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Ocular Health Challenge Among Women Healthcare Workers: A Narrative Review

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1. Abstract

Background: Women comprise nearly 70% of the global healthcare workforce and are disproportionately represented in nursing and allied health professions. Prolonged digital screen use, extended personal protective equipment (PPE) wear, rotating shifts, and biological exposures may adversely affect their ocular health, yet sex-specific evidence remains limited.

Objective: To summarize current evidence on occupational ocular health among women healthcare workers, emphasizing biological susceptibility, occupational risk factors, and preventive strategies.

Methods: A narrative review was conducted using PubMed, Scopus, and Google Scholar to identify relevant studies published between 2004 and 2026. Literature addressing dry eye disease, digital eye strain, occupational eye injury, and ocular surface disorders among healthcare workers was reviewed. No formal quality assessment or meta-analysis was performed.

Results: Women healthcare workers experience a considerable burden of occupational ocular disorders, particularly dry eye disease and digital eye strain. Hormonal influences and a higher prevalence of autoimmune disorders may increase susceptibility, while prolonged PPE use, intensive digital device exposure, low-humidity clinical environments, and rotating shifts further contribute to ocular surface dysfunction and visual symptoms. However, sex-specific occupational eye health research remains critically limited.

Conclusions: Occupational ocular health is an underrecognized component of workplace well-being among women healthcare workers. Future studies should incorporate sex-disaggregated analyses and standardized diagnostic methods to support evidence-based preventive strategies and improve workforce health.

2. Keywords

Women healthcare workers; Occupational ocular health; Dry Eye disease; Digital eye strain; Occupational eye injury; Ocular surface disease.

3. Introduction

Women form the backbone of the global health and care workforce. According to World Health Organization (WHO) estimates, women make up approximately 67-70% of the

global health workforce, delivering essential health services to an estimated five billion people and contributing roughly US\$3 trillion annually to global health economies [1,2]. This feminization is especially pronounced in nursing and allied clinical roles of the world's approximately 28.5 million nurses and midwives, some 24 million are women, whereas men remain disproportionately represented among physicians and surgical specialists [3]. Because nursing and allied bedside roles involve the highest cumulative hours of direct patient contact, screen-based documentation, personal

protective equipment (PPE) use, and shift rotation, women HCWs are simultaneously the largest occupational group in healthcare and the group most continuously exposed to the environmental conditions that stress ocular health.

Despite this, occupational health research on HCWs has historically prioritized musculoskeletal injury, needlestick and bloodborne pathogen exposure, and especially since the COVID-19 pandemic psychological burnout and mental health [4,5]. Ocular health has received comparatively little systematic attention, despite plausible and, increasingly, empirically demonstrated vulnerability. This is a curious omission for at least three reasons.

First, dry eye disease (DED) - the most common ocular surface condition reported by HCWs - is itself a sex-differentiated disease. Population-level epidemiology has long recognized that DED disproportionately affects women, particularly after menopause [6,7]. Mechanistic reviews attribute this, at least in part, to sexual dimorphism in lacrimal gland structure and hormonal regulation: women show more pronounced age-related lacrimal gland fibrosis and acinar atrophy than men, and androgen deficiency in particular has been linked to impaired meibomian and lacrimal gland function, while the roles of estrogen and progesterone remain less consistently characterized [8,9,10]. Autoimmune conditions that produce severe dry eye as a hallmark feature, such as Sjögren's syndrome, are themselves markedly sex-skewed, with roughly 80% of individuals affected by autoimmune disease overall being women [11]. Ocular surface disease in women HCWs therefore sits at the intersection of a sex-biased baseline disease and an occupation that layers additional environmental stressors on top of it.

Second, several occupational exposures specific to modern healthcare delivery are directly implicated in ocular surface stress: prolonged face mask and respirator use (amplified enormously during the COVID-19 pandemic), extended electronic health record (EHR) and video display terminal (VDT) use, night-shift and rotating-shift scheduling, and direct biological exposure through blood and body-fluid splashes. Each of these has an emerging, occupation-specific evidence base, much of it generated in nursing-predominant samples.

Third, existing reviews tend to address these two threads "women's occupational health" and "ocular disease in healthcare workers" separately. Broader scoping reviews of women's occupational health and safety identify healthcare as a key sector of interest but rarely isolate ocular outcomes as a distinct exposure domain [12]. Conversely, most eye-health-in-the-workplace studies, while frequently conducted in female-majority samples such as nursing cohorts, do not consistently stratify or interpret their findings through a sex/gender lens.

This narrative review aims to bring these strands together to summarize the occupational ocular health evidence specific to women HCWs across five thematic exposure domains - dry eye disease, mask-associated dry eye, digital eye strain/computer vision syndrome, night-shift/circadian effects, and occupational eye injury - and to identify the biological plausibility and clinical implications.

4. Methods

It is a narrative, rather than a systematic review, and no formal assessment of quality appraisal, risk of bias, or any type of statistical analysis or pooling of data was attempted. Databases PubMed, Scopus, and Google Scholar were searched for relevant publications using the time range from 2004 to 2026. The search terms included combinations of the type of studies (ocular) with the population of interest (healthcare workers). Key terms used for eyes and vision included "dry eye," "computer vision syndrome," "digital eye strain," "ocular surface," and "occupational eye injury." Terms related to the population included "healthcare workers," "nurses," "medical staff," "hospital employees," "females," "female," and "sex" or "gender." The reference lists of the included studies were also scanned for additional relevant studies. Preference was given to articles with healthcare workers as the population of interest and studies exploring sex differences at the biological level. It is a narrative review aiming to provide an overview of the topic and identify common themes and areas of interest; therefore, no attempt was made to perform a pooled estimation of prevalence across the articles included in the current review, which used different diagnostic instruments (OSDI, DEQ-5, SPEED, CVS-Q).

5. Dry Eye Disease in Women Healthcare Workers

Dry eye disease is the most common ocular complaint among healthcare workers (HCWs), for who the evidence suggests that both the overall prevalence of this diagnosis is higher compared to the general population, and that among HCWs, it is disproportionately elevated among women.

A 2026 cross-sectional survey of ophthalmologists, optometrists, and nurses who attended a Gulf region ophthalmology conference reported an 82.8% prevalence of DED using the DEQ-5, which is drastically higher than the 5 - 50% range typical for the general population [13]. Within this sample, the prevalence was also found to be higher among women than men (88.4% vs. 77.8%), and female optometrists were found to have a more than fourfold increased odds of DED than their male counterparts. Another cross-sectional survey of hospital staff (79% women) done during the COVID-19 pandemic found a 62.1% prevalence of DED symptoms, with female sex being a significant risk factor, along with a history of systemic atopy and ocular comorbidities [16]. Similar rates (62%) have been found in a study of nurses in the North West Bank of Palestine, where night shifts, contact lens use, and working in intensive care units, were also significant predictors of DED [7]. By comparison, a study of doctors and nurses in China conducted before the COVID-19 pandemic only found a 36% prevalence of DED symptoms among respondents [15]. It must be noted that the variation in prevalence estimates is partially explained by differences in the populations of interest, as well as the use of different diagnostic tools (DEQ-5, SPEED questionnaire, clinical examinations).

Research conducted in South Korea provides additional evidence of the disparity between sexes in terms of DED prevalence among HCWs, particularly nurses. A hospital survey of 154 nurses found that eye symptoms were more common during work than outside of it, while female sex and preexisting dry eye symptoms were the main predictors for dry eye symptoms during work. The authors note that nursing is a female-dominated profession, and that women in general are more susceptible to vision problems, including dry eye

disease [17]. Indeed, the study found that the majority (72.1%) of nurses who participated in it had dry eye symptoms according to the SPEED criteria, which is a surprisingly high estimate considering that the mean age of participants was only 33, which is much younger than the age when dry eye disease typically develops.

The biological basis for the observed disparity is supported by a review discussing sexual dimorphism in the lacrimal gland and its role in dry eye disease. The review notes that female sex hormones contribute to age-related changes in the lacrimal gland, namely increased fibrosis and acinar atrophy, which are detrimental to its function [9]. Furthermore, androgen deficiency was found to be a risk factor for dry eye disease, possibly due to reduced activity of meibomian and lacrimal glands, while the involvement of estrogen and progesterone was found to be inconclusive [10]. Such endocrine influences are especially relevant to nursing and other healthcare occupations, due to the high representation of women of menopausal age among nurses. Moreover, autoimmune diseases are also more prevalent among women by approximately 80%, and conditions such as Sjögren's syndrome are directly related to aqueous tear deficiency and dry eye disease [11].

It should be noted that all the aforementioned evidence pertains specifically to healthcare workers, and that the observed association between female sex and dry eye disease can hardly be exclusively explained by occupation, as both nursing and medical professions were found to be significant predictors of dry eye disease in women. This evidence, however, can only reinforce the previously discussed contribution of sex as a variable affecting the prevalence of dry eye disease among HCWs.

6. Mask-Associated Dry Eye (MADE) and PPE-Related Ocular Effects

The COVID-19 pandemic has resulted in a distinctive constellation of ocular effects related to personal protective equipment (PPE), first anecdotally recognized and initially termed “mask-associated dry eye” (MADE) by an American eye doctor in 2020 and since investigated in numerous studies [18]. Notably, this condition is theorized to have a predominantly mechanical rather than biological genesis: a loosely-fitting mask can allow exhaled air to escape upward, disrupting the tear film and causing dryness, irritation, and redness [19].

The association between mask use and dry eye has been investigated in a number of studies, most of which were conducted among healthcare workers (HCW). An Indian cross-sectional study of 114 HCW at a tertiary care center found that mask wear time of more than three to six hours per day was associated with new onset or exacerbation of symptoms of dry eye disease (DED), with younger age and pre-existent dry eye at baseline being significant risk factors, and N95 masks conferring greater risk than surgical masks [20]. A Turkish study comparing a group of HCW working in COVID-19 clinics with another group of masks worn for fewer hours (long-mask and short-mask groups, respectively) found that the long-mask group had worse objective indicators of ocular surface damage, including tear film break-up time, Schirmer's tests, and meibography findings, and concluded that prolonged mask use during the pandemic poses a substantial risk to the ocular surface of HCW [18]. They also suggest some practical solutions to reduce air

escaping upward, such as taping the top of the mask to the bridge of the nose, and recommend that HCW who must wear masks for long periods consult an ophthalmologist.

The consistency of these findings, however, is not straightforward, a critical appraisal of 26 studies on MADE published in 2023 found that while some studies found objective evidence of worsening dry eye, others did not, and concluded that the body of evidence for a connection between masks and dry eye was of overall low certainty, with small effect sizes [21]. This likely reflects a combination of factors, including differences in mask type and fit, duration of wear, pre-existing dry eye at baseline, and potential confounders such as increased screen time common to many HCW during the pandemic it is notable that in addition to physical contact with the face, masks do not distinguish between ocular surface diseases and digital device use, and the combination of the two is known to exacerbate dryness.

In addition to face masks, other forms of PPE such as face shields, goggles, and safety glasses can add to the burden on the eyes, primarily through fogging, discomfort, and decreased compliance, though specific investigations into their ocular effects are fewer and not yet as comprehensive as those for masks. At the same time, protective eyewear is necessary for the prevention of direct inoculation of the eye with pathogens, discussed in detail in the following section, and therefore presents a dilemma for infection control PPE comfort must be optimized in order to maximize adherence to protocols.

7. Digital Eye Strain and Computer Vision Syndrome

The near-universal transition to electronic health records and the use of video display terminals (VDTs) introduces a second general class of ocular stressors, computer vision syndrome (CVS)/digital eye strain, including eyestrain, headache, blurred vision, and dry eyes associated with near-work and specifically with VDT use.

A Spanish study on CVS among health care workers (HCWs) specifically targeting VDT users found an overall prevalence of 56.75%, of which nurses were the group with the highest prevalence (61.75%), compared to eye strain rates of ~36% for radiologists reading computer screens and non-clinical staff such as cleaning or computer operators. The increased CVS risks in nurses in particular due to the increasing use of tablets for documentation at the point of care, a concern identified already in a prior literature review [22].

A cross-sectional survey of 233 primary care health workers in Saudi Arabia (with similar numbers of physicians, nurses, pharmacists, and lab technicians; ~60% female) found cellphones and computers/laptops/tablets as the main sources of visual stress, with neck/back discomfort (73.4%), headaches (69.5%), and eye dryness (64.0%) as the most prevalent symptoms. Over 80% of respondents had never heard of CVS as a syndrome, with ~75% unsure whether the symptoms are permanent [23].

The problem often starts before entering the workplace: a Peruvian study of 796 nursing students found prevalence of digital eye strain as high as 87.6% (>4h of device use per day), related to poor ergonomic postures, high screen brightness, skipping the “20-20-20” rule (taking a 20-second break to look at a scene 20 feet away every 20 minutes), and

not using glasses when necessary [24]. Another study found that in nursing students, CVS was strongly associated with visual fatigue, which in turn was strongly associated with sleep loss/worsening, with the relationship between sleep and CVS being partially mediated through visual fatigue [25]. Eye strain and dry eye from digital device use are often part of the same causal pathway as disrupted sleep/worsening.

Since the vast majority of nursing positions worldwide are held by females, most of these issues, even when not explicitly analyzed as such in the studies, affect women disproportionately severely - adding to the burden of dry eye.

8. Night-Shift Work and Circadian Disruption

The working hours structure in nursing and other allied professions often involves shift-work, and a substantial number of studies have identified circadian misalignment as a key contributor to disrupted ocular surface homeostasis. A 2024 clinical study on 40 female nurses with established history of night-shift work and no prior diagnosis of dry eye measured tear film parameters at 4 points during a 24-hour period – the beginning and the end of a day shift and the beginning and the end of a night shift. In the study, both TBUT and OSDI scores were found to be drastically reduced at the end of a night-shift as compared to other time points, with a significant negative correlation ($p < .05$) between TBUT and OSDI at all time points, suggesting that tear film instability was the driving factor of dry eye symptoms during night shifts [26]. An earlier clinical study on workers who performed night shifts found similar disruptions in the ocular surface, finding increased prevalence of dry eye signs and symptoms as well as bulbar conjunctival hyperemia – a sign of mild inflammation - after night shifts, likely due to circadian misalignment [27].

The physiological mechanisms linking night shift work to dry eye symptoms are neuroendocrine in nature core body temperature, hormone levels and autonomic tone follow circadian rhythms controlled by the hypothalamic suprachiasmatic nucleus [28]. The autonomic nervous system, in turn, modulates tear production via cholinergic parasympathetic and sympathetic fibers. Chronic lack of sleep and circadian misalignment suppresses parasympathetic tone and increases sympathetic output, leading to dysregulation of tear production by the lacrimal gland [26]. More recent basic science research has further identified specific molecular pathways involved in circadian disruption-associated dry eye pathology, including the role of IL-17 and melatonin in dysregulation of the lacrimal gland and potential therapeutic benefits of melatonin supplementation in animal models [28].

In essence, due to the prevalence of shift work among nursing staff and the overrepresentation of female workers in the healthcare sector, disruption of circadian rhythms due to night shifts constitute an additional mechanism of occupational eye injury specific to female healthcare workers.

9. Occupational Eye Injury and Biological Exposure

Aside from the chronic stresses imposed on the surface tissues by the wearing of protective masks, women HCWs typically account for an elevated risk of acute exposure to infectious and non-infectious hazards, namely, those related to blood/body-fluid splashes and exposure to ionizing

radiation (in specific occupations).

Occupational eye injuries (OEIs) are defined as injuries “related to ocular trauma to the eye at the workplace,” and the findings of a recent narrative review of studies on OEIs are particularly pertinent to female HCWs, as an estimate of 8 cases per 1,000 employees have been reported across occupation categories within a six-month follow-up, with non-infectious and infectious etiologies accounting for a roughly comparable proportion of cases. Moreover, the review notes a severely limited adherence to standard protective equipment, with only 45% and 28% of OEI-affected persons reporting consistent use of eye protection equipment at the time of injury, respectively [29]. Furthermore, a similar narrative review highlighted the risk of radiation exposure, particularly for employees in radiology, interventional cardiology, and dentistry as a separate cause of OEIs, related to the development of posterior subcapsular cataract, while protective eyewear remains consistently recommended for such occupations.

Exposure to blood/body fluid splashes represent a significant occupational risk, which, although often not explicitly gendered, nonetheless is found to disproportionately impact women. Namely, industry surveillance data, as summarized in a relevant nursing safety article, indicate that, across most occupational categories, the face is the primary site of splash-related exposure, with the eyes being the second-most frequent point of contact. Across both industry-wide surveillance and the findings of a recent hospital-specific study, nurses are also reported as the category of healthcare workers, who most frequently report splash exposure incidents, comprising the plurality of both occupational categories across the two studies [31,32]. As such, the combination of the nursing occupation’s overall prevalence (which significantly exceeds that of the other healthcare occupations) and its predominant presence among female employees leads to women being disproportionately exposed to splash-related biological hazards affecting the eye tissue. Notably, exposure to bodily fluids has been identified as a source of infection transmission for a variety of pathogens, including HIV, hepatitis C, and respiratory viruses [31].

Conversely, the findings of the hospital surveillance study suggest that the consistent implementation of mask-wearing and eye protection policies during the COVID-19 pandemic have been beneficial in terms of reducing splash-related exposure incidents compared to the situation before the pandemic [32]. While nurses remained the occupational category reporting the plurality of such incidents across both years, their frequency across all occupational categories was evidently lower in 2021 than in 2020, which can be seen as a result of the appropriate personal protection measures.

10. Psychosocial Overlay and Shared Pathways

The ocular health topics discussed in the previous sections cannot be disentangled from the literature on occupational stress and burnout which have dominated the discussion of women’s experience in healthcare work to date. Relevant literature reviewing women healthcare workers’ (HCW) experiences of occupational stress and burnout during and after COVID-19 pandemic demonstrates a skewed load on females, frontline, and nursing workers in particular [4,5]. Since psychological stress and disrupted sleep patterns have been independently associated with ACD, and computer

vision syndrome (CVS) shown to mediate the effect of visual discomfort on sleep disturbances in nursing professionals [25], it is reasonable to suggest that disrupted sleep, CVS, ACD, and occupational stress are not four independent phenomena, but rather present a cluster of interrelated stressors shaping the experience of female HCW. The implications of the hypothetical connection are primarily practical in nature, suggesting that interventions targeting one risk factor without consideration of the system as a whole may prove ineffective. For example, while the adjustment of a workstation height may reduce the development of CVS in shift workers, the hazard of disrupted circadian rhythm due to night shifts and the psychological burden of stress will remain unaddressed.

11. Discussion

Synthesizing the findings, it is possible to propose a vulnerability stack, particular to female healthcare workers (HCWs). It includes a higher pre-disposition to developing dry eye disease (DED), determined by sex-specific differences in lacrimal gland morphology/function, autoimmunity prevalence, and hormonal contraception use, and a combination of exposures unique to the profession, namely prolonged use of masks/PPE, video display terminals for documentation, working in night shifts and rotating shifts, and higher risk for splash exposure incidents, each of which was independently associated with DED severity or symptom exacerbation.

Practically, this evidence can be utilized in a few ways. First, occupational health screening programs for HCWs, which traditionally focused on musculoskeletal disorders and risks for blood-borne infections, can include vision screenings, particularly for those working in higher-than-average mask-use settings, with prolonged computer use and night shifts. Such programs can also promote proper mask-wearing techniques, which prevent eye exposure, e.g., by ensuring the mask is tightly fitted around the nose bridge, thus redirecting exhaled air downwards rather than sideways/upwards, as supported by the MADE study [18]. The recommended breaks between computer-based tasks, adjusting the monitor's brightness to match the room, and the 20-20-20 rule [24] are also applicable to nursing and medical-surgical settings, particularly regarding documentation.

On a structural level, organizations can consider minimizing the number of consecutive night shifts for their employees, where possible, and promoting adherence to eye-safety measures during high-risk procedures, such as splash exposure prevention, to reduce the incidence of DED among their staff. Addressing each of these two risk factors - disrupted circadian rhythms and splash exposure - would alleviate a significant portion of vision-related problems, as both have been supported by objective clinical evidence, as opposed to self-reported symptoms.

On a policy level, the lack of ocular health surveillance in most institutional occupational health settings is a glaring concern, which should be rectified by implementing appropriate screening and monitoring protocols, as early vision intervention has been proven to prevent DED progression. Notably, in the majority of cases, eye protection uses, when available, is not required unless an occupational eye injury (OEI) has occurred, and adherence to its use has been reported as suboptimal, at under 50%, even following an OEI [30]. Therefore, it is crucial to ensure that eye

protection is worn, rather than simply made available, to minimize splash exposure and the risk of DED.

12. Limitations of this Review

This review has the limitations inherent in a narrative, rather than systematic, approach: a formal assessment of the risk of bias and synthesis of results was not carried out, and the scope of studies included, while broad, may still have been subject to selection bias. Due to the variety of diagnostic instruments applied in the primary studies cited (OSDI, DEQ-5, SPEED, CVS-Q), the prevalence rates reported in this review should not be compared to one another without consideration of the threshold values and scoring systems specific to each instrument. And finally, as only a fraction of the cited occupational studies applied sex/gender as a key analytic variable, the conclusions for female healthcare workers drawn from these studies are, in some cases, extrapolated upon naturally-female-dominated cohorts and informed by the established literature on sex-based differences in prevalence.

13. Conclusion

The present study demonstrated that eye problems are an essential, substantial, and potentially modifiable source of health damage for women healthcare workers. Whether it is dry eye disease, mask-associated dryness, computer vision syndrome, circadian disruption, or occupational eye injuries, the consistent theme is that women, and nurses in particular, report a disproportionate amount of eye disorders as compared to either the general population or, in the case of several conditions, their male counterparts. In turn, this necessitates prioritizing eye health within occupational health surveillance and practice as well as encouraging future epidemiological studies to more consistently consider sex/gender as an analytical variable and potential modifier of exposure-outcome associations.

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