Factors predisposing the Asian eye to dry eye disease

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Background

Asian ethnicity is a mostly consistent risk factor for dry eye disease (DED) according to TFOS DEWS II.[1] However, differences in climate, environment and lifestyle, as well as in diagnostic criteria and methodology across different continents, limit direct inter-ethnic comparison of study outcomes and reported prevalence rates.

Aim

A series of studies by our group sought to compare DED prevalence, across a range of ages, in co-located Asian and Caucasian cohorts.[2-4]

Methods

Age, sex, environment and lifestyle matched individuals of East Asian or Caucasian descent (n=350), divided into pediatric (5 - 17 years), young adult (18 - 25 years), middle adult (25 - 45 years) and older adult (≥ 46 years) and who were NZ born and raised (pediatric and young adult), or resident for a minimum of 15 years in NZ (middle and older adults), underwent DED screening that included evaluation of symptoms (OSDI), tear film, meibomian glands, ocular surface, blinking and dry eye prevalence. Effects of age and ethnicity on DED prevalence and development were assessed.

Parameters assessed
OSDI dry eye symptomology score
McMonnies dry eye symptomology score
Non-invasive tear film breakup time (s)
Tear film osmolarity (mOsmol/L)
Inter-ocular difference in osmolarity (mOsmol/L)
Corneal staining > 5 spots
Bulbar conjunctival staining > 9 spots
Lid wiper epitheliopathy ≥ 2mm length and ≥ 25% width
Blink rate and completeness
Tear meniscus height (mm)
Lipid layer grade (out of 5)
Expressed meibum grade (out of 4)
Meibography grade (out of 4)

Parameter	Surrogate Measurement	Ethnic disparity identified			
		Pediatric	Young adult	Middle adult	Older adult
Eyelid shear stress	Lid wiper epitheliopathy	Yes	Yes	Yes	Yes
Blinking pattern	Incomplete blinking	Yes	Yes	Yes	Yes
Meibomian gland morphology	Meibomian gland dropout	No	Yes	Yes	Yes
Meibomian gland function	Expressed meibum quality	No	No	Yes	Yes
	Tear film lipid layer grade	No	No	Yes	Yes
Tear film homeostasis	Non-invasive breakup time	No	No	Yes	Yes
	Tear osmolarity	No	No	Yes	Yes
Dry eye symptomology	OSDI score	No	No	Yes	Yes
Dry eye disease diagnosis	TFOS DEWS II criteria	No	No	Yes	Yes
Ocular surface staining	Bulbar conjunctival staining	No	No	No	Yes
	Corneal staining	No	No	No	Yes
Aqueous tear production	Tear meniscus height	No	No	No	No

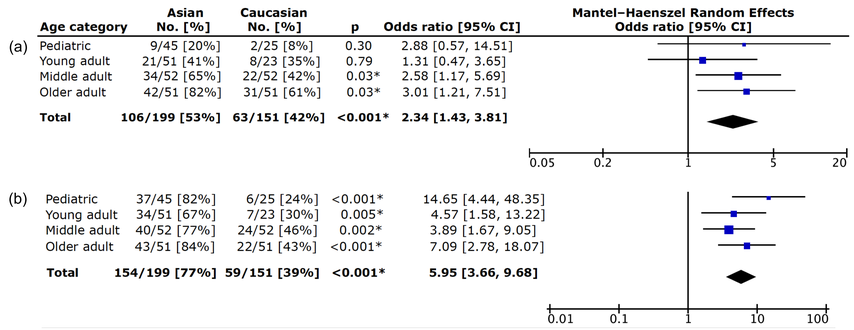

Figure 1: Box plots of pooled odds ratios of Asian participants (a) fulfilling the TFOS DEWS II dry eye disease diagnostic criteria and (b) exhibiting incomplete blinking, relative to Caucasian participants by age category: pediatric (5 - 17 years), young adult (18 - 25 years), middle adult (26 - 45 years), and older adult (≥ 46 years)

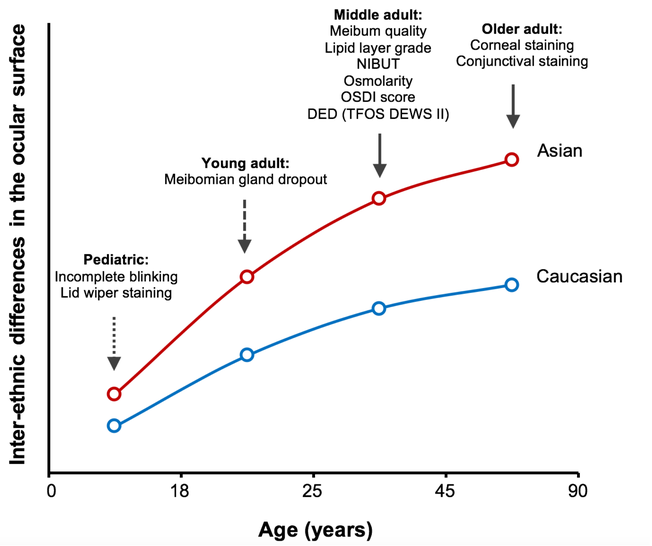

Figure 2: Schematic representation summarizing the onset of ethnic differences in the natural history of dry eye disease

Results

- While DED prevalence and meibomian gland dropout rates in the pediatric group did not differ significantly between ethnic groups ($p>0.05$), significantly greater blink incompleteness and lid wiper epitheliopathy were observed in the Asian group (both $p<0.05$; Figure 1).
- Incomplete blinking and LWE persisted throughout life, compounded by increasing inter-ethnic disparities in meibomian gland drop out and more marked loss of tear film homeostasis, as well as symptoms, in the middle and older adult groups (all $p<0.05$; Figure 1).
- Dry eye prevalence showed increasing disparity between ethnic groups with advancing age (Figure 2)

Conclusions

- Consistent with the literature, DED prevalence increased in both ethnic groups with age.
- A predisposition to DED was noted in the co-located, environment and lifestyle-matched Asian cohort.
- Earliest inter-ethnic disparity in incomplete blink closure, may be associated with increased eyelid tension in the Asian eye
- Incomplete blinking hypothesized to predispose the eye to poorer meibomian gland health with age, leading to poorer tear film quality, ocular surface health, and symptoms.
- Alignment of observed changes with tear *quality* rather than tear *quantity* implicates hyperevaporation, secondary to loss of meibomian gland function, rather than aqueous deficiency, as key in the natural history of DED development.

References

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