Review Article

Socioeconomic status and diabetic retinopathy in India

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Socioeconomic status (SES) may influence the general health and the health-seeking behavior of an individual. Understanding the disease prevalence in different social strata may lead us to the important linkages that SES might have with diabetic retinopathy (DR). The knowledge on the prevalence of DR in the community based on their SES may help design strategies to provide affordable, last-mile care to the population most at risk of this blinding complication of diabetes mellitus. Our systematic search for population-based Indian studies found three studies in the past three decades that evaluated the effect of socioeconomic factors on the prevalence of diabetic retinopathy. The data on the prevalence in various socioeconomic strata was equivocal and the study settings were mostly urban. The parameters used to assess the SES differed among studies. This underscores the need for further research on SES-related diabetic retinopathy complications in India. Future studies should employ more robust socioeconomic scales to define the divide better.

Key words: Diabetes, prevalence, retinopathy, rural, urban

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The interplay of disease and the socioeconomic status (SES) of an individual is complex. Diabetic retinopathy (DR), including diabetic maculopathy, is a common cause of visual impairment in people with diabetes mellitus (DM). It impacts the livelihood and the socioeconomic status of the individual and family. Poverty and lower literacy prevalent in lower SES often contribute to poorer health-seeking behavior.[1] Unawareness and delays in seeking medical help lead to complications, resulting in a manyfold increase in diabetic eye care costs.[2] These costs push individual households to further economic hardships and inadequate treatment. In several population-based studies, a low SES was associated with poor metabolic control and resulted in a higher prevalence of DM and DR.[3]

In the last five decades, the prevalence of DM has increased in rural and urban India from 2.4% and 3.3% in 1972 to 15% and 19%, respectively, in 2015–2019; it is higher than the worldwide rural (7.2%) and urban (10.8%) prevalence of DM.[4,5] Over these decades, there has been a significant shift in Indian socioeconomic structure. The nominal per capita gross domestic product (GDP) has increased from USD 370 in 1990 to USD 2100 in 2019.[6] The life expectancy has jumped by 68% from 41 years in 1960 to 69 years in 2018.[7] With fast urbanization of rural settlements and improved socioeconomic opportunities, epidemiological studies report a higher prevalence of diabetes in "rural riches" and "urban poor," indicating an inverse relationship of DM with SES in rural and urban settings, respectively.[8,9] Changing dietary habits and decreased levels of physical activity have resulted in increases in obesity and diabetes in rural and semi-urban areas, as well as in urban-based people living in resettlement colonies.[10]

Epidemiological studies have reported socioeconomic inequalities in diabetes care.[3] Complications of DM such as nephropathy and neuropathy have been increasingly reported in the low- and middle-income groups.[11,12] A low SES associated with poor metabolic control concurred with a greater prevalence of DR in several population-based studies across the globe.[3] We reviewed the published population-based studies in India to understand the socioeconomic dimensions of DR.

Methods

Studies reporting the prevalence of diabetic retinopathy and socioeconomic status classification were included; hospital-based studies and studies conducted outside India were excluded. The literature search was carried out on the PubMed database using the search keywords "diabetic retinopathy," "prevalence," "socioeconomic," and "India" for articles published between 1990 and 2021. The search yielded a total of 37 articles, which were screened by two authors (UCB, ASB); full texts of relevant articles were assessed, and data on socioeconomic status and DR prevalence was extracted.

Results

Our search identified three studies that have evaluated the relationship between SES and DR in India [Table 1].[13-16] Andhra Pradesh Eye Disease Study (APEDS urban population – Hyderabad city, South India, 1999) showed that subjects in the upper/middle economic strata had a higher chance (odds ratio: 1.86) of developing DR than

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Table 1: Studies on SES and DR relationship in India

Study Name	Author, Publication Year	Population/setting/ Age	Study population	DR prevalence (*n*=population/DM screened)	
				Lower SES	Higher SES
Andhra Pradesh Eye Disease Study (APEDS)	Dandona L, *et al.*[14] 1999	Hyderabad City/ Community/>30 years	Urban	1.42% (population screened=636)	2.66% (population screened=718)
-	Ramachandran A, *et al.*[15] 2002	Madras/ Community/>40 years	Urban	12% (218 subjects with DM)	21.5% (221 subjects with DM)
Andhra Pradesh Eye Disease Study (APEDS)	Krishnaiah S, *et al.*[16] 2007	Hyderabad and rural clusters/ Community/>30 years	Urban and Rural	0.4% (population screened=3426)	1.3% (population screened=2074)
Sankara Nethralaya diabetic retinopathy Epidemiology and Molecular Genetics Study report 2 (SN-DREAMS 2)	Raman R, *et al.*[13] 2009	Chennai/ Community/>40	Urban	Not available	Not available

Table 2: Various socioeconomic scales used in Indian studies

SES Scale	Variables (Number)	First introduced (revised)
B G Prasad classification	Per capita monthly income (1)	1961 (1968, 1970)
Udai Pareek classification	Caste, occupation, education, level of social participation of the head of the family, landholding, housing, farm power, material possession, total members in the family (9)	1964 (2019)
Modified Kuppuswamy scale	Education and occupation of the head of the family, Income per month from all sources (3)	1976 (1982,1998, 2001, 2017, 2019, 2020)
Standard of Living Index scale Used in National Family Health Survey (NFHS -II)	House type, source of lighting, toilet facility, main fuel for cooking, source of drinking water, separate room for cooking, ownership of the house, ownership of agricultural land, ownership of irrigated land, ownership of livestock, ownership of durable goods (11)	2006

people in extreme lower/lower SES but did not meet statistical significance.[14] The SES stratification was based on the monthly per capita income of the individual in rupees (extreme lower: ≤200; lower: 201–500; middle: 501–2000; upper: >2000). The same study (APEDS, urban, and rural population) on completion found a further increase in the prevalence of DR in the upper/ middle SES group (odds ratio: 2.34).[16] A lower predisposition to DR incidence and high mortality at a relatively younger age in the lower SES strata was speculated to be the cause of the lower prevalence. The population studied was older than 30 years of age. A study in Chennai (urban population, Tamil Nadu state, South India, 2002) also reported a lower prevalence of DR in the lower-income group (household annual income: INR < 30,000).[15] The cohort had a lower prevalence of diabetes and obesity. The recent Chennai study (SN-DREAMS I, urban population, 2009) did not find an influence of SES on the prevalence and severity of DR.[13] The study used scores to stratify streets in the study area as low, middle, and high SES streets. The study assessed SES based on income, education, occupation, and caste.[17] None of the studies were powered to determine the prevalence based on the SES.

Discussion

Socioeconomic status and socioeconomic scales

Socioeconomic status signifies the position of an individual/ family in reference to the prevailing average standards of cultural/material possessions, income, and participation in a group activity of the community.[18] Many factors are considered during the determination of SES, such as income, occupation, housing and neighborhood, material possessions, and membership of societies/organizations. These determinants are further quantified using various scales to classify an individual/family into different hierarchical classes. Historically, social status was inherited and static, but in today's society, it allows a transition from a relatively lower class to a relatively higher class based on income, education, and/or changes in occupation. In India, one of the earliest successful attempts at a scale to measure the SES of a family was the BG Prasad classification (1961), which was based on per capita monthly income. It was modified in 1968 and 1970 and was used extensively.[19] For rural India, Udai Pareek classification (based on nine characteristics) and for urban India, modified Kuppuswamy scale (based on three variables) are widely used among others [Table 2]. The scales incorporating income as a variable require frequent simultaneous updates, e.g. modified Kuppuswamy scale, based on a conversion factor derived from the prevailing All India Consumer Price Index. The scales that are independent of income considerations are devoid of this drawback and hence may be more valid.[20]

Several studies using SES determinants of social caste, household wealth, income, and education, either in isolation or composite, have provided evidence of a positive association between SES and the prevalence of diabetes.[8,21,22] The markers of SES in these studies, when used in combination, incorporated the determinants into the analysis model individually and later in combination. In a nationally representative study, the SES grades that had education, social caste, and household wealth as the determinants, a strong and consistent gradient

Table 3: Incidence and Prevalence of Type 2 Diabetes Mellitus in India and the World. [Data from Global Health Data Exchange]

Location	Prevalence in 1990 [Percent (lower - upper)]	Prevalence in 2019 [Percent (lower - upper value)]	Incidence in 1990 [Rate per 100,000 (lower - upper value)]	Incidence in 2019 [Rate per 100,000 (lower - upper value)]
World Bank High Income	4.71 (4.31-5.09)	9.59 (8.8-10.37)	228.71 (212.27-246.02)	399.29 (368.40-431.75)
World Bank Upper-Middle Income	2.98 (2.71-3.27)	6.53 (5.99-7.11)	162.25 (149.23-176.36)	292.65 (270.83-318.15)
World Bank Lower-Middle Income	2.11 (1.90-2.34)	4.80 (4.35-5.30)	125.48 (114.43-137.64)	256.73 (235.30-281.17)
World Bank Low Income	1.43 (1.29-1.58)	2.20 (1.98-2.45)	93.55 (85.78-102.53)	135.28 (123.50-148.12)
India	2.47 (2.20-2.79)	6.03 (5.41-6.70)	143.44 (129.32-159.70)	302.48 (274.81-334.17)

was observed when household wealth was used as the SES marker.[9] The household wealth was defined by an index based on indicators of asset ownership (phone, television, etc.) and housing characteristics such as type of windows, water supply, and sanitation facility. They were weighted and combined using a factor analysis approach (principal component analysis).[23] Using the same SES parameters, a newer nationwide study evaluating the relationship of diabetes, hypertension, and obesity in various SES grades in India found household wealth again as the socioeconomic indicator most consistently associated with the outcomes.[24]

Using the national poverty indices, studies in Asia and Europe have reported a higher prevalence of DR and nephropathy in individuals in lower SES.[25,26] In contrast, the Indian studies evaluating DR prevalence by SES that used family income as the determinant reported greater DR prevalence in high SES.[14,15] The SN-DREAMS study though had the other determinants incorporated, did not have a sequential analysis to determine the most consistent socioeconomic indicator associated with the DR prevalence.[13] The study did not observe any influence of SES on DR occurrence.

Newer scales to correlate the health status and SES

The newer scales utilize multiple variables to capture data, have a sound statistical basis, and can analyze the socioeconomic status of the individual as well as the region. The ALSES (area-level SES) indicators cover a broad socioeconomic spectrum in both material and social terms. They characterize the entire population (males and females from various geographic settings) and produce estimates that are statistically reliable and consistent with individual indicators. Moreover, the inequalities can be tracked through time and by geographic location.[27] A nation's SES can also be determined using socio-demographic index, which considers average income per person, educational attainment, and the total fertility rate.[28]

Diabetes and DR burden – India and worldwide scenario

Based on the gross national income per capita, the World Bank has classified countries into low, lower-middle, upper-middle, and high. India is ranked among the lower-middle-income countries.[28] The type 2 DM figures between 1990 and 2019 in India when compared with the World Bank classification of countries show a steadily rising prevalence (2.47% in 1990 to 6.03% in 2019), but the incidence has recently surpassed that of the upper-middle-income countries [Table 3].[29] This foretells a pattern of an accelerating epidemic in India, even as the growth phase in other countries is remaining stable or plateauing. The prevalence of DR in the population with DM ranged from 18% in the SN-DREAMS study to 19.4% in APEDS.[13,16] Aggregated data from population-based studies in India reporting the prevalence of DR between 1990 and 2021 in a meta-analysis study showed an overall DR prevalence of 16.10% (95% CI: 13.16%–24.32%) (unpublished observations by the authors). A recent meta-analysis comprising 59 studies across the world found a higher DR prevalence estimate of 22.27%.[30]

Modifiable risks linked to SES and diabetes

Socioeconomic status is an important factor that influences the health, nutritional status, morbidity, and mortality of a population. SES also influences the acceptability, affordability, accessibility, and actual ground utilization of various available health facilities. In primary care settings, examinations of socioeconomic scales often reveal inequities in access to health care. It also shows a pattern to the health problems existing in a specific population with respect to their socioeconomic class.[20] Socioeconomic factors influencing the development and progression of some clinical processes have been well documented.[27]

Socioeconomic inequality can have its pros and cons, both in urban and rural settings. People who are underprivileged economically generally remain engaged in moderate to strenuous physical and occupational activity that is thought to be protective against the onset of microvascular complications of diabetes.[31] The ICMR INDIAB study has shown significant inactivity in urban areas.[32] A lower prevalence of diabetes in rural settings and in people of low SES in India supports the observation.

The quality of diet follows a socioeconomic gradient. While higher quality diets are associated with greater affluence, energy-dense diets that are nutrient-poor are preferentially consumed by individuals of lower SES.[33] Though the diet is important in the development of diabetes, its role in diabetic retinopathy has not been clearly identified. A systematic review found the Mediterranean diet, high fruit, vegetable, and fish intake protective against the development of diabetic retinopathy, but the evidence was limited.[34] In an urban population-based study in south India, subjects on a low-dietary-fiber diet belonged to low SES, had poorer glycemic control, and higher prevalence of DR.[35] High total caloric intake is associated with a higher risk of DR. Interestingly, evidence unequivocally suggests that there is no significant association of DR with increased carbohydrate intake, one of the key contributors of total caloric intake.[36] There are large differences in dietary patterns of rural and urban, and rich and poor households in India. Affluent households in both rural and urban areas consume >3000 kcal/day, i.e. 20% more than the reference diet. Their calorie intake per person/day is

almost twice as high as their poorest counterparts who consume only 1645 kcal/person/day.[37] Calorie-rich diets in people with higher incomes and greater DR prevalence in high SES concur with each other.

High BMI, one of the risks of DR in high SES, is greatly affected by dietary habits and physical inactivity. Globalization and emerging supermarkets increase access to processed, high-fat, and sugary foods. Relative low price and high accessibility of energy-dense but low-nutrient food decrease the consumption of whole grains, fruits, and vegetables. High subsidies on rice and sugar through public distribution systems in India induce people in low SES to consume more of low-nutrient calorie-rich food. Improved awareness about healthy diet and lifestyle changes may mitigate the problem.

Low education in lower SES is a surrogate for broader social disadvantage. It may directly impair an individual's ability to obtain effective care. Low awareness may become a barrier to the importance of seeking timely care due to reduced access to information on the source of care, either through formal channels or social networks. Lower education also reduces life opportunities that may hold them from meeting the health care expense in general and force them to live in neighborhoods with worse access to healthcare facilities.[38] Conversely, the more educated subjects tend to acquire better information and make informed choices with respect to lifestyle and health behaviors.[1] Thus, socioeconomic status may influence diabetes-related knowledge, communication with providers, treatment choices, and adherence to recommended medication, exercise, and dietary regimens.[3] Low education and its association with greater prevalence of diabetes have been reported in large Indian studies.[39,40] A population with no history of schooling in a rural setting was found to have the highest risk of DR in a south Indian study.[41]

Socioeconomic woes and health care access in India

India is an overpopulous country with a teetering health care system. The public spending on health for the financial year 2017–2020 was estimated to be around 1.28% of the country's GDP. In comparison, the United States' budget estimates show an outlay of over 17% of the GDP to public health expenditure in the year 2018.[42] The low health expenditure by the government has led to a highly developed private health care sector, which accounts for half of the health care infrastructure. The treatment offered is expensive and only the well-to-do or with private health insurance coverage can afford a timely treatment. To reach out to the common man, the government has provisions of eye care under the National Health Mission and Ayushman Bharat. However, specialized eye care is mostly concentrated in urban areas. In the remote rural hinterland, primary care facilities are ill-equipped in terms of basic eye care services. It was not until 2010 that these centers were upgraded to include the screening of non-communicable diseases (NCDs) such as diabetes and other lifestyle-related diseases. These facilities though quite accessible, are often under-utilized because of poor knowledge and awareness about diabetes and its attendant complications. The absence of eye care screening in National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular diseases, and Stroke (NPCDCS) clinics is a shortcoming that may affect early retinopathy detection. Even the recent expansion of such clinics to a "National Multi-sectoral Action Plan" for prevention and control of common NCDs has no provision of DR screening as part of the package. From 1990 to 2016, diabetes had the highest increase in disability-adjusted life-years rate among NCDs with an age-standardized increase of 39.6% in India.[28] In this milieu, diabetic retinopathy screening programs in rural and semi-urban settings may help detection and treatment of diabetic retinopathy early. Use of fundus cameras in NCD clinics to screen DR and a robust referral mechanism for the complications may reduce the blindness burden due to diabetes. Public-private partnerships may bridge the operational gaps.

Interpretation of SES dimensions of DR prevalence in India

Population data from India on the influence of SES on DR prevalence show equivocal results. Variability in DR prevalence in the Indian studies may have been due to the disparities in the applicable developmental indices of the study region. The Indian cultural and social diversity may explain the significant variation in diabetes and diabetic retinopathy prevalence between different regions and states of India. As there is a clear SES divide and epidemiological transition level in India, it may be fair to expect a variation in the prevalence in different SES levels. Nonetheless, the Indian studies that included SES as part of the risk analysis were not powered to determine the variance of prevalence among the socioeconomic classes. The SES determinants used were not uniform. In the absence of sufficient data, there is a lack of a clear understanding of the relationship of SES with DR incidence in India.

Conclusion

Developing a model for determining the relationship of DR with the SES in India is difficult in the absence of well-designed studies on the subject. This data scarcity may have ramifications, e.g. limiting projection estimates that are key to policy recommendations and health care resource allocation. Nationally representative longitudinal studies should be conducted using standardized socioeconomic indices (based on factor analysis approaches) so that this knowledge gap can be bridged.

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Conflicts of interest

There are no conflicts of interest.

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