

REVIEW ARTICLE

Mask-associated dry eye and other mask-associated eye diseases (mask-associated eye irritation, MAEID): post-COVID-19 review

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ABSTRACT

The objective of the article is to analyze the literature regarding the association between COVID-19 and mask-associated dry eye and ocular irritation. As the COVID-19 pandemic has resulted in a large percentage of the world population wearing masks, there will most likely be some diseases or disorders associated with these changes in habits. There are multiple studies in the literature related to mask-associated dry eye (MADE), but no literature review has focused solely on MADE. The most recent studies related to mask-associated dry eye have included some form of clinical assessment of dry eye, as opposed to a questionnaire-based research. We focused more on the results of these studies and the common associations in them. Medline/PubMed, as well as Epocrates, was used to search for key terms, including MADE + COVID-19, dry eye disease, and dry eye syndrome. A total of 70 studies were found, 10 of which were included.

Keywords: COVID-19, dry eye syndrome, mask-associated dry eye, chalazion.

Introduction

In order to understand mask-associated dry eye, subsequently abbreviated as mask-associated dry eye (MADE), one has to understand dry eye syndrome (DES also known as DED), also known as Keratoconjunctivitis sicca, as well as the pathophysiology surrounding it. DES is defined as a “disorder of the tear film which occurs due to tear deficiency or excessive tear evaporation” [1]. The prevalence of DES is estimated to be 7.4%-33.7% in one study [2], showing that a large portion of the population is most likely affected by this syndrome. Moreover, according to the American Academy of Ophthalmology (AAO), the definition of this syndrome is still under revision, which makes it difficult to concisely diagnose [3]. But according to the Tear Film and Ocular Surface Dry Eye Workshop II, the definition of DES is a “multifactorial disease of the ocular surface which involves tear film instability, ocular surface inflammation and damage” [4]. The American Academy of Ophthalmology lists many causes of DES, including infrequent blinking, contact lens use, and chemical exposure, but does not specifically list MADE [3]. Stern et al. [5] described the pathology of DES to be under one of the two categories which is either evaporative or tear deficient. Evaporative dry eye is related to either exposure via tear film evaporation or meibomian gland disease, whereas tear-

deficient dry eye is related to the production of tears [6]. In this review, we will focus more on evaporative dry eye, as it is most likely related to the pathophysiology surrounding MADE. There have been many papers regarding mask-associated dry eye recently, and this is most likely related to the current COVID-19 pandemic. In this review, we will take a look at the most up-to-date papers regarding this topic and conclude with possible solutions and recommendations.

Methods

We investigated Medline/PubMed and Epocrates' archives using MADE + COVID-19, dry eye disease and DES as keywords and found a total of 70 articles. A total of 10 relevant articles were chosen for this study. The relevant literature was composed of three prospective

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studies, one of which included many methods of clinical evaluation including: tear breakup time and Schirmer's test [7], among other parameters. Another prospective study which is of great importance included tear breakup time, Schirmer's test, fluorescein and lissamine, and corneal dendritic cell density, among other parameters.

Discussion

The term MADE was most likely first devised by White [8], in which he described that he had been seeing more frequent cases of dry eye recently which were most likely associated with mask wearing. The first paper that actually described air flow in association with DED was Hayirci et al. [9], whose conclusion found that CPAP therapy resulted in an increase in eye irritation and tear evaporation, associated with squamous metaplasia of the conjunctiva. A major factor contributing to the latest increase in papers with regard to mask-associated ocular disease is most likely due to the recent coronavirus 2019 pandemic which enabled most of the world population in developed countries to wear masks of many different kinds [10]. In general, the majority of the relevant studies leaned toward subjective or questionnaire-based research with the Ocular Surface Disease Index (OSDI) questionnaire which was utilized in 4 of the 11 studies (~35%) [11-14]. The OSDI is a valued questionnaire that includes many parameters associated with dry eye disease. This questionnaire showed "reliability and validity with regard to measuring the severity of dry eye disease" in Schiffman et al.'s [15] paper. There were major associations between most of the studies which included a female predilection to increased dry eye associated with masking. The downfall of this predilection is that there is a chance that females might be more likely to report irritation, as the studies that included a female predilection were mostly questionnaire-based.

In the largest survey related to MADE of about 3600 participants, the type of questionnaire used was not specified, although the referenced paper within this survey included the OSDI among other dry eye questionnaires. Stratification in 3 studies [12,14,16] included time-based mask use with the survey of 203 participants stratifying based 1 <3 hours use and 3-6-hour use. Another study by Scalini et al., which was a prospective cross-sectional study, was also stratified based on ≥ 6 hours per day at least 5 days per week vs standard use which was not defined. Scalini's study included people who were previously diagnosed with DES, and excluded severe DES, most likely due to a higher likelihood of change in ocular discomfort due to mask use. Both of these studies showed a correlation between more time wearing the mask, and dry eye syndrome. The only literature review found regarding a similar subject was by Koh et al. [17], talking generally about COVID-19 and dry eye. The study included all aspects of dry eye related to COVID-19 and had a section regarding mask-associated dry eye. The study was informative and included general information regarding pre- and post-COVID-19-related

dry eye statistics. The study focused more on COVID-19 in general, as opposed to only MADE.

The newest notable study included a cross-sectional study on patients with moderate or severe dry eye. Tear stability was measured with keratography, with initial measurement with a mask then a second after 10 minutes without wearing a mask. The conclusion showed that stability of the tear film decreased in patients with moderate to severe dry eye [18]. This objective method of measurement was not found in any other study, which makes it a unique factor into contributing to understanding MADE better.

On another note, a paper regarding mask-associated eye disease attracted our attention. The first paper by Silkiss et al. [19], which was a retrospective study through two California private practice medical records. It focused on the incidence of chalazion from 2016 to 2020. The results were that the incidence of chalazion increased dramatically in 2020 as compared to the previous years. By August 2020, "202 of 1,338 an incidence of 0.151 patients were seen for chalazion." This is in comparison with an incidence of 0.076 in the same time interval in 2019. This showed a direct association between pre- and post-COVID-19 increase in the incidence of chalazion. Of course, there are many variables that can be associated with the change in incidence, but one change that cannot be overlooked is the increased use of masks in the normal population.

Conclusion

As we are still currently living in the COVID-19 era, people will still be masking until the foreseen future. This is most likely going to be a result of the general population's increased awareness on masking, and general prevention of infectious diseases. Consequently, the general shared conclusion of most of the studies seen displayed a positive correlation between mask use and dry eye, especially with an increase in how much time the mask was used for. There also seemed to be a correlation between the female gender and mask use. The latest studies that included clinical objective methods of dry eye displayed an association with mask use as well. There are various methods suggested to decrease MADE in many of the studies, including using a better type of mask that is tighter at the nose arc, to decrease the frequency of mask use, and to use tape to decrease the amount of breath going up to the eye. The negatives in most of the studies are that the type of mask used was not mentioned. Furthermore, there were only two studies that used objective methods and were prospective in design [13,15]. More studies of this design are needed to get a better understanding of the main parameters that are affected by mask use with regard to mask-associated irritation. Finally, there also seems to be a possible correlation between mask use and other eye diseases, including chalazion [18]. This also needs stronger studies in the future to better understand the possible increase in incidence of such diseases. We further suggest that there is most likely a positive correlation between chalazion, dry eye, and possibly other eye irritation-related ocular disease,

such as pterygia, which can be called mask-associated eye irritation disorders. We agree that the major methods to decrease MADE could be to increase tightness around the nose and by taping to decrease breath from escaping to the eye. Another aspect that should also be focused on more is the type of mask being used. In conclusion, in order to have a better understanding and grasp on matters related to dry eye and masking, more studies that have similar parameters, as well as clinical considerations, should not be overlooked.

List of Abbreviations

COVID-19	Coronavirus Disease-19
DED	Dry Eye Disease
DES	Dry Eye Syndrome
MADE	Mask Associated Dry Eye
MAEID	Mask Association Eye Inflammatory Diseases
OSDI	Ocular Surface Disease Index

Conflict of Interest

There is not conflict of interest related to the publication of this article.

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