 30 | 28.8 |
| **Lakshadweep** | 1062 | 24.5 | 20.5 | 23.5 | 17.5 | 24.5 | 23.3 |
| **Puducherry** | 1288 | 23.5 | 23.5 | 24.5 | 4.5 | 26.5 | 24.3 |
| **Tamil Nadu** | 3205 | 20.5 | 20 | 21 | 17.5 | 25 | 21 |
| **Telangana** | 2252 | 14.5 | 11 | 14.5 | 7.5 | 27.5 | 14.3 |
| **India** | 65562 | 13 | 12 | 12.5 | 8.5 | 20 | 12.5 |

**Table 2: Percentage of diabetes by various morbid conditions among men and women in India, LASI wave-1, 2017-2018.**

| Morbid condition | Men | | Women | | Total | |
|---|---|---|---|---|---|---|
| | % | $\chi^2$ | % | $\chi^2$ | % | $\chi^2$ |
| **Hypertension** | | | | | | |
| No | 7.6 | 2600*** | 6.5 | 2400*** | 7.03 | 4900*** |
| Yes | 30.6 | | 25.1 | | 27.3 | |
| **Cancer** | | | | | | |
| No | 13.2 | 6.9** | 12.4 | 19.2*** | 12.8 | 25.2*** |
| Yes | 20.3 | | 21.2 | | 20.8 | |
| **Lung disease** | | | | | | |
| No | 13.1 | 11.1*** | 12.2 | 40.3*** | 12.6 | 47.3*** |
| Yes | 15.8 | | 17.3 | | 16.5 | |
| **Heart disease** | | | | | | |
| No | 12.5 | 363.7*** | 11.9 | 395.88*** | 12.2 | 762.4*** |
| Yes | 31 | | 32.1 | | 31.5 | |
| **Stroke** | | | | | | |
| No | 12.9 | 150.7*** | 12.3 | 111.7*** | 12.6 | 267.1... |
| Yes | 28.6 | | 28.4 | | 28.5 | |
| **Bone/joint disease** | | | | | | |
| No | 12.7 | 64.7*** | 11.5 | 162.0*** | 12.1 | 213.58*** |
| Yes | 17.7 | | 17.4 | | 17.5 | |

Continued.

| Morbid condition | Men | | Women | | Total | |
|---|---|---|---|---|---|---|
| | % | $\chi^2$ | % | $\chi^2$ | % | $\chi^2$ |
| **Physical/mental impairment** | | | | | | |
| No | 13.1 | 13.7*** | 12.4 | 1.78 | 12.7 | 12.8*** |
| Yes | 15.8 | | 13.4 | | 14.5 | |
| **Neurological/psychiatric disease** | | | | | | |
| No | 13.2 | 17.5*** | 12.4 | 16.6*** | 12.7 | 34.2*** |
| Yes | 18.6 | | 17.3 | | 17.9 | |
| **High cholesterol** | | | | | | |
| No | 12.3 | 831.7*** | 11.4 | 970.4*** | 11.8 | 1800*** |
| Yes | 44.2 | | 40.2 | | 41.9 | |
| **Hearing problem** | | | | | | |
| No | 13 | 18.0*** | 12.2 | 27.9... | 12.6 | 45.9*** |
| Yes | 16.2 | | 15.9 | | 16.1 | |
| **Vision problem** | | | | | | |
| No | 7.9 | 825.5*** | 7.6 | 739.78*** | 7.7 | 1600*** |
| Yes | 19.1 | | 17.6 | | 18.3 | |

**Significant at 5% level of significance, ***significant at 1% level of significance, and *significant at 0.1% level of significance

**Table 3: Association of sociodemographic factors with rural and urban settings.**

| Variables | Rural (odds ratio, 95% CI) | Urban (odds ratio, 95% CI) |
|---|---|---|
| **Age group (60-69) (reference)** | | |
| 60-69 | | |
| 70 and above | 0.89 (0.78-1.01) | 1.23 (1.09-1.38) *** |
| **Gender** | | |
| Male | | |
| Female | 1.35 (1.22-1.49) *** | 1.18 (1.07-1.31) ** |
| **Marital status** | | |
| Married | | |
| Never married | 0.91 (0.78-1.06) | 1.10 (0.97-1.25) |
| Divorced/separated/deserted | 1.15 (0.99-1.33) | 1.08 (0.92-1.25) |
| **Education** | | |
| No | | |
| Below primary | 1.29 (1.10-1.50) ** | 1.18 (1.03-1.36) * |
| Primary | 1.50 (1.28-1.76) *** | 1.13 (0.98-1.30) |
| Secondary | 1.73 (1.49-2.00) *** | 1.08 (0.94-1.23) |
| Higher | 1.58 (1.36-1.83) *** | 1.25 (1.08-1.45) ** |
| **Religion** | | |
| Hindu | | |
| Muslim | 1.06 (0.96-1.18) | 1.20 (1.09-1.32) ** |
| **Wealth** | | |
| Poor | | |
| Non-poor | 1.28 (1.15-1.42) ** | 1.12 (1.01-1.25) * |
| **Currently working** | | |
| Yes | | |
| No | 1.15 (1.04-1.27) * | 1.18 (1.06-1.31) ** |
| **Chewing tobacco** | | |
| Yes | | |
| No | 1.11 (0.99-1.24) | 1.23 (1.10-1.38) ** |
| **Alcohol consumption** | | |
| Yes | | |
| No | 1.09 (0.97-1.23) | 1.19 (1.06-1.34) ** |

**Table 4: Decomposing the disparity in diabetes prevalence among elderly individuals in urban and rural areas of India.**

| Variables | Coefficient | Standard error | P value | Lower Cl at 95% | Upper Cl at 95% | Percent contribution |
|---|---|---|---|---|---|---|
| **Age** | 0.000189 | 0.000501 | 0.600 | -0.00078 | 0.001166 | 0.31 |
| **Sex** | 0.005759 | 0.001816 | 0.002 | 0.002089 | 0.009519 | 9.79 |
| **Marital status** | 0.001198 | 0.000778 | 0.119 | -0.00033 | 0.00263.3 | 2.01 |
| **Education** | 0.03099 | 0.007698 | 0.000 | 0.015707 | 0.046274 | 52.02 |
| **Religion** | 0.000448 | 0.00031 | 0.149 | -0.00016 | 0.001055 | 0.75 |
| **Wealth** | 0.00026 | 0.000675 | 0.7000 | -0.00105 | 0.001582 | 0.39 |
| **Currently working** | 0.009186 | 0.003131 | 0.003 | 0.003212 | 0.013442 | 14.57 |
| **Chewing tobacco** | 0.011629 | 0.003045 | 0.000 | 0.005558 | 0.017507 | 18.89 |
| **Alcohol consumption** | -0.00032 | 0.000659 | 0.620 | -0.00162 | 0.000969 | -0.54 |
| **Total explained=0.059486** | | | | | | |

## DISCUSSION

This study aimed to determine the prevalence of self-reported diabetes based on gender and explore the socioeconomic, demographic, and lifestyle risk factors associated with diabetes. The study also sought to understand the coexistence of diabetes with other health conditions. The findings revealed that the prevalence of self-reported diabetes is slightly higher among elderly men compared to women, although the difference is not significant. Similar study conducted on the prevalence of diabetes among the elderly, reported similar findings, showing a slightly higher prevalence of self-reported diabetes among elderly men compared to women, but the difference was not statistically significant.[47,48] However, these findings contradict a study conducted in rural Uttarakhand.[49] Moreover, the study observed that both self-reported diabetes and hypertension are more prevalent in urban areas than in rural areas in India. This finding aligns with similar studies conducted in India.[11,23] This disparity can be attributed to the higher rates of obesity and lower levels of physical activity among the urban population compared to the rural population.[50] Additionally, the study found that the prevalence of diabetes is higher in the southern states of India, which could be attributed to their diet and lifestyle choices. The study demonstrates that among elderly men, the likelihood of having diabetes increases with higher levels of education, whereas the opposite trend is observed in women. A similar finding was reported in a study conducted in Uttarakhand.[49] Contradicting elderly women, elderly men who are widowed, divorced, or separated show a lower likelihood of having diabetes. Furthermore, elderly individuals who have never worked are more likely to have diabetes compared to working men and women. Family history of diabetes is associated with approximately three times higher odds of having diabetes in elderly men and women, consistent with a study conducted in Punjab, as diabetes can be influenced by genetic factors.[51,52]

Both men and women who are obese or overweight, exhibit abdominal obesity measured by waist circumference, experience depression, and engage in less physical activity are more likely to have diabetes. Similar results have been found in several studies conducted in India, highlighting the importance of exercise in maintaining healthy blood pressure, weight, and blood sugar levels.[33,53,54] The study also aims to examine the impact of lifestyle factors such as alcohol consumption, smokeless tobacco use, and smoking. These three factors have a negative effect on diabetes; however, the study's data does not account for the quantity, frequency, or duration of alcohol use, smoking, or smokeless tobacco in the analysis. Additionally, the study reveals a significant association between diabetes in elderly men and women and other health conditions, including cancer, lung disease, heart disease, stroke, bone/joint disease, neurological/psychiatric disease, high cholesterol, and hearing and vision problems.

It is imperative for India to address the significant risk of diabetes before the situation becomes uncontrollable. If current trends persist, achieving global targets for reducing non-communicable disease (NCD) deaths will become challenging.[13] Aging is not a disease itself, but it renders the elderly population susceptible to various diseases, including non-communicable diseases. Effective interventions should focus on promoting a healthy lifestyle, including regular exercise and weight management. Lifestyle changes play a crucial role in effectively reducing diabetes, even though having a family history of the disease poses a high risk. It is often said that genetics loads the gun, but lifestyle pulls the trigger. The decomposition analysis revealed that education plays a significant role in explaining the disparity in diabetes prevalence among the elderly in urban and rural areas of India. Chewing tobacco, gender, currently working, and marital status also contribute to the observed disparity, although to a lesser extent.

### *Strengths and limitations of the study*

The study's strength lies in its representative sample and inclusion of various factors, enhancing the external validity and providing a comprehensive understanding of

diabetes risk factors. However, reliance on self-reported data introduces recall biases and limits direct comparisons with clinical data. Despite limitations, adherence to rigorous research standards enhances the credibility of the findings. Caution is advised when interpreting the results due to the inherent limitations of self-reported information in studying diabetes prevalence.

## CONCLUSION

The study provides valuable insights into the prevalence and risk factors associated with self-reported diabetes, particularly among elderly men and women in India. The findings reveal gender-specific patterns, with the odds of having diabetes increasing with higher levels of education among elderly men but showing the opposite trend in women. Urban areas have higher prevalence rates of diabetes and hypertension compared to rural areas, likely due to factors such as obesity and reduced physical activity. The study also highlights the coexistence of diabetes with other morbid conditions, emphasizing the need for integrated care and management approaches. While the study's reliance on self-reported data and the cross-sectional design pose limitations, the adherence to rigorous research designs and tools enhances the credibility of the findings.

### *Recommendations*

Based on the study's findings, policy recommendations to address the burden of diabetes in India include enhancing diabetes awareness and education, promoting healthy lifestyles, strengthening healthcare systems, fostering integrated care, and supporting research and data collection. Implementing these recommendations can contribute to the prevention and management of diabetes, improving the overall health and well-being of the population in India.

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## REFERENCES

1. Goli S, Arokiasamy P. Demographic Transition in India: An Evolutionary Interpretation of Population and Health Trends Using 'Change-Point Analysis.' Schooling CM, editor. PLoS One. 2013;8(10):e76404.
2. Mason A, Lee SH, Park D. Demographic Change, Economic Growth, and Old-Age Economic Security: Asia and the World. Asian Development Review. 2022;39(01):131-67.
3. Medhi GK, Dutta G, Borah P, Lyngdoh M, Sarma A. Prevalence of Diabetes and Its Relationship With Body Mass Index Among Elderly People in a Rural Area of Northeastern State of India. Cureus. 2021;13:1.
4. Department of Economic and Social Affairs, Population Division. World population ageing, 2019 highlights. United Nations New York. 2019. Available at: https://digitallibrary.un.org/record/3846855?ln=en. Accessed on 09 September 2023.
5. Gu D, Andreev K, E. Dupre M, United Nations Population Division, New York, USA, Department of Population Health Sciences & Department of Sociology, Duke University, North Carolina, USA. Major Trends in Population Growth Around the World. China CDC Weekly. 2021;3(28):604-13.
6. Doddamani A, Ballala ABK, Madhyastha SP, Kamath A, Kulkarni MM. A cross-sectional study to identify the determinants of non-communicable diseases among fishermen in Southern India. BMC Public Health. 2021;21(1):414.
7. Kohler IV, Sudharsanan N, Bandawe C, Kohler HP. Aging and hypertension among the global poor—Panel data evidence from Malawi. Invitation PE, editor. PLOS Glob Public Health. 2022;2(6):e0000600.
8. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes – Global Burden of Disease and Forecasted Trends. JEGH. 2019;10(1):107.
9. Geldsetzer P, Manne-Goehler J, Theilmann M, Davies JI, Awasthi A, Vollmer S, et al. Diabetes and Hypertension in India: A Nationally Representative Study of 1.3 Million Adults. JAMA Intern Med. 2018;178(3):363.
10. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. Indian J Ophthalmol. 2021;69(11):2932.
11. Arokiasamy P. India's escalating burden of non-communicable diseases. The Lancet Global Health. 2018;6(12):e1262-3.
12. Galicia-Garcia U, Benito-Vicente A, Jebari S, Larrea-Sebal A, Siddiqi H, Uribe KB, et al. Pathophysiology of Type 2 Diabetes Mellitus. IJMS. 2020;21(17):6275.
13. Budreviciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, et al. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. Front Public Health. 2020;8:574111.
14. Galaviz KI, Narayan KMV, Lobelo F, Weber MB. Lifestyle and the Prevention of Type 2 Diabetes: A Status Report. Am J Lifestyle Med. 2018;12(1):4-20.

15. Nolan CJ, Damm P, Prentki M. Type 2 diabetes across generations: from pathophysiology to prevention and management. The Lancet. 2011;378(9786):169-81.
16. Teo ZL, Tham YC, Yu M, Chee ML, Rim TH, Cheung N, et al. Global Prevalence of Diabetic Retinopathy and Projection of Burden through 2045. Ophthalmology. 2021;128(11):1580-91.
17. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Research and Clinical Practice. 2019;157:107843.
18. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Research and Clinical Practice. 2022;183:109119.
19. Liu J, Ren ZH, Qiang H, Wu J, Shen M, Zhang L, et al. Trends in the incidence of diabetes mellitus: results from the Global Burden of Disease Study 2017 and implications for diabetes mellitus prevention. BMC Public Health. 2020;20(1):1415.
20. Lin X, Xu Y, Pan X, Xu J, Ding Y, Sun X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci Rep. 2020;10(1):14790.
21. Wu Y, Ding Y, Tanaka Y, Zhang W. Risk Factors Contributing to Type 2 Diabetes and Recent Advances in the Treatment and Prevention. Int J Med Sci. 2014;11(11):1185-200.
22. Hill-Briggs F, Adler NE, Berkowitz SA, Chin MH, Gary-Webb TL, Navas-Acien A, et al. Social Determinants of Health and Diabetes: A Scientific Review. Diabetes Care. 2021;44(1):258-79.
23. Bhagyalaxmi A, Atul T, Shikha J. Prevalence of Risk Factors of Non-communicable Diseases in a District of Gujarat, India. J Health Popul Nutr. 2013;31(1):78-85.
24. Zhang J, Xu L, Li J, Sun L, Qin W, Ding G, et al. Gender differences in the association between body mass index and health-related quality of life among adults:a cross-sectional study in Shandong, China. BMC Public Health. 2019;19(1):1021.
25. Teufel F, Seiglie JA, Geldsetzer P, Theilmann M, Marcus ME, Ebert C, et al. Body-mass index and diabetes risk in 57 low-income and middle-income countries: a cross-sectional study of nationally representative, individual-level data in 685 616 adults. The Lancet. 2021;398(10296):238-48.
26. Bays HE, Chapman RH, Grandy S, SHIELD Investigators' Group. The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: comparison of data from two national surveys. Int J Clin Pract. 2007;61(5):737-47.
27. Aggarwal H, Kaur H, Saklani R, Saba N, Choudhary S, Dogra S, et al. Prevalence of obesity and associated hypertension and diabetes in Delhi, metropolitan city of India. Indian J Med Specialities. 2015;6(3):82-7.
28. Hajar R. Risk factors for coronary artery disease: Historical perspectives. Heart Views. 2017;18(3):109.
29. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. PharmacoEconomics. 2015;33(7):673-89.
30. Yang J, Qian F, Chavarro JE, Ley SH, Tobias DK, Yeung E, et al. Modifiable risk factors and long term risk of type 2 diabetes among individuals with a history of gestational diabetes mellitus: prospective cohort study. BMJ. 2022;e070312.
31. Majumdar S, Gangopadhyay KK, Chowdhuri N, Majumder A, Ghoshdastidar B, Bhattacharjee K, et al. Barriers to Exercise in Type 2 DM Patients: An Institutional Cross-Sectional Descriptive Study. JDMC. 2019;1-6.
32. Quarti Machado Rosa M, dos Santos Rosa R, Correia M, Araujo D, Bahia L, Toscano C. Disease and Economic Burden of Hospitalizations Attributable to Diabetes Mellitus and Its Complications: A Nationwide Study in Brazil. IJERPH. 2018;15(2):294.
33. Booth FW, Roberts CK, Laye MJ. Lack of Exercise Is a Major Cause of Chronic Diseases. In: Terjung R, editor. Comprehensive Physiology. 1st ed. Wiley. 2012;1143-211.
34. Bavuma CM, Niyibizi JB, Bitunguhari L, Musafi S, McQuillan R, Wild S. Prevalence and characteristics associated with diabetes mellitus and impaired fasting glucose among people aged 15 to 64 years in rural and urban Rwanda: secondary data analysis of World Health Organization surveillance data. Pan Afr Med J. 2022;41.
35. Pandey AR, Aryal KK, Shrestha N, Sharma D, Maskey J, Dhimal M. Burden of Diabetes Mellitus in Nepal: An Analysis of Global Burden of Disease Study 2019. Cardoso C, editor. J Diabet Res. 2022;2022:1-15.
36. Hu FB. Globalization of Diabetes. Diabetes Care. 2011;34(6):1249-57.
37. Tabish SA. Is Diabetes Becoming the Biggest Epidemic of the Twenty-first Century? Int J Health Sci (Qassim). 2007;1(2):V-VIII.
38. World Health Organization. Global report on diabetes. Geneva: World Health Organization. 2016. Available at: https://apps.who.int/iris/handle/10665/204871. Accessed on 09 September 2023.
39. Longitudinal Ageing Study in India (LASI) | International Institute for Population Sciences (IIPS). Longitudinal Ageing Study in India (LASI) | International Institute for Population Sciences (IIPS). 2022. Available at: https://www.iipsindia.ac.in/lasi. Accessed on 09 September 2023.
40. Bloom DE, Sekher TV, Lee J. Longitudinal Aging Study in India (LASI): new data resources for addressing aging in India. Nat Aging. 2021;1(12):1070-2.

41. Perianayagam A, Bloom D, Lee J, Parasuraman S, Sekher TV, Mohanty SK, et al. Cohort Profile: The Longitudinal Ageing Study in India (LASI). Int J Epidemiol. 2022;51(4):e167-76.
42. Gateway to Global Aging Data. Gateway to Global Aging Data. 2023. Available at: https://g2aging.org/. Accessed on 09 September 2023.
43. O'Donnell O, O'Neill S, Van Ourti T, Walsh B. conindex: Estimation of concentration indices. Stata J. 2016;16(1):112-38.
44. Ataguba JE. A short note revisiting the concentration index: Does the normalization of the concentration index matter? Health Economics. 2022;31(7):1506-12.
45. Sudharsanan N, Bijlsma MJ. Educational note: causal decomposition of population health differences using Monte Carlo integration and the g-formula. Int J Epidemiol. 2022;50(6):2098-107.
46. Hwang J, Lee EY, Lee CG. Measuring Socioeconomic Inequalities in Obesity among Korean Adults, 1998–2015. IJERPH. 2019;16(9):1617.
47. Megari K. Quality of life in chronic disease patients. Health Psych Res. 2013;1(3):27.
48. Olanrewaju TO, Aderibigbe A, Popoola AA, Braimoh KT, Buhari MO, Adedoyin OT, et al. Prevalence of chronic kidney disease and risk factors in North-Central Nigeria: a population-based survey. BMC Nephrol. 2020;21(1):467.
49. Kapil U, Khandelwal R, Ramakrishnan L, Khenduja P, Gupta A, Pandey R, et al. Prevalence of hypertension, diabetes, and associated risk factors among geriatric population living in a high-altitude region of rural Uttarakhand, India. J Family Med Prim Care. 2018;7(6):1527.
50. Cohen AK, Nussbaum J, Weintraub MLR, Nichols CR, Yen IH. Association of Adult Depression With Educational Attainment, Aspirations, and Expectations. Prev Chronic Dis. 2020;17:E94.
51. Ramezankhani A, Azizi F, Hadaegh F. Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: A long term follow-up study. Shimosawa T, editor. PLoS One. 2019;14(4):e0215593.
52. Vlassoff C. Gender differences in determinants and consequences of health and illness. J Health Popul Nutr. 2007;25(1):47-61.
53. Anjana RM, Pradeepa R, Das AK, Deepa M, Bhansali A, Joshi SR, et al. Physical activity and inactivity patterns in India – results from the ICMR-INDIAB study (Phase-1) [ICMR-INDIAB-5]. Int J Behav Nutr Phys Act. 2014;11(1):26.
54. Kriska AM. Physical Activity, Obesity, and the Incidence of Type 2 Diabetes in a High-Risk Population. Am J Epidemiol. 2003;158(7):669-75.

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