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**Research Article**

# Prevalence and Patterns of Ocular Comorbidities among Geriatric Population Residents in Rural Eastern India: A Cross-Sectional Study

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**Abstract**

***Background***: With the increase in overall life expectancy, the number of people above 60 years old will increase globally from 1 billion in 2020 to 1.4 billion in 2050 and is expected to double by 2.1 billion by 2050 with an increase in age-related comorbidities. Age-related ocular co-morbidities are a major comorbidity. According to India's visual impairment and blindness data, cataracts and severe and moderate visual impairment are the most common cases. ***Objective***: To assess the ocular comorbidities among the geriatric population. ***Methods***: A community-based cross-sectional study was undertaken in the field practice area of the Rural Health Training Center (RHTC), Jamujhari, Khordha, affiliated with the Department of Community Medicine, IMS & SUM Hospital, Bhubaneswar. Stratified random sampling was done, and one stratum constituted three nearby adopted villages. Four strata were included to select the households, and the first household was selected randomly in each village. A socio-demographic profile and detailed clinical history were collected, and the required clinical examinations were conducted after obtaining consent. ***Results***: The prevalence of ocular morbidity (OM) was found to be 96.8%. Refractive error (RE) has the highest prevalence (86.52%), including prescription-corrected glasses users, whereas age-related macular degeneration (ARMD) and ectropion (EC) have the lowest prevalence (3.2%). ***Conclusions***: The study findings show a need for proactive management and earlier screening for better quality of life in the geriatric population.

***Keywords***: Cataract, Diabetic retinopathy, Geriatric patients, Ocular morbidity, Refractive error.

**انتشار وأنماط امراض العيون بين السكان المسنين المقيمين في المناطق الريفية في شرق الهند: دراسة مقطعية**

**الخلاصة**

**الخلفية**: مع زيادة متوسط العمر المتوقع الإجمالي، سيزداد عدد الأشخاص الذين تزيد أعمارهم عن 60 عاما على مستوى العالم من مليار شخص في عام 2020 إلى 1.4 مليار شخص في عام 2050، ومن المتوقع أن يتضاعف بمقدار 2.1 مليار شخص بحلول عام 2050 مع زيادة في الأمراض المصاحبة المرتبطة بالعمر. تعد أمراض العين المشتركة المرتبطة بالعمر من الأمراض المصاحبة الرئيسية. وفقا لبيانات ضعف البصر والعمى في الهند ، فإن إعتام عدسة العين وضعف البصر الشديد والمعتدل هي الحالات الأكثر شيوعا. **الهدف**: تقييم اعتلالات العيون واسبابها بين السكان المسنين في شرق الهند. **الطرائق**: أجريت دراسة مقطعية مجتمعية في مجال الممارسة الميدانية لمركز التدريب الصحي الريفي (RHTC) ، جاموجهاري ، خوردا، التابع لقسم طب المجتمع ، IMSومستشفى SUM ، بوبانسوار. تم أخذ عينات عشوائية طبقية ، وشكلت طبقة واحدة ثلاث قرى متباينة قريبة. تم تضمين أربع طبقات لاختيار الأسر، وتم اختيار الأسرة الأولى عشوائيا في كل قرية. تم جمع ملف تعريف اجتماعي وديموغرافي وتاريخ سريري مفصل وتم إجراء الفحوصات السريرية المطلوبة بعد الحصول على الموافقة. **النتائج**: وجد أن معدل انتشار المراضة العينية (OM) هو 96.8٪. الخطأ الانكساري (RE) لديه أعلى معدل انتشار (86.52٪) ، بما في ذلك مستخدمي النظارات المصححة بوصفة طبية ، في حين أن التنكس البقعي المرتبط بالعمر (ARMD) والشتر الخارجي (EC) لهما أدنى معدل انتشار (3.2٪). **الاستنتاجات**: تظهر نتائج الدراسة الحاجة إلى إدارة استباقية وفحص مبكر لتحسين نوعية الحياة لدى كبار السن.

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## INTRODUCTION

As life expectancy increases, the global population of individuals over 60 is projected to rise from 1 billion in 2020 to 1.4 billion by 2030, and it is expected to double to 2.1 billion by 2050 [1]. This results in the buildup of various types of molecular and cellular damage over time. This leads to numerous age-related complications, with the eye being one of the organs most affected. According to the latest data from the Blindness and Vision Impairment Collaborators and the World Health Organization (WHO), approximately 295 million people worldwide had moderate to severe vision impairment in 2020, with 43.3 million of them being blind. Corrected refractive errors and cataracts are not the primary causes of visual impairment, but cataracts account for the majority of blindness (45.5%), with glaucoma following closely behind [2]. Low- and middle-income countries harbor a staggering 90% of the

vision-impaired population [3]. Ocular diseases have an increased prevalence after the age of 60 [4]. The Indian scenario shows an estimated prevalence of 1.99% blindness and 9.85% visual impairment, with cataracts and refractive error being the top two causes [5]. With increasing lifestyle changes and habits, non-communicable diseases like diabetes, hypertension, etc. have also come up invariably. Diabetes is a chronic disease that can cause severe, costly, and life-threatening complications, reducing life expectancy [6]. While India is second to China in terms of the number of people with diabetes, 74.2 million people are estimated to have diabetes in India, and with the increasing population and prevalence of risk factors, it is estimated to reach 124.9 million by the end of 2045 [7]. The mean direct and indirect costs of diabetes for the whole of India were Rs 9996 and 5327 per annum, respectively [8]. The ocular complications of diabetes are many, but diabetic retinopathy has a prevalence of 12.5% in the Indian population [9]. In 2019, researchers conducted a district-wise analysis of visual impairment and blindness data for India, focusing on only 31 districts. Recent studies reveal that cataracts are the primary cause of visual impairment and blindness in individuals aged 50 years and older. Cataracts cause approximately 66.2% of blindness cases, 80.7% of severe visual impairments, and 70.2% of moderate visual impairments. This highlights the importance of regular eye check-ups, especially for those in the above-average age group. Good visual function is crucial for optimal orientation in functional and social life, which also influences physical and emotional well-being [10]. Therefore, with the above in mind, the objective of this study was to assess the ocular comorbidities among the geriatric population.

## METHODS

### *Study design and setting*

It is a field-based cross-sectional study conducted in the Rural Health Training Centre of IMS and SUM Hospital, situated in Jamujhari, Bhubaneswar. The duration of the study was from January 1 to June 31, 2022. The study population consisted of a geriatric population (>60 years old) residing in those localities for a minimum of 1 year and consenting to participate in the study. The present study excluded people who were either seriously ill, incapacitated by mental illness, or reluctant to participate.

### *Sample size*

The rural health training center's field practice area covered thirteen villages. Using the formula $n=Z^2PQ/d^2$, based on prevalence (P = 71.6%) from a previous study, the sample size was calculated to be 313, where Z equals 1.96 at a 95% confidence interval and a margin of error of 5% [11]. Stratified random sampling was done. Four strata were identified, and one stratum constituted three nearby adopted villages. For each village, we conducted a line listing of households and used simple random sampling methods to select the beginning house. After obtaining prior consent, we randomly selected a person >60 years old from the chosen houses as a study participant. The technique was reiterated until the necessary number of participants, i.e., approximately 80 people per stratum, was achieved. If the chosen house did not fulfill the inclusion criteria, or in the event of a non-response, we moved over to the next available house. After achieving the required sample size for the study, we escorted the participants to a planned village-wide eye screening camp, which our rural hospital staff organized every two weeks, and gathered the data in a systematic manner following the required clinical assessment.

### *Outcome measurements*

A predesigned and pretested, semi-structured questionnaire that comprised of questions about the study population's sociodemographic profile and health status. Post consent, the participant's complete history, clinical examination, previous clinical documents, and treatment history for the defined research group were acquired. The interview was conducted in the native language which lasted roughly 20 to 25 minutes apiece.

### Statistical analysis

After having been entered into Microsoft Excel, the acquired data were analyzed using appropriate statistical methods with SPSS V.25. A $p$-value < 0.05 indicated a significant association.

## RESULTS

A total of 282 geriatric participants were included in the study for analysis. Figure 1 represents the distribution of geriatric participants' gender in the form of a pie chart, with males (n=171) being more than females (n=111).

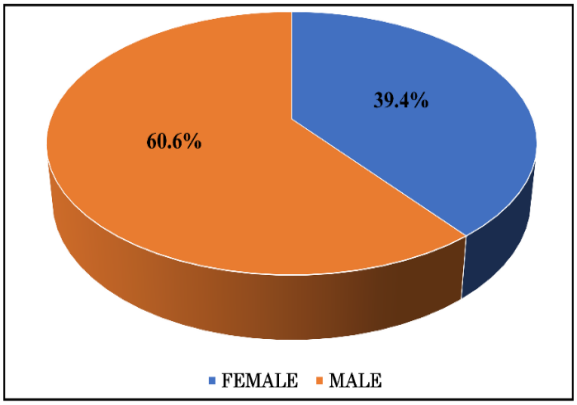


**Figure 1**: Pie chart depicting the gender distribution of participants (n=282).

Figure 2 represents the ocular morbidity (OM) with a prevalence of 96.8% and the factors contributing to it. Refractive error (RE) has the highest prevalence (86.52%) and includes prescription-corrected glass users, with age-related macular degeneration (ARMD) and ectropion (EC) being the least prevalent (3.2%) among them. 45.4% of participants are aged 60–69, followed by 32.3% aged 70–79 and 22.3% over 80 years.

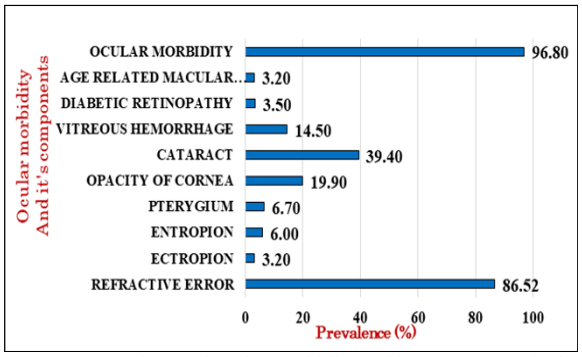


**Figure 2**: Prevalence of ocular morbidity and its components in the participants (n=282).

Table 1 shows the age-group distribution of the ocular morbidity components along with the history of diabetes mellitus type 2 and hypertension, or both. Age-related macular degeneration (ARMD) was only seen in the >80-year-old age group and diabetic retinopathy with cataracts was spread evenly across all age groups.

**Table 1**: Age-group distribution of the ocular morbidity components along with the history of diabetes mellitus type 2 and hypertension, or both

| Components | AGE (year) | | |
|---|---|---|---|
| | Number | mean±SD | *p*-value |
| DM | Present (60) | 68.88±7.80 | 0.016 |
| | Absent (222) | 71.74±8.22 | |
| New DM | New DM (09) | 65.67±4.153 | 0.007 |
| | Old DM (55) | 70.98±7.66 | |
| EC | Present (09) | 72.44±9.72 | 0.62 |
| | Absent (273) | 71.09±8.16 | |
| EN | Present (17) | 71.53±9.22 | 0.83 |
| | Absent (265) | 71.11±8.15 | |
| PT | Present (19) | 71.37±8.97 | 0.89 |
| | Absent (263) | 71.11±8.15 | |
| OC | Present (56) | 74.16±8.40 | 0.002 |
| | Not present (226) | 70.38±7.99 | |
| CT | Present (171) | 73.62±7.04 | <0.001 |
| | Absent(111) | 67.30±8.41 | |
| VH | Present(41) | 73.88±7.46 | 0.02 |
| | Absent(241) | 70.66±8.24 | |
| DR (n) | Present (10) | 73.40±10.16 | 0.37 |
| | Absent (272) | 71.05±8.13 | |
| ARMD | Present (09) | 86.44±5.03 | <0.001 |
| | Absent (273) | 70.63±7.79 | |
| OM | Present (273) | 71.41±8.18 | <0.001 |
| | Absent (09) | 62.78±2.68 | |

Values are presented as numbers and mean±SD. DM: diabetes mellitus; EC: ectropion; EN: entropion; PT: pterygium; OC: Opacity of cornea; VH: vitreous hemorrhage; DR: diabetic retinopathy; ARMD: age related macular degeneration; OM: Ocular morbidity.

Table 2 demonstrates the association between age and ocular morbidity components analyzed by appropriate test. Diabetes mellitus type 2 ($p$=0.016), corneal opacity (OC) ($p$=0.002), cataract (CT) ($p$<0.001), vitreous hemorrhage (VH) ($p$=0.02), age-related macular degeneration (ARMD) ($p$<0.001) and ocular morbidity ($p$<0.001) all show a significant association with age. Among the participants, there were some newly diagnosed DM participants (n=9) while there were also participants with a history of DM (n=51). Table 3 represents the age group distribution of newly diagnosed DM and participants with a history of DM. None of the other components showed any significant association with DM. Newly diagnosed participants also had no significant association with any components of ocular morbidity, as demonstrated in Table 4. The association between DM and components of ocular morbidity was shown accordingly using the Chi-Square or Fisher's exact test. The association between diabetic retinopathy (DR) and DM was found to be significant ($p$<0.001) with an Odds Ratio (OR) of 0.18 (CI: 0.14-0.23) in Table 5.

## DISCUSSION

According to a study by Mitchell *et al*. (2001), 143 patients (3.9%) had EC in either eye, and 101 patients (70.6%) had bilateral EC. Researchers discovered EC in 0.3% of individuals under 60 years old, 1.2% of those aged 60–69 years, 6.7% of those aged 70–79 years, and 16.7% of those aged 80 years or older [12]. However, in the present study, we found that 3.1% of those in the age group 60–69, 3.3% in the age group 70–79, and 3.2% in the age group more than 80 years of age had EC. Diabetes mellitus (DM) is a chronic metabolic disorder characterized by defects in either insulin action or secretion, or both, and is the hallmark of DM. It is known that DM can cause several ocular problems, which can impair one's quality of life. Our study did not find any significant association between the development of RE and DM ($p$=0.957). Sawada *et al*. conducted another study in Japan and found that the prevalence of myopia declines with age up to 70 to 79 years, but slightly increases in individuals 80 years and older. The prevalence of hyperopia follows a reverse trend, whereas that of astigmatism and anisometropia increases with age. [13] Chen *et al*. discovered a link between DM and a higher risk of developing myopia, with 44.1% of diabetics having myopia and 13% having high myopia [14]. In the current study, despite the odds of developing cataracts in diabetics being 1.23 times higher than those of non-diabetics, the association was deemed non-significant by the chi-square test performed ($p$= 0.403). There was a substantial tendency toward increased occurrence with age, but no sex influence. Klein *et al*. conducted a study in the USA and found that the likelihood of early cataracts surged among both sexes between the ages of 65 and 74, but decreased in those 75 and older. The incidence of late cataracts increased progressively with age [15]. A study by Alabdulwahhab *et al*. revealed a strong link between DR and cataracts (odds ratio: 2.464; 95% CI: 1.752–3.465, $p$<0.001) and an even stronger link when the variables were adjusted (odds ratio: 1.668; 95% CI: 1.135–2.451, $p$=0.009) [16]. Furthermore, researchers have implicated oxidative stress and the accumulation of advanced glycation end products (AGEs) in the pathogenesis of diabetic cataracts [17]. Diabetes is a risk factor for age-related cataracts, with a higher prevalence in females as age increases [18]. DR is one of the most common and serious ocular complications of DM, affecting up to 80% of people with type 1 DM and 40% of those with type 2 DM [19]. Several studies have explained the complicated pathophysiology of DR, which includes oxidative stress, inflammation, vascular endothelial dysfunction, and persistent hyperglycemia [20,21]. The current study found a significant association between ARMD and age ($p$<0.001).

**Table 2**: The association between age and ocular morbidity components

| Components | | Age group (year) n(%) | | |
|---|---|---|---|---|
| | | 60-69 | 70-79 | >80 |
| T2DM | DM | 34(26.6) | 17(18.7) | 9(14.3) |
| | No DM | 94(73.4) | 74(81.3) | 54(85.7) |
| | Total | 128 | 91 | 63 |
| Previous disease | No | 71(55.5) | 69(75.8) | 39(61.9) |
| | DM | 19(14.8) | 8(8.8) | 1(1.6) |
| | DM and HTN | 6(4.7) | 6(6.6) | 2(3.2) |
| | HTN | 32(25) | 8(8.8) | 21(33.3) |
| | Total | 128 | 91 | 63 |
| RE, REG | No RE | 36(28.1) | 2(2.2) | 0 |
| | RE | 76(59.4) | 68(74.7) | 41(65.1) |
| | REG | 16(12.5) | 21(23.1) | 22(34.9) |
| | Total | 128 | 91 | 63 |
| EC | No EC | 124(96.9) | 88(96.7) | 61(96.8) |
| | EC | 4(3.1) | 3(3.3) | 2(3.2) |
| | Total | 128 | 91 | 63 |
| EN | No EN | 121(94.5) | 87(95.6) | 57(90.5) |
| | EN | 7(5.5) | 4(4.4) | 6(9.5) |
| | Total | 128 | 91 | 63 |
| PT | NO PT | 121(94.5) | 83(91.2) | 59(93.7) |
| | PT | 7(5.5) | 8(8.8) | 4(6.3) |
| | Total | 128 | 91 | 63 |
| OC | No OC | 110(85.9) | 75(82.4) | 41(65.1) |
| | OC | 18(14.1) | 16(17.6) | 22(34.9) |
| | Total | 128 | 91 | 63 |
| VH | No VH | 114(89.1) | 79(86.8) | 48(76.2) |
| | VH | 14(10.9) | 12(13.2) | 15(23.8) |
| | Total | 128 | 91 | 63 |
| ARMD | No ARMD | 128(100) | 91(100) | 54(85.7) |
| | ARMD | 0 | 0 | 9(14.3) |
| | Total | 128 | 91 | 63 |
| DR | No DR | 125(97.7) | 88(96.7) | 59(93.7) |
| | DR | 3(2.3) | 3(3.3) | 4(6.3) |
| | Total | 128 | 91 | 63 |
| CT | CT | 53(41.4) | 71(78) | 47(74.6) |
| | No CT | 75(58.6) | 20(22) | 16(25.4) |
| | Total | 128 | 91 | 63 |
| OM | No OM | 9(7) | 0 | 0 |
| | OM | 119(93) | 91 | 63 |
| | Total | 128 | 91 | 63 |

Values are presented as frequencies and percentages. T2DM: type 2 diabetes mellitus; HTN: hypertension; EC: ectropion; EN: entropion; PT: pterygium; OC: Opacity of cornea; VH: vitreous hemorrhage; DR: diabetic retinopathy; ARMD: age related macular degeneration; OM: Ocular morbidity; CT: cataract; RE: refractive error; REG: Refractive Error corrected with prescription glass.

**Table 3**: Age-wise distribution of old and new diagnosed cases of DM

| | | Age group (year) n(%) | | |
|---|---|---|---|---|
| | | 60-69 | 70-79 | >80 |
| DM status | Old DM case | 29(85.3) | 16(94.11) | 6(66.6) |
| | New DM case | 5(14.7) | 1(5.89) | 3(33.3) |
| | Subtotal | 34 | 17 | 9 |

**Table 4**: Association of DM (old or new cases) with the components of ocular morbidity (OM)

| Components | | DM status- new case and old case | | | |
|---|---|---|---|---|---|
| | | New case n(%) | Old case n(%) | *p*-value | Odds ratio (95% CI) |
| PT | Present | 0 | 1(2) | 1 | 0.84(0.76-0.94) |
| | Absent | 9(100) | 50(98) | | |
| OC | Present | 1(11.1) | 12(23.5) | 0.66 | 2.46(0.27-21.7) |
| | Absent | 8(88.9) | 39(76.5) | | |
| CT | Present | 5(55.6) | 31(60.8) | 1 | 0.8(0.19-3.37) |
| | Absent | 4(44.4) | 20(39.2) | | |
| DR | Present | 1(11.1) | 1(2) | 0.28 | 0.16(0.09-2.8) |
| | Absent | 8(88.9) | 50(98) | | |

Values are presented as frequencies and percentages. DR: diabetic retinopathy; PT: pterygium; OC: Opacity of cornea; CT: cataract.

**Table 5:** The association between DM and components of ocular morbidity

| Components | | DM | | *p*-value | Odds ratio (95% CI) |
|---|---|---|---|---|---|
| | | Present n(%) | Not present n (%) | | |
| RE | RE | 40(66.7) | 145 (65.3) | 0.89 | NA |
| | REG | 13(21.7) | 46 (20.7) | | |
| | No RE | 07(11.7) | 31 (14) | | |
| EC | Present | 0 | 9 (4.1) | 0.21 | NA |
| | Absent | 60(100) | 213(95.9) | | |
| EN | Present | 6(10) | 11(5) | 0.216 | 0.469(0.16-1.3) |
| | Absent | 54(90) | 211(95) | | |
| PT | Present | 1(1.7) | 18(8.1) | 0.08 | 5.20(0.68-39.8) |
| | Absent | 59(98.3) | 204(91.9) | | |
| OC | Present | 15(25) | 41(18.5) | 0.26 | 0.68(0.34-1.33) |
| | Absent | 45(75) | 181(81.5) | | |
| CT | Present | 36(60) | 135(60.8) | 0.90 | 0.9(.54-1.73) |
| | Absent | 24(40) | 87(39.2) | | |
| VH | Present | 8(13.3) | 33(14.9) | 0.76 | 1.13(0.49-2.60) |
| | Absent | 52(86.7) | 189(85.1) | | |
| DR | Present | 10(16.7) | 0 | <0.001 | 0.18(0.14-0.23) |
| | Absent | 50(83.3) | 222(100) | | |
| ARMD | Present | 1(1.7) | 8(3.6) | 0.69 | 2.2(0.27-17.98) |
| | Absent | 59(98.3) | 214(96.4) | | |
| OM | Present | 57(95) | 216(97.3) | 0.40 | 1.89(0.46-7.8) |
| | Absent | 03(5) | 6(2.7) | | |

Values are presented as frequencies and percentages. DM: diabetes mellitus; EC: ectropion; EN: entropion; PT: pterygium; OC: Opacity of cornea; VH: vitreous hemorrhage; DR: diabetic retinopathy; ARMD: age related macular degeneration; OM: Ocular morbidity; CT: cataract; RE: refractive error; REG: Refractive Error corrected with prescription glass.

## Conclusion

The results show a high incidence of ocular morbidity, with refractive error being the most frequent condition and age-related macular degeneration (ARMD) and ectropion being the least prevalent. The findings emphasize the importance of frequent eye exams and tailored healthcare treatments to alleviate the considerable burden of visual impairment in older people. Ocular comorbidities have a significant impact on the social and emotional well-being of the elderly, in addition to their physical health. As a result, creating community-based eye care initiatives and increasing the accessibility of ophthalmic services in rural regions are critical steps toward improving the quality of life for the aging population. Overall, these data support a proactive strategy for managing ocular health in the elderly, stressing early identification, regular monitoring, and appropriate medicinal or surgical therapies to avoid and reduce the effects of visual impairment.

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## Conflict of interests

No conflict of interests was declared by the authors.

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## Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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