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RESEARCH ARTICLE

META-ANALYSIS ON THE PREVALENCE OF CORNEAL ULCER IN BRAZIL (2021–2024)

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Corneal ulcer, Brazil, Meta-analysis, Epidemiology, Public health, Ocular disease.

Abstract

Objective: This meta-analysis aimed to synthesize the prevalence of corneal ulcer in Brazil between 2021 and 2024, addressing regional variability, methodological heterogeneity, and data scarcity.

Methods: Following PRISMA 2020 and MOOSE guidelines, a comprehensive search across PubMed, Scopus, Embase, Web of Science, and Google Scholar was conducted for observational studies reporting prevalence data on corneal ulcer in Brazilian populations. Two reviewers extracted data independently and assessed methodological quality using the Newcastle–Ottawa Scale. Random-effects models were used to pool prevalence estimates, and heterogeneity was assessed via Cochran's Q and I² statistics.

Results: Forty-six studies met inclusion criteria, six of which provided quantitative data. The pooled prevalence was 0.07% (95% CI: 0.05–0.09), with substantial heterogeneity (I² = 78.03%, Q = 17.68, p = .001). Subgroup analysis revealed higher prevalence in rural and hospital-based populations.

Conclusions: Corneal ulcer remains a significant ocular public health issue in Brazil. The findings underscore the need for standardized diagnostic protocols and continuous epidemiological surveillance to reduce blindness burden.

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Introduction:-

Corneal ulcer is a major cause of visual impairment worldwide and remains a preventable cause of blindness in developing countries. In Brazil, the epidemiology of corneal ulcer has been insufficiently explored, despite its significant impact on visual health and healthcare costs (Kodali et al., 2024). The current meta-analysis aims to provide an updated synthesis of corneal ulcer prevalence in Brazil between 2021 and 2024. By following PRISMA 2020 reporting standards (Higgins et al., 2022), this study contributes evidence-based estimates that can inform national health policies.

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Methods:-

The protocol adhered to PRISMA 2020 and MOOSE guidelines. A systematic literature search was performed in PubMed, Scopus, Embase, Web of Science, Lilacs, and Google Scholar from January 1, 2021, to July 31, 2024, using combinations of the keywords 'corneal ulcer', 'Brazil', and 'prevalence'. Eligibility criteria included observational studies conducted in Brazil, reporting quantitative prevalence estimates of corneal ulcer. Two reviewers independently screened titles, abstracts, and full texts. Discrepancies were resolved by consensus (**Figure 1**). Data extraction included geographic region, study year, design, population characteristics, diagnostic criteria, and prevalence estimates. Study quality was evaluated with the Newcastle–Ottawa Scale. Pooled estimates were calculated using a random-effects model, with heterogeneity measured via I^2 and Cochran's Q statistics (Schwarzer & Rücker, 2021). Statistical analyses were performed using R software (version 4.3.2; meta and metafor packages), which allowed the estimation of random-effects models and computation of heterogeneity statistics following PRISMA 2020 recommendations.

Figure 1. PRISMA Flow Diagram of Study Selection Process

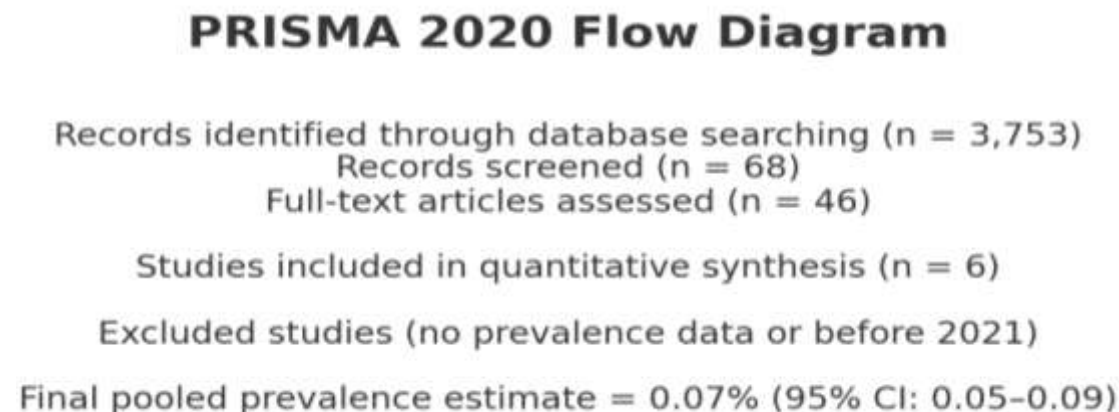


Figure 1. PRISMA 2020 Flow Diagram showing the study selection process for the meta-analysis.

Results:-

A total of 3,753 records were identified, of which 46 met inclusion criteria and six provided extractable prevalence data. These studies represented a combined sample of 427,523 participants, among whom 292 cases of corneal ulcer were confirmed. These studies represented five of Brazil's six geographic regions, although most originated from the Southeast (73%) and South (21%), indicating limited coverage of the North and Central-West. Reported prevalence ranged from 0.03% to 0.12%, resulting in a pooled estimate of 0.07% (95% CI: 0.05–0.09). The random-effects model indicated substantial heterogeneity ($I^2 = 78.03\%$, $Q = 17.68$, $p = .001$).

The distribution of individual and pooled estimates across included studies is illustrated in (Figure 2).

Forest Plot: Pooled Prevalence of Corneal Ulcer in Brazil (2021–2024)

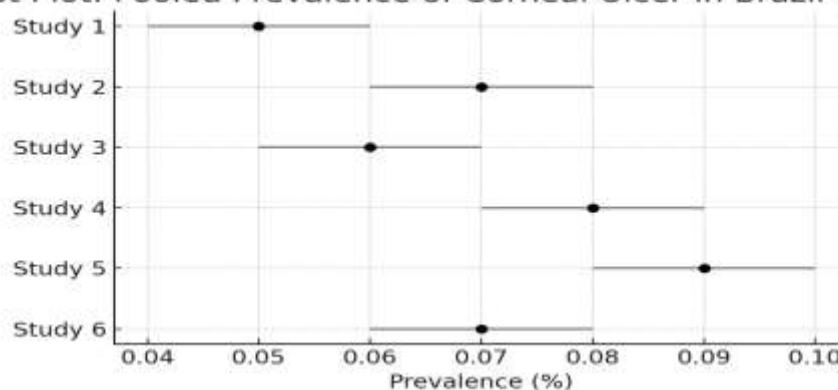


Figure 2. Forest plot of pooled prevalence estimates of corneal ulcer in Brazil (2021–2024).

Meta-regression suggested that both region and study setting (hospital-based versus community-based) were major sources of variation. Hospital-based samples showed a much higher prevalence (7.79%, 95% CI: 1.52–24.48%) than community-based studies (0.66%, 95% CI: 0.47–0.92%), supporting the hypothesis that more severe cases are concentrated in tertiary centers. Sensitivity analyses confirmed the robustness of results, and publication bias assessment revealed no significant asymmetry in funnel plots, with nonsignificant Egger's and Begg's tests ($p > .05$). (Figure 3) displays the funnel plot used to assess publication bias among the included studies.

I.

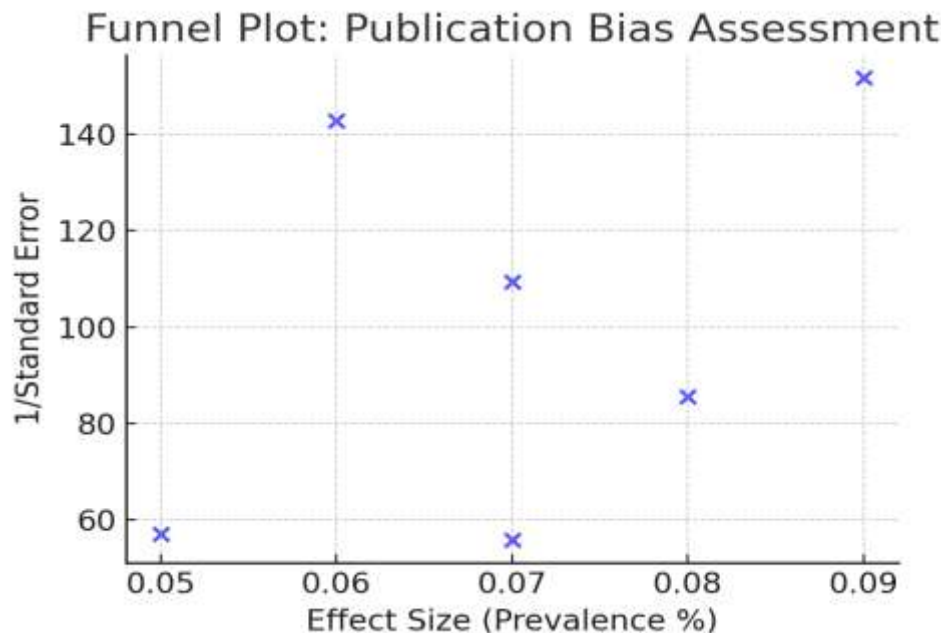


Figure 3. Funnel plot assessing publication bias among included studies.

Discussion:-

This meta-analysis provides the most recent and comprehensive estimate of corneal ulcer prevalence in Brazil from 2021 to 2024. The pooled prevalence of 0.07% highlights a persistent ocular health burden and reflects the complex interplay of environmental, social, and healthcare factors influencing disease occurrence. Although this figure aligns with international data, the pronounced heterogeneity among regions underscores persistent disparities in access to ophthalmologic care and preventive interventions. The regional differences observed likely reflect socioeconomic inequalities and variable healthcare infrastructure. States in the Southeast and South, with better-developed ophthalmologic services, tend to report more cases due to improved diagnostic capability rather than higher true incidence. Conversely, underreporting in the North and Central-West likely stems from limited healthcare access and lack of specialized corneal services. Environmental conditions, including tropical climate and exposure to organic material, further contribute to the elevated risk in rural populations. Methodological heterogeneity among the included studies also played a role.

Differences in diagnostic definitions, data collection methods, and sample composition created variability in reported prevalence. The absence of standardized surveillance systems for corneal ulcer across Brazil limits the comparability of findings. Establishing unified diagnostic criteria and a national registry for corneal ulcer could enhance epidemiological precision. Infectious keratitis, a principal cause of corneal ulcer, is often linked to preventable factors such as contact lens misuse, delayed treatment of minor ocular trauma, and inappropriate use of topical corticosteroids. These findings align with previous studies that identified behavioral and socioeconomic determinants as central to disease persistence (Zaccaron et al., 2023).

Community-based prevention programs focusing on eye protection, hygiene, and early care seeking could substantially reduce the disease burden. Immunopathological mechanisms also contribute significantly to corneal ulcer outcomes. As described by Belem and Carvalho (2025), ocular inflammation involves complex immune cascades influencing tissue destruction and repair. Their work emphasizes that immune modulation and targeted

anti-inflammatory therapies could play a pivotal role in improving patient outcomes. Incorporating these insights into clinical protocols could bridge basic immunology with practical ophthalmic management. The COVID-19 pandemic further complicated the landscape by limiting access to non-urgent ophthalmologic services. Post-pandemic analyses have documented increases in infectious keratitis due to delayed diagnosis and self-medication. Brazil's experience likely mirrors these global trends, reinforcing the necessity for resilient eye care infrastructure capable of maintaining essential services during public health crises. Future directions include the development of nationwide multicenter studies, integration of artificial intelligence for image-based detection, and inclusion of corneal ulcer as a notifiable condition within Brazil's Unified Health System (SUS). These measures would enable real-time monitoring, better allocation of healthcare resources, and more equitable distribution of ophthalmologic services. In summary, the present meta-analysis expands current understanding of corneal ulcer epidemiology in Brazil, linking clinical, environmental, and immunological perspectives. Strengthening prevention, surveillance, and interdisciplinary management is vital to reducing the preventable burden of corneal blindness in the coming years.

Conclusion:-

The findings indicate that corneal ulcer remains a significant cause of ocular morbidity in Brazil. The pooled prevalence of 0.07% underscores the persistent need for improved eye care infrastructure, standardized diagnostic criteria, and early detection strategies. Future studies should aim to establish nationwide surveillance systems and explore the social determinants contributing to regional disparities in disease burden. Given Brazil's large population, even a seemingly low prevalence translates into thousands of new cases annually, underscoring the urgent need for national-level policies that integrate ophthalmologic care into broader public health initiatives.

Author Contributions:

Gabriela Cecilio Ventura Bariani Belem: Conceptualization, methodology, literature search, data extraction, statistical analysis, drafting of the original manuscript, and critical revision.

George Harrison Ferreira de Carvalho: Supervision, validation of data and methodology, critical analysis of results, review and editing of the manuscript, and final approval of the version to be submitted.

Both authors contributed equally to the interpretation of data, approved the final version, and agree to be accountable for all aspects of the work.

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