

# Prevalence of Refractive Errors in Rural Population of Ganjam, Southern Odisha

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## ABSTRACT

### BACKGROUND

Refractive error is an optical defect, intrinsic to the eye which prevents light from being brought to a single point focus on the retina, thus reducing normal vision. Diagnosis and treatment of refractive error is relatively simple and is one of easiest ways to reduce impaired vision. We wanted to determine the prevalence and frequency of various types of refractive errors in rural population of Ganjam, Odisha.

### METHODS

This is a cross sectional study in which 7,384 individuals in the age group of 5-60 years were evaluated during teleophthalmology visits during the period October 2016 to September 2018, in the rural population of Ganjam, Odisha. Individuals whose VA was <6/6 were further evaluated using slit lamp, retinoscopy and ophthalmoscopy. The requisite refractive error correction was carried out and the results were properly recorded to diagnose the type of refractive error.

### RESULTS

The Prevalence of refractive error was found to be 27.40%. Refractive error was found to be more common in males (30.38%) as compared to the female rural population which reported a prevalence of 23.65%. The prevalence of refractive errors was found to be highest in the age group of 5-10 years i.e., 35.50%. In our study, myopia was the most common type of refractive error accounting for 61.31% followed by hypermetropia 26.82% and astigmatism 11.85% respectively. Myopia was the most common refractive error in both males (60.38%) and females (62.82%). Hypermetropia was found to be more common in females (30.69%) as compared to males (24.4%). Astigmatism was more common in males (15.17%) as compared to females (6.47%). It was observed that myopia was the most common refractive error in the age group 5-10 years (75.4%), while hypermetropia was most commonly observed in the age group 41-50 years (41.3%). Out of the 2,024 rural population having refractive error (21.09%), individuals were using glasses. Rest were either unaware or not using glasses. 14.7% of rural population with refractive error had history of spectacle use in siblings and 9.7% had history of spectacle use in either parents.

### CONCLUSIONS

Rural population represents a high-risk group and is often neglected while it accounts for significant proportion of refractive errors. Most of the rural population are unaware of their refractive errors. Refractive errors can be easily treated with spectacles and as such, the detrimental impact of visual impairment on the quality of life can be easily prevented.

### KEYWORDS

Refractive Error, Myopia, Hypermetropia, Astigmatism, Rural Population, Prevalence

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DOI: 10.18410/jebmh/2019/576*

*Financial or Other Competing Interests:  
None.*

*How to Cite This Article:*

*Bhoi S, Mohapatra K, Subudhi BN, et al.  
Prevalence of refractive errors in rural  
population of Ganjam, Southern Odisha.  
J. Evid. Based Med. Healthc. 2019; 6(42),  
2773-2777. DOI:  
10.18410/jebmh/2019/576*

*Submission 01-10-2019,  
Peer Review 04-10-2019,  
Acceptance 19-10-2019,  
Published 21-10-2019.*



## BACKGROUND

Refractive error is an optical defect, intrinsic to the eye which prevents light from being brought to a single point focus on the retina, thus reducing normal vision.<sup>1</sup> Diagnosis and treatment of refractive error is relatively simple and is one of easiest way to reduce impaired vision<sup>2</sup> If untreated it can result in amblyopia or strabismus.<sup>3</sup> Under corrected refractive error is the most common cause of reversible blindness in India.<sup>4</sup> Worldwide, it has been reported that vision impairment and blindness causes loss of productivity and hence economic stagnation<sup>5</sup> mortality, loss of earnings and poor quality of life.<sup>6</sup> The duration of effect is also significant. Refractive error can account for twice as many blind person years compared to cataract, due to earlier age of onset.<sup>7</sup> Uncorrected refractive errors are a leading cause of visual disability globally and no age, gender or ethnic group is exempt from its visually disabling effects.<sup>8</sup>

Refractive errors have been identified as a priority area of the global initiative for the prevention of avoidable blindness under the 'Vision 2020 right to sight' programme. Reliable data on prevalence and distribution of refractive errors can be obtained from such programs which will help in proper planning and intervention and thus reducing the burden of visual impairment in the society. There is variation in many aspects between the rural and urban Indian population. There are limited data available on the prevalence of refractive errors in adult Indian population.<sup>9</sup> The prevalence of refractive errors varies in urban and rural areas due to the possible difference in genetic susceptibility and also environmental influences such as the amount of near work and indoor/outdoor activities.<sup>10</sup> Compared to urban populations, rural dwellers of the same region have more children, weaker economic status and less access to healthcare services.<sup>11</sup> There are new reports released each year on the prevalence of refractive errors and their possible causes, yet, our knowledge on their pattern of distribution and affecting factors is scarce.<sup>12</sup>

The present study examines the prevalence of refractive error and their associated factors in rural settlement population of southern Odisha.

## METHODS

The study was conducted as per the Declaration of Helsinki and the ethical clearance was obtained from the ethical institutional review board. Written informed consent was obtained from the participants under study.

It is a cross sectional study conducted between October 2016 to September 2018 in the rural areas of Ganjam district, Odisha visited during teleophthalmology camps. 8,113 individuals between the age group 5-60 years were selected by random sampling, out of which 7,384 participated for the study. After obtaining consent from respective individuals, the study population was evaluated. The visual acuity of each eye for distant vision was tested using Snellen's Chart at 6-meter distance. Any person who

could not read at least 6/6 of Snellen's Chart were further evaluated meticulously for anterior, posterior segment abnormalities using slit lamp, ophthalmoscopy and were further refracted using auto refractometer and retinoscopy. The cases of VA <6/6 in one or both the eyes in the age group of 5-60 years without any anterior or posterior segment pathology were finally taken up as cases of refractive error for this study.

Unwilling persons, urban patients, patients who were aphakic, pseudophakic and those who had defective vision due to other causes (corneal opacity, cataract, retinal disorder) were excluded. The study population were further questioned for any symptoms like headache, pain in the eye, watering, inability to see distant objects, near objects, duration of such symptoms and family history of refractive error. After detailed evaluation, the requisite refractive error correction was carried out and the results were properly recorded to diagnose the type of refractive error. Myopia was defined as the nearest spherical equivalent power of - 0.50 D or greater. Hypermetropia was defined that as the nearest spherical equivalent power of +0.50 D or greater. Astigmatism was defined as cylindrical correction of  $\pm$  0.25 D or greater.

## RESULTS

7,384 out of 8,113 persons participated in the study of which 4,120 were males and 3,264 were females. Prevalence of Refractive error in rural population (5-60 yrs.) in Ganjam District was found to be 27.40% i.e., 2,024 out of 7,384 population were found to have refractive error. Refractive error was found to be more common in males. The prevalence of refractive error among male rural population in Ganjam district of southern Odisha was found to be 30.38%. The prevalence among female rural population in the same age group was reported 23.65%. The prevalence of refractive error was found to be highest in the age group of 5-10 years i.e., 35.50% followed by 30.08% in 11-20 years age group. While the Prevalence of refractive error was found to be lowest in age group 31-40 years i.e. 23.25% (Table 1). In our study myopia was the most common type of refractive error accounting for 61.31% followed by hypermetropia 26.82% and astigmatism 11.85% respectively (Table 2). It was observed that myopia was the most common refractive error in both males (60.38%) and females (62.82%). Hypermetropia was found more in females (30.69%) as compared to males (24.4%). Astigmatism was more common in males (15.17%) as compared to females (6.47%). It was observed that myopia was the most common refractive error in the age group 5-10 years (75.4%) while hypermetropia was most commonly observed in the age group 41-50 years (41.3%). It was found in our study that the prevalence of myopia decreased with age excepting in the age group of 51-60 years where a secondary peak of 54.8% is noted. The prevalence of hyperopia after 20 years of age shows increase in its prevalence with age excepting in the age group 51-

60(37.1%) years which shows a marginal decrease as compared to 41-50 years (41.3%) (Table 3). Most of the population (73.1%) having myopia had low negative spherical powers (-0.50D to -3.00D) (Table 4). Most of the hypermetropic population (89.3%) had low hypermetropia (+0.50D to +2.00D). Same was observed for astigmatism where (73.3%) astigmatic population had low astigmatic powers ( $\pm 0.25D$  to  $\pm 0.75D$ ) (Table 5). Most of the individuals with astigmatism (74.5%) were having with-the-rule astigmatism. Out of the 2,024 rural population having refractive error (21.09%) individuals were using glasses. Rest were either unaware or not using glasses. 14.7% of rural population with refractive error had history of spectacle use in siblings and 9.7% had history of spectacle use in either parents.

Sl. No.	Age Group	Total Population Evaluated	Population with Refractive Error	Prevalence in Particular Age Group
1.	5-10 yrs.	721	256	35.50%
2.	11-20 yrs.	1572	473	30.08%
3.	21-30 yrs.	1360	392	28.82%
4.	31-40 yrs.	1473	343	23.28%
5.	41-50 yrs.	1310	334	25.49%
6.	51-60 yrs.	948	226	23.83%

**Table 1. Prevalence of Refractive Error in Different Age Group**

Refractive Error	Male	Female	Total
Myopia	756 (60.38%)	485 (62.82%)	1241
Hypermetropia	306 (24.44%)	237 (30.69%)	543
Astigmatism	190 (15.17%)	50 (6.47%)	240
Total	1252	772	2,024

**Table 2. Distribution of Different Type of Refractive Error in Males and Females**

Age	Myopia	Hypermetropia	Astigmatism	Total
5-10 years	193 (75.4%)	57 (22.2%)	6 (2.3%)	256
11-20 years	331 (69.9%)	92 (19.4%)	50 (10.5%)	473
21-30 years	262 (66.8%)	68 (17.3%)	62 (15.8%)	392
31-40 years	199 (58.0%)	104 (30.3%)	40 (11.6%)	343
41-50 years	132 (39.5%)	138 (41.3%)	64 (19.1%)	334
51-60 years	124 (54.8%)	84 (37.1%)	18 (7.9%)	226
Total	1241	543	240	2,024

**Table 3. Distribution of Different Type of Refractive Error in Different Age Group**

Nearest Spherical Equivalent Power	Male	Female	Total
-0.50 to -3.00D (Low Myopia)	565	343	908 (73.1%)
-3.25 to -6.00D (Medium Myopia)	168	128	296 (23.8%)
> -6.00D (High Myopia)	23	14	37 (2.98%)
Total	756	485	1241

**Table 4. Distribution of Low, Medium, High Myopia with Gender Distribution**

Nearest Spherical Equivalent	Male	Female	Total
+0.50 to +2.00D (low hyperopia)	272	213	485 (89.3%)
+2.25 to +5.00D (medium hyperopia)	32	21	53 (9.7%)
> +5.00D (high hyperopia)	2	3	5 (.9%)
Total	306	237	543

**Table 5. Distribution of Low, Medium, High Hypermetropia Along with Gender**

## DISCUSSION

In our study the prevalence of refractive error among the rural population is 27.40% which is similar to study done by

Abdullah et al (21.7%),<sup>13</sup> MOtutu et al (30.8%)<sup>14</sup> and AA Onua et al (28.5%).<sup>15</sup> This result is similar to other studies from the Indian subcontinent where rates varied between 30% to 17.1% (Nangia et al., 2013).<sup>16</sup> But the rate is higher in studies from the developed world such North America by Robinson et al. (2013);<sup>17</sup> Mary Qiu et al.<sup>18</sup> However, direct comparison with the above studies is not possible because of the differences in examination protocol and population studied. Refractive error was found to be more common in males in our study which is in contrast to other studies by R Kumaraswamy et al and Seema et al.

In our study myopia was the most common type of refractive error accounting for 61.31% followed by hypermetropia 26.82% and astigmatism 11.85%. Myopia was by far the commonest refractive error as reported by various studies conducted by Hashemi et al,<sup>19</sup> Raju et al,<sup>9</sup> Dandona et al<sup>20</sup> APEDS Study,<sup>21</sup> Saw et al<sup>22</sup> and the Handan Eye Study.<sup>23</sup> However, studies conducted by Abdullah et al,<sup>13</sup> AAOnua et al,<sup>15</sup> Refractive error study in Finnish rural population<sup>24</sup> reported hypermetropia to be the commonest refractive error. The prevalence of astigmatism in the present study (11.85%) is lower than 24.5% reported by Handan eye Study,<sup>23</sup> 58.7% by Raju et al,<sup>9</sup> 60% by M Otutu et al<sup>14</sup> and 53.8% by the Yazd Eye Study.<sup>12</sup>

Differences in methodology, definition, demographics, sample size and study protocol explain these apparent variations. In our study myopia was the commonest refractive error in both male and female.

Hypermetropia was found more in females (30.69%) as compared to males (24.4%). This distribution pattern agrees with the work of Raju et al<sup>9</sup> (21.76% in females compared to 15.13% in males) and Abdullah et al<sup>13</sup> but contrary findings was reported by Hashemi et al (21.4% in females compared to 24% in males) and M Otutu et al (62% in males compared to 58% in females). Hypermetropia is more common in females could be explained by the facts that female have smaller eyes than males as reported by Kondo et al.<sup>25</sup> Female preponderance of hyperopia may also be related to the fact that women may have a shorter axial length in a subset of population as reported by George R et al.<sup>26</sup>

It is found from our study that the prevalence of myopia decreased with age excepting in the age group of 51-60 years where a secondary peak of 54.8% is noted. This might be due to presence of Nuclear Sclerosis in this age group as reported by Raju et al,<sup>9</sup> Dandona L et al and Barbados Eye Study.<sup>27</sup> Myopia is thought to be commoner in this age range because of the aging changes that occur in the lens and its attendant myopic shift as reported by Clarke-Farr PC.<sup>28</sup> In this study the prevalence of hyperopia after 20 years of age shows increase in its prevalence with 51-60 years (41.3%) group showing marginal decrease as compared to 41-50 years (37.1%). Increase in prevalence of hyperopia in the adult age group until 60 years of age has also been reported by Raju et al,<sup>9</sup> Barbados Eye Study,<sup>27</sup> APEDS,<sup>21</sup> the Blue Mountain eye Study,<sup>29</sup> Beaver Dam Study.<sup>30</sup>

Highest prevalence of astigmatism was observed in 41-50 years age group (19.1%). No specific pattern in the

prevalence of astigmatism was noted which was in contrast to the study done by Raju et al<sup>9</sup> where the prevalence of astigmatism increased significantly with age. In our study astigmatism was more prevalent in males as compared to females contrary to Yazd Eye Study<sup>12</sup> & study by M Otutu et al<sup>14</sup> where no statistically significant difference was observed in the prevalence of astigmatism in relation to gender.

Different methods and population studied may be responsible for the difference in association between refractive error and gender. 485(89.3%) individuals had low hypermetropia, similar results were reported by Alemu et al<sup>31</sup> (low hyperopia 86% as compared to high hyperopia 4.5%) and Raju et al.<sup>9</sup> In our study, 176(73.3%) of individuals out of 240 were having low astigmatism. Similar results were reported by Raju et al<sup>9</sup> (low astigmatism 54.78%) and Abdullah et al which showed that low astigmatism was the most prevalent astigmatic error. In our study there is high prevalence of with-the-rule astigmatism which is contrary to results reported by Raju et al<sup>9</sup> (WTR-9.8% OBL-12.74% ATR-77.4%) and Abdullah et al<sup>13</sup> (ATR-49.02% OBL-29.4% followed by WTR21.5%).

The differences in age distribution of the subjects studied may have played a role in the differences in these reports. The changes associated with age may be explained by the hypothesis that eyelid tension is responsible for with-the-rule astigmatism by steepening the vertical meridian and flattening the horizontal meridian. Out of the 2,024 rural population having refractive error information regarding use of eye glasses could be extracted in 427 (21.09%) individuals. This indicates level of previous knowledge of presence of eye defect.

This low spectacle coverage may be because limited refractive services are available, prescribed spectacles are too expensive or people may have poor perceptions about spectacle wear. Similar trends of poor spectacle coverage (3.3%) was reported by (Kumah et al., 2013).<sup>32</sup> Same trend had been reported in almost every continent in the world (Shah et al., 2008,<sup>33</sup> O'Donoghue et al., 2010).<sup>34</sup> In our study 14.7% of rural population having refractive error gave history of spectacle use in their siblings and 9.7% had history of spectacle use in either parents. Role of heredity in refractive status is supported by Wixon et al.<sup>35</sup> Saw et al reported that a positive family history of myopia is related to the progression of myopia and refractive error.

## CONCLUSIONS

The present study shows that the rural population represents a high-risk group and is often neglected while it accounts for significant proportion of refractive errors. Most of the rural population is unaware of their refractive error. Uncorrected refractive error is a major public health problem in the rural population. Refractive error can be easily treated with spectacles and as such, the detrimental impact of visual impairment on the quality of life can be easily prevented. Therefore, the following suggestions can be made-screening should be carried out periodically, rural population

should be educated about signs and symptoms of refractive errors, ocular hygiene and the risk factors involved in the development of these errors and other ocular pathological problems. More Ophthalmologists & Optometrists need to be trained and deployed in public health system to prevent avoidable visual loss from uncorrected visual impairment correctable with spectacle usage. There should be further studies into the barriers to the use spectacles and spectacle coverage among individuals with refractive error in rural population of Ganjam. This is to obtain specific proportions of individual with uncorrected refractive error who could benefit from spectacle usage as well as the factors that prevent wearing of spectacles. There should be the inclusion of spectacle provision as an integral part of the vision screening program. Access to affordable spectacles should be increased in both the private and public sector. Awareness campaign should be carried out in radios, TV, and all media services regarding refractive error.

## ACKNOWLEDGEMENTS

We would like to thank all the participants, and colleagues who were a part of this study for their kind cooperation.

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