ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 08 | August - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EXAMINING THE ROLE OF DIABETES IN CATARACT PREVALENCE AMONG OLDER ADULTS IN INDIA: INSIGHTS FROM LONGITUDINAL RESEARCH

Ophthalomology

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ABSTRACT

The study delves into the prevalence and risk factors associated with cataract among older adults in India, drawing insights from the Longitudinal Ageing Study in India (LASI) collected between April 2017 and December 2018. Utilizing univariate, bivariate, chi-square tests, and multivariable logistic regression analysis on a sample of 58,850 adults aged 45 years and above, the study reveals that diabetic patients had higher odds of developing cataracts. The findings underscore the critical need for effective diabetic management strategies to curb the risk of ocular complications. The multifaceted nature of cataract risk is influenced by a combination of biological, environmental, and behavioural factors such as age group, place of residence, education, work status, caste, region and tobacco use status. Addressing these factors through regular check-ups and targeted public health interventions could mitigate the burden of cataract-related blindness, necessitating the formulation of structural policies to support these efforts.

KEYWORDS

Cataract, Diabetes, Vision Loss, India; Longitudinal Ageing Study in India.

BACKGROUND

The human lens is a transparent, biconvex structure which helps to refract and focus light onto the retina. Cataract refers to loss of lens transparency due to opacification of the crystalline lens. Cataract, can be defined as the loss of lens transparency or any opacity of the crystalline lens. It causes alteration of refractive properties and elevated light scattering, resulting in hazy vision or blindness (1,2). Cataract is one of the leading causes of blindness and visual impairment worldwide (3,4). Approximately more than 100 million individuals worldwide are affected by cataracts, which are the primary cause of blindness (17.01 million) and the second most common cause of moderate to severe vision impairment (83.48 million) (5). Cataracts are much higher in low- and middle-income countries than in high-income countries (3,6,7). Cataract is one of the most significant causes of blindness in India (8–10). Cataract contributes to 66.2% of blindness and 71.2% of the visual impairment in the population above 50 years in India (8). Cataract also accounts for a significant proportion of avoidable blindness in India (10). Ageing stands as the most important risk factor for cataracts, along with other risk factors such as exposure to diabetes, ultraviolet rays, hypertension, smoking, substance use and socio-economic and lifestyle factors (8,11–16).

Research across clinical, epidemiological, and basic science domains has consistently associated diabetes with cataract development (17–26). Diabetes is associated with an approximately two to five-fold increased detection rate of cataracts as compared to those who are non-diabetic (17,23,24,27–30). Population-based studies, including the Beaver Dam Eye Study [2], the Blue Mountains Eye Study(31) and the Visual Impairment Project(32), have established links between diabetes and have also shown an association between diabetes and posterior subcapsular cataract and less consistently, with cortical cataract. Even in the non-diabetic population, impaired fasting glucose was associated with a risk factor for cortical cataract development(33–35). Moreover, evidence suggests that the risk of cataracts increases with diabetes duration and severity of hyperglycemia (17–19,21,28,36,37).

Diabetes has emerged as a significant global public health concern (38–41), with around half a billion people living with diabetes worldwide (42). Lifestyle changes, urbanization, limited physical activity, obesity and socio-demographic factors such as age, ethnicity, family history, and low socio-economic status are identified as some of the major risk factors for diabetes (43–48). Diabetes can cause damage to the eyes as well as vision loss as blindness. Eye-related diseases that can affect individuals with diabetes are diabetic retinopathy, macular edema, cataracts, and glaucoma (17,23,49–53). The International Diabetes Federation (IDF) has projected that by 2045, approximately 783 million people globally will be living with diabetes (42). The low and middle-income countries share a higher burden of diabetes as compared to the high-income nations. In India, diabetes is fast gaining the status of a potential epidemic, with over 74.9 million adults (20-79 years) in 2021 diagnosed with the disease. The number of diabetic adults in India is projected to increase to 124.9 million by 2045(42).

Given the rising prevalence of type 2 diabetes globally, particularly in countries like India, where it is projected to reach alarming levels, studying the prevalence of cataracts in this population is imperative. Against this background, the study utilizes a nationally representative sample survey of adults aged 45 years and above to explore the association between diabetes and the risk of cataracts among the older population in India. Doing so aims to provide valuable insights into the prevalence and risk factors of these ocular conditions in diabetic populations, ultimately contributing to better preventive and management strategies.

Methodology

This research utilized data from the first wave of the Longitudinal Ageing Study in India (LASI), conducted from April 2017 to

December 2018, as part of the Global Health and Retirement Study (HRS) in collaboration with the Ministry of Health and Family Welfare. LASI aimed to gather comprehensive information on the physical and mental health, social security, and family welfare of individuals aged 45 years and above. Employing a multi-stage stratified probability cluster sampling technique, LASI employed three-stage and four-stage sampling designs for rural and urban areas, respectively. De-identified data from the LASI wave 1 survey were used in this study, which obtained approval from the Indian Council of Medical Research (ICMR) and the institutional review board at the International Institute for Population Sciences, Mumbai, India. Informed consent was obtained from all participants prior to the survey (54). The study sample consisted of 72,250 respondents, of which 58,850 individuals aged 45 years and above (comprising 27,230 males and 31,620 females) formed the analytical sample for this investigation.

Outcome variable

This study focused on vision issues prevalent among older adults. Participants were asked self-reported questions regarding their eye or vision health, including whether they had been diagnosed with any eye or vision problems in one or both eyes. Those who answered affirmatively were then queried about the specific condition they were diagnosed with, including options such as presbyopia, cataract, glaucoma, myopia, hypermetropia, and others. For this study, individuals with diagnosed cataract problems were specifically selected for analysis.

Predictor variable

Self-reported morbidity status served as the basis for estimating the prevalence of diabetes. Participants were asked if a healthcare professional had ever diagnosed them with diabetes. Their responses were coded as "1" for yes and "0" for no. This coding allowed for the examination of the relationship between diabetes, considered as the primary predictor, and the chosen eye problems among older adults in India.

Control variables

The control variables included gender age groups (45– 54, 55–64, 65-74 and 75+ years), gender (male and female), education level (no schooling, completed primary, completed secondary, and higher than secondary), working status (never worked, currently working and not working), marital status (currently married, widowed, Others (divorced/separated/deserted/others)), residence (rural and urban), religion (Hindu, Muslim, Christian, and Others), caste (Scheduled caste (SC), Scheduled Tribes (ST), Other Backword Caste (OBC), and others), monthly per capita consumption expenditure (MPCE) quintile class of the individual (poorest, poorer, middle, richer, and richest), region (North, Central, East, Northeast, West and South), smoking tabacco (never, former and current), chewing tobacco (nver, former and current), alcohol use (no and yes), body mass index (BMI) (normal, underweight and overweight/obese), physical inactivity (active and inactive), difficulty in activities of daily living (ADL) (no and yes), difficulty in instrumental activities of daily living (IADL) (no and yes) and hypertension (no and yes).

Statistical analysis

Descriptive statistics were utilized to analyze the study population, focusing on univariate statistical analysis. The observed prevalence of cataracts was assessed in relation to socio-economic and demographic factors through bivariate cross-tabulation analysis. Unadjusted and adjusted odds ratios were then calculated using binary logistic regression analysis within a multivariate context for each outcome variable.

RESULTS

The majority of the respondents belonged to the age group 45-54 years (34.9%), followed by 55-64 years (30.4%), 65-74 years (24.1%), and 75 years and above (10.6%). The respondents were almost evenly split between males (45.8%) and females (54.2%). Majority of the respondents had no formal education (50.7%). A little over one-fifth of the respondents had primary education, while only 16.2 % and 9.8% had secondary and higher than secondary education, respectively. Around half of the respondents were currently working (47.1%), while a little over one-fourth had never worked (26.1%) and were currently not working (26.8%). The majority of participants are currently married (73.8%), followed by widowed (23.4%), and a smaller percentage were divorced, separated, or with other marital status (2.8%). An overwhelming 70% of the respondents were from the rural areas. The majority of respondents belonged to Hindu (82.6%) religion, OBC (45.6%) caste group and the Eastern region (23.8%). Eighty-three percent of the respondents had never smoked tobacco, while 3.8% were former smokers, and 13.5% were current smokers. A majority of the respondents had never chewed tobacco (76.5%) or consumed alcohol (84.9%), had had a normal BMI (51.5%), were physically active (65.81%) and did not report difficulty in ADL (84.5%) or IADL (63.5%). Twenty-seven percent of the respondents were diagnosed with hypertension, while 11.92% were diagnosed with diabetes (Table 1).

The prevalence of cataracts increased with age, with higher rates among older age groups, ranging from a lowest of 3.4% in the 45-54 age to a highest of 32% in the age group 75 years and above. Females (15.1%) had a slightly higher prevalence of cataracts than males (12.9%). The prevalence of cataracts decreased with the increase in educational qualification, ranging from a highest of 14.7% among those with no formal education to a lowest of 10.7% among those with higher than secondary education. The respondents who were currently not working had the highest prevalence of cataracts (22.6%), while those who were currently working (8.3%) had the lowest prevalence. Widowed respondents had the highest prevalence of cataracts (23.0%), followed by those with other marital status (12.3%) and currently married individuals (11.4%). Urban residents had a higher prevalence of cataracts (17.3%) than rural residents (12.7%). Muslims have the highest prevalence of cataracts (15.4%), followed by Hindus (14.1%), Christians (10.4%), and others (12.1%). Individuals belonging to the Others caste groups had the highest prevalence of cataracts (16.0%). Individuals in the West region have the highest prevalence of cataracts (20.4%). Former smokers (19.3%) and smokeless tobacco users (17%) had higher prevalence rates of cataracts compared to their counterparts. Respondents who consumed alcohol (11.8%) had a lower prevalence of cataracts as compared to the non-consumers of alcohol (14.5%). Respondents who were underweight (15.6%), physically inactive (17.8%), with difficulty in ADL (20.7%) and IADL (18.7%) had a higher prevalence of cataracts as compared to their counterparts (Table 2).

Table 3 presents the multivariable logistic estimates for cataracts. The unadjusted odds ratio (UOR) for diabetes revealed a statistically significant relation with cataracts, indicating that individuals with diabetes had 1.83 times higher odds (95% CI: 1.61 - 2.08) of having cataracts compared to those without diabetes. After adjusting for other covariates, the adjusted odds ratio (AOR) remained significant, indicating that individuals with diabetes had 1.31 times higher odds (95% CI: 1.12 - 1.53) of having cataracts compared to those without diabetes. Similarly, the UOD for hypertension showed a statistically significant relation with cataract, with individuals having hypertension exhibiting 1.86 times higher odds (95% CI: 1.70 - 2.04) of having cataract compared to those without hypertension. After adjusting for other covariates, the AOR remained significant, indicating that individuals with hypertension had 1.30 times higher odds (95% CI: 1.18 - 1.44) of having cataract compared to those without hypertension. When it comes to control variables, age groups exhibited a significant relation with cataract. Respondents in the 55-64 age group had 3.4 times higher odds (95% CI: 2.98 - 3.89), those in the 65-74 age group had 7.08 times higher odds (95% CI: 6.08 - 8.24), and those aged 75 and above had 9.64 times higher odds (95% CI: 8.05- 11.55) of having cataract as compared to those in the age group 45-54 years. Among education levels, only primary education showed a significant association with cataract, with individuals having primary education demonstrating 1.13 times higher odds (95% CI: 1.00 - 1.27) of having cataract compared to those with no education. Currently working individuals exhibited a significant association with cataract, showing 0.80 times lower odds (95% CI: 0.69 - 0.94) of having cataract compared to those who never worked. Being widowed showed a significant association with cataract, with widowed individuals demonstrating 1.20 times higher odds (95% CI: 1.07 - 1.36) of having cataract compared to those currently married. Urban residence exhibited a significant association with cataract, with urban residents showing 1.35 times higher odds (95% CI: 1.21 - 1.51) of having cataract compared to rural residents. Only individuals with "Others" religion demonstrated a significant association with cataract, showing 0.76 times lower odds (95% CI: 0.60 - 0.96) of having cataract compared to Hindus. ST individuals showed a significant association with cataract, demonstrating 0.57 times lower odds (95% CI: 0.47 - 0.69) of having cataract compared to scheduled caste individuals.

Central, East and West regions exhibited higher odds of having cataract as compared to those from the Northen region. Former users of smoking tobacco showed a significant association with cataract, demonstrating 1.22 times higher odds (95% CI: 1.01 - 1.47) of having cataract compared to those who never smoked. Current users of chewing tobacco demonstrated a significant association with cataract, showing 0.89 times lower odds (95% CI: 0.80 - 1.00) of having cataract compared to those who never chewed tobacco. Gender, economic status, alcohol use, physical inactivity, BMI along with difficulty in ADL and IADL did not exhibit a significant association with cataract.

DISCUSSION AND CONCLUSION

Cataract remains a prominent concern in developing nations like India, with its prevalence on the rise, emphasizing the need for heightened attention due to its potential to cause blindness. This study represents an initial endeavor to investigate the link between diabetes and the susceptibility to cataracts among older individuals. The findings offer valuable insights into the prevalence and factors associated with cataract among individuals aged 45 years and above. The study reveals a clear association between certain demographic, socio-economic, lifestyle, and health-related factors with the prevalence of cataract, which is accordant with previous study (55,56). The unadjusted odds ratio revealed individuals with diabetes had 1.83 times higher odds of cataract compared to those without diabetes. Even after adjusting for other covariates, the adjusted odds ratio remained significant at 1.31 times higher odds. This highlights the substantial impact of diabetes as an independent risk factor for cataract development, emphasizing the importance of comprehensive diabetic management strategies to mitigate ocular complications and improve eye health outcomes (57).

Age emerges as a significant predictor of cataract, with increasing age groups exhibiting higher odds of developing cataract compared to the reference group. This aligns with existing literature highlighting age as a primary risk factor for cataract development (58). Additionally, gender, education, marital status, urban residence, religion, caste, region, and tobacco use exhibit varying degrees of association with cataract prevalence. Interestingly, while certain demographic factors like age, education, marital status, and residence demonstrate significant associations with cataract, others, such as gender and socio-economic status, do not exhibit substantial associations. This suggests a complex interplay of factors influencing cataract prevalence, including demographic and lifestyle-related elements.

The observed associations between cataract prevalence and tobacco use highlight the importance of lifestyle factors in eye health. Former users of smoking tobacco exhibit higher odds of cataract, emphasizing the detrimental effects of tobacco on ocular health (59). However, current smokers do not show a significant association, suggesting potential complexities in the relationship between smoking and cataract development. Similarly, the association between chewing tobacco and decreased odds of cataract warrants further investigation. This unexpected finding contradicts existing evidence linking tobacco use to adverse eye health outcomes. Understanding the underlying mechanisms behind this association could provide valuable insights into cataract prevention and management strategies.

Furthermore, the study identifies diabetes and hypertension as significant risk factors for cataract, even after adjusting for other covariates. This underscores the importance of systemic health management in preventing ocular complications, highlighting the need for comprehensive healthcare interventions targeting both systemic and ocular conditions among aging populations. To reduce the prevalence of cataracts, we should encourage people to come for regular check-ups, so that if there are any pre-symptoms of cataracts, we can prevent their progression at that point of time.

In conclusion, the longitudinal study on ageing in India sheds light on the multifaceted nature of cataract prevalence and its associated factors among individuals aged 45 years and above. The findings underscore the importance of considering demographic, socio-economic, lifestyle, and health-related factors in understanding cataract epidemiology. The study highlights the significance of age, diabetes, hypertension, education, marital status, residence, religion, caste, and tobacco use in influencing cataract prevalence. These findings provide valuable insights for policymakers, healthcare providers, and researchers in developing targeted interventions and public health strategies aimed at reducing the burden of cataract and improving eye health outcomes among aging populations.

Tables

Table 1. Sample characteristics individuals aged 45 years and above, LASI, 2017-18, India

Background Characteristics	N	(%)
Age groups		
45-54	21,832	34.9
55-64	18,273	30.4
65-74	13,071	24.1
75+	5,674	10.6
Gender		
Male	27,230	45.8
Female	31,620	54.2
Education level		
No education	27,653	50.7
Primary	14,691	23.3
Secondary	10,876	16.2
Higher than secondary	5,630	9.8
Working status		
Never worked	16,114	26.1
Currently working	27,408	47.1
Currently not working	15,328	26.8
Marital status		
Currently married	44,077	73.8
Widowed	12,895	23.4
Others*	1,878	2.81
Place of residence		
Rural	38,535	69.9
Urban	20,315	30.1
Religion		
Hindu	43,183	82.6
Muslim	6,980	11.0
Christian	5,902	2.9
Others	2,785	3.5
Caste		
Scheduled Castes	9,915	19.5
Scheduled Tribes	10,308	8.6
Other Backward Classes	22,212	45.6
Others	16,415	26.4
MPCE quintile		
Poorest	11,600	21.1
Poorer	11,891	21.3
Middle	11,896	20.4
Richer	11,875	19.7
Richest	11,588	17.6
Region		
North	10,831	12.7
Central	8,082	21.0
East	10,647	23.8
Northeast	7,649	3.4
West	7,707	15.8
South	13,934	23.3
Smoking tobacco		
Never	48,015	82.7
Former	2,678	3.76
Current	8,157	13.54
Chewing tobacco		
Never	45,922	76.5
Former	1,446	2.4
Current	11,482	21.1
Alcohol use		
No	48,248	84.9
Yes	10,602	15.1
BMI categories		
Normal	30,761	51.5
Underweight	10,915	21.4
Overweight/obese	17,174	27.1
Physical inactivity		
Active	38,013	65.9
Inactive	20,837	34.2
Difficulty in ADL		
No	50,886	84.5
Yes	7,964	15.5

Difficulty in IADL		
No	39,746	63.5
Yes	19,104	36.5
Hypertension		
No	42,053	72.9
Yes	16,797	27.0
Diabetes		
No	51,351	88.1
Yes	7,499	11.9
Total	**58,850**	**100.0**

Note:* includes divorced/separated/deserted

Table 2. Prevalence of cataract among individuals aged 45 years and above, LASI, 2017-18, India

Background characteristics	N	Cataract
		% (95%CI)
Age groups		
45-54	730	3.4 (3.1,3.8)
55-64	1,912	11.9 (11.1,12.8)
65-74	2,896	24.5 (23.1,26.0)
75+	1,705	32.0 (29.8,34.2)
Gender		
Male	3,061	12.9 (12.3,13.6)
Female	4,182	15.1 (14.4,15.9)
Education level		
No education	3,540	14.7 (13.9,15.4)
Primary	1,897	15.4 (14.4,16.4)
Secondary	1,199	12.5 (11.5,13.7)
Higher than secondary	607	10.7 (9.2,12.4)
Working status		
Never worked	2,257	15.9 (14.7,17.1)
Currently working	1,865	8.3 (7.7,8.9)
Currently not working	3,121	22.6 (21.6,23.7)
Marital status		
Currently married	4,425	11.4 (10.9,11.9)
Widowed	2,623	23.0 (21.6,24.5)
Others	195	12.3 (9.5,15.8)
Place of residence		
Rural	4,199	12.7 (12.2,13.3)
Urban	3,044	17.3 (16.1,18.6)
Religion		
Hindu	5,664	14.1 (13.6,14.7)
Muslim	968	15.4 (14.0,16.9)
Christian	340	10.4 (8.1,13.2)
Others	271	12.1 (10.1,14.4)
Caste		
Scheduled Castes	1,213	13.6 (12.6,14.8)
Scheduled Tribes	633	8.1 (7.0,9.3)
Other Backward Classes	3,030	14.3 (13.5,15.2)
Others	2,367	16.0 (15.1,16.9)
MPCE quintile		
Poorest	1,429	13.9 (12.9,15.0)
Poorer	1,418	14.3 (13.3,15.5)
Middle	1,451	13.9 (12.8,15.1)
Richer	1,509	14.6 (13.4,15.9)
Richest	1,436	13.7 (12.5,14.9)
Region		
North	1,208	11.3 (10.5,12.2)
Central	1,004	13.8 (12.8,14.9)
East	1,418	13.0 (12.1,13.9)
Northeast	379	8.2 (7.2,9.3)
West	1,354	20.4 (19.0,21.9)
South	1,880	13.6 (12.3,15.0)
Smoking tobacco		
Never	5,965	14.2 (13.7,14.8)
Former	465	19.3 (17.1,21.8)
Current	813	11.8 (10.8,13.0)
Chewing tobacco		
Never	5,743	14.3 (13.7,14.9)
Former	207	17 (13.8,20.7)
Current	1,293	13 (12.1,14.0)
Alcohol use		
No	6,182	14.5 (13.9,15.1)
Yes	1,061	11.8 (10.7,13.0)
BMI categories		
Normal	3,659	14.0 (13.4,14.7)
Underweight	1,499	15.6 (14.5,16.8)
Overweight/obese	2,085	13.1 (12.1,14.2)
Physical inactivity		
Active	4,110	12.2 (11.5,12.8)
Inactive	3,133	17.8 (17.0,18.7)
Difficulty in ADL		
No	5,641	12.9 (12.4,13.4)
Yes	1,602	20.7 (19.3,22.2)
Difficulty in IADL		
No	3,849	11.5 (10.9,12.1)
Yes	3,394	18.7 (17.7,19.6)
Hypertension		
No	4,272	11.9 (11.3,12.5)
Yes	2,971	20.1 (18.9,21.3)
Diabetes		
No	5,723	13.1 (12.6,13.6)
Yes	1,520	21.6 (19.6,23.7)
Total	**7,243**	**14.1 (13.6,14.6)**

Table 3. Multivariable logistic estimates for cataract among individuals aged 45 years and above, LASI, 2017-18, India

Background Characteristics	UOR 95% CI	AOR 95% CI
Diabetes		
No	Ref.	Ref.
Yes	1.83*** (1.61 2.08)	1.31*** (1.12 1.53)
Hypertension		
No	Ref.	Ref.
Yes	1.86*** (1.70 2.04)	1.30*** (1.18 1.44)
Age groups		
45-54		Ref.
55-64		3.40*** (2.98 3.89)
65-74		7.08*** (6.08 8.24)
75+		9.64*** (8.05 11.55)
Gender		
Male		Ref.
Female		1.12 (0.98 1.28)
Education level		
No education		Ref.
Primary		1.13* (1.00 1.27)
Secondary		0.98 (0.80 1.20)
Higher than secondary		0.87 (0.71 1.07)
Working status		
Never worked		Ref.
Currently working		0.80** (0.69 0.94)
Currently not working		1.14 (0.99 1.30)
Marital Status		
Currently married		Ref.
Widowed		1.20** (1.07 1.36)
Others		1.20 (0.92 1.55)
Place of residence		
Rural		Ref.
Urban		1.35*** (1.21 1.51)
Religion		
Hindu		Ref.
Muslim		1.06 (0.93 1.21)
Christian		0.85 (0.65 1.12)
Others		0.76* (0.60 0.96)
Caste		
Scheduled Castes		Ref.
Scheduled Tribes		0.57*** (0.47 0.69)
Other Backward Classes		0.92 (0.81 1.05)
Others		0.97 (0.85 1.12)
MPCE quintile		
Poorest		Ref.
Poorer		1.04 (0.91 1.19)

Middle		1.02 (0.89 1.18)
Richer		1.06 (0.91 1.24)
Richest		1.04 (0.88 1.22)
Region		
North		Ref.
Central		1.44*** (1.26 1.65)
East		1.29*** (1.13 1.48)
Northeast		0.93 (0.77 1.12)
West		2.13*** (1.85 2.44)
South		1.16 (0.99 1.36)
Smoking tobacco		
Never		Ref.
Former		1.22* (1.01 1.47)
Current		0.94 (0.81 1.09)
Chewing tobacco		
Never		Ref.
Former		0.85 (0.65 1.12)
Current		0.89* (0.80 1.00)
Alcohol use		
No		Ref.
Yes		1.06 (0.91 1.23)
BMI categories		
Normal		Ref.
Underweight		1.01 (0.91 1.13)
Overweight/obese		0.89 (0.79 1.01)
Physical inactivity		
Active		Ref.
Inactive		1.03 (0.93 1.13)
Difficulty in ADL		
No		Ref.
Yes		0.95 (0.84 1.07)
Difficulty in IADL		
No		Ref.
Yes		1.12 (1.00 1.26)

Note: Ref- Reference category

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