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Prevalence of Meibomian Gland Dysfunction in China: A Systematic Review and Meta-Analysis

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 November 2025 and was last updated on 30 November 2025.

INTRODUCTION

Review question / Objective Systematic evaluation of the prevalence of meibomian gland dysfunction in China.

Rationale With accelerating societal pace, population aging, and excessive use of video terminals, the prevalence of dry eye disease is rising, driven by heterogeneous and multifactorial etiologies. Meibomian gland dysfunction (MGD) is playing an increasingly important role in the onset and progression of dry eye. MGD is a chronic, diffuse eyelid disorder characterized principally by obstruction of the terminal ducts of the meibomian glands and/or qualitative or quantitative abnormalities of glandular secretion. This dysfunction leads to defects in the lipid layer of the tear film, causing increased tear evaporation, elevated tear film osmolarity, and ocular surface inflammation, and ultimately manifests as a spectrum of ocular irritation symptoms, ocular surface damage, and tear film instability. To date, however, there is no evidence-based epidemiological meta-analysis of the prevalence of MGD in the Chinese population. This study will fill this gap through a systematic review and meta-analysis, providing cognitive assistance for the prevention and treatment of this disease.

Condition being studied Meibomian gland dysfunction (MGD) is a chronic and diffuse eyelid disorder. As the primary cause of evaporative dry eye, it has received increasing attention in clinical practice. The core pathophysiological changes of this disease lie in the obstruction of the terminal ducts of the meibomian glands and/or the qualitative and quantitative abnormalities of the lipids (i.e., "meibum") secreted by the glands. The meibum secreted by the meibomian glands is a key component of the outermost layer of the tear film - the lipid layer. A healthy lipid layer can effectively prevent excessive evaporation of tears, maintain the stability of the tear film, and lubricate the contact surface between the eyelids and the eyeballs. When MGD occurs, the secreted meibum

becomes viscous and has an increased melting point, leading to glandular duct blockage and impaired excretion. This results in defects in the tear film lipid layer, which in turn causes rapid tear evaporation, increased tear film osmolarity, and activates the chronic inflammatory pathway on the ocular surface. Patients often present with a series of symptoms such as dry eyes, burning, foreign body sensation, red eyes, fluctuating vision, and heavy eyelids. Its diagnosis relies on examinations including clinical symptoms, evaluation of glandular orifices under a slit - lamp, analysis of meibum properties, and meibomian gland imaging. The risk of MGD is associated with multiple factors, including aging, changes in hormone levels, altered blinking habits due to excessive use of video terminals, and a strong association with systemic diseases such as rosacea. With the accelerated aging process of Chinese society and the widespread popularity of electronic products, it is crucial to systematically evaluate the disease burden of MGD in the Chinese population. This study aims to accurately estimate the prevalence of meibomian gland dysfunction in the Chinese population by comprehensively analyzing existing epidemiological surveys through systematic review and Meta - analysis.

METHODS

Search strategy This study adhered to the Preferred Reporting Items for Systematic Reviews and Meta - Analyses (PRISMA) guidelines. We searched major Chinese and English medical databases. Chinese databases included CNKI, Wanfang, VIP, and SinoMed, while English databases included PubMed, Embase, Web of Science, Ovid MEDLINE, and Scopus. The subject term for the disease type in this search was "meibomian gland dysfunction", and the free - text terms included Meibomian Gland Dysfunctions, Meibomian Gland Disease, Tarsal Gland Dysfunction, Meibum, etc. The subject terms for research methods included Prevalence, Incidence, Epidemiology, Epidemiologic Methods, morbidity, and the free - text terms included Prevalences, Incidences, Morbidities, Cross - Sectional Studies, Health Survey, Frequency, Patient rate, disease burden, Occurrence, etc. The subject term for the research region was "china", and the free - text terms included People's Republic of China, Chinese, Taiwan, Hong Kong, Macau, Mainland China, etc. Different search languages and strategies were developed according to the specific characteristics of different databases. All literatures were independently reviewed by two researchers in two stages: first, titles and abstracts were screened, and then full - texts were evaluated. The search was limited to Chinese and English. There was no start - time setting for the search, and studies published up to November 29, 2025, were searched to provide an accurate and comprehensive estimate of the prevalence of meibomian gland dysfunction.

Participant or population Chinese.

Intervention Not applicable.

Comparator Not applicable.

Study designs to be included Observational studies: cross-sectional studies, cohort prospective studies and cohort retrospective studies will be included.

Eligibility criteria Literature inclusion criteria: (1) The study type must be a cross-sectional study, a cohort study (both prospective and retrospective are acceptable), or data from an epidemiological survey using a secondary healthcare database; (2) The study subjects must be the Chinese population; (3) The exposure factors should be consistent; (4) The outcome indicator is an observational study that reports the prevalence of meibomian gland dysfunction or provides the data required to calculate this rate. Literature exclusion criteria: (1) Non-Chinese/English literature and studies not on the Chinese population; (2) Animal experiments, clinical trials, case reports, case series, case-control studies, interventional studies, reviews, biomedical and pharmacokinetic studies, and literature that does not clearly state the study type; (3) Literature that is repeatedly published, or from which the full text and key data cannot be obtained; (4) Literature with a total sample size of less than 50 and obvious errors in key data.

Information sources International electronic databases, including PubMed, Embase, Web of Science, Ovid MEDLINE, Scopus, along with Chinese databases, China National Knowledge Infrastructure (CNKI), Wanfang Database, Chinese VIP Information and China Biology Medicine (CBM) were searched.

Main outcome(s) The prevalence of meibomian gland dysfunction in Chinese population.

Additional outcome(s) Prevalence of blepharospasmal dysfunction in different subgroups of the Chinese population. Different subgroups include: age, gender, occupation, environment, co-morbidities, etc.

Data management We will use Endnote X9 to manage the literature. First, duplicate literatures will be removed. Second, literatures related to reviews, systematic evaluations, comments, animal experiments, etc. will be excluded. Third, by reading the titles and abstracts, literatures whose research contents do not match will be removed, such as those related to non-Chinese people, non-Chinese or non-English languages, clinical trials, case reports, case series, case-control studies, randomized controlled trials, etc. Then, literatures with non-rigorous observational designs, incorrect research methods, or inconsistent outcome indicators will be excluded. Finally, through reading the full texts, the final eligible literatures will be selected. When the two reviewers disagreed, the decision on whether to include the study was made by the principal investigator. For articles where the full - text cannot be obtained, an email request is sent to the corresponding author, and their response within two weeks will be considered.

Quality assessment / Risk of bias analysis The risk of bias assessment of the studies will be independently conducted by two reviewers. For different types of studies, we will use corresponding standardized tools: The quality of cross-sectional studies will be evaluated using the Joanna Briggs Institute's Critical Appraisal Checklist for Cross-Sectional Studies. The quality of cohort studies will be assessed using the Newcastle-Ottawa Scale. Any disagreements will be resolved through consultation or adjudication by a third senior researcher.

Strategy of data synthesis Data processing was performed using the statistical software Stata 15.1. The $\chi 2$ test was used to examine the heterogeneity among studies, with a significance level of $\alpha = 0.1$. Then, the degree of heterogeneity was estimated based on the I2 value: $I2 < 50\%$, it suggested the presence of statistical heterogeneity, and a random - effect model was used for the meta - analysis.

Subgroup analysis To explore the sources of heterogeneity and provide more accurate prevalence estimates, this study plans to conduct subgroup analyses. The factors for analysis include: demographic characteristics (e.g., age, gender, geographical distribution), study design (cross - sectional studies vs. cohort studies), meibomian gland dysfunction (MGD) diagnostic criteria (e.g., based on signs, symptoms, TFOS DEWS II guidelines, or ICD codes), and study quality. Additionally, when data are available, the impact of occupational exposure (e.g., duration of video terminal use, outdoor workers) will be analyzed. Differences between subgroups will be statistically compared through inter - group heterogeneity tests.

Sensitivity analysis In this study, a sensitivity analysis was conducted. By excluding individual studies one by one, alternately using fixed and random - effect models, and repeating the pooling process with different rate conversion methods, the results showed that there were no significant clinically meaningful changes in the point estimates and confidence intervals of the pooled effect size under all scenarios. This indicates that the results of this Meta - analysis are robust and reliable, not overly influenced by any single study or the choice of statistical method, and the overall stability is good.

Language restriction English or Chinese.

Country(ies) involved China.

Other relevant information No

Keywords China, Meibomian Gland Dysfunction, Prevalence, meta-analysis, dry eye disease.

Dissemination plans We plan to disseminate the study results through various channels. First, the complete report will be submitted to a peer-reviewed scientific journal for publication. Second, we will present the findings at relevant academic conferences. Additionally, we will create a summary for ophthalmologists and distribute it via professional online platforms to aid in translating the findings into clinical practice. Lastly, the anonymized data from this systematic evaluation will be available from the corresponding authors upon reasonable request.

Contributions of each author

Author 1 - Baocang Ma - Conceptualized the study, and was responsible for drafting and editing the manuscript.
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Author 2 - Yizhi Li - A literature retrieval strategy was designed, and the literature was screened and evaluated.
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