



Research article

A cross-sectional study of optometrists' attitudes towards dry eye disease management in Hong Kong: A web-based survey in Hong Kong

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ABSTRACT

Purpose: This study aimed to explore the practices of optometrists in Hong Kong towards diagnosing and managing dry eye disease (DED).

Methods: From September 2021 to March 2022, an online questionnaire was distributed to optometrists in Hong Kong through several professional associations. The questionnaire included questions about the importance and usefulness of various diagnostic tests, as well as inquiries about management strategies and recommended follow-up schedules for DED. Responses were compared between optometrists who were more or less proactive in continuing education to identify potential differences.

Results: The analysis included 68 valid responses. Sixty-one of them were Part 1 optometrists that represents 5.5 % of registered Part 1 optometrists back in 2022. Assessment of clinical symptoms was the most commonly performed investigation (93 %) and considered the most important (75 %) procedure in DED assessments, followed by corneal staining and fluorescein tear break-up time. Traditional diagnostic tests were preferred over newer methods, such as osmolarity, which were not yet commonly used. Unpreserved lubricants (90 %) and lid hygiene (63 %) were the primary treatments recommended for mild DED. Optometrists who had more experience and frequent participation in continuing education were more confident in diagnosing and managing DED, and more likely to recommend omega-3 supplements for moderate DED.

Conclusion: The diagnostic and management strategies of optometrists in Hong Kong were generally consistent with the recommendations of the Dry Eye Workshop II report. However, standardized DED questionnaires and newer diagnostic tools were not commonly used. Evidence-based optometric care for dry eye management should be encouraged in Hong Kong optometric practice.

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1. Introduction

Dry eye disease (DED) is a complex multifactorial disorder of the tear film and ocular surface [1]. It has been reported that Asian ethnicity is a non-modifiable risk factor for DED with prevalence estimated to be as high as 50 % [2]. There is considerable variation in the diagnosis and management of DED among eye care practitioners, because of the lack of a universal consensus for a ‘Gold standard’ of diagnosis. Studies have been performed by eye care practitioners worldwide to evaluate the dry eye management [3–10], mostly prior to publication of The Tear Film & Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II) report [1]. More recently, Wolffsohn and colleagues [11] studied clinical practice patterns in DED management worldwide and found that the management approaches differed significantly across countries. For example, lid hygiene using wipes was less frequently recommended for aqueous deficient DED in Hong Kong than in Russia, but essential fatty acids were more frequently prescribed for aqueous deficient DED in Asia than in Latin America.

As optometrists’ scope of practice varies significantly among countries, it is important to design country/region specific questionnaires because the accessibility of diagnostic tools and management options may differ in availability. In Hong Kong, optometrists are registered into four different groups by the Optometrist Board, which are mainly differentiated by the qualification the optometrist holds (<https://www.smp-council.org.hk/op/en>). It is not known if the level of qualification, number of years in practice, and continuing education would enhance their competency or affect the clinical management of DED. Hong Kong Optometry Board has set a requirement for the registered optometrists to attending the Continuing Professional Development (CPD) programme for a certain number of hours, in order to have their license renewed starting from year 2021. Understanding Hong Kong optometrists’ practices to DED diagnosis and management could help determine if optometrists are practicing up-to-date and evidence-based optometric care. The level of adherence of respondent’s clinical decisions with the current TFOS DEWS II report [12,13] was also investigated.

2. Method

This study was approved by the Institutional Review Board of The Hong Kong Polytechnic University (#HSEARS20210510004) on 01, Jun 2021 and followed the tenets of the Declaration of Helsinki. An online electronic survey, hosted by Qualtrics XM (Qualtrics LLC, Seattle, USA), was distributed through six local optometric associations to their members via email, WhatsApp (Meta, California, USA), and Signal (Signal Technology Foundation, California, USA) mobile messenger applications between September 2021 and March 2022. The questionnaire was conducted anonymously and a total of 14 questions (Table 1) were presented in English or Traditional Chinese with no option to review or alter answers after submission. The survey was modified based on the survey developed by Downie and colleagues [8] and adapted to professional role and scope of practice of Hong Kong optometrists’. Treatment modalities outside the scope of regulation in Hong Kong, such as the use of corticosteroids, were not given as an option in the treatment strategy. In brief, questions of demographics, diagnostic methods, and management approaches towards DED of optometrists were investigated. The results of the questionnaires were also analyzed by dividing participants into two groups (completed and non-completed CPD groups), stratified by the participants receiving at least 10 h of CPD per year as recommended by the Optometrists

Table 1
Summary of questionnaire questions modified from the questionnaire developed by Downie and colleagues [8].

Questions category	Questions details
Demographic	1 Number of years in practising Optometry
	2 Registration Level ^a (Part I, II, III or IV)
	3 Mode of Optometry Practice (i.e. Corporate practice, independent practice, ophthalmology or optometry clinic, industry, academic, and research)
	4 Number of hours obtained in continuing education in year 2020 cycle (1–20 and > 20)
	5 Confidence level in diagnosing DED (1 = Extremely lacking confidence, 2 = Not confident, 3 = Fair, 4 = Confident, 5 = Extremely confident)
	Confidence level in managing DED (1 = Extremely lacking confidence, 2 = Not confident, 3 = Fair, 4 = Confident, 5 = Extremely confident)
Diagnostic methods	6 Interest in developing DED management service (1 = Extremely disinterested, 2 = Not interested, 3 = Neutral, 4 = Interested, 5 = Extremely interested, N/A)
	7 Selection of tests performed routinely for DED assessment (a total of 18 options; unrestricted number of responses)
	8 Selection of 3 most important techniques in diagnosing DED
Management approaches	9 Rate the usefulness of each diagnostic technique in diagnosing DED (1 = Never useful, 2 = rarely useful, 3 = sometimes useful, 4 = often useful, 5 = Always useful, 6 = not familiar)
	10 Choices of treatment recommended for mild DED (forced-choice selection from 12 selections; maximum 3 choices)
	11 Choices of treatment recommended for moderate DED (forced-choice selection from 12 selections; maximum 3 choices)
	12 Choices of treatment recommended for severe DED (forced-choice selection from 12 selections; maximum 3 choices)
	13 Frequency of follow up for mild, moderate and severe DED patients (1 week, 2 weeks, 3 weeks, 1–3 months, 4–6 months, 7–12 months, >12 months, N/A)
	14 Likelihood in recommending Omega-3 supplement (1 = Very unlikely, 2 = unlikely, 3 = neutral, 4 = Likely, 5 = Very likely) with follow up questions asking for reasons for no recommendation (unfamiliar with nutrition, undesirable effect of Omega-3, natural food source has enough Omega-3, Omega-3 is not effective, insufficient scientific evidence)

DED: Dry eye disease.

^a Optometrists in Hong Kong are divided into 4 Parts of registry, based on qualifications. Some assessments are restricted for some Parts of the registry.

Board in Hong Kong.

2.1. Statistical analysis

Data was analyzed using SPSS (Version 26, IBM Inc., Armonk, NY, USA) and Prism 9 (Graphpad Software LLC, San Diego, USA). Only survey results with more than 80 % completion were included in the analysis. Descriptive statistics were used to summarize the demographic information and the frequency of the preferred diagnostic techniques and management strategies. Demographic data were not normally distributed (Shapiro-Wilk test), so the data were reported as median and interquartile range. Mann-Whitney U tests were used to test the differences in the years of practice and number of tests used in the DED assessment between the completed 10-h and non-completed CPD groups. Spearman correlation was performed to test the relationship between interest level and confidence in diagnosing and managing DED, and the relationship of the number of CPD hours with their confidence level in DED diagnosis and management. Testing of proportions (confidence and interest level of DED between groups; choice of tests between groups) was conducted using Fisher's exact test or Chi square test. A p value of less than 0.05 was considered statistically significant.

3. Results

A total of 87 responses (74 part 1 optometrist, 6.6 % of those registered in HK back to 2022) were received, but 19 were excluded from analysis because less than 20 % of the survey questions were answered. The respondents' experience varied from one to 41 years of practice, with a median of 13 years. The majority of respondents (88 %) were in Part I Registrants, who are licensed to use diagnostic eyedrops and fluorescein dye in their practice, whilst 4 % and 6 % of the respondents were allowed to use fluorescein dye only (Part II Registry) and not allowed to use any eyedrops or dyes (Part IV Registry), respectively. Around 36.8 % were in independent practice, 23.5 % in optical chain, 25.0 % in hospitals and clinics, 4.4 % and 10.3 % in industry and academic institutes, respectively. The median number of CPD hours obtained in the 2020 cycle was 7.5 h, ranging from 1 to 21 h. Practitioners' clinical experience had no correlation with the CPD hours obtained ($r_s = 0.214$, $p = 0.079$).

3.1. Diagnostic approach

Of the 68 study respondents analyzed, 68 % ($n = 46$) reported that they were confident (top two box (T2B) scores) in diagnosing DED, but only 56 % ($n = 38$) were confident in managing DED. The self-reported interest in developing a dry eye practice was 91 % ($n = 62$), suggesting that they were keen to practice DED assessment. The optometrists with more CPD hours tended, although not statistically significant, to have more years of practice, more confidence in diagnosing and managing DED, more interest in DED practice, and use more clinical tests to assess DED (Table 2).

Fig. 1 shows the percentage of respondents who utilized a specific procedure for DED assessment. The most common clinical procedures used for DED diagnosis were reported symptoms of the patients (93 %), corneal staining (69 %), fluorescein tear-break up time (FBUT) (69 %), meibography (MG) (59 %), conjunctival staining (57 %), and tear meniscus height (TMH) (53 %). Patients' symptoms (T2B 75 %), corneal staining (T2B 49 %) and FBUT (T2B 41 %) were also rated as the top 3 important techniques in DED diagnosis (Fig. 2). Among the available diagnostic procedures, these three were also perceived as the most valuable (T2B > 79 %). Other valuable procedures included conjunctival staining (T2B 78 %), non-invasive tear breakup time (NIBUT) (T2B 66 %) and Ocular Surface Disease Index (OSDI)/5-Item Dry Eye Questionnaire (DEQ5) (T2B 54 %). However, only 40 % of the respondents agreed that osmolarity was a valuable test in the DED assessment. Respondents reported that they were not familiar with some tests, including osmolarity (T2B 24 %), matrix metalloproteinase-9 (MMP-9) (T2B 40 %), and dry eye questionnaires, such as OSDI and DEQ-5 (T2B 16 %). Fig. 2 summarizes the percentage of respondents who rated the clinical value of each procedure.

A significant positive correlation was found between the number of tests routinely performed and the number of CPD hours ($r_s = 0.345$, $p = 0.004$). Respondents who were interested in developing DED practice were more confident in diagnosing ($r_s = 0.343$, $p = 0.004$) and managing DED ($r_s = 0.405$, $p = 0.001$). Corneal staining assessment was more routinely performed by the optometrists who completed CPD ($p = 0.018$). No significant differences were observed between those who completed CPD and those who did not for other tests used. The majority of respondents, for most tests, were neutral, considered them not valuable, extremely not valuable or were unfamiliar.

Table 2

Demographic of the CPD completion groups: (<10 h) and ≥ 10 h).

	Did not complete CPD ($n = 37$)	Completed CPD ($n = 31$)	P value
Years of practice (median, interquartile range)	8 (4–23)	17 (13–26)	0.026
Confidence in diagnosing DED (T2B %)	62	97	<0.001
Confidence in managing DED (T2B %)	43	81	0.003
Interest in DED practice (T2B %)	30	84	<0.001
Number of tests used in DED assessment (median, interquartile range)	4 (3–6)	6 (4–6)	0.014

CPD: Continuing Professional Development; DED: Dry eye disease; T2B: Top two box score.

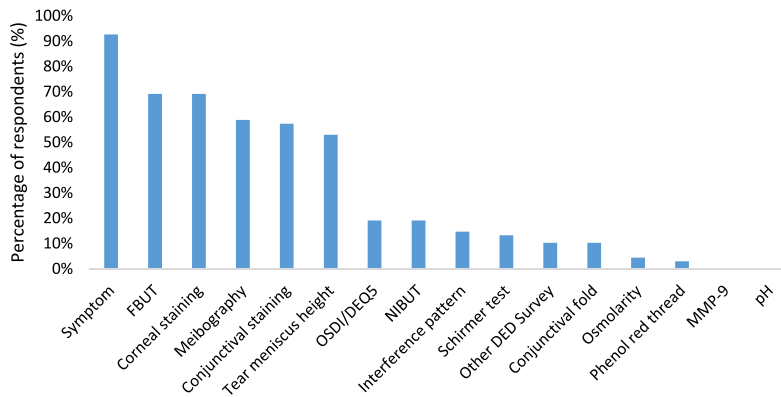


Fig. 1. Percentage of respondents who chose each clinical procedure(s) in their routine dry eye assessment. DED: Dry eye disease; FBUT: fluorescein tear-break up time; NTBUT: non-invasive tear breakup time; Ocular Surface Disease Index: OSDI; 5-Item Dry Eye Questionnaire: DEQ5.

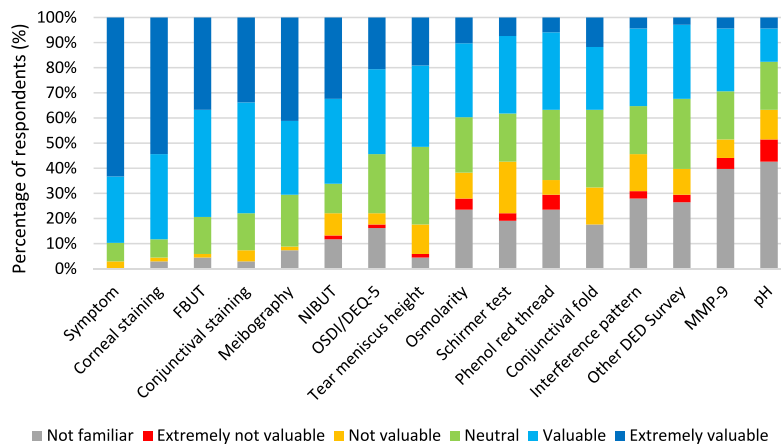


Fig. 2. Percentage of respondents who rated the clinical value for each clinical procedure in dry eye assessment. DED: Dry eye disease; FBUT: fluorescein tear-break up time; NTBUT: non-invasive tear breakup time; Ocular Surface Disease Index: OSDI; 5-Item Dry Eye Questionnaire: DEQ5.

3.2. Treatment strategy

The management approach for different levels of severity of DED was also studied. For mild DED, preservative-free eyedrops (90 %), lid hygiene (63 %), and omega-3 rich foods (30 %) were the top three recommendations by responded optometrists. For moderate DED, preservative-free eyedrops (66 %) and lid hygiene (66 %) remained as the most popular choices of treatment. However, preservative-free eye gels (54 %), omega-3 rich foods (24 %), and supplements (34 %) were added into the treatment plan. For severe

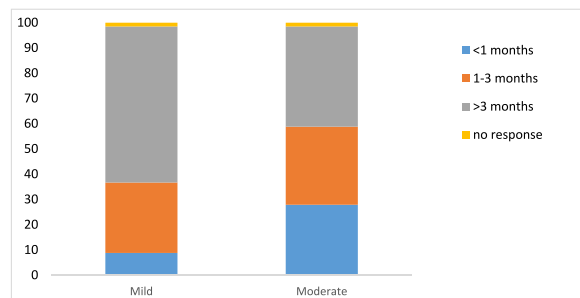


Fig. 3. Suggested follow-up schedules (%) for dry eye disease patients with mild or moderate symptoms.

DED, 67 % of the respondents referred the patients to ophthalmologists, recommended a punctal plug (39 %), or scleral lenses (18 %).

There was considerable variation in respondents suggested follow-up schedules for both mild and moderate DED, which was not associated with completion of CPD (Fig. 3).

No significant differences were found in the recommended follow-up schedules in the completed and non-completed CPD groups ($p > 0.05$) for both mild and moderate DED. There was no difference between the CPD groups with most optometrists recommending referral to ophthalmologists ($p = 0.303$, but the non-completed CPD group was significantly more likely to refer even moderate DED patients to ophthalmologists for management (19 % vs 0 %; $p = 0.014$).

When respondents were asked about the value of recommending omega-3 supplement, two-thirds respondents were comfortable with the recommendation and only 6 % expressed concern, because they were not familiar with nutrition science. Although there was no differences in recommended use of omega-3 supplements for management of mild DED between the two groups associated with completion of CPD, these supplements were recommended significantly more often by the completed CPD group for the management of moderate DED (22 % vs 50 %; $p = 0.021$). However, while for severe DED, those who had not completed CPD were more likely to continue recommending preservative-free eye gel (62 % vs 30 %; $p = 0.014$), while the completed CPD group tended to recommend scleral lenses (8 % vs 30 %; $p = 0.027$).

4. Discussion

Clinical diagnostic procedures and management of DED differs between professions [9,14] and between countries [8,11]. The clinical practices of optometrists and ophthalmologists in diagnosing and managing DED have been previously reported in Australia and New Zealand [4,7–10], United States [5,15], United Kingdom [4,8] and the Netherlands [14]. The study performed by Wolffsohn and colleagues [11] was more focused on investigating the management patterns of DED, whilst diagnostic patterns of DED were not addressed. This study investigated the practice pattern in Hong Kong optometrists for the first time, and found that the management approach towards DED appeared to be similar to TFOS's suggestion in most respondents. However, this study also revealed considerable variation in adoption of standardized DED questionnaires and newer diagnostic tools. By recognizing and acting on these clinical implications, practitioners can strive to provide more evidence-based and comprehensive care for patients with DED.

The diagnostic tests used by Hong Kong optometrists in DED assessment were similar to the recommended diagnostic criteria by TFOS DEWS II [12]. Patient symptoms and the essential tests, such as FBUT and corneal staining, were the top three important tests in the DED assessment. Patient symptoms were rated as the most commonly used (93 %) and most important (75 %) diagnostic tool in DED assessment. However, only slightly more than half (54 %) of the respondents agreed that standardized DED questionnaires, like the OSDI and DEQ-5, were valuable, and only 19 % used these in their routine assessment. This suggests that optometrists are not adopting standardized DED questionnaires in their practice, which may be due to limited understanding about the use of DED questionnaires or the absence of validated Chinese versions of OSDI and DEQ-5. A similar trend was also found for NIBUT as 66 % of respondents agreed that it was valuable, but only less than 20 % performed this as a diagnostic tool, tending to perform FBUT and corneal staining more often. This is in agreement with previous studies indicating that FBUT was preferred by optometrists [3–5,7]. This maybe due to the CPD offerings do not include presentations on DED at that moment. A possible explanation is that NIBUT requires specialized instrumentation (e.g., a corneal topographer), which is not considered essential, unless the practice also provides advanced contact lens services, such as orthokeratology fitting.

Osmolarity is another recommended DED diagnostic test in TFOS DEWS II. It is objective, easy and quick to perform *in vivo*, although its validity has been challenged [16]. As 24 % of the respondents were not familiar with osmolarity and only 40 % agreed that it was valuable in DED diagnosis, both equipment unavailability and low validity of tear osmolarity systems could be reasons for its low adoption for DED diagnosis. The clinical patterns of Hong Kong optometrists in diagnosing DED appeared to largely follow TFOS DEWS II, which is a consensus of opinion of researchers and clinicians.

Non-preserved eyedrops and lid hygiene were the favored treatments for all levels of DED severity, although non-preserved eye gels were more likely to be prescribed for moderate to severe DED patients. A very low preference for prescribing preserved lubricants was noted, suggesting that optometrists may be aware of the disadvantages of preserved lubricants. The management approach for mild and moderate DED was similar, except that omega-3 supplements were more likely to be recommended in moderate DED. Optometrists in Hong Kong were generally positive towards recommending omega-3 supplement to their DED patients. Although a large scale randomized controlled trial reported that essential fatty acids, compared to olive oil, did not perform better in outcomes for DED management [17], a systematic review and meta-analysis concluded that omega-3 supplement may have a role in improving dry eye symptoms and signs in DED patients, despite the inconsistent results between studies [18,19]. For severe DED, most practitioners opted to refer the patients to an ophthalmologist for therapeutic treatment. The management approach of Hong Kong optometrists is similar to Australian optometrists with the exception that Australian optometrists were more likely to prescribe corticosteroid and anti-inflammatory eyedrops for severe DED patients [7]. This difference may be partly explained by the prohibition of Hong Kong optometrists to prescribe these therapeutic agents. Despite this, the management approach of Hong Kong optometrists was in agreement with the suggestions of TFOS DEWS II staged management recommendations [13].

Approximately two-thirds of optometrists suggested follow-up schedule of >3 months for mild DED patients, while most of the remainder recommended 1–3 months. This percentage distribution changed for moderate DED patients. More than one-third of the optometrists (39 %) preferred seeing the patients after >3 months, while 28 % and 31 % of the respondents recommended a follow-up schedule of within 1 month or 1–3 months respectively. A recent randomized clinical trial investigating the therapeutic effects of artificial tear eyedrops also revealed improvement in symptoms and NIBUT after 1 month and 4 months of treatment, respectively [20]. To date, there is no specific timeframe for DED follow-up arrangement, but TFOS DEWS II concluded that most studies employed

a follow-up period ranging from 1 to 3 months after an intervention or treatment was implemented [13]. Depending on the treatments prescribed, the follow-up schedule may vary as some may take longer to be effective. Further investigation is warranted to evaluate the suitable follow-up schedule for artificial tear eyedrops.

For optometrists who were more experienced and proactive in continuing education, their self-reported confidence in diagnosing and managing DED were significantly higher. There was no significant difference in preference of tests used in diagnosing DED, although the completed CPD optometrists reported more frequent use of corneal staining in their routine assessment. They were also more likely to recommend omega-3 supplements to moderate DED patients, while the non-completed CPD optometrists were more inclined to refer moderate DED patients to ophthalmologists. The results suggested that continuing education may not profoundly influence the practice of DED assessment, but have positive influence on enhancing the competency of the standard practice despite not all continuing education offerings were related to DED. In comparison with other studies worldwide, optometrists in Hong Kong have similarities in their clinical practices with optometrists in other countries. Almost all eye care practitioners agreed that patient symptoms were important in diagnosis of DED, but standardized questionnaires were not used [21,22]. This was also noted in studies surveying practitioners in Australia and New Zealand [7,8,10]. The use of standardized and validated DED questionnaires helps to quantify symptoms and is useful in monitoring disease progress and treatment effectiveness [12]. Non-preserved eyedrops and gels were the first-line treatment of choices in DED in Australia [7] and Hong Kong optometrists. Preserved lubricants were obviously the least favorable to Hong Kong optometrists, regardless of the severity of DED.

There were some inherent limitations in this study. The participation rate (15 %) and sample size (68 only) of the current study was quite low and most responses were from Part I registry practitioners. Surveys performed elsewhere had around a 20 % response rate. As optometrists in the Part I registry constitute more than half of the practicing optometrists in Hong Kong, the results may not be completely representative of the practice of Hong Kong optometrists in other registry categories. Selection bias was also unavoidable, because practitioners who were more interested in this topic were more likely to participate in the survey. In addition, whether or not these clinics were fully equipped for some essential diagnostic tests were not asked in the questionnaire, this specific question should be covered in the future study. The management approaches may also vary in different subtypes of DED. In this questionnaire, as the level of knowledge towards DED was unknown, optometrists were only asked to indicate their management for various DED severities, but not specific to the subtypes of DED. Finally, continuing education is also not the only resource for DED for optometrists. Failure of optometrists to attain CPD recognition does not imply they are inferior in practicing evidence-based DED assessment, because there was no indication whether those who completed CPD hours had actually engaged in diagnosing and treating DED in their practices.

In conclusion, the clinical practice of DED assessment and management of Hong Kong optometrists, in terms of choice of tests, indicated they shared both similarities and differences to the guidelines of TFOS DEWS II. Hong Kong optometrists acknowledged the importance of symptomology in the diagnosis of DED, but standardized DED questionnaires were not routinely used. Traditional DED clinical procedures, such as FBUT and corneal staining were still preferred in aiding DED diagnosis and non-preserved lubricant and lid hygiene are the mainstays of treatments in mild and moderate DED. Non-preserved lubricants and lid hygiene are the main treatment choices recommended for mild to moderate DED. Increased use of omega-3 supplement is seen in managing moderate DED and by optometrists who are more experienced and those proactive in participating in continuing education are more likely to prescribe supplements. They are also more confident in diagnosing and managing DED patients in their day-to-day practice. The use of validated DED questionnaires and newer diagnostic tools should be promoted. Incorporating these insights into practice may lead to improved diagnosis, more targeted management, and ultimately better outcomes for DED patients.

Data availability statement

The data will not be publicly available, as the data and analysis have been included in the article.

CRediT authorship contribution statement

Ka Yin Chan: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Biyue Guo:** Writing – review & editing, Formal analysis. **Jimmy SH. Tse:** Writing – review & editing, Methodology, Conceptualization. **Peter H. Li:** Methodology, Investigation, Data curation. **Allen MY. Cheong:** Writing – review & editing, Funding acquisition, Conceptualization. **William Ngo:** Writing – review & editing, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Thomas C. Lam:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e31181>.

References

- [1] J.P. Craig, K.K. Nichols, E.K. Akpek, B. Caffery, H.S. Dua, C.-K. Joo, et al., TFOS DEWS II definition and classification report, *Ocul. Surf.* 15 (2017) 276–283.
- [2] F. Stapleton, M. Alves, V.Y. Bunya, I. Jalbert, K. Lekhanont, F. Malet, et al., TFOS DEWS II epidemiology report, *Ocul. Surf.* 15 (2017) 334–365.
- [3] D.R. Korb, Survey of preferred tests for diagnosis of the tear film and dry eye, *Cornea* 19 (2000) 483–486.
- [4] A.W. Turner, C.J. Layton, A.J. Bron, Survey of eye practitioners' attitudes towards diagnostic tests and therapies for dry eye disease, *Clin. Exp. Ophthalmol.* 33 (2005) 351–355.
- [5] J. Smith, K.K. Nichols, E.K. Baldwin, Current patterns in the use of diagnostic tests in dry eye evaluation, *Cornea* 27 (2008) 656–662.
- [6] J.E. Graham, V.E. McGilligan, D. Berran, A. Leccisotti, J.E. Moore, A.J. Bron, et al., Attitudes towards diagnostic tests and therapies for dry eye disease, *Ophthalmic Res.* 43 (2010) 11–17.
- [7] L.E. Downie, P.R. Keller, A.J. Vingrys, An evidence-based analysis of Australian optometrists' dry eye practices, *Optom. Vis. Sci.* 90 (2013) 1385–1395.
- [8] L.E. Downie, N. Rumney, A. Gad, P.R. Keller, C. Purslow, A.J. Vingrys, Comparing self-reported optometric dry eye clinical practices in Australia and the United Kingdom: is there scope for practice improvement? *Ophthalmic Physiol. Opt.* 36 (2016) 140–151.
- [9] A.L. Xue, L.E. Downie, S.E. Ormonde, J.P. Craig, A comparison of the self-reported dry eye practices of New Zealand optometrists and ophthalmologists, *Ophthalmic Physiol. Opt.* 37 (2017) 191–201.
- [10] Y. Li, R.G. Smith, J.C. Steel, C.J. Layton, Attitudes of eye health practitioners towards diagnostic tests and therapies for dry eye disease in Australasia, *Cont Lens Anterior Eye* 45 (2022) 101724.
- [11] J.S. Wolffsohn, S.T. Huarte, L. Jones, J.P. Craig, M.T. Wang, Clinical practice patterns in the management of dry eye disease: a TFOS international survey, *Ocul. Surf.* 21 (2021) 78–86.
- [12] J.S. Wolffsohn, R. Arita, R. Chalmers, A. Djalilian, M. Dogru, K. Dumbleton, et al., TFOS DEWS II diagnostic methodology report, *Ocul. Surf.* 15 (2017) 539–574.
- [13] L. Jones, L.E. Downie, D. Korb, J.M. Benitez-del-Castillo, R. Dana, S.X. Deng, et al., TFOS DEWS II management and therapy report, *Ocul. Surf.* 15 (2017) 575–628.
- [14] M. van Tilborg, P.J. Murphy, K.S. Evans, Agreement in dry eye management between optometrists and general practitioners in primary health care in The Netherlands, *Cont Lens Anterior Eye* 38 (2015) 283–293.
- [15] J.F. Williamson, K. Huynh, M.A. Weaver, R.M. Davis, Perceptions of dry eye disease management in current clinical practice, *Eye Contact Lens* 40 (2014) 111.
- [16] A. Tavakoli, M. Markoulli, J. Flanagan, E. Papas, The validity of point of care tear film osmometers in the diagnosis of dry eye, *Ophthalmic Physiol. Opt.* 42 (2022) 140–148.
- [17] Eye A. Dry, G. Management Study Research, P.A. Asbell, M.G. Maguire, M. Pistilli, G.S. Ying, et al., n-3 fatty acid supplementation for the treatment of dry eye disease, *N. Engl. J. Med.* 378 (2018) 1681–1690.
- [18] L.E. Downie, S.M. Ng, K.B. Lindsley, E.K. Akpek, Omega-3 and omega-6 polyunsaturated fatty acids for dry eye disease, *Cochrane Database Syst. Rev.* (2019), <https://doi.org/10.1002/14651858.CD011016.pub2>.
- [19] G. Giannaccare, M. Pellegrini, S. Sebastiani, F. Bernabei, M. Roda, L. Taroni, et al., Efficacy of omega-3 fatty acid supplementation for treatment of dry eye disease: a meta-analysis of randomized clinical trials, *Cornea* 38 (2019) 565–573.
- [20] J.P. Craig, A. Muntz, M.T. Wang, D. Luensmann, J. Tan, S.T. Huarte, et al., Developing evidence-based guidance for the treatment of dry eye disease with artificial tear supplements: a six-month multicentre, double-masked randomised controlled trial, *Ocul. Surf.* 20 (2021) 62–69.
- [21] M.M. Hantera, Trends in dry eye disease management worldwide, *Clin. Ophthalmol.* (2021) 165–173.
- [22] A. Shiraiishi, Y. Sakane, Assessment of dry eye symptoms: current trends and issues of dry eye questionnaires in Japan, *Invest. Ophthalmol. Vis. Sci.* 59 (2018) D23–D28.