A Comprehensive Ocular Surface Evaluation in a Portuguese Pediatric Cohort

Avaliação Completa da Superfície Ocular num Coorte Pediátrico Português

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ABSTRACT

INTRODUCTION: Few studies have been published regarding dry eye disease (DED) in the pediatric age group and all have been performed outside of the European setting, where genetic and environmental factors may be different. Moreover, the analysis of the ocular surface and, consequently, the diagnosis of DED is progressing towards objective and standardized methods. Our purpose was to quantitatively describe the ocular surface in the Portuguese pediatric population and how it is influenced by the use of screen devices, eye rubbing and sleeping habits. Moreover, we aim to form a plain language summary that can be given to children and their parents for advice.

METHODS: Cross-sectional study that included healthy subjects aged 8 to 18 years. Exclusion criteria were systemic disorders or treatments known to affect the eye, any ocular or palpebral disease (such as diagnosed DED, meibomian gland disease or conjunctivitis, but not refractive error), use of contact lenses or any kind of eye drops. Subjects underwent: a customized survey together with the validated OSDI-6 questionnaire; IDRA® Ocular Surface Analyzer; tear osmolarity; basal tear secretion test with Schirmer strips (BTS), after instillation of topical anesthetic; and slip lamp evaluation of corneal fluorescein staining (CFS).

RESULTS: For analysis, 142 eyes of 72 subjects, with mean age 14.2 ± 2.6 [8.8-18.6] years, were included. Symptoms of DED were present in 35%: itching was the most frequent symptom (30%), followed by tearing (9%) and discomfort or dryness (7%). The OSDI-6 score was suggestive of dry eye in 54%. Any degree of CFS was present in 51% and formal DED diagnosis according to TFOS II criteria in 49%. CFS was not associated with symptoms (p=0.063) and 46% of subjects without symptoms still had some degree of CFS. There was negative correlation between on-screen time and eye blink quality score (EB, r=-0.218; p=0.009), BTS (r=-0.255; p=0.002) and non-invasive break-up time (NIBUT, r=-0.169; p=0.045), even after considering possible confounders. The presence of CFS was associated with higher on-screen time (6.8 *vs* 5.6 hours per day, p=0.015). Better eye blinking quality was observed in subjects that reported symptoms (p<0.001). Basal tear secretion was reduced in eyes with CFS (p<0.001), but there were no differences in osmolarity, NIBUT, EB, lipid layer thickness, loss area of meibomian glands or tear meniscus heigh (p>0.110). There were no differences regarding eye rubbing or sleeping habits (p>0.098).

CONCLUSION: In a healthy pediatric cohort, the prevalence of DED was around 50%. Blinking, tear production and tear stability may be affected by the overuse of screen devices.

The functional integrity of the ocular surface depends on the blinking reflex, which appears to be mostly defective in individuals without symptoms and probably impaired somaesthesia. The incorporation of symptomatology in the diagnosis of DED should be carefully reconsidered in this age group, as it may not be necessarily pathological. Many may show signs of disease without symptoms which in turn aggravates blinking dynamics and may impair a proper neurotrophic response. From a practical standpoint and in plain text, children can be advised that too much screen time may continuously affect their eyes, regardless of complains.

KEYWORDS: Blinking; Child; Dry Eye Syndromes; Keratoconjunctivitis Sicca.

RESUMO

INTRODUÇÃO: Existem poucos estudos publicados sobre doença do olho seco (DOS) no grupo etário pediátrico e os que existem foram realizados fora da Europa, onde os fatores genéticos e ambientais poderão ser diferentes. Além disso, o estudo da superfície ocular e, consequentemente, o diagnóstico da DOS cada vez mais tendem para métodos objetivos e padronizados. O objetivo primário desde trabalho foi descrever, de forma automatizada, a superfície ocular de indivíduos portugueses saudáveis em idade pediátrica. O objetivo secundário foi avaliar como o uso de dispositivos eletrónicos, hábitos de esfregar os olhos e posição preferencial a dormir podem influenciar a superfície ocular dessa população.

MÉTODOS: Estudo prospetivo transversal que incluiu indivíduos saudáveis com idade compreendida entre os 8 e os 18 anos. Os critérios de exclusão foram doenças ou tratamentos sistémicos associados a alterações oftalmológicas, doenças oculares ou palpebrais (tais como: diagnóstico prévio de DOS, disfunção das glândulas de Meibomius, conjuntivite de qualquer tipo, mas não erro refrativo), uso de lentes de contacto ou de qualquer tipo de colírio. O protocolo de estudo compreendeu, do menos para o mais invasivo: um questionário validado para DOS (OSDI-6); avaliação com o IDRA® *Ocular Surface Analyzer*, medição da osmolaridade lacrimal, produção lacrimal basal (PLB) com tiras de Schirmer após anestesia tópica e avaliação de epiteliopatia corneana fluoropositiva (ECF).

RESULTADOS: Foram incluídos para análise 142 olhos de 72 participantes com idade 14,2 ± 2,6 [8,8-18,6] anos. Sintomas de DOS estavam presentes em 35%: o sintoma mais frequente foi prurido (30%), seguido de lacrimejo (9%) e desconforto ou secura (7%). O OSDI-6 foi sugestivo de DOS em 54%. Algum grau de ECF estava presente em 51% e o diagnóstico formal de DOS em 49% de acordo com os critérios da TFOS DEWS II. ECF não estava associada a sintomas (p=0,063) e 46% dos participantes sem sintomas tinham algum grau de ECF. Observou-se uma correlação negativa entre o tempo diário de utilização de dispositivos eletrónicos e a qualidade do pestanejo (r=–0,218; p=0,009), PLB (r=–0,255; p=0,002) e o tempo de rotura do filme lacrimal (NIBUT, r=–0,169; p=0,045), mesmo após corrigir para possíveis confundidores. A presença de CFS estava associada a maior tempo diário de utilização de dispositivos eletrónicos. Participantes que referiam sintomas tiveram melhor qualidade de pestanejo (p<0,001). A PLB estava diminuída nos olhos com ECF (p<0,001), mas não se observaram diferenças na osmolaridade, NIBUT, qualidade de pestanejo, espessura da camada lipídica da lágrima, área de perda de glândulas de Meibomius ou na altura do menisco lacrimal (p>0,110). Não se observaram diferenças consoante o hábito de esfregar os olhos ou posição preferencial a dormir (p>0,098).

CONCLUSÃO: Numa amostra de crianças saudáveis, a prevalência de DOS foi cerca de 50%. A qualidade do pestanejo, a produção lacrimal aquosa e a estabilidade lacrimal parecem estar afetadas pelo uso excessivo de dispositivos eletrónicos. A integridade funcional da superfície ocular depende também do reflexo do pestanejo que, por sua vez, parece estar mais defeituoso em indivíduos sem sintomas e provavelmente com somastesia diminuída. A imprescindibilidade de sintomas para o diagnóstico de DOS poderá ser reconsiderada neste grupo etário, visto não ser necessariamente patológica. Muitos indivíduos têm sinais objetivos de olho seco, sem sintomas, o que por sua fez agrava a dinâmica do pestanejo e dificulta uma resposta neurotrófica adequada. Em conclusão em linguagem acessível, as crianças e os seus pais podem ser informados que o tempo de utilização de dispositivos eletrónicos afeta os olhos, independentemente da presença de queixas.

PALAVRAS-CHAVE: Criança; Piscadela; Queratoconjuntivite Seca; Síndromes de Olho Seco.

INTRODUCTION

There have been few studies examining the prevalence of dry eye disease (DED) among children and adolescents. Most of the known risk factors for dry eye disease used to be more frequent in adults, however this may no longer be the case, given the recent trend for the use of screen-equipped devices, namely in Portuguese children.[1]

According to the TFOS DEWS II Epidemiology Report the prevalence of DED increases with age, mainly after the age of 40.[2] However, some pediatric populational studies suggest a secondary prevalence peak: Uchino *et al* reported a prevalence of 11%-12% of severe dry eye symptoms in non-contact lens wearers between 15 and 18 years old.[3] Moon *et al* found a prevalence of DED of 6.6% in children aged from 7 to 12 using the International Dry Eye Workshop diagnosis guidelines and also that smartphone use was a major risk factor for pediatric DED.[4] Using Tear Film and Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II) diagnostic criteria, two recent studies found a 8% to 33% prevalence of pediatric DED, differing according to the ethnicity.[5,6] These studies have been performed outside of the European setting, where genetic and environmental factors may be different.

More recently, the diagnosis and monitoring of DED has been complemented with a battery of tests that are now recommended to properly evaluate tear homeostasis.[7]

To our best knowledge, there are no studies about pediatric DED in the European population. Our purpose was to fill this gap and to perform a complete ocular surface analysis in a pediatric population of Portuguese origin and to evaluate how it is influenced by the use of screen devices, eye rubbing and sleeping habits. Moreover, we aim to form a plain language evidence-based summary that can be given to children and their parents for advice.

METHODS

STUDY DESIGN:

Observational noncomparative cross-sectional study in a healthy pediatric cohort in Centro Hospitalar Universitário do Porto, Porto, Portugal.

STUDY PARTICIPANTS:

Consecutive subjects aged 8 to 18 years were invited to participate in the study during regular appointments at the ophthalmological outpatient clinic during 2021.

Exclusion criteria were systemic autoimmune disorders known to affect the eye; systemic treatment with isotretinoin, antihistamines, antidepressants, or steroids; previous diagnosis of any ocular or palpebral disease (such as diagnosed DED, meibomian gland disease or conjunctivitis), previous ocular surgery or trauma; use of contact lenses or any kind of eye drops. If exclusion criteria applied unilaterally, the fellow eye could be included in the study. Refractive error was not part of the exclusion criteria.

STUDY PROTOCOL:

All included subjects underwent the study evaluation between 14:00 and 18:00, in ascending order of invasiveness to minimize the impact on subsequent tests:

(1) To assess symptomatology, we used a modified version of the validated questionnaire OSDI-6[8-10] We replaced question 3 "Driving or being driven at night?" with "Being driven at night?". After the questionnaire, subjects were asked about felling daily one or more of the following symptoms: eye itching, tearing, discomfort and / or dryness. Subjects were further inquired about the use of screen-equipped devices, and eye rubbing and sleeping habits. The subjects' parent or guardian could intervein in the questionnaire to corroborate the answers.

(2) Automated ocular surface analysis (IDRA® Ocular Surface Analyzer SBM Sistemi, Italy) that reported non-invasive break-up time (NIBUT), blink rate (BR), lipid layer thickness (LLT), loss area of the meibomian glands (LAMG) and tear meniscus height (TMH).

(3) Tear osmolarity (OSM), measured with TearLab® Osmolarity System, Tearlab, San Diego, CA, USA.

(4) Basal tear secretion test with Schirmer strips (BTS), after instillation of topical anesthetic.

(5) Slip lamp evaluation with fluorescein dye and the presence of corneal staining (CFS) was classified according to the Oxford scale from 0 to 5.

Previous clinical history and refractive error data were recorded from the patients' charts.

DATA ANALYSIS:

Subjects were considered the statistical unit for demographics, habits, medical history, and symptoms. Eyes were considered the statistical unit for the ocular surface analysis. Eyes were grouped according to 2 different criteria:

– presence of formal TFOS DEWS II criteria for DED (OSDI-6 score over 4 and one of the following: NIBUT under 10s; osmolarity over 307 mOsm/L; interocular difference in osmolarity over 8 mOsm/L; presence of CFS).

– presence of CFS, a definitive sign of ocular surface aggression

Descriptive statistics are shown as mean ± standard deviation [minimum-maximum]. A sample of approximately 63 subjects was estimated[8] for a power of 80%, a significance level of 5% to find a 1% difference in tear osmolarity, based on measurements from a previous study.[9] Both eyes of each subject could be included for analysis if no exclusion criteria were met.

Association between two variables were assessed with Pearson correlation coefficient and linear regression. Group differences were analyzed with independent t-test or chi-square test. Risk and protective factors for DED were analyzed with logistic regression. Lastly, we performed a plain language summary that can be given to children and their parents for advice.

RESULTS

One hundred fifty-eight eyes of 79 subjects were recruited for the study. Of those, 16 eyes were excluded: 10 eyes of 5 subjects because papillary conjunctivitis was identified in the study visit; 4 eyes from 2 subjects because of poor collaboration to perform most of the exams; 1 eye because of post-viral conjunctivitis corneal infiltrates and 1 eye because of unilateral contact lens use. Therefore 142 eyes (71 right eyes and 71 left eyes) of 72 subjects were included for analysis, 61% of which girls. Mean age was 14.2 ± 2.6 [8.8-18.6].

HABITS, MEDICAL HISTORY, AND SYMPTOMS

Ninety-four percent (94%) of patients owned a mobile phone. Mean on-screen time was 6.2 ± 2.7 [1.5-14.0] hours per day. Age correlated with on-screen time (B=22 min/year of age, r=0.352, p<0.001).

Regarding practice of physical activity: 4% practiced none; 48% twice a week; 48% four times a week and 6% six times a week.

Previous history of atopy (except conjunctivitis) was present in 28%: rhinitis in 16%; asthma in 10% and dermatitis in 6%. In our sample, 58% of subjects wear spectacles for distance and 15% wear sunglasses regularly.

Any kind of DED symptoms were present in 35% of subjects: itching was the most frequent symptom (30%), followed by tearing (9%) and discomfort or dryness (7%). The OSDI-6 score was abnormal (equal to or over 4) in 54%.

Eye rubbing habit was present in 66% and was associated with an history of atopy (85% with atopy vs 15% without atopy rubbed their eyes, p=0.002). Eye rubbing was also associated with the presence of symptoms (84% with symptoms versus 16% without symptoms rubbed their eyes, p=0.001).

OCULAR SURFACE ANALYSIS

There was some missing information in the analyzed variables, namely OSM (2 eyes, because of device error while reading osmolarity); LAMG (3 eyes because of device error during segmentation of the image); THM (4 eyes because of device error while calculating the value) and BTS (4 eyes of 2 patients that were not cooperative only for this specific test).

Any degree of CFS was present in 51%, level 2 or higher of the Oxford classification in 26% and level III or higher in 14%. Diagnosis of DED according to TFOS DEWS II criteria was present in 49% of eyes. Of these, 13% had evaporative subtype (normal BTS and TMH); 17% had aqueous deficient subtype (normal LLT and NIBUT) and 70% had a mixed type, considering the TFOS DWES II classification.[11]

Fig. 1 compared the frequency of symptoms, signs, and formal diagnosis of DED. Fig. 2 shows the receiver operating characteristic analysis of each ocular surface measurement considering DED diagnosis according to TFOS DWES II criteria.

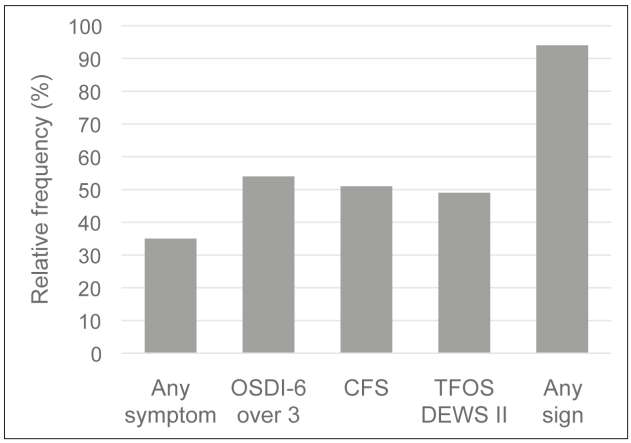

Figure 1. Bar chart showing the relative frequency of subjects with any symptom of dry eye disease; subjects with OSDI score suggestive of dry eye disease; subjects with corneal fluorescein staining (CFS); subjects with diagnosis of dry eye disease according to TFOS DEWS II criteria and subjects with any sign of dry eye disease (any altered ocular surface variable or CFS).

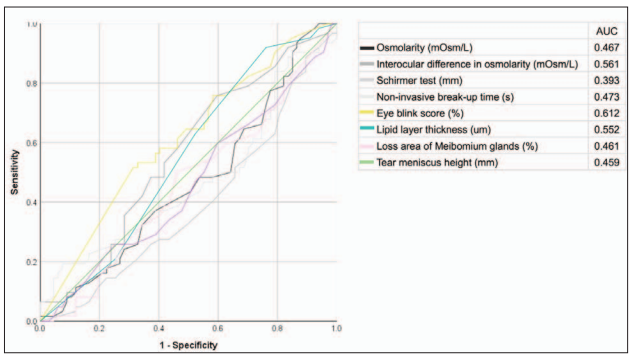

Figure 2. Receiver operating characteristic analysis of each ocular surface measurement considering DED diagnosis according to TFOS DWES II criteria. The table on the right shows the legend for the graph and the area under the curve (AUC).

ASSOCIATION BETWEEN HABITS, MEDICAL HISTORY, SYMPTOMS, AND OCULAR SURFACE

Symptoms were not associated with CFS (p=0.063) and 46% of subjects without symptoms had at least some degree of CFS. The presence of CFS was associated with higher on-screen time (6.8 *vs* 5.6 hours per day, p=0.015).

There was a negative correlation between on-screen time and EB (r=-0.218; p=0.009), BTS (r=-0.255; p=0.002) and NIBUT (r=-0.169; p=0.045). There were no significant correlations between age (a possible confounder) and EB or BTS (p=0.635 and p=0.253, respectively). There was a positive correlation between NIBUT and age (r=0.234; p=0.005), which reinforces a true effect of on-screen time on NIBUT.

No difference was found regarding the presence of symptoms, except for a better eye blink quality in the presence of symptoms (86.1±19.7% *vs* 72.49±21.7%, p<0.001). This difference was observed both in the presence and absence of CFS (p=0.026 and p=0.003, respectively). OSDI cor-

related with EB (r=0.179; *p*=0.034), but not with the other measurements (*p*>0.095).

Tables 1 and 2 show possible demographic and clinical risk factors for DED (accordingly to TFOS DEWS II criteria) and for the presence of CFS. Table 3 shows differences in ocular surface tests accordingly to the presence of CFS. Differences in ocular surface tests accordingly to the presence of TFOS DEWS II criteria are not shown because independence of the variables is not verified (the same tests are part of the TFOS DEWS II criteria).

Table 1. Logistic regression odds ratio of age, habits, and history for dry eye disease according to TFOS DEWS II criteria.

TFOS	Unadjusted univariate logistic regression		Multivariate-adjusted logistic regression	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age (years)	1.050 (0.920-1.199)	0.469	-	-
On-screen time (1h/day)	1.068 (0.942-1.210)	0.305	-	-
Male gender	0.568 (0.284-1.135)	0.109	-	-
History of atopy	1.841 (0.871-3.891)	0.110	-	-
Physical activity (days/week)	0.978 (0.635-1.506)	0.919	-	-
Eye rubbing	1.965 (0.958-4.032)	0.065	-	-
Homolateral side sleeping position	1.429 (0.653-3.125)	0.372	-	-
Sleeping position ventral / dorsal	4.107 (0.817-20.656)	0.086	-	-

Statistically significant values are highlighted in **bold**.

Table 2. Logistic regression odds ratio of age, habits, and history for corneal fluorescein staining (CFS).

CFS	Unadjusted univariate logistic regression		Multivariate-adjusted logistic regression	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age (years)	1.075 (0.947-1.219)	0.263	-	-
Male gender	0.810 (0.413-1.588)	0.539	-	-
On-screen time (1h/day)	1.168 (1.028-1.327)	**0.017**	1.153 (1.011-1.315)	**0.033**
History of atopy	2.174 (1.019-4.630)	**0.045**	1.948 (0.895-4.238)	0.093
Physical activity (days/week)	1.213 (0.782-1.881)	0.389	-	-
Eye rubbing	1.921 (0.952-3.877)	0.068	-	-
Homolateral side sleeping position	1.305 (0.606-2.810)	0.496	-	-
Sleeping position ventral / dorsal	3.048 (0.814-11.413)	0.098	-	-

Statistically significant values are highlighted in **bold**. Variables that reached statistical significance were incorporated in a multivariate logistic regression.

Table 3. Differences in outcomes accordingly to the presence of corneal fluorescein staining (CFS)..

	CFS, n=73		No CFS, n=69				Group comparison	
	Mean	*SD*	Mean	SD	P5	P95	*p*-value	AUC
OSM (mOsm/L)	308.7	12.7	307.0	12.4	284.3	328.3	0.429	0.526
OSM-Dif (mOsm/L)	9.9	11.9	9.5	7.3	1.0	24.0	0.787	0.460
BTS (mm)	17.0	7.5	22.5	**8.5**	**8.3**	**35**	**<0.001**	0.323
NIBUT (s)	10.2	3.5	9.4	2.8	4.7	14.0	0.110	0.564
EB (%)	76.8	21.7	77.8	22.3	50	100	0.798	0.487
LLT (um)	70.3	25.3	67.0	26.8	15	100	0.453	0.544
LAMG (%)	10.9	10.9	11.7	10.7	0.0	34.7	0.209	0.490
TMH (mm)	0.22	0.07	0.24	0.13	0.14	0.30	0.653	0.488

Statistically significant values are highlighted in **bold**. Percentile 5 and 95 for eyes with no CFS (considered normal) are also shown. For group comparison, *p*-value relates to independent sample t-test and area under the receiver operator characteristic curve (AUC).

DISCUSSION

The current report is the first clinical study about pediatric DED in the European setting. Moreover, we used a classical clinical evaluation together with the most important ocular surface tests, as preconized by the TFOS DWES II.

In our healthy cohort, the rate of pediatric DED (49%) was higher than previous studies using the same criteria (22%-33%).[5,6] Nonetheless, this is the first to be published after the COVID-19 pandemic, a period that may have aggravated on-screen habits, as suggested by the Portuguese study group of Baptista *et al*.[12] The most recent reports on adult DED using TFOS DEWS II criteria showed a prevalence of 29%-30%,[13,14] which is also lower than our current pediatric sample.

We used a modified but validated version of the OSDI questionnaire with 6 questions due to its good predictability and better repeatability when compared to the 12-question OSDI.[10] Moreover, in the pediatric population, we hypothesized that a reduced number of questions and questionnaire time would improve its validity.

Dry eye disease is complex, multifactorial and there is a level of imprecision in its diagnosis,[15] particularly in children. In fact, as shown in Fig. 2 no single measurement is close to differentiating eyes with formal DED diagnosis. The diagnostic methodology is yet to be standardized and normal values for the questionnaire and for the tests are not yet established in the pediatric population. We considered CFS as a secondary grouping variable as it may be the most definite sign of ocular surface damage. The rate of CFS was equally high (51%). For diagnosis, we recommend a multifactorial and personalized approach that should include, not exclusively but more importantly, slit-lamp examination with fluorescein staining and eyelid inspection, objective evaluation of blinking dynamics and estimation of tear production given these were the measurements associated with symptoms or risk factors in our study.

We observed a poor correlation between symptoms and objective signs. In adults, the discordance between symptoms and signs has been observed in multiple studies and older age has been associated with decreased symptoms in relation to signs.[16-19] The TFOS DEWS II Epidemiology Report reaches the same conclusion regarding the adult population and points out disease heterogenicity and variability in sensitivity thresholds as the main reasons.[2] Additionally, analyzing corneal mechanical sensitivity threshold, Spierer el al found a correlation with age but not with ocular signs of DED.[20] In younger age groups, studies evaluating ocular surface sensitivity are missing.

Our results, together with Rojas-Carabali *et al* in South America,[6] showed a high rate of DED signs (94%-98%) to a relatively low rate of symptoms (33%-54%) in children. In contrast, most (57%-72%) adults with DED reported symptoms.[18,19] Feeling and reporting symptoms depend on an afferent pathway that involves not only the ocular surface and trigeminal nerve but also the supranuclear pathways and cortical interpretation. We postulate that the unexpected low sensitivity threshold in children is a combination of neural plasticity[21] and somatosensory dysfunction.[22]

The most frequent symptom was itching, even though children with allergic conjunctivitis had been excluded. Differently, the most frequent symptoms in adults are dryness, grittiness and fatigue.[19]

Moreover, subjects with signs of DED and worse eye blink quality reported symptoms were less frequently. This finding may reveal the importance of proprioception in blinking: absence of symptoms may convey reduced corneal and conjunctival sensitivity. In fact, it has been demonstrated that patients with DED show decreased corneal sensitivity due to decreased corneal nerve density and morphology.[23,24] Additionally, the blinking rate and quality appears to be dependent on the sensitivity of the ocular surface.[25,26] Corneal nerves not only induce tear production, but also stimulate the blinking reflex through an elaborate interplay between the corneal and conjunctival epithelium, nerve reflexes, facial muscles and lacrimal glands.[27]

The association between on-screen time and poor blinking quality corroborates previous studies showing that spontaneous eye blinking is altered during screen devices use, both in adults and children.[4,28,29] Our results further suggest that blinking may be affected not only during screen device use but also sustainably in time, as our questionnaire contemplated average device use and, in our protocol, blinking quality was accessed while asking to "act normally".

Higher on-screen time was also associated with the presence of CFS, lower BTS and NIBUT. Such evaluation has been reported in few studies in adults,[30,31] that corroborate our results in children. One study found reduced mucin concentration in the tears of subjects that used screen devices for a longer time, which may also justify the reduced tear stability observed.[32] Corneal damage and decreased tear production and stability may be incorporated in the pathological cycle of DED associated with screen overuse.

The main limitations of this study are the hospital-based setting and the sampling method, as subjects were recruited from the outpatient clinic. This is a biased cohort because participants had already been referred to an ophthalmologist. Our sample is not a true representation of the population which hinders the calculation of prevalence values. To minimize this bias, we have excluded patients with ophthalmological disorders such as previous diagnosis of DED; use of contact lenses, since it has previously been associated with changes in the ocular surface; and meibomian gland dysfunction, a subset of DED that has already been observed in other study with a relatively high rate in the pediatric population.[33] This study was set during the pandemic period when possibly some of the included subjects were attending online classes, increasing the on-screen time when compared to real-life (non-pandemic) periods. Still, this bias may influence the reported on-screen time but does not influence our conclusions.

Corneal sensation seems critical to the structural and functional integrity of the ocular surface. Patients may show signs of disease without symptoms which in turn aggravates blinking dynamics and may impair a proper neu-

rotrophic response. Future studies should also try to access if corneal sensitivity is directly affected by screen-device use and how it may be incorporated in the mechanisms of dry eye disease and in the diagnostic assessment.

The importance of this study goes beyond the scope of researchers and clinicians: it may be helpful for parents and their children to acknowledge dry eye disease, answer the question "Is frequent mobile phone use harmful for your eyes?" and eventually amend unhealthy lifestyles. Given our findings, it seems advisable that too much screen time may continuously affect their eyes, regardless of complains.

In conclusion, DED may be highly prevalent in the pediatric population. According to our results, the most important risk factor found for DED is screen device use and children that report symptoms have better eye blink quality. The incorporation of symptomatology in the diagnosis of DED should be carefully reconsidered, as it may not be necessarily pathological.

CONTRIBUTORSHIP STATEMENT / DECLARAÇÃO DE CONTRIBUIÇÃO:

JHM, AF, CC: Study design and article writing; Data collection, statistical analysis and interpretation: Writing and approval of the final version.

AM, DJ, PS, IN, PM, IB: Critical review of the manuscript and approval of the final version.

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