Patient-reported experience of dry eye management: an international multicentre survey

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Abstract

Purpose: To explore the journey taken by patients in a range of different countries to manage their dry eye symptoms.

Method: Members of the general public who responded positively to the question “Do your eyes ever feel dry?” completed a questionnaire describing their demographics, the impact of their symptomology, the advice they have received and the management options they have tried. The Ocular Surface Disease Index (OSDI) questionnaire was also completed.

Results: A total of 916 individuals (Canada = 235, Mexico = 127, New Zealand = 157, Taiwan = 246, UK = 151) of similar age distribution (median 38 years, IQR: 27-50) completed the survey. The reported duration of symptoms was longest in Canada (median 4 years, range 2-10) and least in Taiwan (2 years, range 1-3; $p<0.001$), and similar trends were observed for symptom severity ($p=0.001$). However, there was no statistically significant difference between countries with respect to the impact of symptoms on quality of life (median 3/10; $p = 0.08$).

Less than half of the individuals in any country had consulted with a health professional. About half had tried a treatment for their dry eye symptoms, with artificial tears being the most common treatment, followed by warm compresses, and both were rated as reasonably effective (median 5-7/10).
Conclusion: Many people with dry eye symptoms are not consulting health care professionals who can confirm the diagnosis, exclude differential diagnoses, and offer a wide range of treatments targeted at the dry eye subtype.

INTRODUCTION

Dry eye disease is a multifactorial disease of the ocular surface. It is characterised by a loss of homeostasis of the tear film, accompanied by ocular symptoms such as discomfort [1]. Tear film hyperosmolarity plays an important role in pathophysiology, where excessive evaporation at the ocular surface results in an abnormally high concentration of salts in the tears compared to the healthy eye. A reduction in the quality and/or quantity of tears induces a range of issues, including tear film instability, wetting defects, hyperosmolar stress, increased friction and chronic mechanical irritation at the ocular surface [2, 3]. Each of these problems may themselves initiate a chain of inflammatory events that leads to surface damage as part of the vicious circle of dry eye disease, that perpetuates itself and characterises the disease process [3]. The condition can have a devastating impact on those affected; studies have found dry eye has a significant impact on patients' lives [4], where similar utility assessment scores using time trade-off methods (1.0=perfect health to 0.0=death) found severe cases (0.56) to be comparable to hospital dialysis (0.56-0.59) and severe angina (0.50) [5]. Thus, it is crucial to fully appreciate this condition with respect to its impact on patients and manage them appropriately.

Many studies have examined how dry eye is diagnosed and managed by eye/health care professionals using surveys [6-13], roundtable discussion [14], analysis of patient records [15] and mystery shopper-based [16] methodologies, and observed how these compare to preferred practice patterns [17]. These studies highlight generally high consensus for dry eye treatments, where the vast majority rely on eyelid hygiene measures and topical ocular lubricants, between: optometrists and medical practitioners [7, 11, 12]; optometrists from different countries [9]; and relative to professional standards [14, 17]. Diagnostic testing and disease monitoring relies mainly on symptom assessment due to frequent disparity with clinical signs, as well as a lack of access to specialised equipment and training of non-eye care professionals [6, 7, 9, 11, 12, 16, 18]. This is further complicated by differences between practices in different countries with respect to access for professionals to testing resources and training, and patient access to healthcare; in addition, there are few studies investigating dry eye practice in less well developed countries [6, 13, 18]. Despite these challenges, the existing studies have shed significant light on dry eye disease detection and treatment in clinical settings.

Conversely, much less is known about the experience of dry eye disease from the patient's perspective and how it is typically managed [19-23]. Studies assessing the agreement between clinicians and patients with respect to the patient's dry eye severity reveal that clinicians frequently underestimate symptom severity [19, 21]; indeed, Chalmers et al. (2005) found that over 40% of patients reported their symptoms to be more severe than clinician assessment predicted, particularly amongst females and the elderly. This significant disparity

has also been observed with respect to treatment response; Yeh et al. (2015) reported that clinician assessed dry eye improved in 88% of patients after treatment, whereas only 35% of the patients themselves reported this to be the case. While dry eye is recognised to be more prevalent amongst women, females are also reported to experience: more severe and frequent dry eye symptoms (which have greater impact on overall well-being); higher use of medical/surgical interventions; increased financial burden of treatment; and generally greater dissatisfaction due to perceived treatment side effects and the length of time required to experience treatments effects [20]. Long-term follow-up studies of dry eye show worsening of ocular surface symptoms in nearly a quarter of patients, and of vision-related symptoms in nearly one-third over a mean 10-year duration from diagnosis [22, 24]. However, on average, over an 8-year observation period, dry eye patients reported improved symptoms and reduced artificial tear usage compared to baseline [24]. More recently, a survey assessing patient needs and preferences, with regard to dry eye treatment, revealed treatment effectiveness as the most important perceived attribute in both moderate and severe groups [23].

The cited studies, reflecting the breadth of research in the published literature, are based on data typically from developed countries with advanced and accessible healthcare systems and highly trained clinicians. They fail to explore the often long and circuitous route to management that lies between over-the-counter self-medication and consultation with some, or all, of a range of general and specialist health professionals a person with dry eye can interact with in an attempt to ameliorate their symptoms. Such knowledge may help shape current and future guidance towards effective dry eye management in attempting to optimise the patient journey. Therefore, this study aimed to investigate the patient-reported experience of dry eye management in an international multicentre survey.

METHODOLOGY

A paper based survey was constructed (Figure 1), trialled and refined with dry eye patients (n=5) and eye care practitioners (n=5) to collect data on participant demographics (age, sex, ethnicity and contact lens wearing history), symptomology (duration, severity between the eyes, consistency, severity and impact) and management (health professional(s) consulted and treatments tried)

Dry Eye Natural History

Demographics: Age __years Gender M / F Ethnicity _____ Regular contact lens wearer No ❑ Yes ❑

Do your eyes ever feel dry? No ❑ Yes ❑

How long have you had these symptoms? _____ years

Have they remained constant ❑, increased in severity ❑, decreased in severity ❑ or fluctuated ❑ over time?

Do they occur at a particular time of day or with any particular activity? No ❑ Yes _____

How severe are these symptoms? Slight ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ Very

How much impact does this have on your life? None ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ A great deal

Does it affect both eyes equally? No ❑ Yes ❑

Have you seen health professional(s) about it? No ❑ Yes _____

Have you tried any treatments? No ❑ Yes ❑

Which treatment(s) have you tried?			
For how long did you try the treatment for?			
Are you still using it:	Yes ❑ Occasionally ❑ No ❑	Yes ❑ Occasionally ❑ No ❑	Yes ❑ Occasionally ❑ No ❑
What informed your choice of treatment?			
Do you feel the treatment worked?	Not at all ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ Cured	Not at all ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ Cured	Not at all ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ Cured

Figure 1: Dry eye journey survey.

A positive response to the screening question of "Do your eyes ever feel dry?" and being at least 18 years of age were the inclusion criteria. It is difficult to get a truly representative sample of a population, but participants were recruited from the general public, outside of eye care settings, from university campuses (random approach of people from public locations where people congregate), social media (Facebook and Twitter from university rather than personal accounts, not related to eye care postings and unpaid) and word of mouth in Canada, Mexico, New Zealand, Taiwan and the United Kingdom. The survey was completed independently in paper form. In Canada, Mexico, New Zealand and the UK the individuals also completed the Ocular Surface Disease Index (OSDI) questionnaire [25]. The study was approved by local ethical review boards in each of these locations and the research conformed to the tenets of the Declaration of Helsinki. As the survey data were ordinal in nature, non-parametric statistics (Kruskal-Wallis H Test) were applied to evaluate differences between countries; parametric statistics (ANOVA) were applied to the normally distributed OSDI data (SPSS v25, Chicago, IL, USA). Responses to open response questions were categorised by reading all the responses, drafting categories and then checking that >90% of responses could

be attached to one of the categories. Data shown in the tables generally relate to where the number of respondents were at least 8 to avoid skewed or misrepresentations of findings caused by lower numbers.

RESULTS

A total of 916 individuals (Canada = 235, Mexico = 127, New Zealand = 157, Taiwan = 246, UK = 151) completed the survey.

Participant demographics

The sex (~65% female for all countries) and median age (Figure 2) profile of the different samples were similar, but statistical analysis showed there was difference between countries for age (H =52.39, p<0.001) where post-hoc analysis reveals New Zealand (40 years (IQR: 20-50); p<0.001) and Taiwan (40 years (20-50); p<0.001) had slightly younger age groups compared to Canada (40 years (30-50)), Mexico (40 years (30-60)), and the UK (40 years (30-50)). Approximately 39% of the UK and Taiwan sample were contact lens wearers, 28% and 22% for New Zealand and Canada, and only 4% in Mexico. Ethnicity varied with country as expected (predominant race: Canada 62% Caucasian; Mexico 97% Hispanic or Latino; New Zealand 46% Caucasian; Taiwan 100% South East Asian; UK 67% Caucasian).

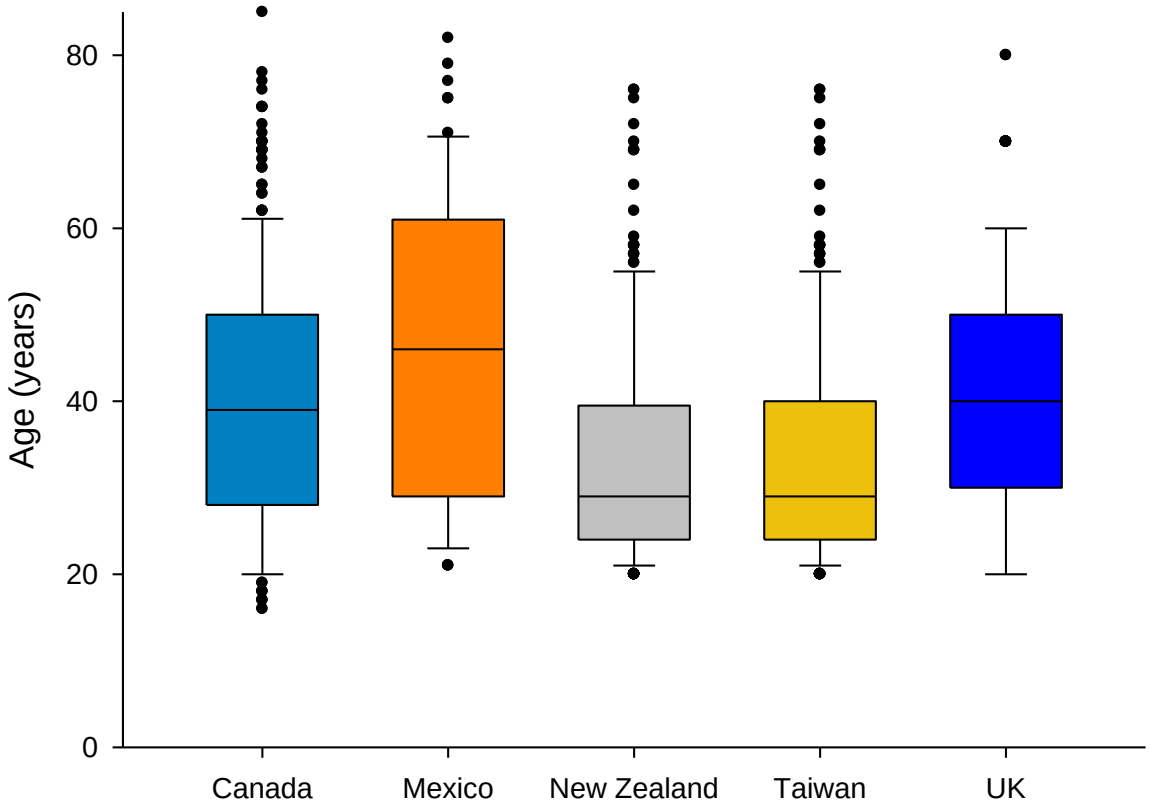

Figure 2: Age of individuals (decades) reporting symptoms of ocular dryness and/or irritation in their respective countries. The box indicates the 25% to 75% quartiles with the contained line being the median, the attached whiskers the 95% confidence intervals and the dots, data points beyond this.

Impact of symptomology

There was a statistically significant difference in duration of symptoms (Figure 3) between countries (H = 71.16, p <0.001), and post-hoc testing showed Canada had longer duration (median 4(2-10) years) compared all other countries (all p <0.001) (Mexico (3(1-5), New Zealand (3(1-7), Taiwan (2(1-3), and UK 3(1-7.5)). There was no significant difference between Mexico, New Zealand and the UK, but mean duration of symptoms in all these countries was significantly longer than that reported for Taiwan (all p <0.001).

Symptom severity was relatively symmetrical between the two eyes in around 80% of individuals regardless of country, with a reasonably equal spread between participants reporting fluctuating, increasing, decreasing, or constant symptoms over time since their commencement (Figure 4). Only ~30% reported consistency of symptoms during the course of the day, with the majority of free-text comments indicating their symptoms were worse at night (~30%) or in the morning (~10%), when viewing digital screens (~20%), driving, reading, outdoors and in air conditioning (all ~10%). Changes in symptom severity when wearing contact lenses or during the allergy season were rarely reported.

The severity of reported symptoms (Figure 5) differed significantly between countries (H =16.92, p = 0.02). However, post-hoc testing showed this difference lay only between Canada (median 5(3-7)) and Taiwan (4 (2-5.8)), with the former reporting higher severity scores (p = 0.001). The difference between all other post-hoc country comparisons was not statistically significant.

In contrast, while there was also a statistically significant difference in OSDI scores between countries (F = 9.10, p <0.001); post-hoc testing showed Mexico had higher OSDI scores (mean 24.4±19.9) than New Zealand (18.0±15.0; p <0.01) and the UK (20.0±18.4; p = 0.02); and Canada had higher OSDI scores (27.4±18.4) compared to New Zealand (p <0.001) and the UK (p <0.001). There was no significant difference in OSDI scores between Mexico and Canada or between New Zealand and the UK. OSDI data were not available for Taiwan.

There was no statistically significant difference between countries with respect to the perceived impact of symptoms on quality of life (H = 6.90, p = 0.08; Figure 6).

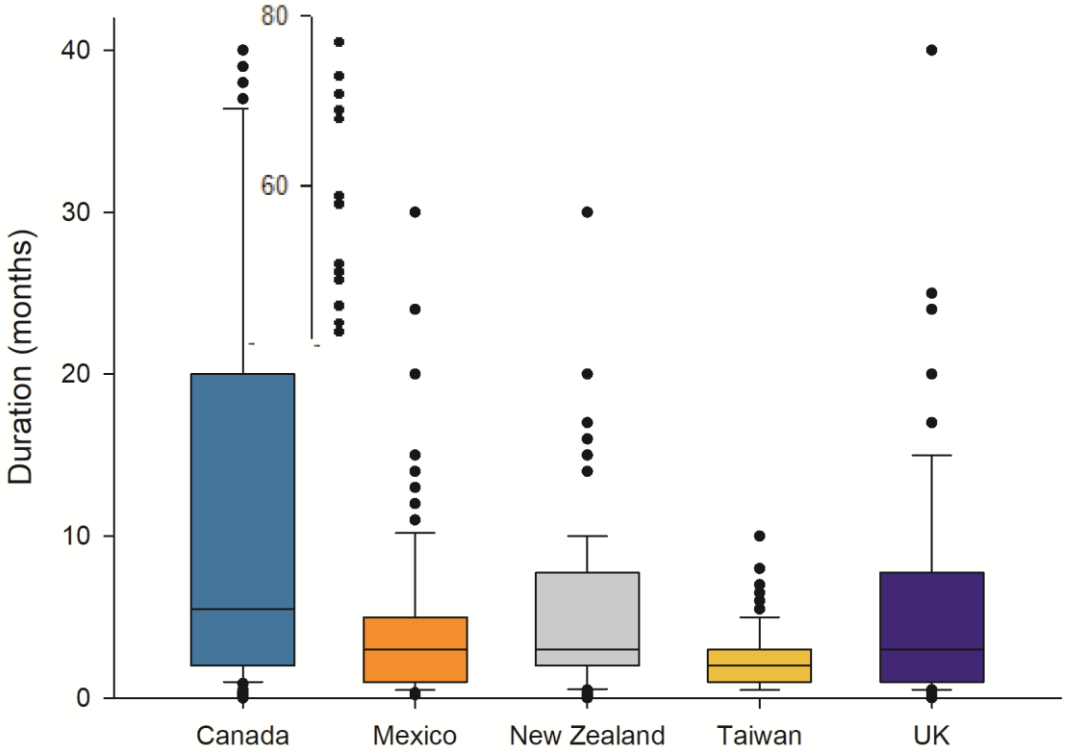

Figure 3: Duration of dry eye symptoms (months) of individuals in their respective countries. The box indicates the 25% to 75% quartiles with the contained line being the median, the attached whiskers the 95% confidence intervals and the dots, data points beyond this.

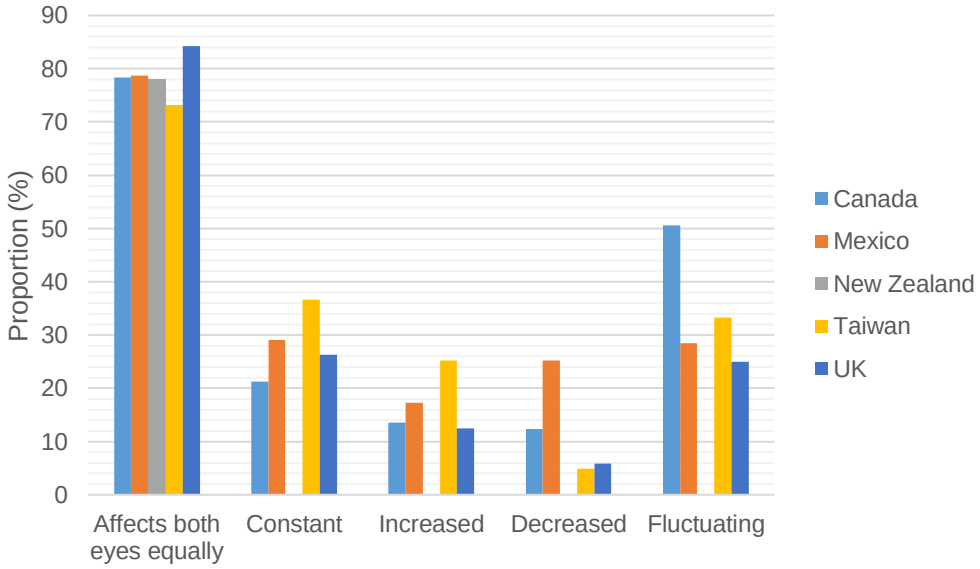

Figure 4: Consistency of reported symptoms as a proportion of the sample, between eyes of individual participants, and stability since commencement (not collected on the New Zealand cohort).

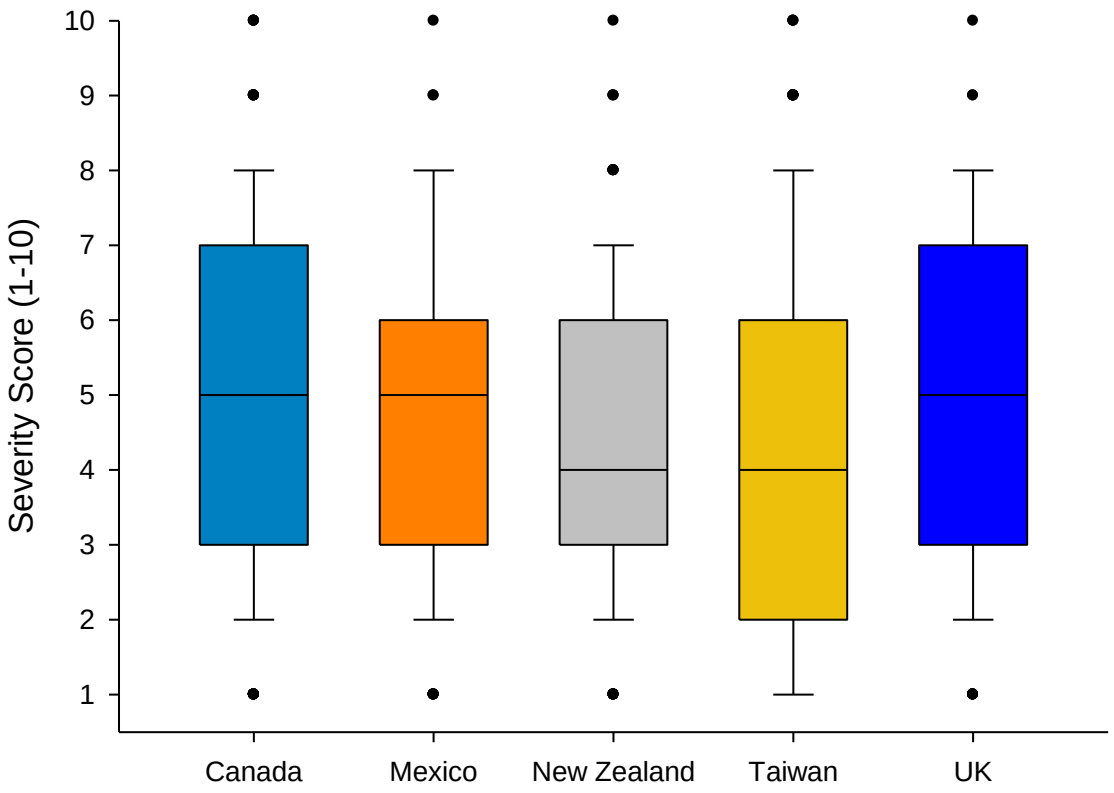

Figure 5: Severity of self-reported dry eye symptoms (1-10; 1=none, 10=highest) in different countries. The box indicates the 25% to 75% quartiles with the contained line being the median, the attached whiskers the 95% confidence intervals and the dots, data points beyond this.

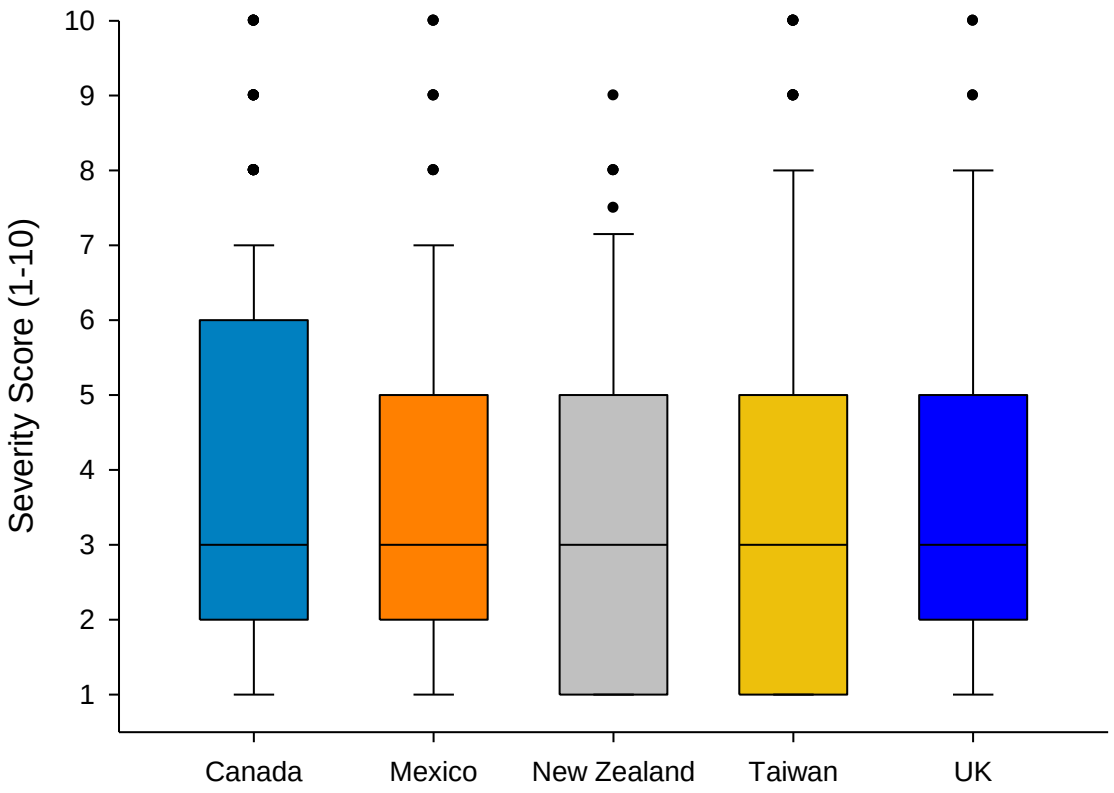

Figure 6: Self-reported impact of dry eye symptoms on quality of life (1-10; 1=none, 10=highest) of individuals in their respective countries. The box indicates the 25% to 75% quartiles with the contained line being the median, the attached whiskers the 95% confidence intervals and the dots, data points beyond this.

Management

Less than half of the individuals in any country had consulted with a health professional (approximately 44% in Canada and New Zealand, 30% in Mexico and the UK, and 24% in Taiwan) (Figure 7).

Approximately half of the respondents had trialled a treatment for their dryness symptoms (Figure 7). Artificial tears were the most common treatment, followed by warm compresses in Canada and New Zealand, where the use of two or more treatments was more common (Figure 8). The survey did not explore whether they were concurrently used. There was a statistically significant difference between the reported durations of treatments between all countries (H = 21.78, p <0.001; Table 1). Post-hoc testing showed participants in Canada (median 12 months (2-36)) had significantly shorter treatment use compared to Mexico (24 months (12-48); p =0.001), but was similar to all the other countries (p > 0.05 in all cases).

Participants in Mexico reported significantly longer individual treatment durations of use compared to New Zealand (18 months (3-36); $p = 0.03$), Taiwan (12 months (6-24); $p < 0.001$) and the UK (8 months (2.5-24); $p < 0.001$). Similarly, New Zealand participants reported significantly longer treatment durations than Taiwan ($p = 0.01$) and the UK ($p = 0.001$), but there was no significant difference in that reported between Taiwan and the UK ($p = 0.29$; Table 1). The duration of less commonly used treatments included immunomodulation ([Restasis] Canada: 12 months (9-12), n=5), antibiotic eye drops/tablets (Taiwan: 12 months (12-54), n=8), steroid drops (Canada: 6 months (2-6), n=8), liposomal spray (UK: 0.8 months (0.6-0.9), n=7), anti-allergy eye drops/tablets (Canada: 24 months (18-30), n=4; New Zealand: 54 months (24-120), n=11) and Chamomile eye drops (Mexico: 24 months (24-60), n=8). Of the common treatments, the regularity of use is presented in Table 2); artificial tears generally were deemed reasonably effective as were warm compresses (median effectiveness score 5-7/10), but no treatment provided complete relief in a substantial sample of individuals (Table 3).

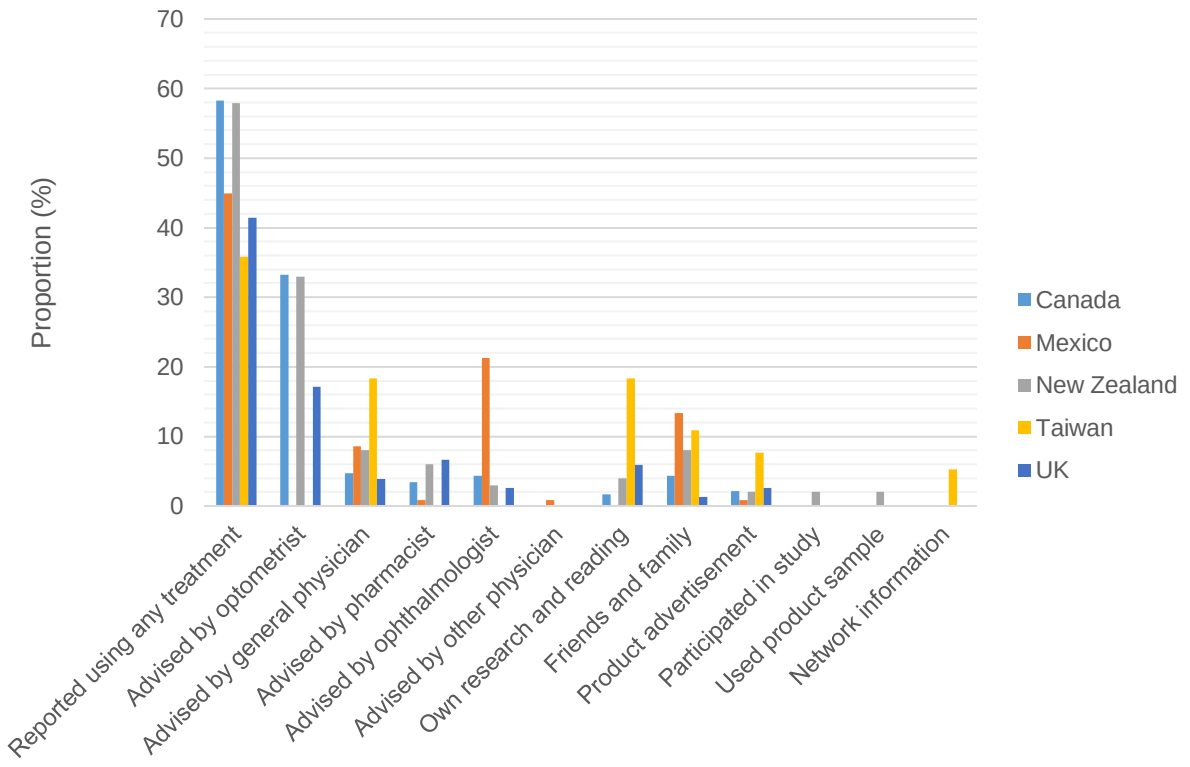

Figure 7: Proportion (%) of individuals reporting having used dry eye treatment and from whom/where recommendation sought.

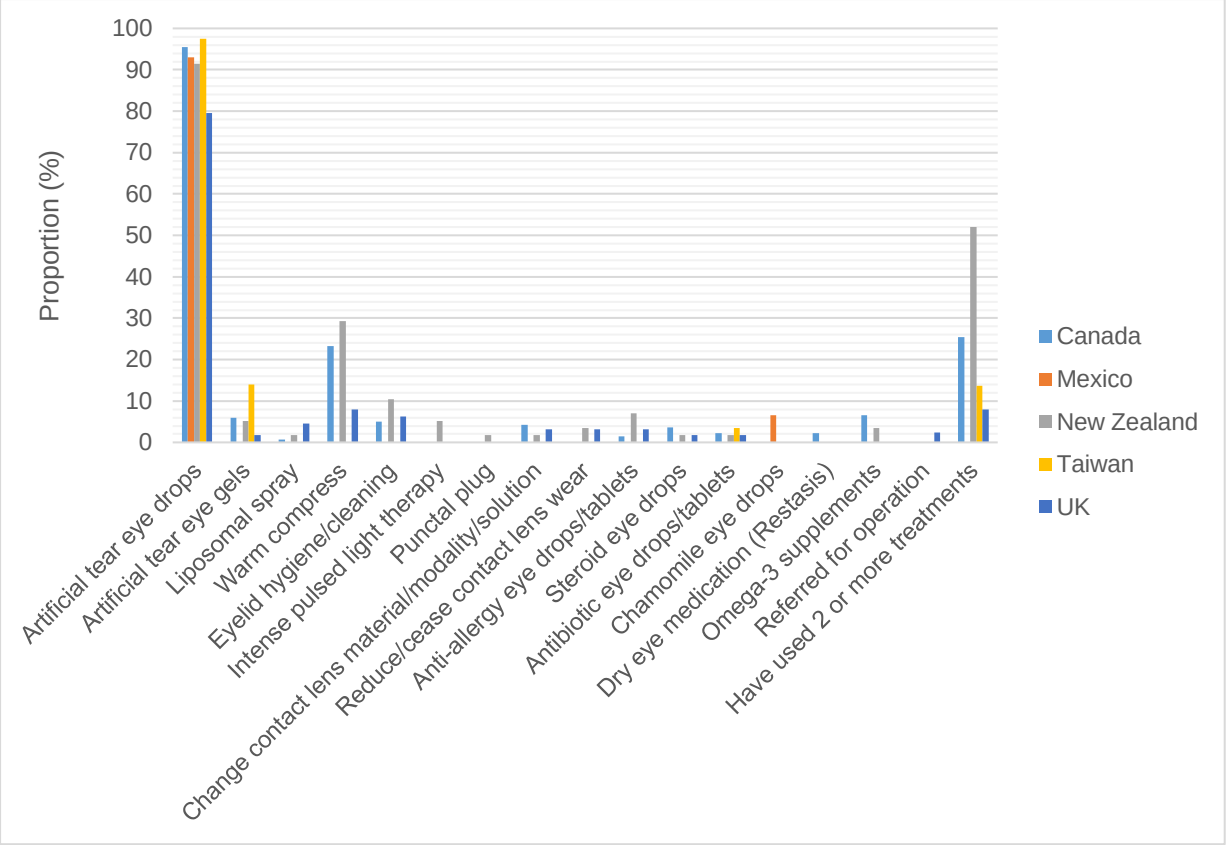

Figure 8: Proportion (%) of individuals who reported having trialled a treatment / strategy used for dry eye.

	Duration individual dry eye therapies were trialled (months)				
	Canada	Mexico	New Zealand	Taiwan	UK
All treatments	**12 (2-36)**	**24 (12-48)**	**18 (3-36)**	**12 (6-24)**	**8 (2.5-24)**
Artificial tear eye drops	12 (2-36) [224]	24 (12-48) [118]	15 (2-36) [144]	12 (6-24) [240]	6 (1.5-21) [120]
Artificial tear eye gels	48 (42-54) [14]	-	36 (27-36) [8]	15.5 (5.5-27) [34]	-
Warm compresses	7.5 (2-16.5) [54]	-	3 (1-18) [46]	-	8 (6-10) [12]
Eyelid hygiene/cleansing	0.6 (0.5-3.6) [12]	-	3 (1-4.5) [16]	-	6 (3.8-93) [10]

Table 1: Duration (months) of commonly (n>7) reported individual treatment use by individuals [number] for dry eyes. Data shown as median value (with the range in brackets). The order or concurrency of treatments used was not investigated.

	Regular					Occasional					Discontinued				
	Canada	Mexico	New Zealand	Taiwan	UK	Canada	Mexico	New Zealand	Taiwan	UK	Canada	Mexico	New Zealand	Taiwan	UK
Artificial tear eye drops	36.6	28.3	34.0	72.1	38.0	46.6	60.4	49.0	25.6	36.0	16.0	11.3	2.0	2.3	26.0
Artificial tear eye gels	57.1		40.0	100		42.9		20.0		100			40.0		
Warm compress	34.4		15.0		60.0	56.3		58.0			9.3		27.0		20.0
Eyelid hygiene/cleaning	57.1		29.0			28.6		14.0		75.0	14.3		57.0		25.0

Table 2: Continuation behaviour by dry eye individuals, by country, on treatments in Table 1. Regular use = at least once per day; occasional use = at least once per week, but less frequently than once per day or used as needed; discontinued = no longer used. Data shown as proportion (%) of strategy use.

	Canada	Mexico	New Zealand	Taiwan	UK
Perceived treatment efficacy overall	**5 (4-7)**	**7 (5-9)**	**6 (5-8)**	**7 (5-8)**	**5 (3-7)**
Artificial tear eye drops	5 (4-7)	7 (5-9)	6 (4-8)	7 (5-8)	5.5 (4-8)
Artificial tear eye gels	6 (4-8)		5 (3-7)	9 (8-9)	10
Warm compresses	7 (5-8)		5 (3-7)		7 (5-7)
Eyelid hygiene/cleansing	8 (6.5-8)		6		6.5 (4.8-7.8)

Table 3: Perceived efficacy of strategies noted in Table 1 (perceived level of relief from 0 "not at all" to 10 "cured") among respondents reporting symptoms of dry eye and irritation and using treatment. Data are presented as median or median (interquartile range).

DISCUSSION

This study aimed to investigate in members of the general public, outside eyecare settings, the patient-reported experience of dry eye management in an international multicentre survey. Dry eye symptoms alone are not sufficient for the diagnosis of dry eye disease and there are several differential diagnoses that need to be considered [1, 26]. However, there are effective treatments available, so the choice of professional that individuals consult with about managing their disease is an important consideration towards maximising quality of life. The mean OSDI symptom scores of the country cohorts assessed in this study were between 18.0 and 27.4, well above the established threshold of ≥ 13 for a positive result in symptom screening for dry eye disease [26]. However, there were participants who reported that their eyes did feel dry, at least occasionally, that had an OSDI result below the level that would trigger a full diagnostic work-up [26] who took part in this survey. They felt their symptoms were worth reporting and they may be a precursor to a level of dry eye that would be diagnosed; hence their 'journey' was felt appropriate to include in this study. If anything, their inclusion cause an underestimation of the impact of symptoms. It should be noted that the OSDI assesses symptom frequency and not severity, so the cut-off is less likely to be reached by individuals that have symptoms that fluctuate. The questionnaire relied on the recall and honesty of participants, which is a limitation of cross-sectional survey data. Recruiting a truly representative sample of a population is difficult, as any mention of eye care is likely to attract those who have been more proactive about managing their condition, so participants were recruited from the general public, outside of eye care settings. Attracting people who are more interested in their eye care would likely cause a reduction in severity and impact on quality of life due to better treatment. As the number of participants reporting advice by a health professional was quite low, it implies that such a bias was minimised by the recruitment approach. The questions were kept simple to minimise cultural differences in interpretation of the questions. A major limitation in comparing between populations is heterogeneity, due to different demographic characteristics [4]; however, the age range of individuals reporting dry eye symptoms between the study populations was remarkably similar (median 4-5th decade for all countries) and a greater proportion were female (59% - 78%), which is consistent with previous studies reporting increased prevalence amongst older people and female sex [4]. Asian race has also been identified as a major risk factor for dry eye, with an odds ratio of 1.5-2.2 times that of Caucasians (age and sex controlled [4]. Despite the anticipated ethnic differences between countries, however, the self-reported severity proved to be similar.

The duration of dry eye symptoms varied widely between participants in all countries, but median values were between 2 and 4 years (Figure 3). In Taiwan, the duration range was shorter (0.5 – 11 years) than the largely Caucasian cohorts (Canada, New Zealand and the UK), despite the higher predisposition towards dry eye in Asian races [4]. On a subjective

rating of symptom severity, median scores reveal relatively mild to moderate disease is most common (5/10 median); in cohorts that completed the OSDI, on average, mild symptoms (range 13-22) were observed in New Zealand and UK, and moderate (range 23-32) in Mexico and Canada [25]. This led to a consistent, but mild effect on quality of life (median 3/10 across all countries), but ranged from 'none' to 'a great deal' despite less than half being managed by an eye care professional. Unless questioned about specific dry eye symptoms during routine eye health consultations, such individuals may be poorly managed at best and at worst overlooked. Indeed, a similar cross-sectional survey to investigate patient experiences of dry eye, found statistically significant relationships between delay in diagnosis (>1 year), the need to see more than one clinician and increased eye drop use (>3 times daily), with a lower quality of life [27]. This suggests that over the counter access to treatments might not be adequate as the disease cannot be readily diagnosed by the public and treatments can mask the symptoms, increasing health risks. This serves to highlight the need for clinicians to properly screen for dry eye utilising a validated questionnaire to detect the presence of dry eye symptoms at an early stage [26], along with assessing the homeostasis of the tear film in order to improve quality of life, reduce unnecessary expenditure of what may be ineffective treatments, and seek to prevent further dry eye disease progression [27]. There is also a need for greater patient education and public awareness of the disease. The data supported the observation that dry eye is generally a bilateral disease [1] although symptom consistency since commencement varies amongst individuals, in a similar manner across countries, which may reflect the waxing and waning nature of dry eye disease over time [1, 4].

While approximately a quarter to one-third of individuals did not attribute their dry eye symptoms to a specific task or environment, many reported experiencing worse dry eye symptoms in the morning/evening and while observing digital device screens, as has been reported previously [4, 28]. The association with screen time is not unexpected as visual display unit use and tasks requiring concentration during the working day are recognised to reduce blink completeness and blink rate, promoting increased tear film instability and evaporation from the ocular surface; this leads to hyperosmolarity and subsequent inflammation, accompanied by dry eye symptoms [2, 3, 7, 29-32]. Environmental exposure to conditions such as wind (outdoors, riding scooter) and low humidity (air conditioning) reported by individuals are also established risk factors for dry eye [4, 33-35]. Surprisingly, few subjects reported associations with contact lens wear (2 - 8%), despite a high proportion reporting contact lens use (22-38% except for Mexico). Contact lens wear may contribute to the development of dry eye symptoms due to disruption of ocular surface homeostasis [4, 36-38]. Indeed, dry eye has been previously reported to be in the order of 4 times more prevalent in contact lens wearers than non-wearers [39-41] and wearers are reported to experience more severe dry eye symptoms [42].

With respect to healthcare-seeking behaviour, less than half of patients reporting dry eye symptoms had visited an eye care professional for investigation. It may be that these patients did not consider their symptoms sufficiently severe or bothersome to justify seeking advice, or that they may not have known where to do so. The highest proportions were in those countries with well-established healthcare systems, notably Canada, New Zealand and the UK where primary eye care is predominantly delivered by optometrists who are highly trained to diagnose and possess prescribing rights in many cases, which allow management of eye conditions in lieu of referral to an ophthalmologist. This is reflected in the highest consultation rates with this form of health professional in these countries. In Mexico, there is a shortage of optometrists, whose profession has required university level education and national regulation only since 2015 [43]; again, this is reflected by the predominance of ophthalmologist or general physician visits. Likewise, legislation was only passed as recently as 2015 in Taiwan for optometrists to be recognised eye care practitioners, and the first set of examinations for qualification took place in 2017. This explains the lack of advice from optometrists in this country [44]. Surprisingly, given that many dry eye treatments are available over the counter without prescription, very few patients, overall, sought advice from a pharmacist. It may be that patients consider pharmacists' expertise to lie elsewhere and thus seek investigation from an eye care/medical professional or self-treat based on general marketing.

Despite experiencing dry eye symptoms, only 36-58% of subjects reported using specific treatments to help provide relief. Laboutelle et al. (2017), identified that 41% of their respondents were not diagnosed at symptom onset, and of these, almost a third (31.6%) waited more than one year to be diagnosed after noticing symptoms. Of those who did report using a dry eye treatment, the vast majority in each country described use of artificial tear supplements (Figure 8), which was unsurprising given the widely accessible nature of these eye drops without need for a prescription [45]. The frequent and long duration of use indicated high patient acceptability. Although warm compresses, liposomal sprays, omega-3 supplements, and eyelid hygiene measures are typically recommended for meibomian gland dysfunction (MGD) [45, 46], a leading cause of dry eye [1], relatively few in this study reported using these treatments (Figure 8). Indeed, due to the low number of users with these latter treatments and their associated duration and effectiveness, the sample size is insufficient to determine generalisations with respect to their usage. Moreover, few respondents reported using more than one therapy, except for in New Zealand, where over 50% used 2 or more treatments (Figure 8). Such a failure to use more than one therapy is not ideal given recent evidence in treatment guidance; this advocates a multi-pronged treatment strategy targeting identified deficiencies and breaking the vicious cycle of dry eye to restore ocular surface homeostasis, particularly given the frequency with which signs of MGD are detected in the vast majority of patients [2, 45]. In order for warm compress and eyelid hygiene strategies to

be effective, regular long-term use is advised [45, 46], however, like artificial tears the data describing continuation shows many subjects use them only occasionally or had discontinued (Table 2). This serves to highlight the need for eye care professionals to fully explain the chronic nature of dry eye disease and emphasise the importance of long-term combination treatment where warranted, with artificial tears and eyelid warming/cleansing, particularly, as respondents reported perceived moderate to good effectiveness with these treatments (Table 3).

The most unexpected treatment to be reported as commonly used was chamomile eye drops in Mexico, with approximately 6% of respondents using this treatment (Figure 8). Chamomile eye drops have been manufactured and widely distributed over-the-counter for many years in that country. The median duration of use of treatments was long-term (24 months; Table 1) and was used relatively often (25% regular, 50% occasional; Table 2). There appears to be no clinical evidence or reports of the effectiveness of Chamomile treatment in the scientific literature, but self-reported perceived effectiveness was rated highly (median score of 7 out of 10) (Table 3). Further study to elucidate the pharmacological properties and confirm effectiveness through randomized control trials is required to evaluate the value of this treatment for dry eye disease.

Overall, treatment duration was longest in Mexico, and shortest in the UK and Canada, although the duration of symptoms, rating for severity, and impact on quality of life was very similar for all countries. This difference may be explained by the wide availability of many brands/types of artificial tears available in the latter countries, such that individuals frequently try several in close succession in seeking the most effective treatment option. However, despite availability of a wider range and easier access to high level eye care in the UK, Canada, and New Zealand, perceived effectiveness of treatments overall was surprisingly rated lowest in these same countries (Table 3). Compared to Mexico, these countries have more service based economies with high levels of computer, tablet, and phone display use which may contribute to the perceived lack of effectiveness; indeed, such job roles may increase evaporative exposure of the ocular surface and subjects may not have enough time to use treatments during the day to relieve symptoms. However, cultural expectations and respect for medical professionals may also play a role.

In conclusion, this study has highlighted that a large proportion of the general public who have even moderate dry eye symptoms are failing to seek appropriate healthcare and as a consequence, are either living with a reduced quality of life or are being managed with largely artificial tears despite a wider range of potentially more effective treatments being available [45]. Eye care practitioners need to be more proactive in marketing their management skills in this area and to encourage regular check-ups to promote timely diagnosis [26] and targeted

management [45] of this chronic and debilitating disease, to maximise an individual's quality of life.

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