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A Systematic Review of the Prevalence of Refractive Errors, Uncorrected Refractive Errors, and Presbyopia in Adults in India

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ABSTRACT
Estimating the prevalence of refractive errors, uncorrected refractive error (URE), and uncorrected presbyopia in adults in India under the age of 30 is the goal of this review. Methods: The standards set forth by Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) were adhered to. Using the Cochrane Library, Medline, and Embase, a thorough literature search was conducted to cover all studies published from India starting in the year 1990. Ametropia >0.50 D was used to characterise refractive error. Uncorrected presbyopia is described as near vision N8 improving with correction in the absence of distant URE, while URE is defined as presenting visual acuity (PVA) poorer than 6/18 improving with pinhole or spectacle correction.
There were 15 studies from South India, 1 each from Western and Central India, and 1 study that comprised 15 states in total. The prevalence of myopia and hyperopia was 27.7% and 22.9%, respectively, while RE of at least 0.50 D of spherical equivalent ametropia was 53.1% [(95% confidence interval (CI): 37.2-68.5). The prevalence of URE was 10.2% (95% CI: 6.9-14.8), but there was a significant amount of variation. Presbyopia prevalence was 33% (95% confidence interval [CI]: 19.1-51.0). The severity of refractive errors among adults in India is highlighted in this review. In areas where there is a dearth of knowledge on UREs, more investigations utilising conventional techniques are required. Adult eyewear delivery programmes in India must concentrate primarily on reading glasses to treat presbyopia as well as eyewear to treat hyperopia and myopia.

Keywords: Hyperopia, myopia, presbyopia, refractive errors, visual impairment.

1. INTRODUCTION

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One of the most prevalent optical disorders affecting people of all ages is refractive error (RE), which is prioritised under the VISION 2020 project. The majority of REs are simple to rectify in primary care with glasses. Uncorrected refractive error (URE), despite the existence of a financially viable remedy to address this issue, is a significant public health issue. URE is the second-leading cause of blindness in poor nations, including India, and the primary cause of vision impairment globally. [1,2] Adults with URE may develop visual impairment or blindness, which can have a serious impact on their social and economic well-being. This can include limiting their options for schooling and employment. [3] Globally, the cost of lost productivity from URE was projected to be over $269 billion[4]; the cost of uncorrected presbyopia was assessed to be US$11.023 billion.[5]

The amount of population-based research from India on various eye disorders has increased over the past ten years, and several publications have been released with the goal of figuring out the incidence of REs among various age groups across various communities in India. These estimates, however, were created using a number of different criteria and approaches. Due to variations in the study populations, methodology, and definitions of the conditions under investigation, the reported prevalence varies significantly between studies. The definitions employed in the research have the most impact on the projected prevalence rates of all the variations.We conducted a systematic review to determine the pooled prevalence of REs in India using a standard definition since population-based pooled estimates provide evidence for policy decisions. Through estimates of the incidence of URE and uncorrected presbyopia, this study aims to evaluate the prevalence of REs among adults in India under the age of 30 and the need for refractive therapies.

2. METHODS

For this review, we adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards.

Search strategy

From 1990 to 2018, we looked through the Medline, Embase, CINAHL, and Cochrane libraries. (The most recent search was conducted in September 2018 using OVID and EBSCOHOST.) The MeSH for medical subject headline and keywords to search in the title and abstract were used in the search, which was based on medical terms. The broad search strategy combined terms related to disease (including MeSH search using exp refractive error *, exp myopia *, exp hypermetropia *, exp astigmatism *, exp presbyopia *, and keyword search using the term refractive error, myopia *, hypermetropia *, astigmatism *, and presbyopia *), terms related to epidemiology (including MeSH search using exp prevalence and exp epidemiology and keyword search using the words prevalence, epidemiology, incidence, rates To find other studies, we also looked through the reference lists of the studies we included.

Inclusion and exclusion criteria

We looked for any research from any part of India that estimated the prevalence and/or incidence of REs and/or presbyopia among all age groups. Prevalence was defined as the proportion of people at risk to the total population with RE at a particular time. The number of new cases of RE that develop over a predetermined amount of time is referred to as the incidence. All reports on incidence and prevalence from epidemiological studies were

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included. Additionally, we examined all pertinent National, Regional, and International reports that have been released since 1990. We didn't include research that just employed qualitative techniques, review articles, or studies that had only been abstracted or presented at conferences without being fully published. Duplicate publications from the same study were eliminated. We incorporated data reported on individuals under the age of 30 in this systematic review, and the findings about REs in children from this search have already been published. [6]

Definitions used

Spherical equivalent (SE) ametropy was used to determine RE, with the two main subgroups being myopia (SE worse than 0.50 D) and hyperopia (SE worse than +0.50 D). URE was described as having a VA of less than 6/18 and improving to 6/18 after using a pinhole in either eye or after correcting the vision with glasses. Uncorrected presbyopia was defined as binocularly presenting distance VA of at least 6/18 in the better eye and improving to N8 after correction.

Data abstraction and quality assessment

The thorough search was carried out and all pertinent studies were located by the lead reviewer (SS). The included studies were evaluated separately by the lead and second reviewers (SB) based on the abstract and title in accordance with the inclusion criteria, and the articles were then shortlisted for full-text evaluation. Utilizing the critical appraisal checklist designed by Munn et al. (2014) for prevalence studies, a thorough methodological quality assessment was carried out independently on the complete texts of the studies that were shortlisted. [7] To extract study features such as study design, geographic location, study population, participant demographics (including age and gender), screening techniques, definitions utilised, and prevalence information, we created a data extraction form. Consensus was reached in order to settle any differences between the reviewers' assessments at each level. We tried to synthesise quantitative data using Microsoft Office's MetaXL programme. [8]

Statistical methods

After stabilising the variance of individual studies, we were able to estimate the prevalence and incidence across all included research. This was done since we anticipated significant design and outcome measure heterogeneity among the included studies. This was accomplished using the MetaXL programme and the Freeman-Tukey double arcsine transformation[8]. We quantified the heterogeneity by computing the I 2 and evaluated it using the 2 test on Cochrane's Q statistic. [9] The percentage of overall variation between trials that is attributable to heterogeneity rather than chance is expressed by the I2 statistic. No heterogeneity is shown by a value of 0%, and increasing heterogeneity is indicated by bigger values. Additionally, we measured the heterogeneity in the forest plot by looking at the overlap of the confidence intervals.

We computed the overall prevalence under three categories because there are different metrics used to describe refractive errors and spectacle coverage for both RE and presbyopia in the included studies. (3) Prevalence of uncorrected presbyopia. (1) Prevalence of REs with subcategories of myopia and hyperopia. (2) Prevalence of URE based on presenting visual acuity (PVA) improving with pinhole and/or after best correction. Planning refractive services requires consideration of the prevalence of REs as well as spectacle coverage for

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distance RE and presbyopia. Data were summarised separately and excluded from pooled estimates where criteria varied.

3. RESULTS

Out of 169 possibly applicable titles/abstracts, 43 full-text articles based on population-based data were deemed suitable.

Study characteristics and methodological quality

In the final analysis, 18 research that reported on the prevalence of REs were taken into account. Presbyopia and RE data were reported in two research [10,11], and information from these studies was retrieved and categorised for the study. In the end, we included 6 cross-sectional studies and 14 studies that presented data on distance RE and URE, including the Rapid Assessment of Avoidable Blindness (RAAB), Rapid Assessment of Visual Impairment (RAVI), and Rapid Assessment of Refractive Errors (RARE) (RARE).

There were 15 studies total, including 9 from Andhra Pradesh, 6 from Tamil Nadu, 1 each from Gujarat and Maharashtra in the West and Central regions of India, and 1 research that comprised 15 different Indian states. Only two studies[21,28] reported the prevalence of REs by gender; no information on the gender characteristics of the study participants was provided. [12,19] On the prevalence of REs in India, no information was available. The estimations from the included studies within the three categories have a very high degree of variation.

The prevalence of RE in adults was evaluated by four population-based studies. 53.1% (95% CI: 37.2-68.5) of people have RE of at least 0.50 D, of which 27.7% (95% CI: 18.3-39.6) have myopia and 22.9% (95% CI: 13.9-35.3) have hyperopia. This was the mean estimate across four population-based studies, with estimates ranging widely (37–68%). Based on greatest correction or improvement with pinhole, the prevalence of URE is predicted to be 10.2% (95% CI: 6.9-14.8).

Based on the synthesis of nine studies using comparable definitions for URE, this was made. The pooled estimate was quite diverse, with prevalence reaching as high as 26% in Gujarat [15] in 2007 and Tamil Nadu[21] in the late 1990s. The prevalence of URE was also grouped by study and examined using cross-sectional, RAAB, and RAVI methodologies; the results showed that the combined prevalences were 10.2, 10.8, and 9.6 (95% CI: 5.5-16.2), respectively.

According to estimates, 33% of individuals in India have uncorrected presbyopia, however the range of this estimate's confidence intervals (95% CI: 19.1-51.0) was relatively large. Only two studies from Andhra Pradesh[25,26] included information on uncorrected presbyopia by gender, and the combined prevalence rates for males and females were 50% (95% CI: 17.4-82.6) and 55% (95% CI: 24.7-82.3), respectively. The prevalence by gender, urban vs. rural, and other factors could not be determined due to a lack of data, which is crucial for developing strategies to target the issue in these populations.

4. DISCUSSION

The prevalence of REs and the requirement for refractive correction in adult Indians have been the subject of population-based studies, but this is the first systematic review of such studies. In India, REs are relatively widespread, and 53.1% of people have myopia or

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hyperopia of at least half a dioptre. According to estimates, 10.2% of Indian adults have URE. Presbyopia is an eye condition that affects around one third of adults nationwide. Refractive services and spectacle delivery initiatives must be given top priority when it comes to policy because the problem is so large overall. The prevalence of RE as a cause of vision impairment and blindness should be given high importance among the three estimations presented in this review since it has a significant influence on people's productivity and quality of life. It's crucial to maintain sharp near vision, which can be readily fixed with reading glasses. In our research, the percentage of RE-related vision impairment and blindness (10.2%) is much greater than the global estimates of 5.7% (95% CI: 5.0-6.9%) in the population over 50. The bulk of participants in this evaluation are from rural parts of India, with the exception of the age discrepancies in these two publications. The greater stated prevalence may be because to the relative absence of refractive services in rural locations, suggesting a viable area to concentrate on when planning any intervention.

Another likely explanation for the greater prevalence of RE in rural areas is cataract-induced index myopia. The goal of the majority of systematic reviews is to determine a single estimate of the problem's size. To plan refractive services and spectacle supply plans, findings have been provided in three categories because there are diverse remedies for various refractive difficulties. According to earlier reports, subjective refraction is a more accurate means of determining REs than predicting REs based on vision improvement with a pinhole. We discovered that the prevalence of URE using pinhole assessment is lower than URE diagnosed through refraction, which is consistent with past findings. In India, the prevalence of refractive error based on vision improvement with a pinhole is 9.4%, and the prevalence of vision impairment and blindness that is resolved following refractive correction is 10.2%. However, pinhole assessment with the VA cut-point of 6/18 is more practical to utilise in fast assessment surveys and community-based vision screenings when taking into account the logistics, time, and resource requirements for population-based assessments. Instead of using the WHO cut-point of 6/18, one study by Marmamula and colleagues from 2009 used the cut-point of 6/12. [10] The majority of studies used 6/18 as the cutoff, which is the WHO standard, hence this study was not included in the pooled estimations. It may be claimed, however, that a better cut-point for evaluating vision impairment is 6/12. Due to the included studies' high level of heterogeneity—nearly 100%—low confidence is placed in the pooled estimates. It is unclear why these differences exist. Different methodologies or terminology employed in the included research can cause heterogeneity. However, the included studies' methodology received very good marks for quality assessment. Furthermore, the included studies' very small confidence intervals suggest that the sample under study had little volatility. The prevalence of RE, URE, and uncorrected presbyopia may also be naturally vary due to variations in socioeconomic position, urban versus rural location, and assessment era. Temporal trends can affect the frequency and types of REs. Furthermore, the coverage of spectacles for presbyopia and RE can depend on economic conditions. The pooled estimates for the three categories were estimated in light of the high calibre of the included research, but additional population-based data from India are required to fully describe the factors influencing RE and spectacle coverage.

15 out of the 18 included papers are from the southern regions of India, which dominate this study. Given the diversity of the country's demography and healthcare system, it is advised to have prevalence statistics using accepted methodology from each region individually for a trustworthy estimate. There was no data on the prevalence of refractive errors in adults from India. The majority of incidence studies are carried out on children since REs like myopia

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often manifest themselves in childhood. In addition, nothing is known about the frequency of RE in various areas. In areas where data are insufficient or unavailable, more studies utilising standard technique are needed.

Compared to other eye conditions that affect vision, correcting REs in adults presents less difficulties. The majority of RE correction services are provided as part of primary eye care service delivery, and there are numerous established models for doing so at reasonable costs. The high prevalence suggests that more research on the accessibility of, access to, and utilisation of services is required given the heterogeneity in availability and adoption for RE correction across India. Further research is also necessary to identify any personal, cultural, and social barriers that might hinder people from using the services already in place.

Only two research reported data on REs by gender, despite the fact that the majority of the included studies collected gender-related information. Estimates based on gender are crucial for assessing the scope of the problem and guaranteeing equal access to services. Previous research has shown that women are more likely than men to experience REs and other eye problems. Additionally, wearing glasses interferes with certain professions like that of agricultural labourers and others where bending forward is frequently necessary for the task. These factors are significant in this context since the bulk of the participants in the studies included in this review come from rural regions, where agricultural work predominates as a form of employment.

When calculating the total prevalence of REs in this review, astigmatism was not taken into account. If astigmatism is taken into account, the estimated prevalence of refractive errors among people in India is further increased. Although it is difficult to reach a single estimate that is appropriate for policy decisions due to the lack of uniform methodology and definitions used in the studies evaluated, certain estimates can be produced.

5. CONCLUSION

This analysis comes to the conclusion that REs in the adult population is a significant public health issue with an economic impact in India due to lost productivity from URE and untreated presbyopia. If the government invests in providing RE services at a bigger scale through public-private partnerships engaging all stakeholders to address this issue, it will be possible to avoid this potentially enormous loss to the national economy.

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