Optometry status in Italy: current views

Following a previous Editorial published in *Scandenavian Journal of Optometry and Visual Science* in July 2020 where the Italian Optometric Society (SOPTI) and The Norwegian Association of Optometry (NOF) decided to join to support SJOVS to further and faster development of the field of optometry in Europe, we asked to Anto Rossetti, O.D., teacher at Istituto Statale of Pordenone and Associate Professor at the University of Padua to share the current views of the status of Italian Optometry:

"In Italy, both opticians and optometrists are classified by the National Institute of Statistics (Istat) as "health technical professions" where the latter (always also licensed opticians) may be considered "specialised opticians" that offer all services opticians can offer and some additional ones. While opticians are basically regulated by an old law (dated 1928) that qualifies them to work independently with "simple defects of myopia and presbyopia", optometrists are not, but their practice is legal and generally accepted. They must have completed an education in optometry to become qualified optometrists (e.g., previously a regional qualification similar to level EQF 5 [European Qualifications Framework], or currently through a university program to EQF 6). Currently, no "single practice act" exists for opticians and optometrists, instead a complex of acts (both specific and general) defines the professional practice. An inter-association committee (TiOpto) has recently summarised (2021) typical services delivered by optometrists in addition to the well-established ones of supplying spectacles, contact lenses, and optical devices, and educating wearers and users, such as measurement of any refractive error, custom-made contact lenses, visual training, some examinations of ocular health (like non-contact tonometry, visual field testing, etc). As a system, opticians and optometrists can provide a wide range of services, even if some improvement in the laws remains necessary."

During the last annual National Conference of the Italian Optometric Association (SOPTI) (Bologna, 29–30 May 2022) entitled *"Technical procedures for good clinical practice in optometry"*, the message sounded very clear: only by considering interdisciplinarity and working together with other eye care professionals and by applying good evidence-based clinical practice, can Italian optometry grow and progress further in Europe. The abstracts from the accepted posters are presented in this issue of *SJOVS*.

In this issue you can read about the requirement for further research to understand and tackle the problem of dry eye in Sweden. Using an online survey, Roth *et. al.* provide insight into the problem of dry eye symptoms in Sweden. The findings of the study confirm that dry eye symptoms are common among the Swedish population.

Additionally, we announce *SJOVS*' second special topic. We encourage optometrists, researchers, and related professionals to submit their work to be considered for publication in standard issues of SJOVS over a two-year period. If accepted, manuscripts will be included in the online collection of the given special topic. The second special topic is going to be: OCT imaging, in particular automatic segmentation of choroidal thickness and ocular blood flow measurements in both healthy and diseased eyes. The special topic editorial on optical coherence tomography is authored by Scientific Advisory Board member and guest editor Prof. Christine Wildsoet and editorial board member Karthikeyan Baskaran.

On behalf of SJOVS, we wish you all a safe and peaceful summer.

Editorial Board Member Alberto Recchioni
Editor-in-Chief Rigmor C. Baraas

Optical Coherence Tomography (OCT): Newer technologies and technical challenges

Since its invention in 1991 (Huang et al., 1991) optical coherence tomography (OCT) has seen increasingly wide application in medical imaging, due in part to its non-invasive nature and also the unmatched resolution provided by the most advanced instruments. In ophthalmology and optometry, high resolution cross-sectional images of the posterior eye, as captured by OCT, have become one of the most important diagnostic tools, allowing normal anatomical variations in retinal and/or choroidal morphology to be distinguished from early subtle changes, which may herald the onset of pathology. OCT is based on the principle of low coherence interferometry, with ophthalmic imaging instruments typically making use of long wavelength infrared light ranging from 840 nm to 1050 nm (Potsaid et al., 2010). Recent years have also seen rapid advances from the earliest time domain OCT (TD-OCT) instruments, with spectral domain (SD-OCT) and swept source OCT (SS-OCT) instruments offering improvements in image resolution of up to 3 – 5 μm.

Of the posterior ocular layers of the eye, the choroid has become the focus of attention from vision research and clinical communities. Choroidal thickness (CT) has long been known to be influenced by various physiological factors and with the development of improved imaging techniques, has been shown to undergo diurnal variation, when appropriately tracked. It has also been shown to be influenced by many other factors, including age, gender, ethnicity, refraction (myopia), and axial length. Most studies have measured CT, defined for imaging purposes as the distance from the posterior edge of the retinal pigment epithelium (RPE) to the choroidal scleral interface, using manual segmentation, with good interobserver and intersystem repeatability for subfoveal measurements (Mrejen & Spaide, 2013). While the time consuming nature of manual segmentation limits its application in a clinical setting, the alternative of automated segmentation remains limited due to the difficulty of reliably identifying the posterior choroidoscleral interface (Alonso-Caneiro et al., 2013).

With the addition of enhanced depth imaging, it is now feasible to visualise the structural details of the choroid, including the choriocapillaris, Haller's layer, and Sattler's layer (Singh et al., 2019). Other recent advances in imaging have allowed ocular blood flow, e.g., of the inner retinal layers to be evaluated. One such technique that has gained popularity in the last decade is optical coherence tomography angiography (OCTA), which allows for rapid acquisition of volumetric angiographic information of the retina. By visualisation of perfused retinal vasculature, various quantitative metrics such as foveal avascular zone area, vessel density, and vessel perfusion can be derived. Nonetheless, there are also potential shortcomings in published data, as such measurements are greatly influenced by a number of factors, including lateral magnification, which is directly influenced by the axial length of the individual and may differ from that used in an OCT instrument's calibration. Indeed, a recent review article reported that 468 (92%) of published articles did not consider lateral magnification, potentially leading to erroneous conclusions of their findings (Llanas et al., 2020).

In this special topic of the *Scandinavian Journal of Optometry and Vision Science* we invite contributions covering OCT imaging, with the goal of improved understanding of related technical issues across the research and clinical communities. We are specifically interested in receiving manuscripts on automatic segmentation of choroidal thickness and ocular blood flow measurements in both healthy and diseased eyes. We hope that by making OCT imaging a special topic in *SJOVS* we will also encourage collaboration between groups of researchers and clinicians towards developing evidence-based solutions for as yet unresolved technical issues with recent OCT technology.

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Dry eye symptoms using the Ocular Surface Disease Index in Sweden: a short report from a pilot study

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Abstract

The aim of this study was to investigate the prevalence of dry eye symptoms in the Swedish population using a web-based version of the ocular surface disease index (OSDI).

A web-based version of the OSDI questions was implemented in an online form using a software developed by Artologik. The link to the form was distributed via Linnaeus University social media pages. Basic demographic information such as age, sex and county of residence was also collected.

A total of 404 complete responses were received, 303 respondents (75%) were females, the median age = 39 (interquartile range = 28–53) years, median OSDI-score = 19 (interquartile range = 9–32). Crude prevalence of dry eye symptoms (categories mild to severe) was 65% (95% CI = 62–75). The difference in prevalence between males and females was statistically significant (chi-square test, $p=0.007$).

The current study found that the prevalence of dry eye symptoms among a sample of the Swedish population was 65%. These results highlight the need to investigate further the prevalence and risk factors for dry eye disease in the Swedish population.

Keywords: dry eye disease, dry eye symptoms, OSDI, prevalence, Rasch analysis

Introduction

Dry eye disease (DED) is a syndrome related to tear film and ocular surface abnormalities (Stapleton et al., 2017; Valderas et al., 2008). Dry eye symptoms include, for instance, ocular irritation or burning, foreign body sensation, pain, grittiness, photophobia and visual disturbance, causing eye discomfort (Javadi & Feizi, 2011; Kaštelan et al., 2013). As reported by Stapleton et al. (2017), DED can affect up to 50% of the population in certain countries. Prevalence as high as 73% has also been reported (Uchino et al., 2006). Prevalence depends on which diagnostic criteria are used and sample characteristics (for example age). In general, symptoms of dry eye are more frequent among women and older people (Uchino et al., 2011; Um et al., 2014), although they are also common among young people (Stapleton et al., 2017; Zhang et al., 2012). It must be noted that diagnosis of DED is different from symptoms of DED. The diagnosis of DED requires additional clinical testing such as Schirmer, tear break up time, corneal staining and / or meibomian gland dysfunction assessment (Craig et al., 2017).

Some authors consider DED challenging to diagnose because there are no specific "dryness biomarkers" in the surface of the eye that would give a clear answer about abnormalities in ocular surface lubrication (Efron, 2018). One of the most relevant aspects of the diagnosis and management of dry eye is characterisation of the symptoms (Craig et al., 2017). The use of patient reported outcomes is, therefore, fundamental in providing accurate records of symptoms. In general, the use of patient reported outcomes has advantages such as early detection of medical conditions, monitoring treatments and facilitating patient-clinician communication (Nelson et al., 2015; Pesudovs et al., 2013; Valderas et al., 2008). The Tear Film & Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II) diagnostic methodology subcommittee recommend the use of symptomatology questionnaires when diagnosing, monitoring, and managing DED (Wolffsohn et al., 2017).

The ocular surface disease index (OSDI, Allergan plc, Irvine, CA) questionnaire and the Dry Eye Questionnaire (DEQ-5) have been validated and are recommended by the TFOS DEWS II diagnostic methodology subcommittee (Dougherty et al., 2011; Schiffman et al., 2000; Wolffsohn et al., 2017). Even though the OSDI was developed for use in clinically controlled environments, it has been used in prevalence studies outside clinical settings to determine the occurrence of dry eye symptoms in the general population (Hernandez-Llamas et al., 2020; Schiffman et al., 2000). Allergan Inc. has developed a smartphone application which makes it possible to use the OSDI questionnaire remotely, which allows unlimited use of this symptomatology scale (Inomata et al., 2019). More recently, Inomate and colleagues implemented the OSDI in their unsupervised monitoring app "DryEyeRhythm" (Inomata et al., 2019; Okumura et al., 2020)]. These studies indicate that the OSDI is a good instrument for monitoring dry eye symptoms remotely.

There is currently limited information about the prevalence of symptoms of dry eye in the Swedish population. This gap in knowledge can be investigated by using a digital version of the OSDI and making it available to remote respondents. The aim of this study was to investigate the prevalence of dry eye symptoms in a sample of the Swedish population using a web-based version of the OSDI.

Materials

Study sample

Participants answered the OSDI questions online in a form implemented in the "Survey and report" software developed by Artologik (Survey & Report, v4.3.9.5) (Schiffman et al., 2000; Walt et al., 1997). Sample size calculations made with OpenEpi software (https://www.openepi.com) indicated that $n = 384$ answers would be enough to estimate with a confidence level of 95% and an absolute precision of ±5 percentage units assuming a prevalence of 50% in the sample. The link to the form was distributed via Linnaeus University social media pages ("twitter" and "Facebook") and participation was encouraged in a message running on internal screens at the campus. The form also collected basic demographic information such as age, sex a geographic location (county). These data were anonymised. The link to the form was public – anyone with the link was able to answer the questions – but only one respondent per device was allowed by the system. In other words, according to the platform provider Artologik, the server can identify devices previously used to answer the questionnaire and rejects multiple attempts from those devices.

Dry eye symptoms scale

The OSDI is a self-administrated symptoms questionnaire consisting of 12 questions. The scale is expected to capture symptoms experienced during the previous week regarding ocular discomfort, vision related functions and environmental triggers

of ocular discomfort. Subjects rate symptoms on a scale from 0–4 (0 = none of the time, 1 = some of the time, 2 = half of the time, 3 = most of the time, 4 = all the time). For questions 5 to 12 the option "not applicable" is available. The final individual score is computed using the formula: OSDI = (sum of scores) x 25/ (number of questions answered).

The maximum score is 100 and the cut-off values used in this study for diagnosis of dry eye symptoms were: normal (non-symptomatic) for scores below 13 and symptomatic for scores 13 or above (Schiffman et al., 2000; Walt et al., 1997; Willcox et al., 2017). The OSDI was available in two languages, English and Swedish, and subjects selected their preferred language. In the Appendix we provide a brief description of a quality check of the psychometric characteristics of the OSDI according to the information available from this study. Results of the survey were analysed using descriptive statistics, mean and standard deviation (*SD*), median and interquartile range (*IQR*), counts and percentages with 95% confidence interval (95% CI). The chi-square test was used to determine differences between counts.

Ethical considerations

The identity of the participants was unknown and no sensitive information was collected. According to advice from the Ethical Advisory Board in Southeast Sweden, ethical approval was not required for this study (Dnr: EPK 570-2019). Before responding to the survey, all participants were informed that their responses would be anonymised and used to determine the prevalence of dry eye symptoms.

Results

A total of 404 complete responses were received, 303 participants (75%) were female and 101 (25%) were male, 39 out of 404 answers were given using the English version of the OSDI. The mean and the median age of the survey respondents were 41 (*SD* = 14.1) years and 39 (*IQR* = 28–53) years respectively. Median OSDI-score for the total sample were 19 (IQR = 9–32).

The crude prevalence of dry symptoms (categories mild to severe) in the study sample were 65% (95% CI: 62%–75%). The respondents were divided into age categories (19–30, 31–40, 41–50, 51+ years) and the prevalence of symptoms was computed accordingly. Figure 1 shows category specific prevalence, differences between age groups were not statistically significant (chi-square (3, $n=404$) = 4.56 $p=0.21$). Dividing the sample by sex, 68% (95% CI: 63–73%) of the females and 53% (95% CI: 44–63%) of the males reported dry eye symptoms. The difference in prevalence between males and females was statistically significant (chi-square (1, $n=404$) = 7.31 $p=0.007$).

Discussion

The current study used an online version of the OSDI to investigate the frequency of dry eye symptoms in a sample of the Swedish population. This was the first study reporting prevalence of dry eye symptoms in a sample of the Swedish population. The results point to a high prevalence of dry eye symptoms.

The crude prevalence of dry eye symptoms in the sample was 65% (95% CI: 62%–75%), this prevalence is in line with previous studies (Bakkar et al., 2016; Hashmani et al., 2020; Shanti et al., 2020). For example, using a cut-off for the OSDI similar to ours (score 13), Hashmani and colleagues found a prevalence of symptoms of dry eye amongst 2433 respondents to be 64.4%. In contrast, other studies found lower prevalence of symptoms in the general population (Farrand et al., 2017; Sherry et al., 2020). A possible explanation for the high prevalence in our study may be a biased sample. That is, it is possible that people with ocular surface problems or dry eye symptoms were more likely to answer the anonymous questionnaire. Another possible explanation may be that the majority of participants were female, and would be expected to report dry eye symptoms more often than males (Farrand et al., 2017; Shanti et al., 2020). In line with that, results of the current study revealed a difference of 15% in prevalence of symptoms between males and females.

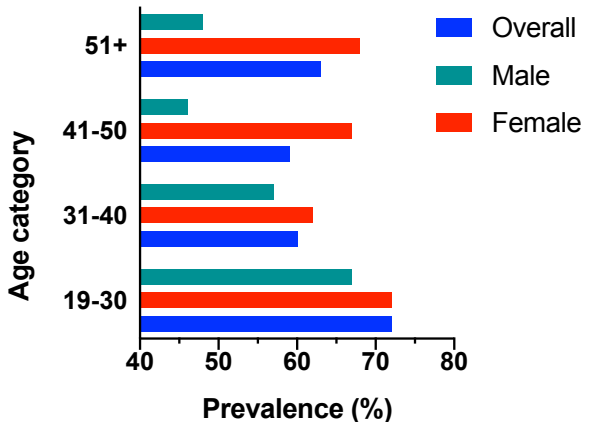

Figure 1: *Category specific prevalence of dry eye symptoms. Bars show the prevalence in percentage.*

More people in the youngest age group (19–30 years) reported symptoms than the other age groups. Despite the differences between age categories, in the current study they failed to reach statistical significance. The high prevalence of symptoms in the younger group was an unexpected finding. Most previous studies have shown that higher age is a risk factor for DED (Caffery et al., 2019; Shanti et al., 2020). However, some studies have found that dry eye symptoms are also common in young people and that this may be related, for example, to prolonged use of computers and smartphones (Asiedu et al., 2016; Choi et al., 2018; Uchino et al., 2013). In addition, young people are more likely to be contact lens wearers, and contact lens wear can increase the likelihood of reporting dry eye symptoms (Bakkar et al., 2016; Morgan et al., 2019). Together, these factors may explain the high prevalence of symptoms among young respondents.

The current pilot study has some limitations. Despite the sample being large enough to determine the prevalence of dry eye symptoms in the Swedish population, the sample is not representative of the Swedish population. Most likely respondents were working or studying at the university, and they were likely to be spending more time looking at screens than the general population and that can interfere with our results. Although, it must be said that symptoms of dry eye still exist regardless of the underlying causes.

The current study found a prevalence of 65% for dry eye symptoms among a sample of the Swedish population. The results highlight the need for investigation of the prevalence and risk factors for dry eye disease in the Swedish population, with comprehensive studies that must include clinical tests and self-reporting of symptoms.

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Appendix A — Ocular Surface disease Index questionnaire in Swedish Language

Frågeformulär - Störning i ögats horn- eller bindhinna

(Swedish version of the OSDI)

Var vänlig och besvara följande frågor genom att kryssa i den ruta som bäst överensstämmer med Ditt svar.

Har Du upplevt något av följande **under den senaste veckan**:

		Hela tiden	Största delen av tiden	Hälften av tiden	En del av tiden	Inget av tiden
1	Ögon som är känsliga för ljus?					
2	Ögon som känns grusiga?					
3	Smärtsamma eller ömma ögon?					
4	Dimsyn?					
5	Dålig syn?					

Har problemen med Dina ögon inskränkt på något av följande **under den senaste veckan**:

		Hela tiden	Största delen av tiden	Hälften av tiden	En del av tiden	Inget av tiden	Ej aktuellt
6	Läsning?						
7	Mörkerkörning?						
8	Använda dator eller bankautomat (Bankomat, Minuten)?						
9	Titta på TV?						

Har Du haft besvär med Dina ögon vid några av följande situationer **under den senaste veckan**:

		Hela tiden	Största delen av tiden	Hälften av tiden	En del av tiden	Inget av tiden	Ej aktuellt
10	Blåsigt väder?						
11	Platser eller områden med låg luftfuktighet (mycket torrt)?						
12	Ställen med luftkonditionering?						

Appendix B — Rasch analysis of the OSDI answers

Questionnaires that are expected to provide a clinically meaningful measure must be validated and tested for reliability using a trustworthy measurement theory (Ishaque et al., 2019; Khadka et al., 2013). A measurement theory is a theory of how the numbers generated by rating scales (scores) relate to measurements of the constructs (in this case the construct is "dry eye symptoms") they seek to estimate (Hobart et al., 2007). There are a few commonly used methods to investigate the validity and the reliability of questionnaires or scales, namely, "classical test theory", "item response theory" and "Rasch measurements theory" (Petrillo et al., 2015). Item response theory and Rasch measurements theory are considered modern psychometric methods, but they apply contrasting approaches. Simplistically, Rasch tests if the data fit a mathematical model and item response tries to find a model that fits the data. These different approaches have distinct advantages whose discussion is outside the scope of this report (Hobart et al., 2007; Kandel et al., 2017). Nonetheless, one important and widely accepted advantage of Rasch analysis is the use of a common log-odds unit (logit) scale for person measures and items difficulty (Bond & Fox, 2015; Dogan et al., 2020; Macedo et al., 2017; Melin et al., 2020).

Rasch analysis

The simplest form of the Rasch model is when responses are dichotomous (yes/no answers) as given here. The model assumes that the probability of a given respondent affirming an item is a logistic function of the relative distance between the item location and the respondent location on a linear scale (Bond & Fox, 2015; Pallant & Tennant, 2007). That is, the probability that a person will affirm an item is a logistic function of the difference between the person's level of, for example, dry eye symptoms (θ) and the level of dry eye symptoms expressed by a positive response to the item (b), and only a function of that difference:

$$p_{ni} = \frac{e^{\theta_n - b_i}}{1 + e^{\theta_n - b_i}}$$

where p_{ni} is the probability that person n will affirm the item i. The formula can be expressed as a logit model:

$$\ln\left(\frac{P_{ni}}{1 - P_{ni}}\right) = \theta_n - b_i$$

where ln is the natural logarithm, P is the probability of person n affirming item i. Consider a scenario of a yes/no question and that the probability of each response category (yes, no) is 0.5. When we replace that in the expression above it becomes: $\ln\left(\frac{0.5}{1-0.5}\right)$, which corresponds to 0; therefore, $\theta_n - b_i = 0$ logits, or $\theta_n = b_i$, and this indicates that the symptoms experienced by the respondent (person measure) are equal to the symptoms measured by the question (item difficulty). Fitting data to the Rasch model places items and persons parameters estimates on the same logit scale, and it is this that gives the linear transformation of the raw score (Bond & Fox, 2015; Glas & Verhelst, 1995; Linacre, 1992; 2002; Pallant & Tennant, 2007).

For the Rasch analysis of the OSDI, higher person measures indicate more symptoms and are reported in units of logits (Linacre & Wright, 1989), see Figure B1. Item measures are also expressed in logits and, with the coding used for the current analysis, higher item measures indicated corresponds to symptoms "more difficult to agree", see also Figure B1. Under Rasch conditions, point-biserial (or point-measure) correlations should be positive (see Table B1 column heading "PTMEASURAL"=> "corr."), so that the item-level scoring accords with the latent variable. However, the size of a positive correlation is of less importance than the fit of the responses to the Rasch model, indicated by the mean-square fit statistics (MNSQ), see Table B1 columns with heading "Infit" and "Outfit". Fit statistics is a quality control mechanism that evaluates how well the data conform to the Rasch model. When data deviate from the Rasch model, the causes need to be considered and the misfitting person or item may have to be removed. Fit can be assessed using two statistical indicators: infit ("inlier-sensitive or information-weighted fit") and outfit ("outlier-sensitive fit") (Linacre, 2002). Boone et al. and others recommend examining standardised fit statistics outfit (MNSQ) before removing any Items or Persons from the analysis. Wright and Linacre suggest that MNSQ values less than 1.4 are acceptable for rating scale data (Boone & Noltemeyer, 2017; Linacre, 1994).

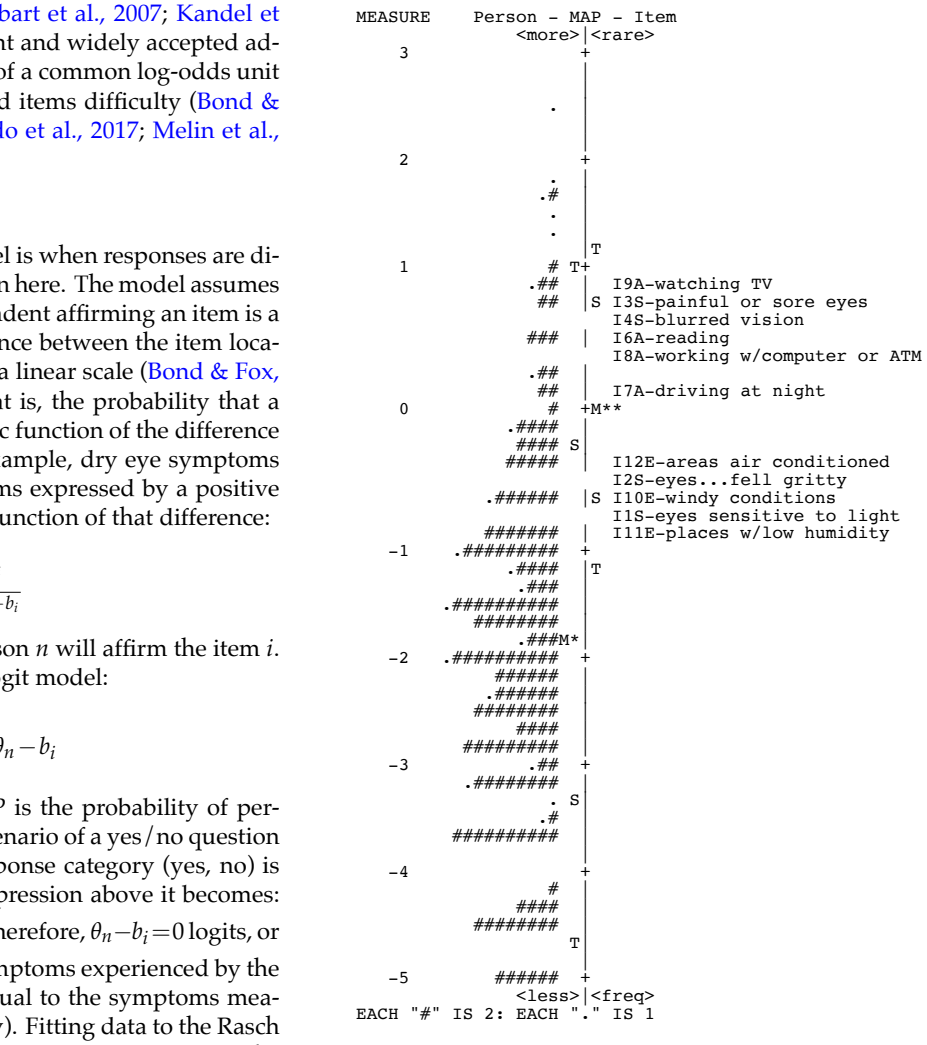

Figure B1: *Person-item map, the left side of the vertical line shows person measure – respondents with more severe symptoms are shown at the top. The right-hand side of the vertical line shows the item measure – items with higher measure correspond to symptoms "more difficult to agree" or "more rare". In other words, symptoms there were reported less often. Measure is given in logits, M = mean, S = standard error, T = two standard errors.*

Evaluating the functioning of a rating scale involves the analysis of response probability curves as shown in Figure B2. Each rating category should have a peak on the curve, revealing that it is the most probable category for some portion of the construct (Bond & Fox, 2015; Boone & Noltemeyer, 2017). In a typical graph the probability of a response is given on the vertical axis (from 0 to 1), each potential response options (0, 1, 2, 3, 4)

should be "the most probable" for a portion of the horizontal axis (Linacre, 2002).

Rasch analysis also includes person and item reliability indices. The item reliability index "indicates the replicability of item placements along the pathway if these same items were given to another same-sized sample of persons who behaved in the same way". It varies between 0 and 1 where higher values indicate better reliability (Bond & Fox, 2015). Item reliability gives an answer to the question: If another sample was given these same items, would the item estimates remain stable? Likewise, person reliability index "indicates the replicability of person ordering we could expect if this sample of persons were given another set of items" (Bond & Fox, 2015). That is, in the case of dry eye symptoms, given another set with the same number and distribution of items supposed to measure the same construct (dry eye symptoms), will respondent A still be estimated as being more symptomatic than respondent B and B more symptomatic than respondent C (Bond & Fox, 2015)?

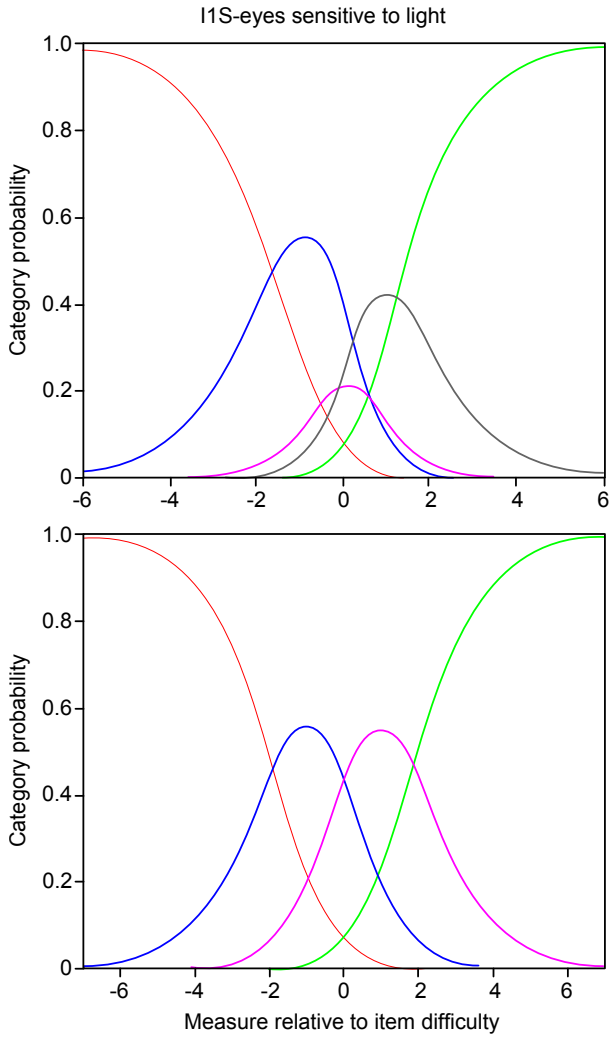

Figure B2: *The top graph shows the Rasch model category probability curves for item 1 showing the likelihood that a participant with problems will select a category. The scale (x-axis) symbolises the latent trait of "dry eye symptoms", with severity increasing towards the right. The y-axis represents the probability of a category being selected. Response categories: 0 – "none of the time" (red curve), 1 – "some of the time" (blue curve), 2 – "half of the time" (pink curve), 3 – "most of the time" (black curve), 4 – "all the time"(green curve). For any given point along this scale, the category most likely to be chosen by a participant is shown by the category curve with the highest probability. This shows that at no point was category 2 the most likely to be chosen, resulting in disordered thresholds. The bottom graph shows the effect of collapsing categories 2 and 3 into a single category (now shown in pink) with the resulting ordered response categories (category 4 is now shown in black).*

Person separation is used to classify how the instrument can distinguish between people. That is, low person separation with a relevant person sample implies that the instrument may not be sensitive enough to distinguish between high and low levels of symptoms. According to Boone and colleagues, person separation of 1.50 is acceptable, 2.00 is good, and 3.00 is excellent. When person separation is below acceptable more items may be needed. Item separation is used to verify the item hierarchy, it can vary from 0 to infinity and higher values indicate better separation. Item separation less than 3 implies that the sample is not large enough to confirm the item difficulty hierarchy (= construct validity) of the instrument (Boone & Noltemeyer, 2017).

A fundamental principle in Rasch theory is that individuals' and items' estimates depend on the magnitude of one quantity only, namely, the latent variable of interest. This is referred to as "unidimensional measurement" (Sjaastad, 2014). The concept of unidimensionality is frequently defined as a single latent trait being able to account for the performance of items forming a questionnaire. It represents a fundamental requirement when an item response theory model or a Rasch model is used in order to obtain a measurement for the latent trait of interest (Linacre, 1998). Mathematically, if there is only one dimension, called the Rasch dimension, captured by the model a principal component analysis on standardised residuals should not contain other significant dimensions (Brentani & Golia, 2007).

Rasch analysis of the OSDI

From the 404 participants, 39 answered the English version of the OSDI, answers from these respondents were filtered (their answers were excluded) before walking through the Rasch assessment of the OSDI.

The top graph of Figure B2 shows the category thresholds with the OSDI five-category response structure. It can be observed that category 2 – "half of the time" is never the most probable category and that makes the responses disordered. The bottom graph of Figure B2 shows the results of a four-category response structure, in which the categories 2 – "half of the time" and 3 – "most of the time" were combined. With four categories the scale shows the expected characteristics of ordered thresholds.

With the new response categories, the MNSQ fit statistics for item 5 was infit = 1.79 and outfit = 1.61, which is outside the acceptable range. When the removal of misfitting items (or persons) fails to improve the model, the cross-plot (measures before and after removing the problematic items or persons) should reveal a strong correlation. As shown in Figure B3, measures obtained with 11 items (after removal of item 5) were highly correlated with measures obtained with 12 items. Therefore, removal of the item failed to improve the model significantly. Although, given the qualitative assessment of the fit, the item was removed during the subsequent steps of the analysis.

Data was re-analysed after excluding item 5 and adjusting the rating scale by merging categories 2–3. An intermediate model showed that 25 participants showed fit statistics that were outside the criteria defined as acceptable fit. Because the person separation value was also below the recommended value (see the methods section for recommendations) the misfit participants were excluded from the final analysis. The final sample of Swedish respondents was formed of 340 responses (including 12 extreme scores that correspond to respondents with a total score of 0 in all items that they answered), the mean person measure was -1.95 logits (SE = 0.63), or -1.82 logits (SE = 0.58) if the 12 extreme cases were excluded. Person separation (extreme cases excluded) was: real = 2.04 and model = 2.17. Person reliability (extreme cases excluded) was: real = 0.81 and model = 0.83. In all instances, real values correspond to conservative estimates

Table B1: *Item statistics ordered by measures entry. The column "Model measure" shows the measure in logits. According to recommendations MNSQ fit values should be within the interval 0.7–1.4 (Linacre & Wright, 1989).*

Entry	Total	Total	Model		Infit		Outfit		PTMEASURE-AL		Exact match		Item
number	score	score	measure	S.E	MNSQ	ZSTD	MNSQ	ZSTD	corr.	exp.	obs%	exp%	
1	326	340	-0.62	0.09	1.12	1.59	1.19	2.34	0.60	0.69	51.8	56.7	I1S-eyes sensitive to light
2	315	340	-0.53	0.09	0.86	-1.84	0.97	-0.30	0.64	0.68	58.8	57.5	I2S-eyes...felt gritty
3	181	340	0.66	0.10	0.96	-0.41	0.86	-1.22	0.62	0.61	65.5	66.3	I3S-painful or sore eyes
4	183	340	0.64	0.10	0.96	-0.40	0.95	-0.41	0.60	0.61	65.9	66.2	I4S-blurred vision
5	Deleted												I5S-poor vision
6	194	330	0.47	0.10	0.96	-0.46	0.95	-0.39	0.63	0.62	64.6	64.5	I6A-reading
7	162	230	0.11	0.12	1.33	3.10	1.18	1.51	0.66	0.67	61.7	62.6	I7A-driving at night
8	184	319	0.51	0.10	0.94	-0.66	0.89	-0.99	0.66	0.62	64.9	64.9	I8A-working w/computer
9	148	310	0.84	0.11	0.82	-2.10	0.74	-2.15	0.65	0.60	71.7	68.9	I9A-watching TV
10	311	323	-0.66	0.09	1.14	1.79	1.10	1.22	0.66	0.68	52.4	56.8	I10E-windy conditions
11	300	287	-0.88	0.09	0.9	-1.20	0.87	-1.60	0.76	0.71	58.8	56.6	I11E-places w/low humidity
12	271	296	-0.64	0.10	1.02	0.22	0.93	-0.75	0.73	0.69	57.2	57.3	I12E-areas air condition

when compared to model values.

Table B1 shows the item measure and fit statistics for the 11 items analysed, the mean item measure was 0.00 logits (SE = 0.10), the item separation was: real = 5.94 and model = 6.13. Item reliability was, both real and model, 0.97. All parameters for the 11 items were within the acceptable range of values given in the methods section. With 11 items and 340 persons, the principal component analysis of the standardised model residuals indicated an acceptable unidimensional measurement with first contrast eigenvalue of 1.99.

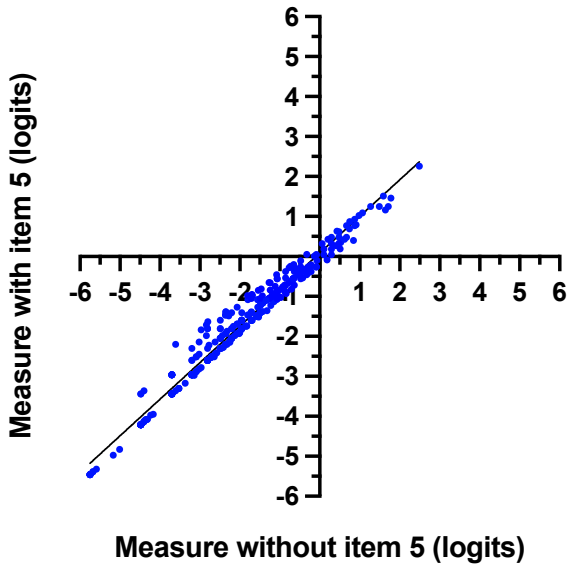

Figure B3: *Cross-plot of measures (dry eye symptoms) obtained with 12 and with 11 items (item 5 removed). The strong correlation, $r = 0.98$ ($p < 0.001$), indicates that removing item 5 fails to improve the model significantly.*

The Rasch analysis of the answers obtained from this online OSDI questionnaire confirmed acceptable measurement properties of this instrument.

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Symptomer på tørre øyne ved bruk av Ocular Surface Disease Index i Sverige: en kort rapport fra en pilotstudie

Sammendrag

Formålet med studien var å undersøke prevalens av symptomer på tørre øyne i den svenske befolkning ved hjelp av en nettbasert versjon av ocular surface disease index (OSDI).

OSDI spørsmålene ble satt inn i et skjema på internett ved hjelp av programvare utviklet av Artologik. Lenken til skjemaet ble sent ut via Linnéuniversitetets sosiale media. Bakgrunnsinformasjon som alder, kjønn og hjemstedsfylke ble også registrert.

Totalt ble 404 fullstendige svar mottatt, 303 (75%) respondenter var kvinnelige, median alder = 39 (interkvartilområde = 28–53) år, median OSDI-score = 19 (interkvartilområde = 9–32). Prevalens av symptomer på tørre øyne (kategorier milde til alvorlige) var 65% (95% CI = 62–75). Forskjellen i prevalens mellom kvinner og menn var signifikant (khikvadrattest, $p = 0.007$).

Denne studien fant at prevalensen av symptomer på tørre øyne blant et utvalg av Sveriges befolkning var 65%. Disse resultatene belyser behovet for videre undersøkelse av prevalens og risikofaktorer for tørre øyne i den svenske befolkning.

Nøkkelord: Tørre øyne, symptomer på tørre øyne, prevalens, Rasch-analyse

Sintomatologia da occhio secco utilizzando l'Ocular Surface Disease Index in Svezia: un breve report da uno studio pilota

Riassunto

Lo scopo di questo studio e' stato quello di investigare la prevalenze della sintomatologia da occhio secco nella popolazione svedese utilizzando una versione online dell'ocular surface disease index (OSDI).

E' stata utilizzata una versione online dell'OSDI in un formato implementato nel software "Survey and report" sviluppato da Artologik. L'indirizzo online e' stato distribuito grazie alle pagine di social media dell'Universita' Linnaeus. Anche le informazioni sulla demografia di base come eta', sesso e regione di residenza sono stato raccolte.

Un totale di 404 risposte complete sono state ricevute, 303 dei rispondenti (75%) erano femmine, con un'eta' media = 39 (rango interquartile = 28–53) anni, un punteggio OSDI medio = 19 (rango interquartile = 9–32). La prevalenza cruda di sintomi da occhio secco (categoria tra moderato e severo) e' stata del 65% (95% CI = 62–75). La differenza in prevalenza tra maschi e femmine e' stata statisticamente significativa (chi-square test, $p = 0.007$).

Il presente studio riporta che la frequenza di sintomi da occhio secco nel campione scelto di popolazione svedese e' stato del 65%. I risultati sottolineano la necessita' di investigare la prevalenza e i fattori di rischio dell'occhio secco nella popolazione svedese.

Parole chiave: occhio secco, sintomi da occhio secco, OSDI, prevalenza, Rasch analisi

SOPTI Meeting 2022: Abstracts

The 27th National Conference of the Italian Optometric Association (SOPTI) was held in Bologna on May 29–30, 2022. This year the conference title was *"Technical procedures for good clinical practice in Optometry"* and was arranged in 3 sessions: presbyopia management, contact lenses and paediatric optometry. Two keynote speakers were invited during the conference: Dr Shehzad Naroo (Reader at Aston University, UK) and Dr Mohammed Jalie (Past head of the Applied Optics department at the City & Islington College and current visiting lecturer at Ulster University).

The abstracts from accepted posters and free papers are presented here.

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Visual performance and adaptation with DIMS (Defocus Incorporated Multiple Segments) ophthalmic lenses

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Abstract

The aim of this study was to compare the visual performances between the single vision spectacle lenses usually worn and the DIMS ophthalmic lenses for the management of myopic progression. Also, to assess the grade of fit after seven days of wearing the DIMS lenses.

The study was carried out on 15 myopic students aged between 22 and 32, treated with DIMS lenses. The inclusion criteria were myopia ≤ -4.00D, astigmatism ≤ -1.00D, habitual use of glasses, normal binocular vision. The visual functions compared between the two lenses were: visual acuity at high (HLVA) and low luminance (LLVA), contrast sensitivity (CS), all at far. At near: reading visual acuity (AV Radner), critical print size (CPS) and reading speed. All tests were carried out, first with the lenses usually worn, then immediately after delivering the glasses with DIMS lenses and again after a week of wearing.

The measurements were carried out with Vision Chart (CSO, Italy), for HVLA, LLVA, CS; with Radner test, for near AV, read speed and critical print size. The Pelli Robson test was used for the measure of the contrast sensitivity.

As for far vision, the differences detected were statistically significant ($p < 0.05$) only for HLVA, not significant for LLVA and CS. However, all have negligible values from a clinical point of view. See the first three lines of Table 1.

Monofocal	DIMS	ODDS	*p*-value	*t*-test	*p*-value Wilcoxon	Adaptation
HLVA	-0.14±0.06	-0.17±0.04	-0.02±0.05		0.049	-0.16±0.04
LLVA	0.01±0.09	0.01±0.07	0.00±0.10		0.909	0.01±0.07
CS	0.01±0.00	0.01±0.00	0.00±0.00		0.472	0.01±0.00
AV Radner	-0.03±0.05	-0.05±0.06	-0.02±0.08		0.183	-0.06±0.06
CPS	0.17±0.07	0.15±0.11	-0.02±0.10	0.424		0.13±0.08
VEL Radner	215.07±24.5	224.6±32.0	9.5±15.8	0.035		225.7±29.5

The Radner test did not reveal statistically significant differences (p> 0.05) for reading acuity and CPS. There was a significant difference in reading speed, but clinically the difference is negligible. See the last three lines of Table 1. See Figure 1 for results of the Radner test for the three measurement conditions.

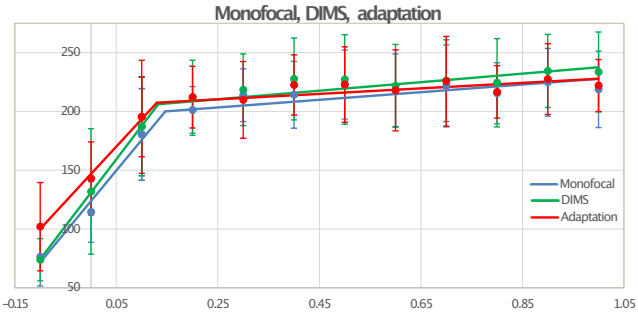

Figure 1: Results of the Radner test with single vision lenses and with DIMS lenses, just after delivering and after a week of wearing.

As for the adaptation during the week of wearing, it was found that the symptoms were mild or absent and the adaptation was complete in less than a week in most of the subjects.

To our knowledge this is the first study in which reading speed with DIMS lenses has been measured. From the data collected in the analysed sample, no significant deterioration in visual performance was shown with DIMS ophthalmic lenses for the control of myopic progression. According to our sample, a certain number of subjects need a short period of adaptation. A limitation of the study relates to the age of the subjects, all were adults. However, it is to be expected that the lenses can be well tolerated by children, who have greater adaptability and lower demands for high visual performance in comparison with adults.

Correlation between corneal and refractive astigmatism with power vectors

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Abstract

This work aimed to investigate the correlation between corneal and refractive astigmatism. Along with the WTR and the ATR types of astigmatism, the oblique astigmatism was considered, unlike previous literature (Javal, 1890).

A sample of 62 eyes was analysed, estimating the corneal astigmatism by the Allergan Humphrey auto keratometer model 420 (autoker), and the refractive astigmatism by an optometric exam.The subjects' ametropia ranged from -11.00 D to +8.00 D with astigmatism ranging from 0.75 D to 5.00 D.

Subjects affected by corneal ectasia and those with an astigmatism less or equal than 0.50 D were excluded from our sample. The corneal astigmatism and refractive astigmatism data were converted into a vector key (see Figure 1) and the analysis was carried out to derive a possible relationship between the two (Liu et al., 2011; Remón et al., 2009).

After converting all data from clinical notation to vector notation and estimating the average value of internal astigmatism (-0.60 ±0.01 D axis 90.47°), four linear regressions were performed to study a relationship between:

1) refractive astigmatism RJ0 and corneal astigmatism CJ0
2) refractive astigmatism RJ45 and corneal astigmatism CJ45
3) internal astigmatism LJ0 and internal astigmatism LJ45
4) and refractive astigmatism and corneal astigmatism.

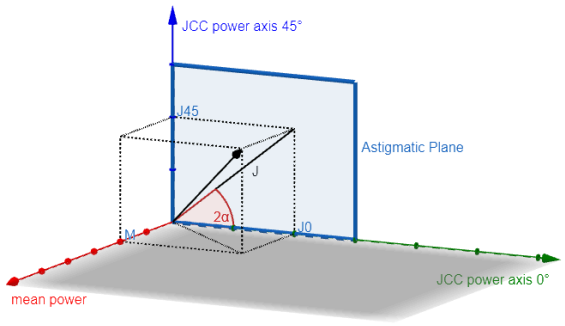

Figure 1: Cartesian representation of power vectors.

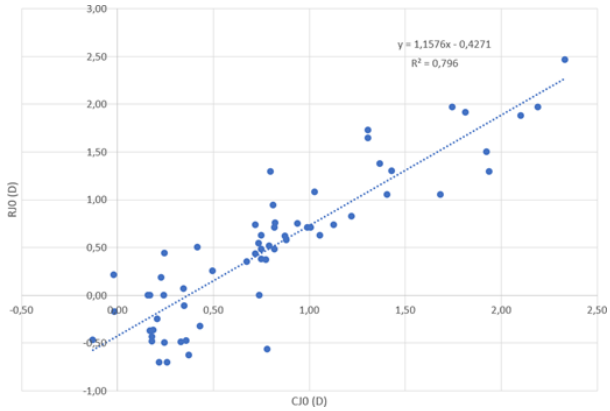

Figure 2: Linear regression of refractive astigmatism RJ0 vs corneal astigmatism CJ0.

Since refractive and corneal astigmatism are linearly correlated, it is possible to estimate refractive astigmatism using corneal astigmatism:

Refractive astigmatism = corneal astigmatism ×(0.94 ± 0.06) – (0.60 ± 0.01 D) axis 90°

This formula is very similar to the approach of the Javal's rule, with the added possibility of making oblique astigmatism predictions by making them more exact and plenary.

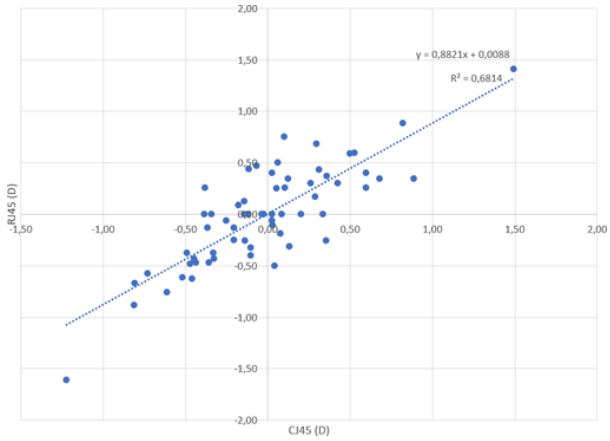

Figure 3: Linear regression of refractive astigmatism RJ45 vs corneal astigmatism CJ45.

Power vectors have been found to facilitate the description of refraction more accurately and comprehensively. In this case it allows us to conduct the analysis and calculations related to the various elements in a mathematical way (Harris, 2007), something that could not happen with clinical notation alone.

Comparisons with previous studies showed that some of the detected parameters of the linear relationship between refractive and corneal values were compatible with those determined in this study.

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Evaluation of automatic morphometric analysis of the corneal endothelium with Perseus

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Abstract

The aim of this study was to compare results obtained from the automatic analysis of endothelial cells operated by the Perseus Specular Microscope's software (CSO, Florence, Italy) with results obtained from a manual analysis of the same images.

A sample of 73 subjects was selected from the Perseus database (CSO, Florence, Italy). For each subject were exported endothelial images from seven different positions of each eye (central C, superior S, superior temportal TS, superior nasal NS, inferior I, inferior temporal TI and inferior nasal NI) were exported. For each image acquired, the software automatically identified the cells and returned the main morphological parameters of the endothelial mosaic. For the same images, the operator manually identified and corrected any errors made by the automatic recognition software in the number of cells and / or in the number of sides of their shape. Once the editing phase was ended, the modified images modified were processed using the same algorithm as the automatic analysis. Of the analysed images, 890 were selected, those with reliability greater than 50% and number of cells recognised greater than 75, for which the number of cells, cell density, coefficient of variation (CoV) and hexagonality were reported, for automatic and manual analysis.

Comparison between the automatic and manual method of analysis was performed for the four indices, separately for the two eyes and for the 7 positions. Between the two procedures, in all positions examined, for both right and left eye, no significant differences were found for CoV and cell density (with the exception of the left eye TS position [paired t-test, $p < 0.05$)]; while the differences were always significant for cell number (paired t-test, $p < 0.001$; Wilcoxon p <v0.001 NS left eye) and for hexagonality (paired t-test, $p < 0.001$).The correlation between the considered parameters with the two methods was significant, more specifically from moderately to strongly positive in all positions.

The integration with the manual analysis of the acquisitions made with the Perseus requires more time than the automatic analysis alone. With manual analysis it is possible to recognize and analyse a significantly higher number of cells, determining a significant difference on the morphological parameter of the hexagonality only. Furthermore, a robust positive correlation was found for all variables.

Ophthalmic applications of Metalenses

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Abstract

Metalenses, also defined as planar lenses, allow you to focus the entire visible spectrum in a single point, thus eliminating the chromatic aberrations from which all optical systems are affected. The nanostructures of which they are composed are designed to manipulate the phase, amplitude and polarisation of light. The nanometric thickness and the way they interact with light make these lenses particularly suitable for applications in the ophthalmic field, such as corrective lenses or contact lenses.

The purpose of this study is to present the development and production phases of a Metalens, highlighting its peculiarities, in particular in relation to the interaction of light with nanostructures, and to investigate the possibility of its use in the ophthalmic field.

The following study was conducted at the QR (Nanofacility) laboratory of the National Institute of Metrological Research (INRiM), under the coordination of Dr. Luca Boarino. The sample of Metalens, under study, was made as follows: Plasma Enhanced Chemical Vapor Deposition (PECVD) of amorphous silicon (a-Si) on a glass substrate; Spin deposition of negative resist; Electron beam lithography (EBL); Development and finally Chemical Etching.

A Metalens with a diameter of 100 μm was designed to focus light with a wavelength λ = 633 nm (red) at a focal length of 200 μm. For the measurement of the focal length, we used an optical bench consisting of a monochromatic laser source (λ = 633 nm), a series of biconvex lenses for the manipulation of the beam, a 10x objective for the imaging of the lens and, finally, a camera with a photographic sensor for the acquisition and processing of the light signal.

Metalenses open up to different possibilities of use. These lenses have been proposed for use in various electronic optical devices such as cameras and smartphone displays, but also in wearable optics, in particular virtual- and augmented-reality.

To answer the question that this research concerns, there is, in accordance with scientific evidence, the concrete possibility of a future use of these metastructures in the ophthalmic field. Glasses and contact lenses will be able to make use of these particular lenses with wave guides arranged in patterns, correcting the various refractive errors. Studying the applications of Metalenses on patients suffering from ametropias and comparing the results with the traditional corrective lenses currently on the market will be the subject of research in the coming years.

Decrease of myopic progression rate by Orthokeratology. Three-year results of a retrospective study

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Abstract

The aim of this work was to study the effectiveness of overnight orthokeratology treatment in a group of young myopic subjects, throughout a period of three years. In this retrospective study the data from clinical records of 41 myopic children who received the overnight orthokeratology (OK group) and of 41 myopic subjects treated with single vision glasses (control, C group) are compared.

The clinical records were acquired in two different private optometric clinics, one for the OK group and the second for C group. The inclusion criteria for treated subjects were those indicated by IMI (International Myopia Institute). Refraction was carried out without cycloplegia by two different optometrists, one for OK group and the other for the C group. The C groups have been matched for ethnicity, age, and refractive error with the OK group.

The mean spherical baseline equivalent was -2.85 ± 1.55 D and -2.51 ± 1.61 D, for OK and C group respectively. The follow-up data was available for two years for all 41 subjects of each group, and for three years for 30 subjects in the experimental group vs 25 in the C group. The data from the three years follow-up were analysed.

The increase in myopia at 3 years was -0.48 ± 0.43 D for the OK group and -1.52 ± 0.90 D ($p < 0.001$) for the C group. The comparison between the two groups is summarised in Table 1 and in Figure 1. The differences found in the myopia progression rates between the two groups (OK vs C) for each year were: -0.15 vs -0.47 ($p < 0.01$) in the first year, -0.13 vs -0.47 ($p < 0.001$) in the second year, -0.19 vs -0.39 ($p < 0.01$) in third year).

	OK group	DS	Control group	DS	*p*
Spherical equivalent					
BL	-2.85	±1.55	-2.51	±1.61	0.183
1	-3.00	±1.58	-2.99	±1.72	0.831
2	-3.13	±1.59	-3.46	±1.83	0.329
3	-3.16	±1.54	-4.24	±2.11	0.018
Myopisation					
BL	0	±0.000	±0.00	0.0001	
1	-0.15	±0.25	-0.47	±0.46	<0.0001
2	-0.28	±0.34	-0.94	±0.70	<0.0001
3	-0.48	±0.43	-1.52	±0.90	<0.0001
Annual myopia rates					
BL	0	±0.00	0	±0.00	0
1	-0.15	±0.25	-0.47	±0.46	0.004
2	-0.13	±0.24	-0.47	±0.44	<0.0001
3	-0.19	±0.28	-0.39	±0.41	0.004

Children treated with OK lenses were found, after three years, to have 68% lower myopic progression compared to children corrected with monofocal ophthalmic lenses. There have been no serious complications or adverse events in the three years of the study.

The results of this retrospective study confirm that overnight OK treatment slows down myopic progression in a reliable way compared to monofocal lenses. The percentage reduction of the myopic progression of the OK group is in line with other published literature. No adverse events have disturbed the wearing of the lenses or caused a drop-out. Overnight orthokeratology can therefore be used as a myopia correction technique, and its increased use among practitioners could help contain the increasing prevalence of this refractive error.

Should we expect corneal warpage with the use of scleral contact lenses in keratoconus?

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Abstract

Wearing scleral contact lenses, especially when applied inadequately, may induce a change in corneal curvature and corneal thickness (Consejo et al., 2019). Variations may be induced by abnormal lacrimal fluid pressure or mechanical contact between the lens and the corneal surface (Consejo et al., 2020). Iatrogenic effects may be changes in corneal thickness more or less associated with corneal signs of disorder, and possibly associated with more or less transient transparency reductions (Consejo et al., 2017). The purpose of this study was to measure the change in corneal shape after the use of properly applied scleral contact lenses in eyes with keratoconus.

Sixty-nine eyes, 38 males and 31 females, aged between 35 and 66 years, average age 46 years, with medical diagnosis of keratoconus, indicated for the use of contact lenses, were measured with an ocular tomograph (Sirius, CSO, Italy) before and after the use of scleral contact lenses. The measurement after use was carried out according to the clinical application protocol, that is a specific timetable of follow-up and minimal activities that has to be executed for verification of efficacy and safety. The first control of the application protocol involves observations and measurements after 15 days of use and with contact lenses worn from 5–6 hours per day continuously. Measurements and observations should be made first with the contact lenses worn and immediately after their removal. The measurements were carried out at Mauro Frisani's optometric and optical centre for the application of specialised contact lenses in Turin.

The clinical data collection procedure for this study, unchanged for all measurements, included corneal curvature detection at 3, 5 and 7 mm from the corneal apex, respectively. All the contact lenses applied followed an appropriate procedure of adaptation to each individual eye. Each contact lens was applied based on tomographic data and direct observations in the slit lamp. Central and peripheral clearance were checked before the trial period and after 15 days of use. Scleral contact lenses have been used with materials with very high transmissibility to gases and built with optimised thicknesses. Each application procedure was performed by the same operator.

The data show no statistically and clinically significant difference.

The difference in keratometric values, in the central area around 3 mm from the corneal vertex, before and after 15 days of contact lens use, was -0.0214 mm ($p > 0.05$; Student's t-test); in the area around 5mm from the corneal vertex, before and after 15 days of contact lens use, was -0.0174 mm ($p > 0.05$; Student's t-test); and in the area around 7 mm from the corneal vertex, before and after 15 days of contact lens use, it was -0.0203 mm ($p > 0.05$; Student's t-test).

It is expected that there will be no changes in corneal curvature in keratoconus, when contact lenses are applied appropriately. Any corneal warpage requires a revision of the fitting of the lenses in respect to the surface of the eye.

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Can we use two different corneal topographers with keratoconus?

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Abstract

The aim of this study was to investigate the degree of agreement between corneal shape measurement in eyes with keratoconus performed by a Placido-disk optical reflection corneal topographer (Keratron, Optikon 2000 spa, Italy) and an acquisition system that combines Placido-disk optical reflection topography with anterior segment Scheimpflug tomography (Sirius, CSO, Italy).

After the verification of the videokeratoscopic reliability, a total of 76 eyes of 76 subjects affected by keratoconus were evaluated by the following parameters: the simulated keratometries related to the two main corneal meridians (Sim-K flat, Sim-K steep), mean corneal keratometry (mean Sim-K) and the geometric coefficient (p). The results obtained with the Keratron corneal topographer were compared with the Sirius acquisition system.

The differences between the two devices in all parameters examined in this study were not statistically significant. The correlation coefficients (95% CI) between the two instruments are 0.865 (upper 0.798, lower 0.912) for the Sim-Ks and 0.757 (upper 0.646, lower 0.837) for the form factor p. The mean differences detected between the two instruments were 0.03 mm for the Sim-K flat parameter, 0.04 mm for the Sim-K steep parameter, 0.03 mm for the mean Sim-K parameter and 0.01 for the p parameter.

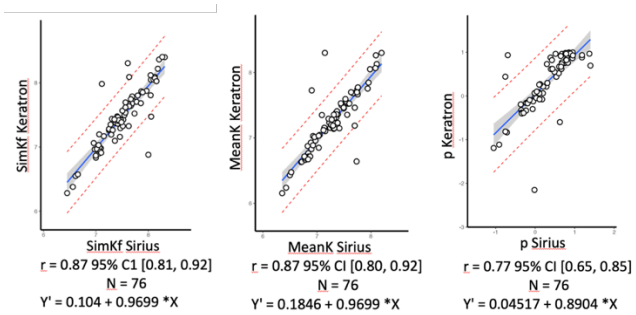

Figure 1: Graphs of the correlation estimate between Keratron and Sirius in the measurement of keratometries, mean corneal power and corneal shape in eyes with keratoconus. The blue line indicates the regression line, the area around the 95% confidence interval, the dashed red lines indicate the prediction interval of the distribution of values for the upper and lower extremes of 95%.

The degree of agreement between the two instruments is good. For the procedure of contact lenses fitting the devices are interchangeable.

Can we use two different corneal topographers before and during orthokeratology?

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Abstract

The aim of this study was to compare the measurement of corneal parameters with two different topographers during a year of orthokeratological treatment for myopia control.

An experienced operator used two different corneal topographers on the same sample. The simulated keratometry data on the flat meridian (K1) and curved meridian (K2), the mean value in a central area of 3mm (Kmax) and the corneal shape index (factor form p) were extrapolated. They were compared before the use of orthokeratology lenses at seven follow-up dates, according to the normal application protocol of effectiveness and safety verification, carried out in the following twelve months

Two different corneal topographers (Sirius, CSO, Italy; Keratron Onda, Optikon, Italy) were used during each follow-up visit during one year of orthokeratology treatment. 132 eyes (58% female) were measured in subjects between the ages of 8 and 15 years. Prior to treatment myopia was on average -2.91 $\pm$ 1.08 D, ranging from -0.75 to -5.25 D.

Statistically and clinically significant differences were found between the two instruments for each measured parameter. At t0, the difference in the 95% match limits between the two devices for K1 was 0.28 mm with less curved measurements found by Sirius than by Keratron. During orthokeratological treatment, the differences were greater than at the baseline and with an opposite estimate, less curved measurements by Keratron than by Sirius. After orthokeratological treatment, the differences for K1 measurement were 4 times higher than the baseline data, for all other parameters the differences were greater than those found for K1. A statistical relevance was found between the two devices for both Kmax and the form factor. For each parameter, no statistical differences between measurements were found in a subsequent follow-up visit, for both devices.

Before and after orthokeratological treatment, the two devices showed a significant clinical and statistical difference. Their use is not interchangeable without considering the distortion estimate observed as the opposite between the two devices before and during treatment. The corneal eccentricity on an 8 mm string and the mean corneal power of 3 mm around the corneal vertex measurements showed poor agreement between the two devices. Stability of the orthokeratological effect on corneal parameters over time has been detected.

Analysis of accommodative microfluctuations

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Abstract

The accommodation carried out by the eye does not remain constant, but it presents some microfluctuations even if the accommodative stimulus is steady (Metlapally et al., 2016). The accommodative microfluctuations cause the observed object to change between the state of perfect sharpness, when the exercised accommodation is very similar to the requested accommodation, and the state of slight blur, when the actual accommodation moves away from the theoretically required accommodation (Charman & Heron, 2015). This study analyses the trend of these accommodative microfluctuations and the relative interval for constant stimuli, in a sample with homogeneous age and occupation.

The dynamic accommodation of 67 students, 48% female, with an average age of 23 years, was measured by means of the aberrometer Osiris (CSO, Italia). This group was made up of 21 emmetropic, 10 hyperopic and 36 myopic subjects. Each measurement had a duration of 30 seconds, with a progressive and constant scale of stimuli. Every stimulus was presented for about 2.5 seconds. Four measurements were taken on each eye, in a complete darkness and after some minutes of dark adaptation.

Table 1: Accommodative response to the three different stimuli.

	Stimulus 4	Stimulus 5	Stimulus 6
Media	3.10	4.04	4.79
Standard deviation	0.618	0.490	0.566
95% CI mean bound	2.92	3.91	4.63
95% CI mean upper bound	3.27	4.18	4.95
Minimum	1.31	2.58	3.03
Maximum	4.05	5.04	6.22

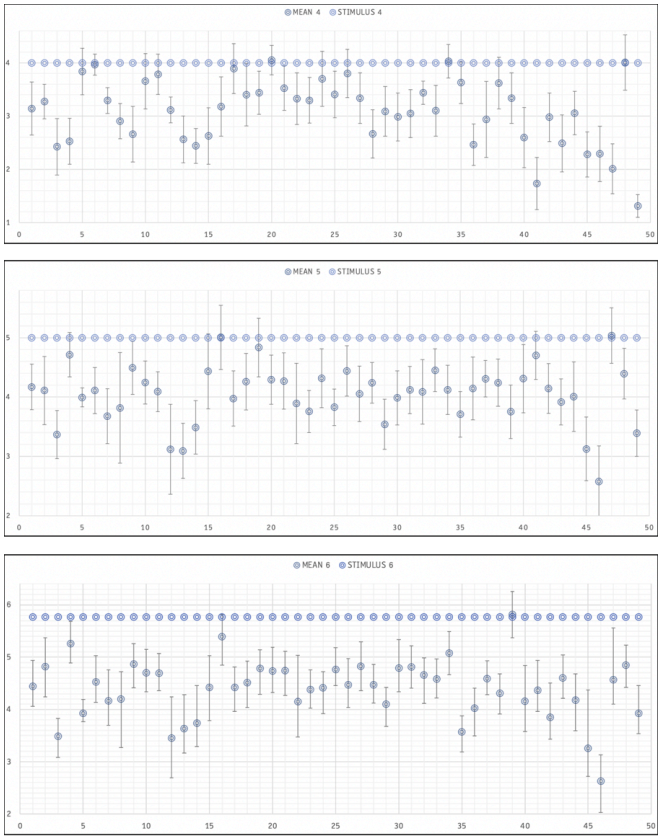

Figure 1: Summary graphs of the behaviour of each individual subject with respect to the accommodation exercised for three different stimuli (4, 5 and 6 D from above, respectively) and expressed microfluctuations in the error bars around the mean value. The values are in diopters.

Three intermediate intervals one dioptre apart were chosen for the analysis, from 4 to 6 D. By analysing the trend of the average accommodation values of both eyes, it can be shown that only the average values of the first stimulus interval (4 D) follow a normal distribution ($p = 0.18$). The average values of the subsequent intervals (5D; 6D) do not follow a normal distribu-

tion ($p = 0.03$; $p = 0.003$). Observing the trend of the box plots of each subject along the three stimuli, 17 subjects presenting a non-progressive trend for an increasing stimulus can be identified. By repeating the analysis, neglecting the subjects with anomalous accommodation, a normal distribution of the average values in all the intervals is obtained. See Table 1 for average values and standard deviations of accommodative response to the different stimuli and Figure 1 for individual subjects' responses.

With the examined data, neglecting the subjects with anomalous accommodation, it was possible to calculate an average value of accommodation for each interval. As confirmed by other studies, the data present an increasing accommodative lag for an increasing stimulus demand (Gambra et al., 2009). The average standard deviation for the single stimuli is around 0.50D, which again is confirmed to be true by scientific literature. It increases slightly as the stimulus demand grows. For subsequent studies a more detailed analysis of the microfluctuations is required. In order to get more significant results, the low frequency microfluctuations should be subtracted from the entire data. In this way only the high frequency band is analysed.

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Evaluation of the applications of corneoscleral contact lenses on regular corneas

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Abstract

The purpose of this study is to illustrate the evaluation of corneoscleral contact lens (CScL) fitting from trial sets on regular corneas and to describe the observations necessary to allow the design of these contact lenses through case reports.

Each CScL is made up of two geometric zones: base curve (CB) and peripheral curve (PC). During the first phase, 40 eyes were selected on which the CScLs were applied according to the application protocol proposed by the manufacturer, which considers, as a parameter, the horizontal diameter of the visible iris, in respect to which, the first applied lens was a flatter, equal or steeper CB than corneal Sim-K. The study consisted of preliminary tests (tear film analysis and ocular morphological evaluation made with slit lamp) and instrumental tests (topography and OCT). The applications were evaluated by observing the fluorescein pattern formed. Applications deemed unsuitable were appropriately replaced before proceeding with a 2-hour adaptation.

The analysis of the results was carried out considering the incidence of the various cases. Particularly an incidence of alignment of 35% was shown post-adaption (see Figure 1), while an important correlation was been noticed in the presence of insufficient post-lens tear turnover, especially in applications with CB aligned-PC steep and CB steep-PC steep (see Figure 2), causing alteration of the corneal physiology.

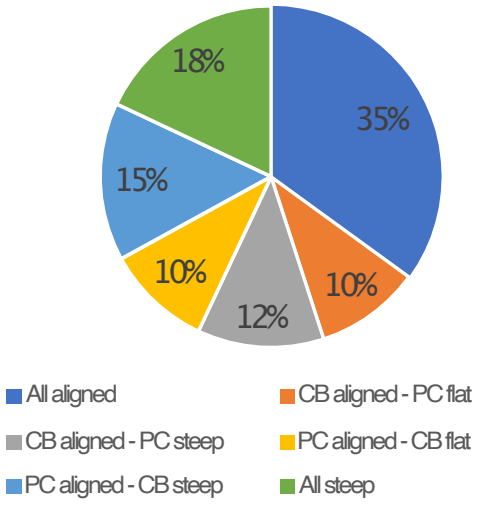

Figure 1: Incidence of post-fitting cases.

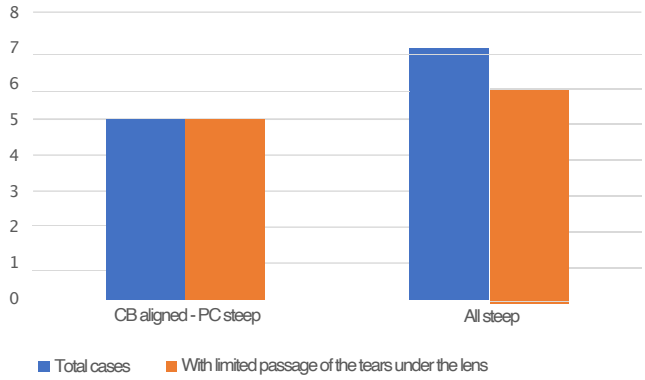

Figure 2: Incidence of the limited post-adaptation tear turnover.

During the second phase of the study, the design of CScL was described for each eye in two case reports. The two subjects (aged 32 and 25) initially had CScL from trial sets applied. Based on observations obtained, each lens was suitably made with the necessary modifications through the manufacturer. Once the CScL obtained was considered overall suitable, a one-month follow-up period was carried out. For the first case report, a suitable application was obtained. The application limitations that emerged, in particular for the second case (which presents an important scleral asymmetry and dry eye due to aqueous deficit), correlate to the limited exchange of the tears behind the lens and the impossibility of making a CScL with asymmetrical periphery in order to manage this condition.

It was possible to observe, through this study, how CScL can be a valid contactological alternative in cases of dry eye, managing to be well tolerated and to maintain a high optical quality thanks to the RGP material of which they are composed, unlike soft contact lenses which tend to dehydrate more rapidly. However, it remains essential to pay attention to the physiological complications that an incorrect application can cause. The possible customisation of additional parameters (e.g., asymmetrical scleral area) would allow for a more versatile and adaptable application to a wider range of cases.