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Prevalence of chronic disease in older adults in multitier eye-care facilities in South India: Electronic medical records-driven big data analytics report

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Purpose: To study the prevalence of systemic conditions in older adults, either self-reported or discovered during routine eye examinations, at multitier eye-care facilities over the past decade, and to explore their association with vision and common ocular disorders, including cataract, glaucoma, and retinopathy. **Methods:** Retrospective review of a large data set compiled from the electronic medical records of patients older than 60 years who presented to an eye facility of a multitier ophthalmology network located in 200 different geographical locations that included urban and rural eye-care centers spread across four states in India over a 10-year period. **Results:** 618,096 subjects aged 60 or older were identified as visiting an eye facility over the 10-year study period. The mean age of the study individuals was 67·28 (±6·14) years. A majority of older adults (66·96%) reported being free of systemic illnesses. Patients from lower socioeconomic status had a lower prevalence of chronic systemic disease, but the presenting vision was poorer. Hypertension (21·62%) and diabetes (18·77%) were the most commonly reported chronic conditions in patients who had concomitant systemic illness with visual concerns. **Conclusion:** The prevalence of chronic systemic illnesses in older adults presenting to multitier eye-care facilities is relatively low, except in those with diabetic retinopathy. These observations suggest a need to include active screening for common chronic diseases in standalone eye-care facilities to achieve a more accurate assessment of chronic disease burden in the older population.

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India is facing unprecedented demographic changes that are mirrored worldwide. Due to increasing longevity and reduced fertility, the population of those aged 60 and older is projected to nearly double over the next 30 years from 10% in 2020 to 19% in 2050. The proportion of people aged 75 and above is expected to increase by 340% by 2050.[1] The proportion of older adults who are considered the "oldest old," aged 80 and older, is also rising significantly. This growth in the older population has significant implications for public health, related health care costs, and public policy.

With increasing age, visual impairment and blinding disorders occur with increasing frequency. The vision-limiting ocular disorders that ensue with aging often reflect the concurrence of chronic conditions and overall health status. Visual impairment adversely impacts health-related quality of life and ability to live independently,[2] increases mortality risk[3,4] and falls,[5] and commands significant community support services.[6]

The systemic conditions that afflict older adults presenting with visual problems are poorly studied in India. Understanding the systemic disease profile may help to identify risk earlier, plan effective intervention, and provide appropriate rehabilitation. Additionally, a closer focus on the aging population can reveal opportunities to better understand, expand, and impact the outcomes of therapies for conditions causing visual impairment. As older populations are heterogeneous in terms of health and function, a better understanding of the prevalence of systemic conditions and their relationship with visual impairment and treatment outcomes may help stratify approaches to older adults and better-individualized eye care.

This study aimed to describe the distribution of systemic conditions that were either self-reported or discovered during routine eye examinations at multitier eye-care facilities over a 10-year period and explore their association with common ocular disorders, including cataract, glaucoma, and retinopathy.

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Methods

This retrospective, observational study included patients older than 60 years who presented to an eye facility that is part of a multitier ophthalmology network located in 200 different geographical locations spread across four Indian states (Telangana, Andhra Pradesh, Odisha, and Karnataka) from August 2010 through April 2020. Though most patients belonged to the abovementioned states, there was representation from all corners of India [Fig. 1]. The ethics approval was waived given the retrospective nature of the study.

All patients filled out a standard consent form for electronic data privacy at the time of registration. None of the identifiable parameters of patient information were used in this analysis of the data set. Institutional ethics committee approval was waived given the retrospective nature of the study. The study followed the Tenets of the Declaration of Helsinki for human research.

The clinical data of each patient who underwent a comprehensive ophthalmic examination was entered into a browser-based electronic medical records system (eyeSmart EMR) by uniformly trained ophthalmic personnel and supervised by an ophthalmologist using a standardized template.[7] The hospitals at all levels of the pyramid used the same EMR software, and the data was sourced from the central server. The database was queried for all patients equal to or greater than 60 years at presentation, and the patients were included in the study as cases. The data points extracted for the study included demographic details, socioeconomic status (based on their ability to pay for the care), systemic illnesses detected on routine medical workup, self-reported systemic illnesses, ocular disease distribution, treatment outcomes, and indications for surgery. The systemic disease history and duration of the disease were analyzed using the finite state modeling algorithm.[8]

All patients received a comprehensive ocular workup at each clinic visit. Internist evaluation of systemic status was done before any intraocular surgical procedure and when an eye disease pointed to an underlying systemic condition. We defined a person as diabetic when their current plasma glucose level was ≥126 mg/dL, or 2h post-load glucose was ≥200 mg/dL, or random plasma glucose was ≥200 mg/dL with hyperglycemia symptoms, or the HbA1c was ≥6·5%.[9] Hypertension was defined as per the Indian norms specified by the National Health Mission as a systolic blood pressure of ≥140 mmHg and a diastolic blood pressure of ≥90 mmHg.[10] Cardiovascular disease (chiefly coronary artery disease) was defined using the World Health Organization definition.[11] Diagnosis of asthma, thyroid disorder, and rheumatoid arthritis was based on the medical history of prior or continued treatment for the individual diseases. A past or present history of treatment with anti-tubercular treatment for pulmonary tuberculosis and any event of cerebrovascular ischemic event were noted. The subjects who were registered under government social security programs and received eye care at no cost were considered as low socioeconomic status (SES). The patients who paid out of pocket for their eye care were considered high SES.

Data were retrieved from the electronic medical record database and sorted into a Microsoft Excel (version 16.40) spreadsheet. The descriptive statistics of mean, median, range, and standard deviation were employed to characterize the study population. Pivot tables with frequency data for different variables were constructed using Microsoft Excel. Categorical data were described in proportions and compared by Chi-square test at $\alpha = 0.05$.

Results

In the study period, 618,096 subjects aged 60 or older were included for analysis. The mean age of the study individuals was 67.28 (±6.14 years); 53·48% (n = 330557) were males. Close to three-quarters (73.79%) of the cohort were in the 60–70-year age bracket, with the hospital visits diminishing with increasing age [Table 1].

A majority of subjects (66.96%; n = 413906) reported being free of systemic illnesses. Hypertension and diabetes were the most commonly reported chronic conditions in patients who had concomitant systemic illness with visual concerns. Patients belonging to higher SES reported concomitant systemic illnesses more often than people in lower SES. This difference was significant for chronic conditions related to lifestyle (DM, hypertension, CAD, and stroke). Infection with tuberculosis, however, was more common in patients in the lower socioeconomic group [Table 2].

Table 1: Age distribution of older adults visiting the eye-care center

Age category	Hospital visit for visual complaints
60-70 years	73.79%
71-80 years	22.23%
81-90 years	3.73%
91-100 years	0.25%

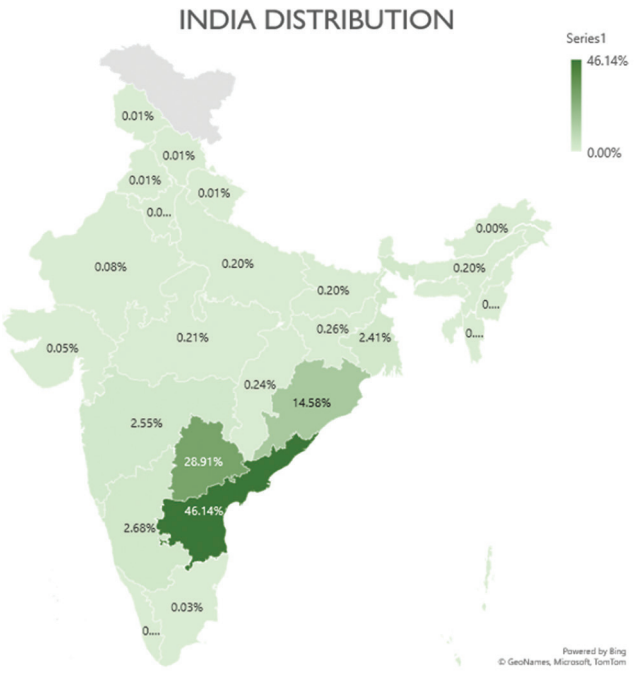

Figure 1: Representation of patients from various parts of India

Table 2: Prevalence of Chronic Conditions in Older Adults

Systemic disease	Overall Prevalence	Prevalence in high SES	Prevalence in low SES	*P*
Diabetes Mellitus	18.77%	25·77	7.75	<0.001
Hypertension	21.62%	27·66	12.10	<0.001
Coronary artery disease	3.49%	4·69	1.59	<0.001
Stroke	0.75%	0·92	0.49	<0.001
Asthma	2.13%	2.14	2.11	0.316
Rheumatoid Arthritis	0.06%	0.09	0.00	<0.001
Hyperthyroidism	0.04%	0.07	0.00	<0.001
Hypothyroidism	0.10%	0.17	0.01	<0.001
Tuberculosis	0.21%	0.13	0.32	<0.001

Though nearly half of the subjects (47%) seen at an eye facility came from a rural area, the majority (61%) belonged to higher SES. There was a seasonal pattern of hospital visits; there were fewer visits in April and May and a peak in July [Fig. 2].

Among the various eye ailments that were detected, cataract (76.73%) formed the major ocular disorder of this cohort, followed by glaucoma (6.38%), diabetic retinopathy (4.1%), and age-related macular degeneration (1.8%). The majority of patients with cataract, glaucoma, and ARMD did not report the presence of chronic diseases [Fig. 3]. The prevalence of diabetic retinopathy among older adults with diabetes was 21.84%. The systemic diseases detected concurrently with cataract is shown in Table 3. Patients who reported TB and asthma had a higher incidence of cataract.

The majority of older adults with concurrent systemic illnesses sought eye care when the vision loss was in the mild to moderate range (20/20 to 20/200). History of stroke and tuberculosis had a larger proportion of patients presenting with severe vision impairment [vision worse than 20/200; Fig. 4]. The mean presenting vision for patients in low SES was worse (OD 0.68; OS.0·70 – Snellen equivalent: 20/100) than the patients in high SES (OD 0.43; OS.0·42 – Snellen equivalent: 20/50).

Table 3: Cataract incidence in various systemic diseases

Systemic disease	Incidence of cataract in systemic disease	*n*	%
Diabetes Mellitus	81316	116039	70.08
Tuberculosis	1049	1274	82.34
Hypertension	98917	133605	74.04
Rheumatoid Arthritis	252	367	68.66
Asthma	10930	13161	83.05
Coronary artery disease	16523	21552	76.67
Hyperthyroidism	156	264	59.09
Hypothyroidism	429	644	66.61
Paralysis/Stroke	3498	4660	75.06

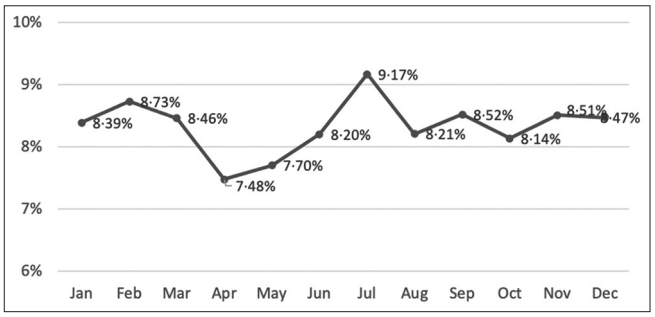

Figure 2: Variation in patient visits to the eye hospital in different months of the year

Discussion

Many chronic conditions increase in prevalence with age, which may influence the development of vision-limiting disorders, and impact vision overall, both at presentation and over time. However, the systemic diseases that are known to have a direct impact on vision, i.e. diabetes and hypertension, were found in a relatively smaller proportion of older adults in this study compared with national population-based studies.

The prevalence of hypertension, according to a recent nationwide study, was 29.7% in India.[12] However, with advancing age, the prevalence was much higher (51.5% for 65 and older subjects).[12] The low prevalence in our cohort (21.62%) may be attributed to the self-reported nature of the data. Conversely, it calls for active screening for hypertension in standalone eye-care facilities as systemic workup is not a routine in these centers. Several epidemiological studies have implicated hypertension in the causation of cataract.[13-17] Two-third (75.35%) of the subjects in our cohort with a history of hypertension had cataract. Hypertension is also known to worsen existing diabetic macular edema and cause retinal venous occlusions.

Similarly, among men older than 65 years, the crude prevalence of diabetes in India is reported to be 14%, which is closer to the prevalence in our cohort (18·77%).[18] The overall prevalence of DR in our cohort was 4.1%, while the prevalence of DR in patients with DM was 21.84%. This is consistent with prior studies of the prevalence of DR among people with diabetes in India, showing a range from 9.6% to 28.2%.[19-26] Three population-based studies, the Beaver Dam Eye Study, Wisconsin Epidemiological Study of Diabetic Retinopathy, and the Barbados Eye Study, have documented the association between DM and cataract.[27-30] In our cohort 70% of the patients with diabetes had cataract. One in five subjects presenting with cataract, glaucoma, and ARMD had associated hypertension and diabetes. Hence, it is imperative to actively screen for diabetes and hypertension on a routine basis in all 65-and-older subjects presenting with visual symptoms.

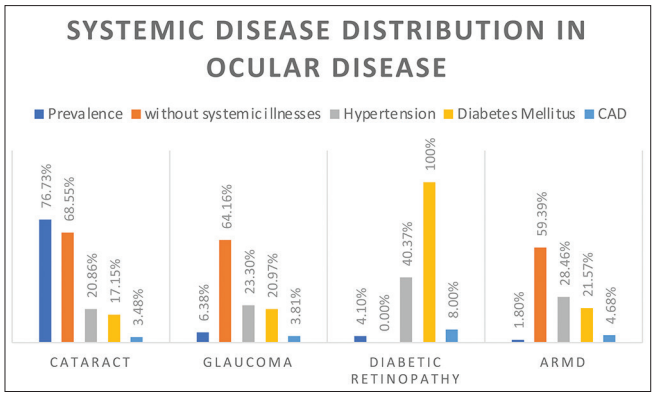

Figure 3: Systemic disease distribution in ocular conditions affecting older adults

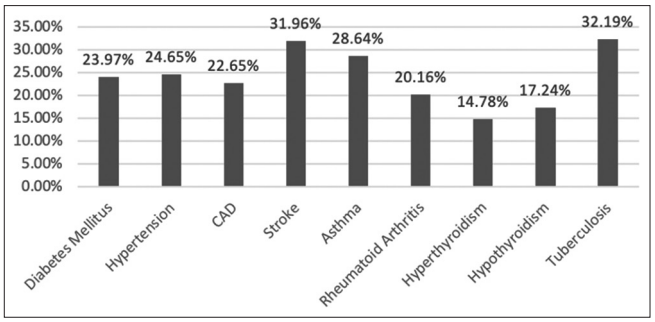

Figure 4: Distribution of severe vision impairment in various systemic diseases of the elderly

There was a lower prevalence of CAD in our cohort (3.5%). However, the age-adjusted prevalence of CAD in participants >45 years was 18.7% in a cross-sectional community-based study in Kerala.[31] This could be a limitation of the hospital-based data. Nevertheless, in a systematic review of CAD prevalence from India, Ahmad *et al*.[32] commented that none of the studies conformed to the requirements of a high-quality epidemiologic study.

SES 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 and poorer health outcomes. Socioeconomic factors influencing the development and progression of many clinical processes have been well documented.[33,34] In India, those in a lower SES have a lower life expectancy and higher rates of chronic illness, and may fail to access health care for prevention and treatment of early disease due to unaffordable out-of-pocket expenses.[35] In this study, 38.8% of the subjects belonged to low SES. The vision at presentation and at the last follow-up visit followed a socioeconomic gradient. Patients in high SES had better vision at presentation despite chronic illnesses being more prevalent. Higher levels of education, better information on health, and easier access to health care may be the reason for this trend. Low education in lower SES 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 how and where to obtain care, either through formal channels or social networks. The results of this study may help develop strategies to focus attention on the older adults belonging to low SES as they are at higher risk of losing vision. Community outreach programs to detect eye diseases in rural and urban resettlement colonies may mitigate the problem.

The strength of this study is the exceptionally large patient sample representing the far corners of the country. The largest Indian study to date (longitudinal aging study in India - LASI) from 35 states and union territories of India included only 31,464 elderly persons of age 60 and above.[1] The large data set helped estimate the common eye and systemic conditions prevalent at a hospital setting that could be compared with the population-based prevalence studies. There were a few notable limitations in this study. First, data were retrospectively collected from a large dataset. Second, several variables, including the presence of chronic conditions, depended on self-report and may be inaccurate. Our study involved patients who presented to an eye facility for evaluation of an eye problem. Hence, it may not capture older adults with asymptomatic systemic disease or represent the general population.

Conclusion

To our knowledge, this is the largest study in India to date (>600,000 patients) that attempts to show correlations between major chronic diseases and known precursors of blindness among the elderly. Cataract was the most common ocular condition in older adults that affected vision. The prevalence of chronic systemic illnesses in older adults presenting to eye hospitals was relatively low in this cohort of elderly subjects. This highlights the need for internist workup of all older adults visiting an eye-care facility because chronic diseases when self-reported were found lower than the national prevalence. We recognize that self-reported data among those who are economically disadvantaged may not accurately capture many cases of chronic disease, especially in asymptomatic conditions such as hypertension and early cardiovascular disease. Nevertheless, confirmatory data on both diabetes and tuberculosis, as well as the large sample size, suggest that lifestyle differences between the two groups are mitigating factors that should be considered for predicting a higher potential of vision impairment. This work suggests an opportunity to increase early outreach and accessibility to eye care to those in lower socioeconomic strata. The study observations may inform planning and allocation of health care resources while setting up elderly care service in a standalone ophthalmic hospital.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. LASI India report – 2020, Executive Summary. International Institute for Population Sciences. Available from: https://www.iipsindia.ac.in/content/lasi-publications.
2. Wang JJ, Mitchell P, Smith W. Vision and low self-rated health: The Blue Mountains eye study. Invest Ophthalmol Vis Sci 2000;41:49-54.
3. Taylor HR, McCarty CA, Nanjan MB. Vision impairment predicts five-year mortality. Trans Am Ophthalmol Soc 2000;98:91-6.
4. Lee DJ, Gomez-Marin O, Lam BL, Zheng DD. Visual acuity impairment and mortality in US adults. Arch Ophthalmol 2002;120:1544-5.
5. Ivers RQ, Cumming RG, Mitchell P, Attebo K. Visual impairment and falls in older adults: The Blue Mountains eye study. J Am Geriatr Soc 1998;46:58-64.
6. Wang JJ, Mitchell P, Smith W, Cumming RG, Attebo K. Impact of visual impairment on use of community support services by elderly persons: The Blue Mountains eye study. Invest Ophthalmol Vis Sci 1999;40:12-9.
7. Das AV, Kammari P, Vadapalli R, Basu S. Big data and the eyeSmart electronic medical record system-An 8-year experience from a three-tier eye care network in India. Indian J Ophthalmol 2020;68:427-32.
8. Sai Prashanthi G, Deva A, Vadapalli R, Das AV. Automated categorization of systemic disease and duration from electronic medical record system data using finite-state machine modelling: Prospective validation study. JMIR Form Res 2020;4:e24490.
9. Diagnostic criteria for diabetes. In ICMR guidelines for management of type 2 diabetes 2018. Available from: https://main.icmr.nic.in/sites/default/files/guidelines/ICMR_GuidelinesType 2diabetes2018_0.pdf. [Last accessed on 2021 Jul 2].
10. Hypertension. In Standard treatment guidelines. Available from: http://nhm.gov.in/images/pdf/guidelines/nrhm-guidelines/stg/hypertension.pdf. [Last accessed on 2021 Jul 2].
11. World Health Organization. Prevention of Cardiovascular Disease: Guidelines for Assessment and Management of Total Cardiovascular Risk. World Health Organization; Geneva, Switzerland 2007. https://apps.who.int/iris/handle/10665/43685.
12. Ramakrishnan S, Zachariah G, Gupta K, Shivkumar Rao J, Mohanan PP, Venugopal K, *et al*. Prevalence of hypertension among Indian adults: Results from the great India blood pressure survey. Indian Heart J 2019;71:309-13.
13. Tsai SY, Hsu WM, Cheng CY, Liu JH, Chou P. Epidemiologic study of age-related cataracts among an elderly Chinese population in Shih-Pai, Taiwan. Ophthalmology 2003;110:1089-95.
14. Shah SP, Dineen B, Jadoon Z, Bourne R, Khan MA. Lens opacities in adults in Pakistan: Prevalence and risk factors. Ophthalmic Epidemiol 2007;14:381-9.
15. Rim TH, Kim MH, Kim WC, Kim TI, Kim EK. Cataract subtype risk factors identified from the Korea national health and nutrition examination survey 2008-2010. BMC Ophthalmol 2014;14:4.
16. Nirmalan PK, Robin AL, Katz J, Tielsch JM, Thulasiraj RD, Krishnadas R, *et al*. Risk factors for age related cataract in a rural population of Southern India: The Aravind comprehensive eye study. Br J Ophthalmol 2004;88:989-94.
17. Mukesh BN, Le A, Dimitrov PN, Ahmed S, Taylor HR, McCarty CA. Development of cataract and associated risk factors. Arch Ophthalmol 2006;124:79-85.
18. 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;178:363-72.
19. Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Rao GN. Population based assessment of diabetic retinopathy in an urban population in Southern India. Br J Ophthalmol 1999;83:937-40.
20. Krishnaiah K, Das T, Nirmalan PK, Shamanna BR, Nutheti R, Rao GN, *et al*. Risk factors for diabetic retinopathy: Findings from the Andhra Pradesh eye disease study. Clin Ophthalmol 2007;4:475-82.
21. Narendran V, John RK, Raghuram A, Ravindran RD, Nirmalan PK, Thulasiraj RD. Diabetic retinopathy among self reported diabetics in southern India: A population based assessment. Br J Ophthalmol 2002;86:1014-8.
22. Mohan R, Premkumar S, Anitha B, Deepa R, Pradeepa R, Mohan V. Prevalence of diabetic retinopathy in urban India: The Chennai urban rural epidemiology study (CURES) I. Invest Ophthalmol Vis Sci 2005;46:2328-33.
23. Pradeepa R, Anjana RM, Unnikrishnan R, Ganesan A, Mohan V, Rema M. Risk factors for microvascular complications of diabetes among South Indian subjects with type 2 diabetes- the Chennai urban rural epidemiology study (CURES) eye study 5. Diabetes Technol Ther 2010;12:755-61.
24. Namperumalsamy P, Kim R, Vignesh TP, Nithya N, Royes J, Gijo T, *et al*. Prevalence and risk factors for diabetic retinopathy: A population-based assessment from Theni district, South India. Br J Ophthalmol 2009;93:429-34.
25. Raman R, Rani PK, Rachepalle SR, Gnanamoorthy P, Uthra S, Kumarmanickavel G, *et al*. Prevalece of diabetic retinopathy in India. Sankara Nethralaya diabetic retinopathy epidemiology and molecular genetics study (SN-DREAMS) report 2. Ophthalmology 2009;116:311-8.
26. Jonas JB, Nangia V, Khare A, Matin A, Bhojwani K, Kulkarni M, *et al*. Prevalence and associated factors of diabetic retinopathy in rural Central India. Diabetes Care 2013;36:e69.
27. Klein BE, Klein R, Lee KE. Diabetes, cardiovascular disease, selected cardiovascular disease risk factors, and the 5-year incidence of age-related cataract and progression of lens opacities: The Beaver Dam eye study. Am J Ophthalmol 1998;126:782-90.
28. Klein BE, Klein R, Wang Q, Moss SE. Older-onset diabetes and lens opacities: The Beaver Dam eye study. Ophthalmic Epidemiol 2005;2:49-55.
29. Klein BE, Klein R, Moss SE. Incidence of cataract surgery in the Wisconsin epidemiologic study of diabetic retinopathy. Am J Ophthalmol 1995;119:295-300.
30. Hennis A, Wu SY, Nemesure B, Leske C, Barbados Eye Studies Group. Risk factors for incident cortical and posterior subcapsular lens opacities in the Barbados eye studies. Arch Ophthalmol 2004;122:525-30.
31. Krishnan MN, Zachariah G, Venugopal K, Mohanan PP, Harikrishanan S, Sanjay G, *et al*. Prevalence of coronary artery disease and its risk factors in Kerala, South India: A community-based cross-sectional study. BMC Cardiovasc Disord 2016;16:12.
32. Ahmad N, Bhopal R. Is coronary heart disease rising in India? A systematic review based on ECG defined coronary heart disease. Heart 2005;91:719-25.
33. Pampalon R, Hamel D, Gamache P. A comparison of individual and area-based socio-economic data for monitoring social inequalities in health. Health Rep 2009;20:85-94.
34. Corsi DJ, Subramanian SV. Socioeconomic gradients and distribution of diabetes, hypertension, and obesity in India. JAMA Netw Open 2019;2:e190411.
35. Asaria M, Mazumdar S, Chowdhury S, Mazumdar P, Mukhopadhyay A, Gupta I. Socioeconomic inequality in life expectancy in India. BMJ Glob Health 2019;4:e001445.