

CORRELATION BETWEEN ALCOHOL CONSUMPTION AND VERY HIGH DIABETES AMONG RURAL AND URBAN MEN IN INDIA

A BIBLIOMETRIC, STATISTICAL, AND GEOGRAPHICAL PERSPECTIVE

Priyanka Puri*

Parul Puri**

ABSTRACT

Diabetes has become a major global health challenge, with India recording one of the sharpest increases in prevalence in recent decades. This rise is widespread across regions and shaped by multiple determinants. Among them, alcohol consumption has been suggested as a contributor to Type 2 Diabetes, though the strength of this association remains uncertain. This study investigates the relationship between alcohol consumption and Diabetes among men in rural and urban India, drawing on NFHS-5 data and supported by statistical, geographical, and bibliometric methods. Results show higher alcohol consumption among rural men, but a greater burden of Diabetes among urban men. Correlation analysis indicates a weak positive association—0.227 for rural men and 0.163 for urban men—suggesting that very high Diabetes levels cannot be attributed primarily to alcoholism, except in limited cases. Spatial patterns reveal clear regional disparities: southern states report the highest Diabetes prevalence, while urban Diabetes generally falls in medium to high ranges, clustering from western to eastern India. Rural Diabetes presents a more mixed distribution. Bibliographic analysis further indicates a surge in publications on Diabetes from the mid-1990s, with output peaking in 2021. The London School of Hygiene and Tropical Medicine, the Public Health Foundation of India, and AIIMS, New Delhi, were leading contributors. Medicine accounted for 47.5% of publications, and maximum co-authorship occurred between the USA and India. Overall, findings suggest alcohol plays a contributory but not dominant role in Diabetes prevalence, while broader lifestyle and regional factors exert stronger influence.

Keywords: Alcohol consumption, Diabetes, health, lifestyle, males, trends, National Family Health Survey.

***Priyanka Puri** is Professor, Department of Geography, Miranda House, University of Delhi, Delhi-110007, India. Corresponding Author Email: priyanka.puri@mirandahouse.ac.in

****Parul Puri** is Assistant Professor, Department of Zoology, Maitreyi College, University of Delhi, Delhi-110021, India. E-mail: parul_acemil11@rediff.com

INTRODUCTION

Modernisation with altered lifestyle is attributed as a cause to manifold rise of Diabetes in the Asian subcontinent (Ramachandran *et al.*, 1999). Diabetes is a challenge to modern medicine and an unprecedented concern in modern times (WHO, 2022). India is no exception to this and is called the 'Diabetes capital of the world' (Unnikrishnan *et al.*, 2016; Yesudian *et al.*, 2014; Mohan and Pradeepa, 2001). Alcohol seems to increase the propensity of Diabetes by manifold, though it cannot be taken as the direct contributory factor to the issue (Yadav *et al.*, 2017; Barik *et al.*, 2016; Mohan *et al.*, 2009). Alcohol misuse and abuse comes under an enhanced focus in this category (Deedwania *et al.*, 2014). It can be broadly said that the risk of Diabetes with alcohol consumption is dependent on a number of other factors ranging from weight, metabolism and type of alcohol intake, to name a few (Polsky *et al.*, 2017; Knott *et al.*, 2015).

Alcohol consumption has been largely studied in non-diabetic population (Polsky *et al.*, 2017; Baliunas *et al.*, 2009; Howard *et al.*, 2004; Wannamethee *et al.*, 2002). It is observed that men in general as compared to women, consume more alcohol. Alcohol consumption is found to be a stronger contributor to Diabetes than gender (Bhalerao *et al.*, 2014). While light to moderate alcohol intake is credited to a decrease in risk of Diabetes, heavy drinking seems to do the reverse (Mohan *et al.*, 2008). It is also interesting to note that a limited alcohol intake can lower risk of cardiovascular diseases, other morbidities as well as mortality (Mohan *et al.*, 2008).

As reported in 1970s, Type 2 Diabetes cases in rural India were 1.5 %, and in urban areas 2.3%. Within two decades, these cases have risen three-fold in urban areas and two-fold in rural areas (Singh *et al.*, 1998). Urban areas, in general, have reportedly higher diabetic rate (Sujata and Thakur, 2021). Further, prediabetic condition is also on the rise (Ramachandran *et al.*, 1999). Various studies exhibit the relationship between Diabetes and alcohol consumption in India.

Very few studies exist on the topic of studying rural-urban differentials in Diabetes in India. A research work on urban areas in India correlated Diabetes with high alcohol intake (Singh *et al.*, 1998). A bibliometric study on large population comprising 1,778,706 adults from rural and urban India, indicated an increase in the disease in both rural as well as urban population. This denotes narrowing of rural-urban gap on Diabetes incidences (Ranasinghe *et al.*, 2021). Alcohol consumption has been found to be much higher in rural areas than urban. This rate of increase is alarming for the country; modernisation, altered lifestyle and changed dietary habits being the contributory factors.

In a study in rural Pondicherry, about 50% of the cases of Diabetes were attributed to obesity and alcohol consumption (Ghorpade *et al.*, 2013). A study on 6,196 men in rural and urban areas in Tamil Nadu indicated alcohol consumption grew to 62% in rural areas as compared to 42% among urban men (Oommen *et al.*, 2016). In another study conducted in India on 13,527 rural men, lower diabetic prevalence was found in these areas with fewer reports on the disease incidences (Ramachandran *et al.*, 1999). Besides, it is also very important

to note that broadly the prevalence of Diabetes in rural areas has remained much lower compared to the urban regions (Jonas *et al.*, 2010). Another study of a tribal rural population in South India indicated no correlation between the two parameters (Shriraam *et al.*, 2021). Yet another work considered trends in Diabetes among 61,361 rural and urban men. It showed the prevalence of disease was higher in urban areas, while alcohol consumption remained higher in rural areas (Agrawal, 2015; Pillai *et al.*, 2013). The epidemiology of Diabetes related to alcohol consumption largely studied for adolescent population indicates that the level of the disease varies and no peculiar trend can be outlined. The relationship can be seen as positive, null, U-shaped or even J-shaped (Polsky *et al.*, 2017; Koppes *et al.*, 2005). The current study proceeds with all these considerations in the background to fill the gap in literature and to examine existing correlation between alcohol consumption and very high Diabetes incidences.

DATABASE AND METHODOLOGY

The current analysis is based on National Family Health Survey (NFHS-5) database. Highlighted as a high quality and reliable database, it is a national, multi-round, large-scale survey conducted on a sample of households across the country under the stewardship of the Ministry of Health and Family Welfare, Government of India (MoHFW, GoI) coordinated by the International Institute for Population Sciences, Mumbai. A group of survey organizations and Population Research Centres, selected after following a rigorous process of selection carried it forward. NFHS-5 Survey was conducted and completed during 2019-2021 and its fieldwork for India was conducted in two phases due to the Covid-19 lockdown- one from 17 June 2019 to 30 January 2020 and phase two from 2 January 2020 to 30 April 2021 by 17 Field Agencies. Information was gathered from 6,36,699 households, 7,24,115 women, and 1,01,839 men (NFHS, 2021)

From this pan-India dataset, two parameters are chosen:

1. **ALCOHOL CONSUMPTION**- Which is divided into two categories as-
 - a. **ALC. RUR.** - Alcohol consumption among men in *rural areas* who are above 15 years of age (%)
 - b. **ALC. URB.** - Alcohol consumption among men in *urban areas* who are above 15 years of age (%)
2. **VERY HIGH Diabetes**- This is divided into two categories as –
 - a. **DIAB. RUR.** -Very high Diabetes among men in *rural areas* who are above 15 years of age >160 mg/dl (%)
 - b. **DIAB. URB.** - Very high Diabetes among men in *urban areas* who are above 15 years of age >160 mg/dl (%)

The research objectives of the study are:

- To observe the relationship between alcohol consumption and Diabetes among urban and rural men in India;

- To outline the strength of this observed relationship;
- To examine and exhibit the statistical findings and supplement those with bibliographic and geographic data.

The target of current attempt is to observe the relationship between alcohol consumption and the incidence of ‘*very high*’ Diabetes cases, without drug intervention among rural and urban men in India. The analysis is supplemented with literature review on the topic through a bibliometric examination. This is done for the purpose of checking the nature of published works on the topic and the detailing of such publications through information on the year, language, co-authorship, co-occurrence, title, and abstract of publications. It can also be useful to check the availability of literature and help in understanding the broad and specific nature of the issue. This is attempted through the two well established publication databases- Scopus and Web of Science (WoS) online through subscription. WoS covers extensive disciplines across academics. Considered as most trusted global citation data, it is provided by Clarivate Analytics with records from 1900 to the present and includes several databases with 1.9 billion cited works from 171 million records (Clarivate, 2024). The WoS Core Collection gives information on more than 115 years of highest quality research works. It includes ten indexes with highly sought indexes such as the Science Citation Index expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts and Humanities Citation Index (AHCI) (WoS, 2022). Results are diagrammatically represented and supplemented with tables and text. VOS Viewer software (version 1.6.18) is used to generate and visualize these diagrams.

The generated data is statistically examined for its individual parameters to check the descriptive statistics. The details of the dataset as derived from NFHS-5 database are highlighted below in Table 1. The NFHS provides Diabetes information in three categories for both males and female:

- Blood sugar level *high*: 141-160 mg/dl (%)
- Blood sugar level *very high*: >160 mg/dl (%)
- Blood sugar level *high or very high*: >140 mg/dl or taking medicine to control blood sugar.

On the basis of the information available through NFHS-5, the following data was derived for the mentioned parameters as can be seen in Table 1 and 2.

Table 1: Sample Size of Men Surveyed by NFHS-5

STATE/UT	No. of Males Surveyed (NFHS-5)
ALL INDIA	101839
Andhra Pradesh	1558
Arunachal Pradesh	2881
Assam	4973
Bihar	4897

Chhattisgarh	4174
Goa	313
Gujarat	5351
Haryana	3224
Himachal Pradesh	1,477
Jharkhand	3,414
Karnataka	4,516
Kerala	1,473
Madhya Pradesh	7,025
Maharashtra	5,497
Manipur	1,162
Meghalaya	1,824
Mizoram	1,105
Nagaland	1,456
Odisha	3,865
Punjab	3,296
Rajasthan	6,353
Sikkim	469
Tamil Nadu	3,372
Telangana	3,863
Tripura	990
Uttar Pradesh	12,043
Uttarakhand	1,586
West Bengal	3,021
Andaman & Nicobar Islands	2,397
Chandigarh	104
Dadra & Nagar Haveli and Daman & Diu	427
NCT Delhi	1,700
Jammu & Kashmir	3,087
Ladakh	307
Lakshadweep	135
Puducherry	534

Source: Authors, 2024 (compiled from NFHS-5 reports for respective states/UTs; NFHS, 2021)

Statistical analysis is based on NCSS Software. Descriptive statistical information is followed by cross-plotting of relevant categories of the data to bring out the trends spatially, statistically, and temporally. Bland Altman Plots are drawn to enhance the analysis followed by Karl Pearson’s Correlation to check the degree of strength between the parameters. This plot visualizes relationships between two variables and is taken as a ‘gold standard’ method (Schoonjans, 2024). The mean difference and the limits of agreement are shown. It is considered as a useful method of displaying the relationship between two paired variables and helps in observing the phenomena. This is a specific scatterplot and is widely used in medical analysis (Riffenburgh and Gillen, 2020). Karl Pearson’s statistical technique is a quantitative method which provides a numerical value to identify the strength of linear relationship between variables.

The coefficient of correlation is represented as ‘r’ and is categorized in the range of -1 to +1. A value of -1 indicates a strong negative correlation while +1 indicates a strong positive correlation (Warner, 2013). The next method of statistical enquiry used is of Odds Ratio (OR). This is defined as a method of association between exposure and outcome. It is a representation that an outcome will take place with an exposure compared to the odds of outcomes in the absence of that exposure. These ratios help in determining if a particular exposure acts as a risk factor for an outcome and can also be used to compare the magnitude of various risk factors for that outcome. It is usually attempted at 95% confidence interval (Szumilas, 2010). The OR can be read as:

- OR=1 Exposure does not affect odds of outcome;
- OR>1 Exposure associated with higher odds of outcome;
- OR<1 Exposure associated with lower odds of outcome.

The findings of Odds Ratio are depicted through a forest plot for meta-analysis of the results . The variables of alcoholism, Diabetes are examined, explored statistically, and plotted. Geographical depiction of the database and findings lead to the spatial distribution analysis and the focal locations that require specific attention. At the All India level, it can provide a useful comparison to pave way for newer research. QGIS software (version 3.26) has been used. It is a free, open source, geographic information system for the analysis and output of geospatial data in multiple forms. A clustered heat map (double dendrogram) is also constructed to visualise the data sets of alcohol and Diabetes categories.

Table 2: Parameters of Analysis

STATE/UT	NFHS-5			
	URBAN (%)		RURAL (%)	
	ALC. URB.	DIAB. URB.	ALC. RUR.	DIAB. RUR.
ALL INDIA	16.5	8.5	19.9	6.5
Andhra Pradesh	20.5	13.7	24.5	10.4

Arunachal Pradesh	44.3	6.4	54.3	4.3
Assam	21.3	9.5	25.9	5.6
Bihar	14	9.2	15.8	6.5
Chhattisgarh	28.6	4.8	36.7	4.2
Goa	38.2	10.8	34.9	12.9
Gujarat	4.6	7.3	6.8	6.9
Haryana	15.7	6.9	16.2	5.9
Himachal Pradesh	30.4	7.7	32.1	6.5
Jharkhand	24.6	7.9	38.7	5.9
Karnataka	15.3	8.6	17.4	7
Kerala	18.7	14.1	21	13.6
Madhya Pradesh	13.2	5.9	18.6	4.6
Maharashtra	13	6.8	14.7	5.2
Manipur	34.6	10.6	39.2	6.8
Meghalaya	28.5	7.6	33.5	3.5
Mizoram	22.8	6.7	25.2	5.2
Nagaland	26.8	6.9	22.5	4.7
Odisha	22.7	11.1	30.2	7.3
Punjab	19.7	8	24.8	6.4
Rajasthan	9.3	3.6	11.6	3.2
Sikkim	37.6	8.1	41.1	6.4
Tamil Nadu	21.5	12.7	29.2	11.2
Telangana	33.9	11.4	49	8.4
Tripura	26.9	10.8	35.9	6.8
Uttar Pradesh	13.2	6.1	15.1	4.6
Uttarakhand	21.7	9.7	27.5	6.6
West Bengal	18.9	10.6	17.7	9
Andaman & Nicobar Islands	33.8	8.6	41.9	6.6
Chandigarh	18.5	8	31.6	8
Dadra & Nagar Haveli and Daman & Diu	29.1	8.5	26.5	6.9
NCT Delhi	21.6	7.4	22.9	5
Jammu & Kashmir	7.7	2.9	9.2	2.7
Ladakh	21.1	0.8	24.2	2.9
Lakshadweep	0.4	9	0.5	5.3
Puducherry	26.7	13.5	30.1	9.3

Source: Authors, 2024; NFHS, 2021

Methodology

The analysis has been conducted as bibliometric, statistical, and geographical. The analysis is divided in three parts:

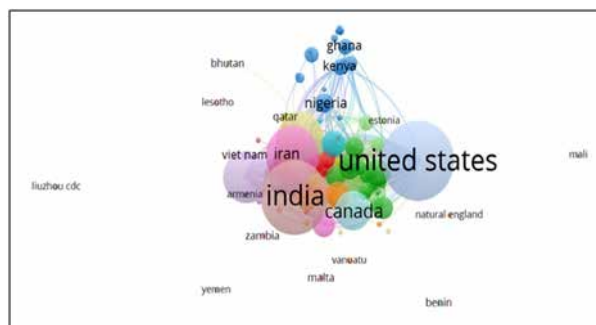
- Bibliometric analysis to examine the relationship between alcohol consumption and Diabetes among rural and urban men in India;
- Statistical examination of the data on alcohol consumption and Diabetes among rural and urban men;
- Geographical analysis of data on alcohol consumption and Diabetes among rural and urban men.

Results and Findings:

- Bibliometric analysis to examine the relationship between alcohol consumption and Diabetes among rural and urban men in India

This was initiated by conducting an exact phrase search as ‘Alcohol *AND* Consumption *AND* Diabetes *AND* Among *AND* Rural *AND* Urban *AND* Men *AND* India’. The results were generated for research publications on the topic from the Scopus and WoS databases. Scopus database generated 4,879 articles generated in the search from the year 1977 onwards and WoS provided only 10 documents till date on the topic. The nature of works on the topic indicate that publications are limited in number, particularly in the Web of Science database. Scopus generated 4,879 publications and WoS gave only 10 publications on the topic. In the WoS categories, Public Environmental Occupational Health category had the maximum publications.

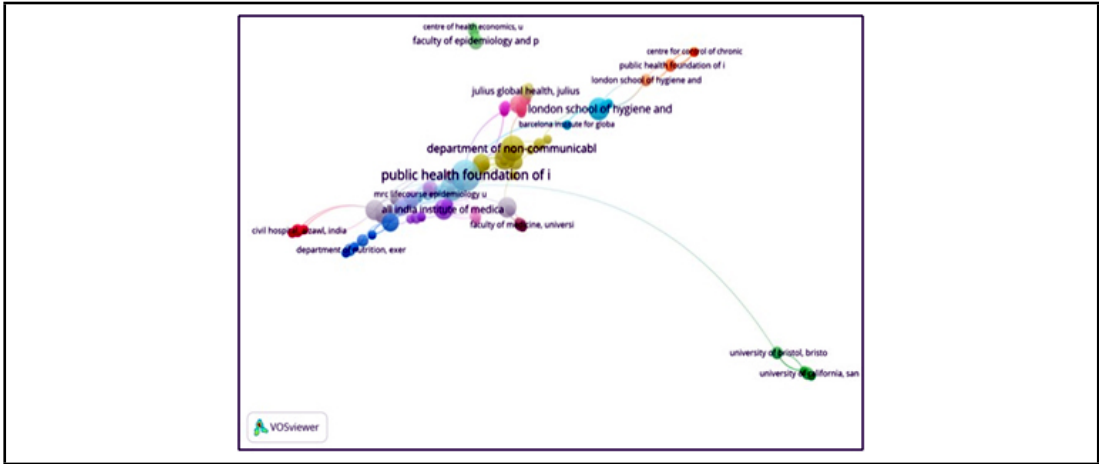
It can be deciphered that these works got a sudden spurt from mid-1990s. United States exhibited a good number of publications. Besides, there is a constant increase in total publications and the highest and maximum can be seen around the year 2021. These were contributed by the London School of Hygiene and Tropical Medicine followed by the Public Health Foundation of India. Third in line was AIIMS, New Delhi. In terms of publications, medicine category had the maximum share at 47.5% followed by ‘Other’ categories at 11.06%. Maximum co-authorship between countries is observed with the USA and India as distinct clusters as can be seen from Fig.1.



Source:
Authors, 2024

Fig.1: Co- authorship by Countries on Publications on Alcohol Consumption and Diabetes Among Rural and Urban Men in India (Scopus, 2024)

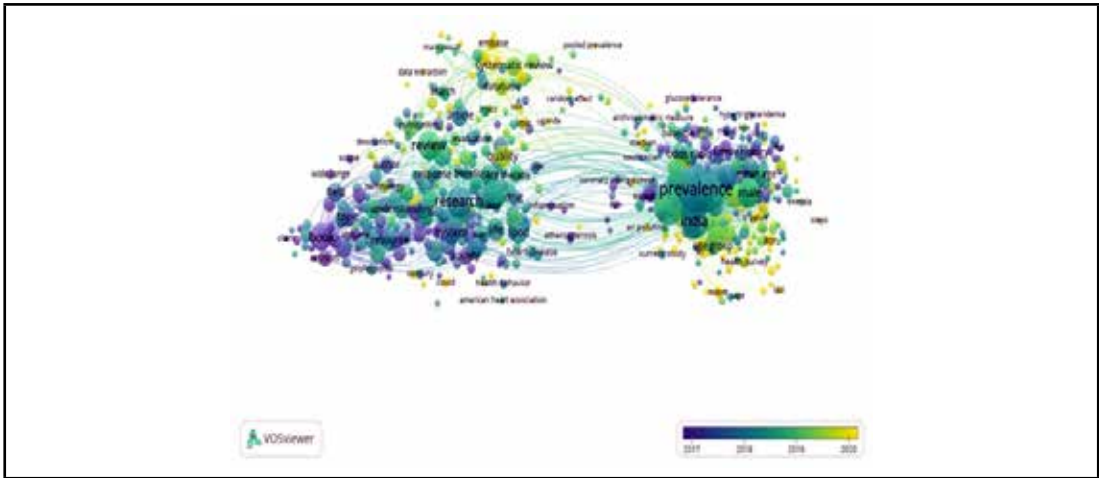
Fig.2. shows the publications by institutions in which a linear clustering can be deciphered with outermost clusters having isolated publications also being visible. The Scopus database results on keywords in abstract and title analysis indicated that there were two distinct clusters on the search. One group highlighted the key words as- prevalence, Kerala, India, age while the other group, which was larger, had the occurrence of research related words as predominant.



Source: Authors, 2024

Fig.2: Publications by Institutions and Linkages on Alcohol Consumption and Diabetes Among Urban and Rural Men in India. (Scopus, 2024)

Some of these can be highlighted as- review, research, quality, systematic review and others, as can be seen from Fig.3.



Source: Authors, 2024

Fig.3: Title and Abstract Keyword Analysis on Alcohol Consumption and Diabetes Among Urban and Rural Men in India. (Scopus, 2024)

WoS indicates that there were only 10 publications on the topic in the country. The record was generated from 1997 till date. These were cited about 344 times, excluding self-citations and having an h-Index of 9. Table 3 indicates the first 10 author affiliations for publications on the topic. Further scope of publications on the topic is vast for WoS as a very limited research is visible on the topic.

Table 3. Institutes with Publication on the Topic Alcohol Consumption and Diabetes Among Rural and Urban Men in India

Affiliations	% of 10
Christian Medical College Hospital, Vellore	30
London School Of Hygiene Tropical Medicine	20
Navrongo Health Research Center	20
Public Health Foundation Of India	20
University Of London	20
University Of Southampton	20
University Of Witwatersrand	20
African Population Health Research Centre	10
All India Institute Of Medical Sciences , New Delhi	10
Ghana Health Service	10

Source: Authors, 2024 from WoS, 2022

b. Statistical examination of the data on alcohol consumption and Diabetes among rural and urban men

Results were generated for the data for various parameters selected on multiple statistical aspects using NCSS software. The main aim of this analysis was to observe the correlation between alcohol consumption and ‘very high’ Diabetes cases as recorded in the NFHS-5 data.

Table 4: Descriptive Statistics of Alcohol Consumption Rate and Diabetes in Urban and Rural Areas

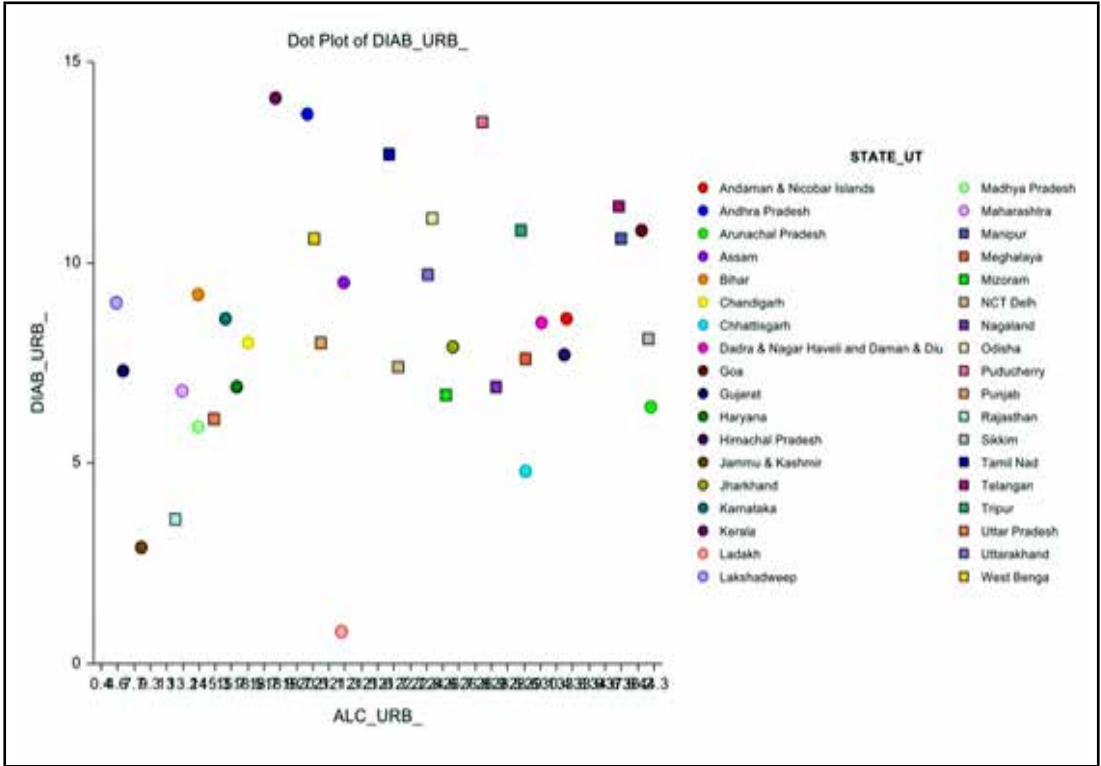
Statistic	ALC_URB	DIA_URB	ALC_RUR	DIA_RUR
Count	36	36	36	36
Sum	799.4	302.2	947	236.3
Mean	22.20555	8.394444	26.30556	6.563889
Standard Deviation	9.690406	2.927988	11.72752	2.543243
Median	21.55	8.05	25.55	6.45
Minimum	0.4	0.8	0.5	2.7
Maximum	44.3	14.1	54.3	13.6
Range	43.9	13.3	53.8	10.9
Variance	93.90397	8.573112	137.5348	6.468087

Source: Authors, 2024

The purpose is also to check whether rural- urban scenarios have a significant bearing on Diabetes occurrence as modern lifestyle, sedentary work and other factors associated with urbanity are considered as major trigger behind current day increasing Diabetes cases.

The derivations can be seen as follows:

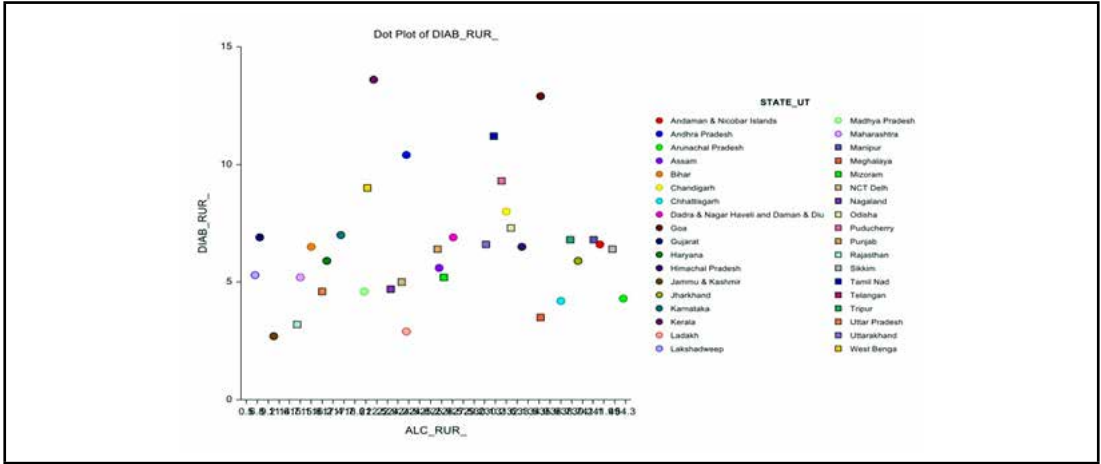
- **Descriptive Statistics:** Table 4 indicates that the mean alcoholism rate in urban regions is 22.2% while in the rural area, it is slightly higher at 26.3%. Interestingly, the range values indicate a wide difference between the lowest recorded and the highest recorded alcoholism rate in both rural and the urban regions. It can be seen from the Table 4, that alcoholism percentage was higher in rural areas as compared to the urban counterpart while ‘very high’ Diabetes rate was higher on an average in the urban areas. Fig. 4 and Fig. 5 show the dot plots of alcoholism and ‘very high’ Diabetes for the states and UTs of the country for the urban and rural regions, respectively.



Source: Authors, 2024

Fig.4: Plotting of Urban Alcoholism and ‘Very High’ Diabetes

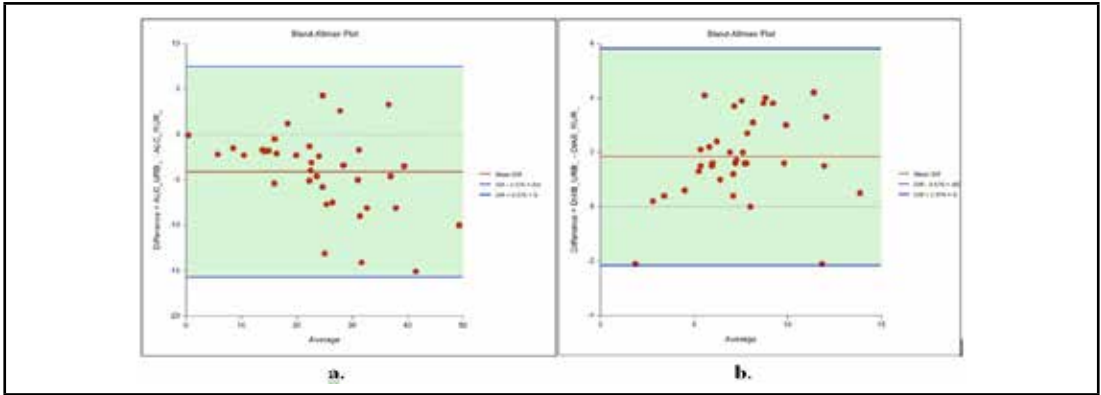
Fig.4. and Fig.5 indicate that no distinct pattern is visible at the state and UT level for both the parameters. However, the values when plotted simultaneously are at the lower end of the spectrum for the rural areas.



Source: Authors, 2024

Fig.5: Plotting of Rural Alcoholism and ‘Very High’ Diabetes

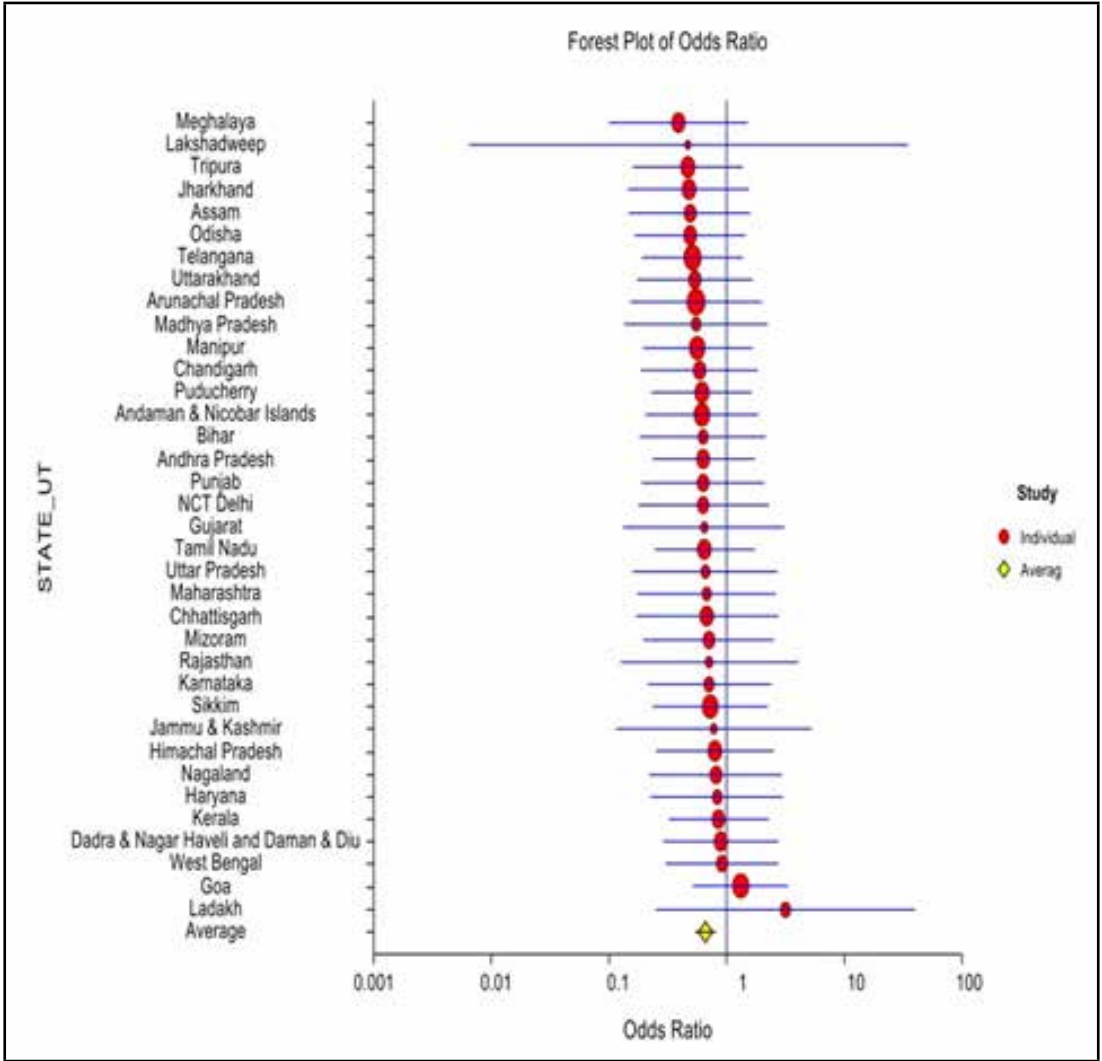
Further examination is done for observing the relationship between the averages and differences through the Bland Altman Plots as can be seen in Fig.6 a. & b. These plots are constructed here for Fig.6 a. Urban and Rural Alcoholism; Fig.6 b. Urban and Rural ‘very high’ Diabetes values. It can be said that there is again no specific trend for alcoholism and ‘very high’ Diabetes for the rural and urban regions. The deviations from the average values with regards to the difference between urban and rural alcoholism, urban and rural Diabetes is again a basic observation. Deviations for mean alcoholism rate is much higher and proceeds towards negative values which indicates that alcohol intake among rural men in India is higher than the urban counterparts. However, for Diabetes, the same cannot be said as these deviations are positive when observed as difference between the urban and rural areas. This supports the average rate findings in which the percentage of ‘very high’ Diabetes category is generally higher for the urban areas.



Source: Authors, 2024

Fig.6: Bland Altman Plots for a. Urban and Rural Alcohol Consumption, b. Urban and Rural ‘Very High’ Diabetes

Next examination checks the correlation between the two parameters for the urban and rural regions. The results are shown in Fig.7 and Fig. 8a. & b.



Source: Authors, 2024

Fig.7: Plotting of Odds Ratio

It can be calculated that in both the cases there is a weak positive correlation between the two parameters (for alcohol consumption and Diabetes in rural men = 0.2274 and in urban men as 0.1633) which suggests that it cannot be said that ‘very high’ Diabetes can be attributed largely to alcoholism except in a few cases.

The examination is enhanced further through the study of measuring association and outcome through meta-analysis of studies by comparing the proportion between the two.

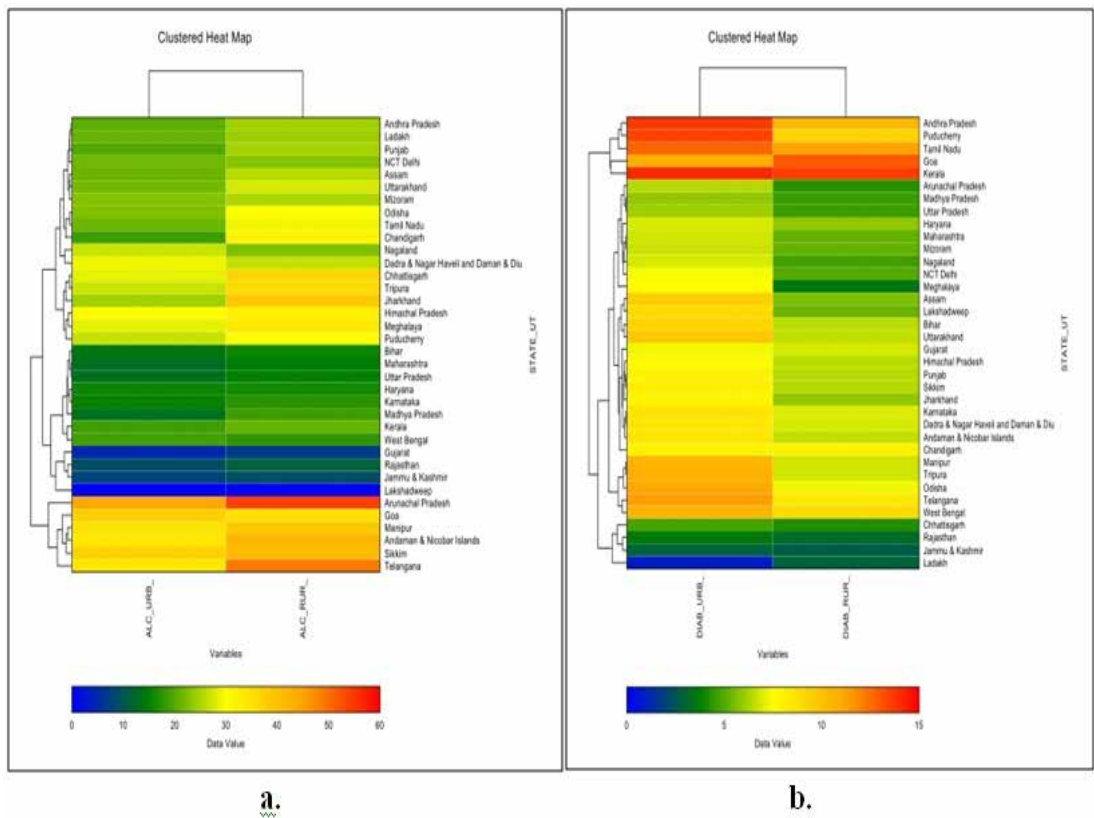
Meta-analysis supports statistical studies by combining all parameters into a single one as is done here through odds ratio and forest plots. The calculations can be seen in Table 5.

Table 5. Odds Ratio of Alcohol Consumption and ‘Very High’ Diabetes Among Rural and Urban Men

STATE_UT	Ratio	STATE_UT	Ratio
Combined		Combined	
Fixed Model	0.6632	Nagaland	0.8113
Random Model	0.6614	Odisha	0.4943
State/UT	Ratio	Punjab	0.6355
Andhra Pradesh	0.6352	Rajasthan	0.7126
Arunachal Pradesh	0.5481	Sikkim	0.7228
Assam	0.4848	Tamil Nadu	0.6493
Bihar	0.626	Telangana	0.5098
Chhattisgarh	0.6819	Tripura	0.4718
Goa	1.3074	Uttar Pradesh	0.6592
Gujarat	0.6394	Uttarakhand	0.5369
Haryana	0.8287	West Bengal	0.9066
Himachal Pradesh	0.7994	Andaman & Nicobar Islands	0.6191
Jharkhand	0.4747	Chandigarh	0.5854
Karnataka	0.7157	Dadra & Nagar Haveli and Daman & Diu	0.8914
Kerala	0.8589	NCT Delhi	0.6373
Madhya Pradesh	0.5533	Jammu & Kashmir	0.7792
Maharashtra	0.6763	Ladakh	3.1606
Manipur	0.5662	Lakshadweep	0.4711
Meghalaya	0.3918	Puducherry	0.6111
Mizoram	0.7022		

Source: Authors, 2024

With the exception of Ladakh, it can be interpreted that the Odds Ratio indicates that the exposure is associated with lower odds of outcome beyond the line of no effect as is visible in Fig.7. This supports the other statistical findings that alcohol consumption and Diabetes are not very strongly related although a slight positive correlation is observed between the two and correlation values are more for urban areas. The average OR is also less than 1 providing similar indications and to the generality of the data as having lower outcomes upon exposure. The point estimates indicate the weight assigned to individual units at the 95% confidence interval.



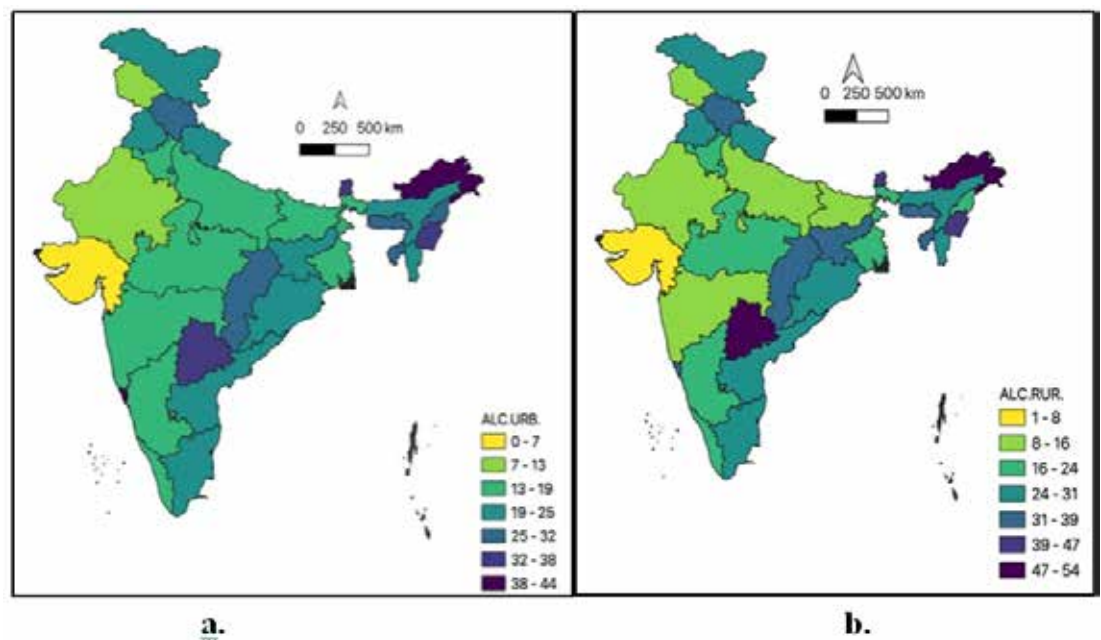
Source: Authors, 2024

Fig.8: a. Clustered Heat Map- Alcohol Consumption, b. Clustered Heat Map- Diabetes

The double dendrogram clustered heat maps in Fig.8 a and b., visualise alcoholism and Diabetes respectively. The range of data is much higher for alcoholism. Alcoholism in urban areas ranges from minimum values to average and not reaching the maximum of the range spectrum while for the rural areas this is not so. However, this gets reversed while analysing Diabetes trend, with values ranging from a miniscule to high ranges. For rural areas, it is observed to be from medium to high value ranges in which the maximum is observed for a few states only.

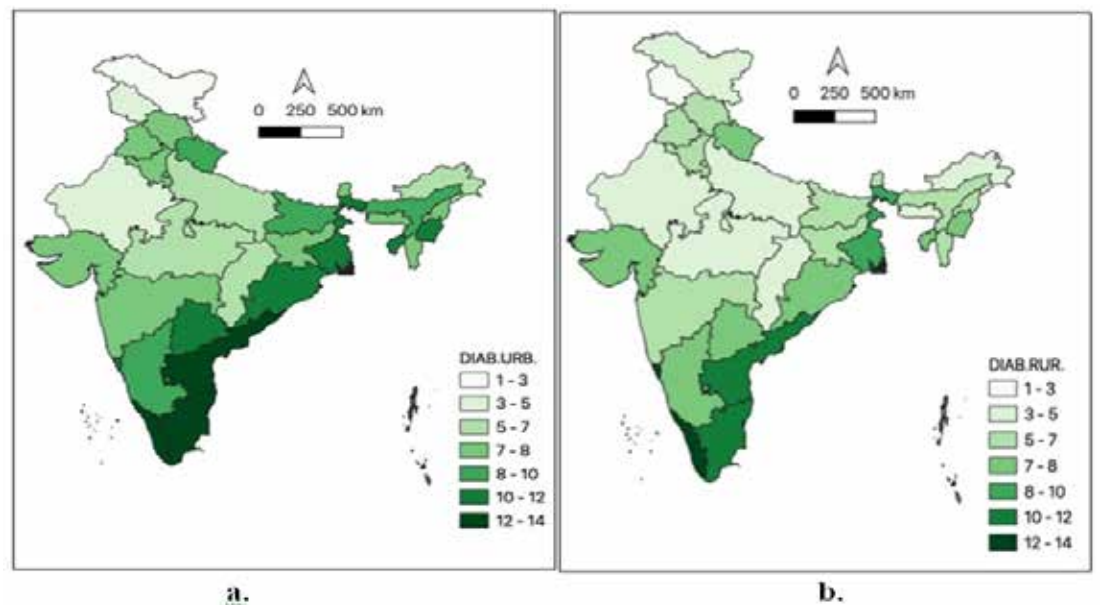
c. Geographical analysis of data on alcohol consumption and Diabetes among rural and urban men

The trends when analysed geographically, seeks to provide a spatial picture of the scenario which well brings out a weak correlation between alcohol consumption and very high Diabetes among men in India. The details can be seen in Fig.9 a. & b. and Fig.10 a. & b. Gujarat shows the minimum alcohol consumption at both the levels. The north-eastern states and Telangana are amongst the highest categories of alcohol consumption. Urban alcoholism is at the higher end for central and south-east India while this is lesser for its rural counterpart.



Source: Authors, 2024

**Fig. 9: Geographical Distribution of Alcohol Consumption in India-
a. Among Urban Men, b. Among Rural Men (2019-21)**



Source: Authors, 2024

**Fig.10: Geographical Distribution of 'Very High' Diabetes in India-
a. Among Urban Men, b. Among Rural Men (2019-21)**

Data for Diabetes indicates that the southern states have the highest values of the disease. With an exception of UTs of Jammu and Kashmir and Ladakh, and Rajasthan, urban Diabetes is prevalent between medium to high ranges. A higher patterning of values can be seen for the states of west to east India. Rural Diabetes, however, shows a mixed pattern but still the southern states and Gujarat move towards higher values.

RESULTS AND CONCLUSIONS

From the above analysis, slightly positive relationship is observed between alcohol consumption and higher levels of Diabetes. The findings are a contribution to literature on the topic and an addition to existing studies which similarly suggest that one cannot point to a single trend over the issue. Type 2 Diabetes poses a severe health risk in current times as numerous studies suggest. It is not only associated with morbidity and mortality but has rather come as a severe concern of present day life. Alcohol is also considered as a source of many diseases and associated mortality as well. However, when the two parameters are combined, there is no evidence of causation and consumption limits in general. But as a good amount of evidence is visible that multiple correlations exist, the current study tends to provide an additional inference of a weak positive correlation between the two elements. Besides, the focus is entirely on the trends observed in urban and rural men, the analysis and findings become specific and peculiar. The NFHS provides information which is first hand, unprecedented, pan-India, authentic and authoritative in the field.

The findings of the current study are indicative of the bibliometric trends, differentials, and geographical distribution. Bibliometric trends show limited publications on the theme and India as being the third most contributor of publications on the topic. Statistical analysis shows the average and correlations of varying degrees, with variations observed for both the parameters. These variations can be explored further for different aspects related to the demographic, dietary, and local variables. The study also stands significant in the light of the fact that India is a signatory to sustainable developmental goals (SDGs) and is committed to reduce its disease burden. The present study contributes to further exploratory analysis on the subject.

Conflict of Interest

The authors declare no potential conflict of interest. Further no funding was received to conduct the research.

REFERENCES

1. Agrawal S. (2015). Frequency of food consumption and self-reported Diabetes among adult men and women in India: A large scale nationally representative cross-sectional study. *J Diabetes Metab*, **6**: 474.
2. Baliunas DO, Taylor BJ, Irving H, Roerecke M, Patra J, Mohapatra S, Rehm J. (2009). Alcohol as a risk factor for Type 2 Diabetes: A systematic review and meta-analysis. *Diabetes Care*. **32**:2123-32.

3. Barik A, Mazumdar S, Chowdhury A, Rai RK (2016). Physiological and behavioral risk factors of Type 2 Diabetes mellitus in rural India. *BMJ Open Diabetes Res Care*; **4**:e000255.
4. Bhalerao SD, Somannavar M, Vernekar SS, Ravishankar R, Goudar SS. (2014). Risk factors for Type 2 Diabetes mellitus in rural population of north Karnataka: a community-based cross sectional study. *Int J Pharm Med Biol Sci.*, **3**:1-14.
5. Clarivate (2024). access.clarivate.com.; Available from: <https://www.webofscience.com: https://www.webofscience.com/wos/woscc/summary/e8222d5c-74c6-4cf1-b526-1776502c3e83-3d700121/relevance/1>.
6. Deedwania PC, Gupta R, Sharma KK, Achari V, Gupta B, Maheshwari A, Gupta A. (2014). High prevalence of metabolic syndrome among urban subjects in India: A multisite study. *Diabetes Metab Syndr.*, **8**:156-61.
7. Ghorpade AG, Majgi SM, Sarkar S, Kar SS, Roy G, Ananthanarayanan PH, Das AK. (2013). Diabetes in rural Pondicherry, India: a population-based study of the incidence and risk factors. *WHO South East Asia J Public Health.*, **2**:149-55.
8. Howard AA, Arnsten JH, Gourevitch MN.(2004). Effect of alcohol consumption on Diabetes mellitus. *Annals of Internal Med.*, **140**:211-19.
9. Jonas JB, Panda-Jonas S, Nangia V, Joshi PP, Matin A. (2010). Diabetes mellitus in rural India. *Epidemiology*, **21**:754-55.
10. Knott C, Bell S, Britton A. Alcohol consumption and the risk of Type 2 Diabetes (2015). A systematic review and dose-response meta-analysis of more than 1.9 million individuals from 38 observational studies. *Diabetes Care*, **38**:1804-12.
11. Koppes LLJ, Dekker JM, Hendriks HFJ, Bouter LM, Heine RJ. (2005). Moderate alcohol consumption lowers the risk of Type 2 Diabetes: A meta-analysis of prospective observational studies. *Diabetes Care*, **28**:719-25.
12. Mohan V, Mathur P, Deepa R, Deepa M, Shukla DK, Menon GR, Anand K, Desai NG, Joshi PP, Mahanta J, Thankappan KR, Shah B (2008). Urban rural differences in prevalence of self-reported Diabetes in India-The WHO-ICMR Indian NCD risk factor surveillance. *Diabetes Res Clin Pract.*, **80**:159-68.
13. Mohan V, Pradeepa R.(2001). Epidemiology of Type 2 Diabetes in India. *Indian J Ophthalmol.* , **69**: 2932-38.
14. Mohan V, Radhika G, Sathya RM, Tamil SR, Ganesan A, Sudha V. (2009). Dietary carbohydrates, glycaemic load, food groups and newly detected Type 2 Diabetes among urban Asian Indian population in Chennai, India (Chennai Urban Rural Epidemiology Study 59). *British J Nutr.*, **102**:1498-1506.
15. NFHS (2021) from <http://rchiips.org>. Ministry of health and family welfare, Government of India; [cited 2024]. Available from: <http://rchiips.org>: <http://rchiips.org/NFHS/NFHS5/>

pdf/NFHS%20data%20quality%20assurance.pdf

16. Oommen A, Abraham V, George K, Jose VJ. (2016). Prevalence of risk factors for non-communicable diseases in rural & urban Tamil Nadu. *Indian J Med Res.*, **144**:460-71.
17. Pillai A, Nayak MB, Greenfield TK, Bond JC, Nadkarni A, Patel V. (2013). Patterns of alcohol use, their correlates, and impact in male drinkers: a population-based survey from Goa, India. *Soc Psychiatry Psychiatr Epidemiol.*, **48**:275-82.
18. Polsky S., Akturk H.K. (2017). Alcohol consumption, Diabetes risk, and cardiovascular disease within Diabetes. *Current Diabetes Reports.*, **17**:136.
19. Ramachandran A, Snehalatha C, Latha E, Manoharan M, Vijay V. (1999). Impacts of urbanisation on the lifestyle and on the prevalence of Diabetes in native Asian Indian population. *Diabetes Res Clin Pract.*, **44**: 207-13.
20. Ranasinghe P, Jayawardena R, Gamage N, Sivanandam N, Misra A. (2021). Prevalence and trends of the Diabetes epidemic in urban and rural India: A pooled systematic review and meta-analysis of 1.7 million adults. *Ann Epidemiol.*, **58**:128-48.
21. Riffenburgh R, Gillen D. (2020). *Statistics in Medicine*. Academic Press, London, 795p.
22. Schoonjans F. MedCalc statistical software - free trial available. (2024). Available from: <https://www.medcalc.org>
23. Scopus Digital Library Platform|College eLibrary|Refread for Digital Libraries.Duelibrary. in. (2024) [cited 2024]. Available from: <https://scopus.duelibrary.in/term/analyzer.uri?sort=plf-f&src=s&sid=f196cde87a2887a57ceb6e8bfd03e51b&sot=a&sdt=a&sl=74&s=TITLE-ABS-KEY%28malaria+AND+geography%29+AND+PUBYEAR+%3e+1945+AND+PUBYEAR+%3c+2025&origin=resultslist&count=10&analyzeResults=Analyze>
24. Shriraam V, Shriraam M, Arumugam P.(2021). Prevalence and risk factors of Diabetes, hypertension and other non-communicable diseases in a tribal population in South India. *Indian J Endocrinol Metab.*, **25**:313-19.
25. Singh RB, Bajaj S, Niaz MA, Rastogi SS, Moshiri M. (1998). Prevalence of Type 2 Diabetes mellitus and risk of hypertension and coronary artery disease in rural and urban population with low rates of obesity. *Int J Cardiol.*, **66**:65-72.
26. Sujata and Thakur R. (2021). Unequal burden of equal risk factors of Diabetes between different gender in India: A cross-sectional analysis. *Sci Rep.* ,**11**: 22653.
27. Szumilas M. (2010). Explaining odds ratios. *J Can Acad Child Adoles Psychiatry*, **19**:227-29.
28. Unnikrishnan R, Anjana RM, Mohan V.(2016). Diabetes mellitus and its complications in India. *Nat Rev Endocrinol.*, **12**:357-70.
29. Wannamethee SG, Shaper AG, Perry IJ, Alberti KM. (2002).Alcohol consumption and the incidence of Type II Diabetes. *J Epidemiol Community Health.* , **56**:542-548.

30. Warner RM. (2013). *Applied statistics: From bivariate through multivariate techniques*. Sage Publications, Thousand Oaks, California, 1172p.
31. WHO (2022). Who.int. Available from: <https://www.who.int/news-room/fact-sheets/detail/Diabetes#:~:text=Diabetes%20is%20a%20chronic%20disease,hormone%20that%20regulates%20blood%20glucose>.
32. WoS. (2022). <https://www.webofscience.com>
33. Yadav A, Prasad J, Shekher C, Vishvakarma M. (2017). A study of morbidity pattern among elderly population in urban India. *J Soc Health Diabetes*, **5**:100-6.
34. Yesudian CA, Grepstad M, Visintin E, Ferrario A. (2014). The economic burden of Diabetes in India: A review of the literature. *Global Health*, **10**:80.