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ORIGINAL STUDY

Soft-Polymeric Contact Lenses Brands Evaluation According to User Preferences

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ABSTRACT

The development of soft-polymeric contact lenses (SPCLs) has significantly enhanced vision correction by integrating advanced polymeric materials with optimized optical properties. This study examines the impact of refractive index (RI), oxygen permeability (Dk/t), and water content (EWC%) on visual quality and ocular health, correlating material properties with user-reported experiences. A survey of 5,585 medical SPCL users revealed that 31% experienced ocular fatigue and redness, often linked to optical aberrations and replacement frequency. Notably, commercially available SPCLs exhibit RI values ranging from 1.37 to 1.43, deviating from the natural ocular tissue RI (∼1.33), which contributes to light distortions and reduced visual clarity. The study also confirms that higher water content lenses are favored for daily use, while those with lower water content but higher oxygen permeability are more suitable for extended wear, minimizing corneal hypoxia risks. Brands such as Biotrue ONEday and Acuvue Moist 1-Day employ advanced polymeric formulations, reducing optical aberrations. Additionally, materials like poly(2-hydroxyethyl methacrylate) (PHEMA) and novel silicone hydrogels offer superior oxygen permeability and hydration balance, mitigating phase separation issues and mechanical degradation. These findings underscore the critical role of polymer engineering in ophthalmic applications, supporting the design of next-generation SPCLs that enhance optical performance, user comfort, and long-term biocompatibility.

Keywords: Contact lens, Refractive error, Oxygen permeability, Equilibrium water content, Refractive index

1. Introduction

As the technology advances, the variation in the choice of contact lens (CL) has widened, and it offers a lot of what customer needs: appropriate for various visual requirements [1], drug release [2], smart monitoring [3], lifestyle [4], and comfort [5] areas. Improvements in material and technology allowing for more oxygen permeability in the lens and safety in wear have led to more user comfort and satisfaction [6]. Supplies include products such as Acuvue, Air Optix, Biofinity, PureVision, Dailies, and SofLens, each offering unique ingredients, specifications, and visual outcomes for different categories of users [7]. The risk of vision loss with CL wear is generally low, but serious problems like microbial keratitis do occur. It was observed by Wu et al. in 2020 that a vision loss post-LASIK had occurred in 66 cases (95 CI %: 34–108) out of 10 000 persons [8]. For comparisons of the rate of vision loss with a LASIK surgery, while a conservative estimate is made at the lower confidence interval, it would take daily-wear CLs or 103 cases (95 CI%: 103–391) years and extended overnight wear of hydrogel lenses or 25 cases (95 CI%: 25–79) years to obtain the number of years equivalent to the number of a one-off LASIK procedure. These CL brands are manufactured by renowned companies like Johnson & Johnson Vision Care Alcon, CooperVision, and

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Bausch + Lomb, each utilizing proprietary materials and designs to optimize user experience. The choice of material offers distinct features for the various brands, like the equilibrium water content (EWC%), oxygen permeability (Dk/t) [9], refractive index (RI) [10] impacting user comfort, ocular health, and general user satisfaction [11]. Material selection influences the oxygen flow to the cornea, therewith offsetting dryness, and irritation, while the water content further supports lens hydration and keeps the wearers comfortable for an extended period [12]. Oxygen transmission rate, an important factor in CL design and performance, is expressed as Dk/t. The larger the Dk/t values allow more oxygen to diffuse through the lens [13], and this is important for maintaining corneal health [14], especially during long use [15].

In addition, water content varies among brands, with some lenses such as Dailies AquaComfort Plus featuring high water content to enhance moisture and comfort, especially for users prone to dry eyes [16]. However, while high water content can increase comfort, it can also make lenses more prone to dehydration over time, requiring a careful balance to achieve optimal wearability [17]. Furthermore, CLs have become an essential tool for specific populations, such as older adults and individuals with conditions like keratoconus. As Naroo and colleagues in 2022 observed, the demand for specialized lenses tailored to unique ocular conditions is growing, necessitating an evaluation of brands based on both general user comfort and specialized performance outcomes [10]. Among various types of CLs, Hybrid CLs (HCL) have proven beneficial for keratoconus patients, significantly enhancing visual acuity compared to eyeglasses [18], especially in moderate to severe cases. A study by Serdarov et al. in 2023, involving 68 patients, assessed clinical performance and satisfaction [19]. While HCLs showed moderate to high overall satisfaction, some challenges, including comfort, insertion/removal difficulties, and high costs, impacted user experience. Nonetheless, HCLs demonstrated valuable improvements in vision quality for keratoconus patients.

The absence of a comprehensive evaluation shed light on the importance of material properties on visual quality, comfort, and ocular health of soft-polymeric CLs (SPCLs). Given the various brands, materials, and preferences of SPCL users, this study took on an analysis of the association between the varying key material parameters such as RI, DK/t, and EWC% with user satisfaction and eye health safety. This article aims to offer an evaluation of popular brands of SPCLs regarding material composition, optical properties, and the replacement frequency, focusing on how they affect eye health and comfort. The research intends therefore to alleviate the acknowledged need for sophisticated SPCL design technology, which harmonizes with the user's varied physical, lifestyle, and environmental factors in attempts to achieve collective advancements in vision care technology.

2. Methodology

The broad characterization of the study proposed in this paper addresses the dependence of SPCL comfort and performance due to various materials in manufacturing. To offer a complete understanding of present-day SPCL options to consumers and eyecare professionals, one would have to consider all major lens brands with emphasis on their chemical composition as well as issues related to eye health and comfort issues. For this study, the sole aspect was dealt with employing a quantitative and descriptive approach, mentioning key results of data collected from CL wearers, likewise comparing material and technical attributes of different world-renowned brands.

3. Population and sampling

The study employed a stratified convenience sampling approach. Participants were categorized based on lens replacement frequency (daily, weekly, monthly, annually) to ensure diverse representation. While not randomly selected, this stratification helped reduce sampling bias related to wear habits. The procedure was implemented as follows:

1. Population: The study targeted CL users aged 18–50 years who had experience with soft-polymeric CLs for at least six months.
2. Sample Size: A total of 6,312 participants were surveyed during 36 month-period, providing a statistically significant dataset for analysis. Some of the responses were recorded in S1 and S2.
3. Inclusion Criteria:
   - Participants who had used lenses for corrective, therapeutic, or cosmetic purposes.
   - Participants with experience using multiple brands.
4. Exclusion Criteria:
   - Individuals with severe ocular conditions unrelated to lens wear.
   - Professional bias (e.g., optometrists or lens manufacturers).

To collect demographic and product-specific data, a full questionnaire survey on wearers of SPCL was undertaken. Data centered on basic demographics, such as their gender and age, to give a clear impression of the profile of SPCL-using populations (please see S3). Moreover, additional information was collected regarding the brands and manufacturers where the contact lenses were acquired, with precise names of the products; it was on this information that the most widely SPCL brands were identified and formed the starting point of further research on various properties of material for these contact lenses.

There was an unusual methodology that was espoused to increase the reliability and accuracy of the entire study. Every product was directly verified with a particular photo of the product through its nameplate, and the technological details specified were very much in accordance with the manufacturers on their official websites. This latest method would support the testing and the data collected of the RI, EWC%, and Dk/t. Such data gave in-depth data on the physical characteristics of each variety, thus giving some insight into their benefits regarding comfort, clearness, and the breathability of the lens while on the eye. The conducted procedure included the following steps:

1. Survey Design: The questionnaire comprised both
   - Closed-Ended Questions: Utilized a Likert scale and categorical options for standardization.
   - Open-Ended Questions: Captured additional insights into user experiences and preferences.
2. Data Analysis
   - Descriptive Statistics: Used to summarize participant demographics and overall preferences.
   - Visualization: Pie charts and bar graphs illustrated gender distribution, usage type, and medical application breakdowns.
   - Comparative Analysis: Evaluated the frequency of side effects against replacement habits.
   - Statistical Tools: Conducted chi-square tests and weighted averages to identify significant patterns.

The data collection was complemented by an analysis of the optical and physiological properties of SPCL materials. This included an examination of the RI of commercial materials, comparing it to the RI of human ocular tissue (1.33) to identify discrepancies that cause optical aberrations and eye fatigue. An ANOVA test was performed to assess the influence of material type on oxygen permeability and water content, establishing that these factors are not significantly dependent on the material.

4. Results and discussions

4.1. Contact lens use for refractive errors

To begin the study, a survey was conducted to gather information about SPCL materials. The questionnaire included questions about gender, age, SPCL brands and manufacturers, as well as the name of the CL product available. With this information, the websites of each SPCL product mentioned by the participants were accessed to obtain details about the characteristics of the lenses, such as the materials used, RI, water permeability, and oxygen transmission rate. By identifying the trade names of the materials, the researchers were able to determine the main polymers used in CL manufacturing, laying the groundwork for exploring the development of new compounds with beneficial properties and the possibility of mitigating any disadvantages of existing materials.

The survey showed a higher participation of women, with a total of 3,715 participants, compared to 2,597 men, as shown in Fig. 1(a). Fig. 1(b) illustrates that 88.5% of participants (5,585 individuals) use SPCLs for therapeutic purposes, such as correcting refractive errors and blocking UV rays, while 11.5% (727 participants) use them for cosmetic purposes. The higher female participation rate could be related to preferences in brands, materials, or frequency of lens replacement, suggesting that a gender-based analysis could provide additional insights. Among participants who use lenses for medical purposes, there could be a trend toward materials that optimize comfort and ocular health. For example, lenses with high DK/t are likely to be more popular among medical users, as they help prevent dryness and ocular discomfort.

Medical interventions to treat refractive errors such as myopia, hyperopia, and astigmatism are critical in vision care [20], as these conditions make it difficult for light to focus properly on the eye [21], causing blurred vision [22]. Approximately 50% of wearers use SPCLs to correct astigmatism, while the remainder use them to correct myopia or hyperopia, as shown in Fig. 2. Unlike participants in Malaysia, who use SPCLs to control hyperopia, this practice is less common in Iraq due to the hot, dusty climate. The study participants, aged 12 to 68, came from a variety of countries, and while some are in good eye health, others suffer from problems related to prolonged use of digital screens and eye strain. In this context, Bullimore reported in 2017, The incidence of infiltrative keratitis in children is lower than in adults when wearing soft CLs [23], even in aged females as described by Berenson and colleagues [24]. Of the

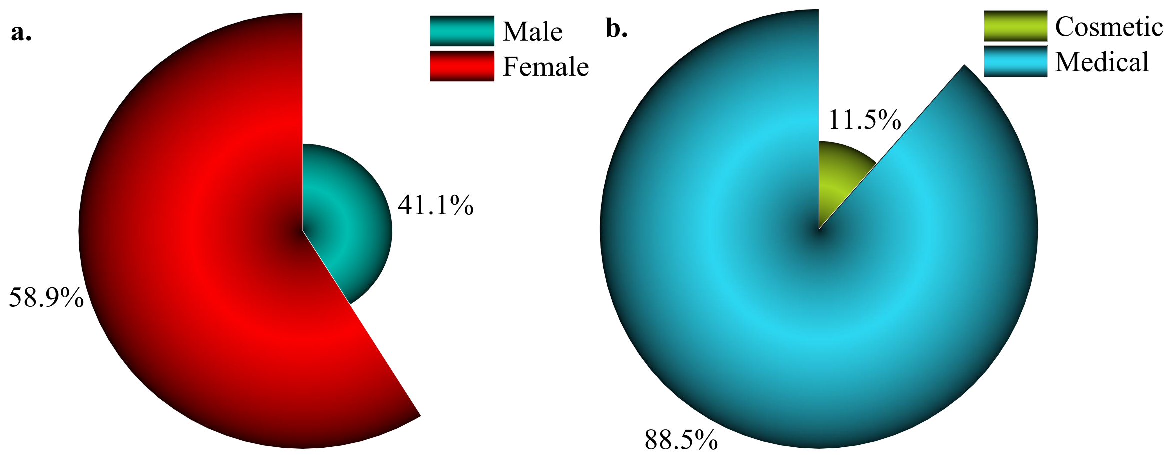

Fig. 1. Number of Participants in percents according to (a) the gender, and (b) the use of prescription SPCLs.

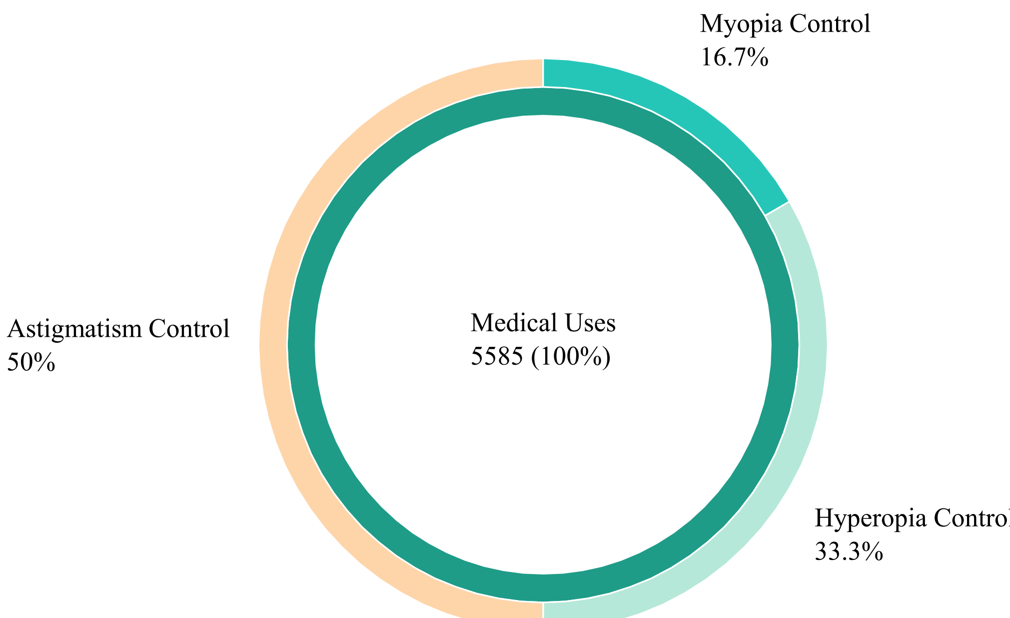

Fig. 2. Number of Participants in percents according to the medical use of prescription SPCLs.

5,585 participants using SPCLs for medical purposes, 1,522 used them for myopia, 2,024 for hyperopia, and 2,039 for astigmatism, with lenses with higher oxygen permeability or high RIs being especially preferred [25].

Further insights into CL use highlight critical differences between cosmetic and refractive lenses. Stapleton et al. (2021) revealed that cosmetic lenses are predominantly used by young females under 25 years of age and are associated with higher risks of complications such as Acanthamoeba infections compared to refractive lenses [26]. These results only highlight how crucial it is to teach the user population about the risks of improper lens wear, particularly in regions where environmental factors heighten this risk. Moreover, as reported by Rhee and co-workers in 2022, CLs are FDA-regulated medical devices whose safety and efficacy highly depend on the composition of the material, the wearing schedule, and care [27]. Our findings supported the importance of DK/t and EWC% parameters in lowering risk of complications like microbial keratitis and corneal hypoxia. Public channels are of paramount importance, should be considered as well. A recent study by Costantini et al. in 2022 pointed that social media platform like TikTok are full of inaccurate and inappropriate information about CLs, most for decoration, and such low-quality swindle traditionally targets teenagers and young adults [28]. These observations reinforce the necessity of regulatory oversight and public awareness campaigns to promote safe CL practices, especially given the

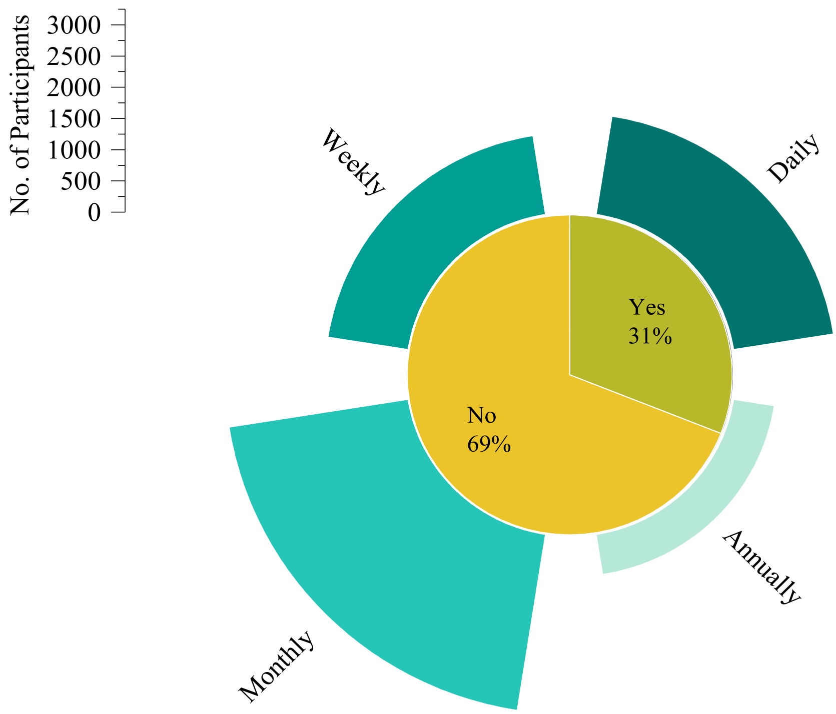

Fig. 3. Number of Participants variation according to the frequency of SPCLs replacement. The circle in the centre represents the percents of the participants who suffer from eye redness and fatigue after wearing SPCLs.

increasing reliance on social media for health-related information.

4.2. Health problems related to contact lens use and replacement frequency

Key findings from a survey of medical SPCL wearers highlight the prevalence of health problems related to the use of these lenses and the impact of optical aberrations on eye fatigue and discomfort [29]. The survey revealed that 31% of these wearers experienced various health problems regardless of the frequency with which they change their lenses, whether daily, weekly, monthly, or annually. Replacement frequency is a crucial aspect of SPCL use and care. In this context, Sapkota et al. (2018) recordrd that 47 myopic subjects wore different lenses in each eye, assessing comfort and ocular effects [30]. Both daily and monthly disposable lenses increased conjunctival redness and staining, with lotrafilcon-B inducing the least limbal redness. Comfort levels decreased similarly for both modalities, with lens material impacting end-of-day comfort.

A significant number of participants adopted different replacement schedules: 1,578 changed their lenses daily, 1,262 weekly, 1,262 monthly, and 633 annually, as shown in Fig. 3. Physiological responses related to the intraocular lens (IOL) include contraction and expansion of the muscles that support the IOL [31], adjusting the focal length to achieve optimal concentration of light rays on a healthy eye without refractive errors [32]. This response may lead to irritation, redness, and dryness on the corneal surface. In addition, eye fatigue or redness appears to be associated with optical aberrations caused by insufficient light transmission, which affects image quality and increases accommodative effort, reducing contrast sensitivity and causing eye fatigue.

Although trends were observed, the analysis showed no statistically significant differences (e.g., $F(4,13) = 1.85$, $p = 0.153$ for Dk/t and $F(4,13) = 1.23$, $p = 0.327$ for EWC%). This suggests that factors beyond material composition, such as lens hygiene, wearing habits, or individual ocular physiology, may also play a substantial role.

Regarding replacement frequency and redness, 1,955 participants reported fatigue or redness, while 4,357 did not present these symptoms, suggesting a possible relationship with material properties and replacement frequency. Low EWC % and high DK/t lenses may reduce redness, as they are designed for long-term wear.

4.3. Contact lens brands and their impact on optical quality

Regarding SPCL brands and their RI, participants reported the use of a variety of products. It has

Table 1. RI of various CL brands and the number of participants involved in their evaluation.

Brand	Manufacturer	RI	No. of participants
Biotrue ONEday	Bausch + Lomb	1.374	441
Dailies Aqua Comfort Plus	Alcon	1.380	526
Proclear	CooperVision	1.390	166
Proclear 1-Day	CooperVision	1.387	130
Soflens Daily	Bausch + Lomb	1.403	613
Acuvue Moist 1-Day	Johnson & Johnson Vision Care	1.400	225
Clariti 1-Day	CooperVision	1.400	200
Acuvue TrueEye 1-Day	Johnson & Johnson Vision Care	1.410	209
MyDay	CooperVision	1.400	128
Biofinity	CooperVision	1.400	1462
Avaira	CooperVision	1.400	60
Menicon PremiO	Menicon Co., Ltd.	1.423	25
Acuvue Oasys 1-Day	Johnson & Johnson Vision Care	1.420	174
PureVision 2	Bausch + Lomb	1.426	311
Dailies Total1	Alcon	1.420	420
Air Optix Aqua	Alcon	1.420	266
Air Optix Night and Day Aqua	Alcon	1.430	935
Maxvue Hydrosoft	Maxvue Vision	1.430	21

been investigated that most commercial SPCLs are composed of polymeric compounds with RI between 1.37 and 1.43, which does not match the RI of the human eye, which is approximately 1.33. This discrepancy explains why patients often experience optical aberrations when wearing these lenses, due to the distortion of light passing through them. Table 1 lists some SPCL brands mentioned and their respective RI. This difference between the RI of SPCLs and that of natural ocular tissues highlights the importance of developing SPCLs with a balanced RI and a favorable Abbe number, with transparent polymers being key in this approach. Regarding specific properties, the mean RI of SPCLs was 1.406 ± 0.017, with a range of 1.374 to 1.430, showing a positive correlation between RI and DK/t, suggesting that lenses with higher RI may improve oxygen flow for greater comfort.

Table 2 provides detailed information about the DK/t, EWC (%), material composition, and base polymers of these lenses. The mean DK/t was 94.59 ± 55.73, with notable variability responding to different materials for short- or long-term wear. EWC % showed an average of $50.33\% \pm 14.08\%$, with a range of 24% to 78%, indicating that lenses with higher water content are preferred for daily wear, while those with lower water content are suitable for long-term wear, given their better oxygen permeability. For instance, brands like Biofinity and Acuvue Oasys have lenses designed for high oxygen permeability, reducing the risk of hypoxia-related complications, and promoting overall ocular health [33]. Traditional hydrogel-based CLs made from HEMA have a Dk of 8–20 barrier and below or equal to 90% transparency, whereas silicone-based polydimethylsiloxane (PDMS) has a Dk value of around 600 [34]. Both have RI less than 1.487. Sometimes, the so-called micro-phase separation of water occurs. This effect works negatively to affect the transparency of hydrogels as it creates areas with different RIs. Biocompatible polymers like PVA are a solution [35], and PVP are used to prepare hydrogels widely for wearable medical applications [36]. Both have been exploited in medical application, industry for adhesive coating, films for its attractive properties. Additionally, PVA is water soluble where the hydroxyl [-OH] group bonding with alternating carbon atom, and as such, it is categorized as hydrophilic material [37]. There is previous evidence that the PVA polymer can be filled with the required drugs

Table 2. Oxygen permeability, equilibrium water content, material composition, and base polymers of the most commonly used CL brands among participants.

DK/t	EWC (%)	Material	Base polymer
42	78	Nesofilcon A	PVP, HEMA
26	69	Nesofilcon A	PVP, HEMA
25	62	Omafilcon B	HEMA
28	60	Omafilcon A	HEMA
19	59	Hilafilcon B	PVP
33	58	Etafilcon A	HEMA
86	56	Somofilcon A	SiHy
118	46	Narafilcon A	SiHy
100	54	Stenfilcon A	SiHy
160	48	Comfilcon A	SiHy
90	55	Fanfilcon A	SiHy
161	40	Asmofilcon A	PDMS
121	38	Senofilcon A	PDMS, PVP, HEMA, Siloxane
130	36	Balafilcon A	PVP, Siloxane
156	33	Delefilcon A	SiHy
138	33	Lotrafilcon B	DMAA, Siloxane
175	24	Lotrafilcon A	DMAA, Siloxane
–	57	HEMA based material	PHEMA

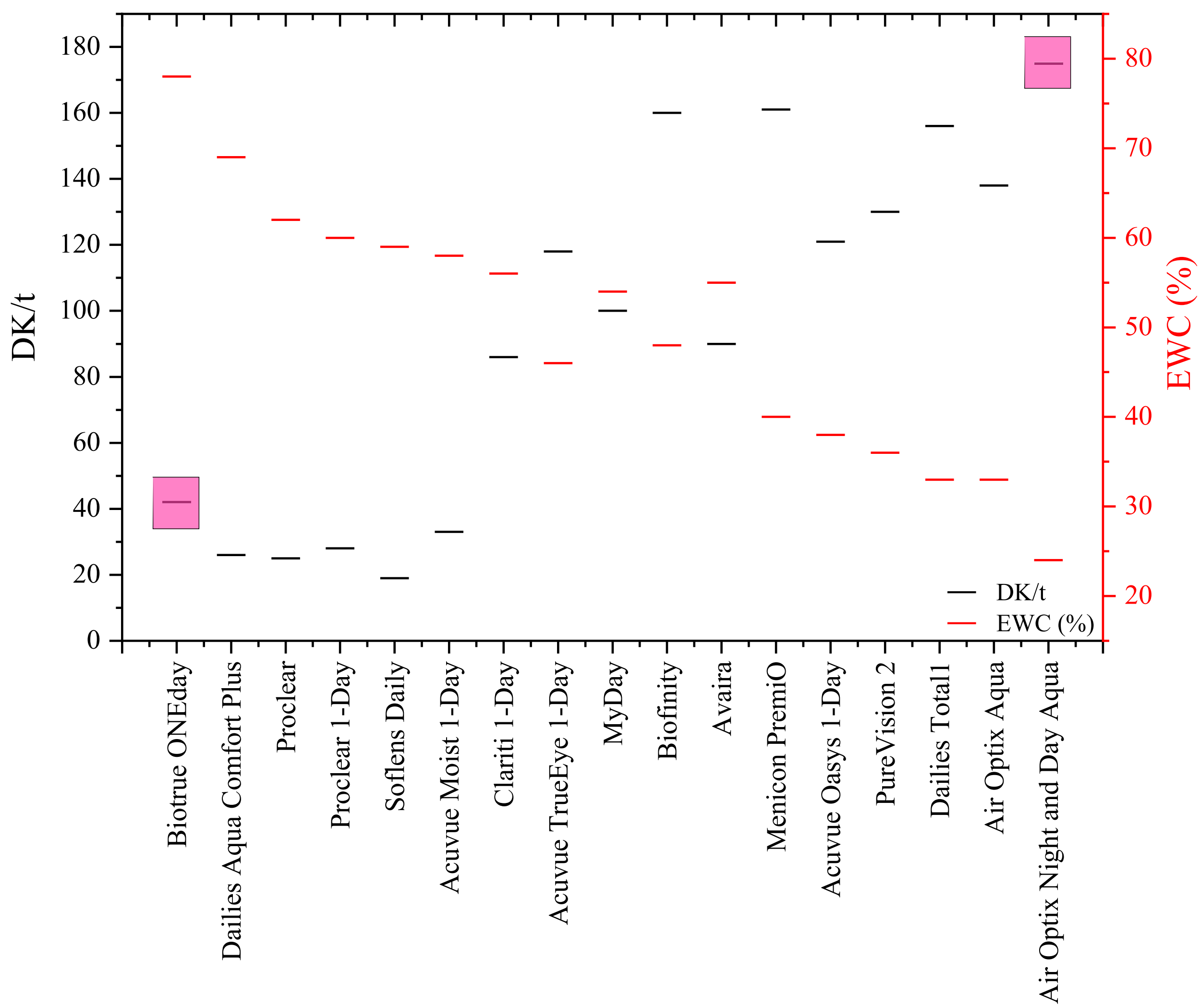

Fig. 4. Visualizations reflect the variation in both DK/t and EWC values across materials but align with the ANOVA results showing no statistically significant differences between material groups.

when it is manufactured [38]. Such materials are environmentally safe and biodegradable. As well as the possibility of loading PVA with nanomaterials for biological purposes [39]. Likewise, with PVP, a polymer used in medical applications due to the low rate of cytotoxicity, as well as its hydrophilic properties and the possibility of using it as a controlled agent to release the drug and as a solid dispersion to control the spread of drug [40].

4.4. Material property analysis and user preference trends

The analysis, visualized in Fig. 4, suggests important trade-offs between oxygen permeability, water content and IR, aligned with different user needs. However, multivariate analysis, including correlation and PCA, indicates that while certain trade-offs exist between Dk/t, EWC%, and RI, the type of material (such as HEMA or PDMS) does not significantly influence Dk/t or EWC%. This is supported by ANOVA results, with p-values of 0.153 and 0.327 respectively, suggesting that other compositional or structural factors may be more impactful. The pink square in each boxplot represents an outlier in the data distribution. In boxplots, data points that are significantly outside the interquartile range (IQR) are considered outliers [41]. In this case, DK/t value and EWC% show materials with values that stand out markedly from the rest. Several materials could further optimize comfort and minimize optical aberrations, improving the visual experience of users. For example, Bae and Lee (2023) showed that cross-linking porous silicone hydrogel lenses with alginate and metal ions improves oxygen permeability, wettability and reduces protein adsorption [42]. Although mechanical strength decreases, the use of Na^{+} instead of Ca^{2+} optimizes these

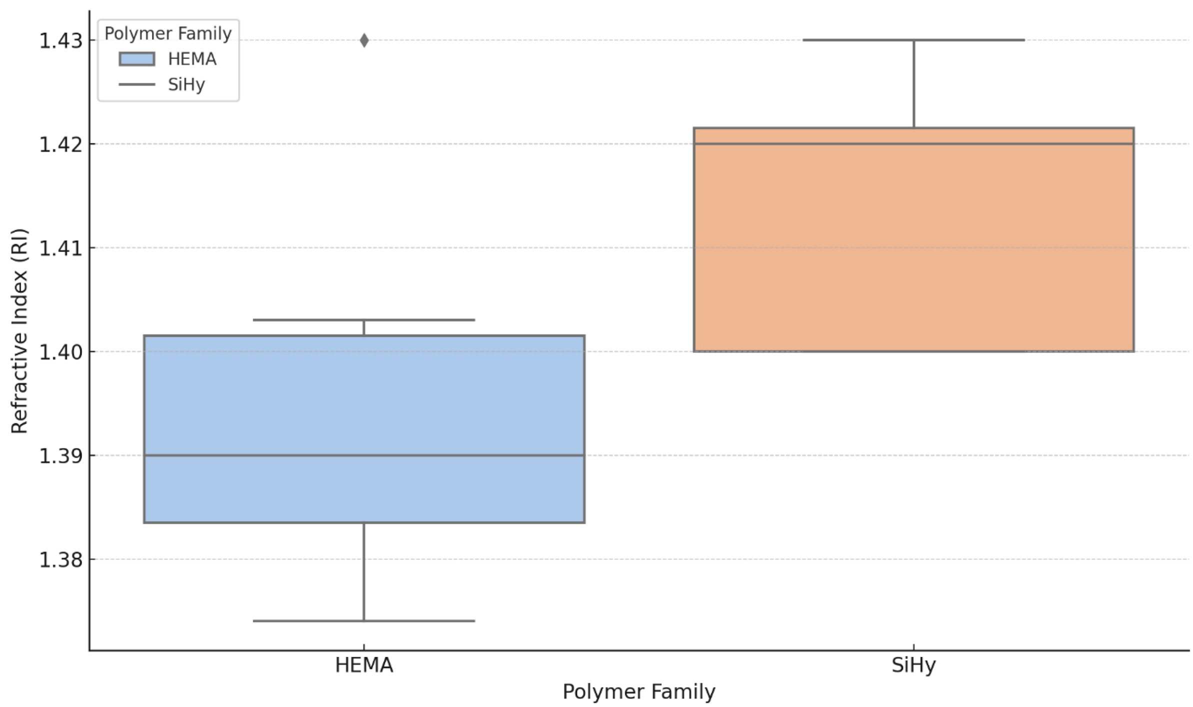

Fig. 5. Distribution of refractive index (RI) values across different contact lens polymer families.

properties, benefiting user comfort. Although the substitution of Ca^{2+} with Na^{+} may reduce mechanical strength, it enhances other material properties; such as flexibility and water retention; which contribute to improved comfort for contact lens users.

The high RI of certain SPCL brands helps reduce optical aberrations, improving visual clarity. Brands such as Biotrue ONEday, Dailies Aqua Comfort Plus and Proclear, with RIs between 1.37 and 1.39, use materials such as Nesofilcon A and Omafilcon B to address these aberrations. Others such as SofLens Daily, Acuvue Moist 1-Day and Clariti 1-Day, with indices between 1.40 and 1.4003, use Hilafilcon B, Etafilcon A and Somofilcon A for the same purpose. Additionally, lenses such as Acuvue TrueEye 1-Day, with a RI of 1.41 and Narafilcon A material, MyDay and Biofinity, with indices of 1.4 and materials such as Stenfilcon A and Comfilcon A, also contribute to reducing aberrations. Additional brands such as Avaira, Premio, Acuvue Oasys 1-Day, PureVision 2, Dailies Total1, Air Optix Aqua, and Air Optix Night and Day Aqua, with RIs between 1.4 and 1.43, employ materials such as Fanfilcon A, Menicon PremiO, Senofilcon A, Balafilcon A, Delefilcon A, Lotrafilcon B, and Lotrafilcon A, respectively, achieving optical clarity. Although Maxvue Hydrosoft has a RI of 1.43, no information is available on its material. Collectively, these lenses serve a broad range of wearers, using a variety of materials and design elements to effectively mitigate optical aberrations. As shown in Fig. 5, HEMA-based lenses generally exhibit lower RI values, ranging approximately from 1.374 to 1.403. In contrast, SiHy lenses display higher RI values, typically between 1.400 and 1.430. This trend reflects the inherent material differences; SiHy materials incorporate silicone components that have a higher RI compared to the hydrogel-only HEMA polymers.

In addition to intrinsic material properties, the performance of contact lenses can be influenced by external environmental and lifestyle factors. Conditions such as smoke, airborne pollen, and cosmetic residue (e.g., eyeliner, mascara, or foundation) are known to exacerbate ocular surface irritation and increase the risk of complications, particularly in individuals with prolonged wear times. Our findings suggest that lenses with higher Dk/t and lower EWC%—particularly SiHy lenses—may offer better tolerance under such stressors due to their enhanced breathability and reduced propensity for deposit accumulation. Proper lens orientation and fit are also critical, as misalignment can amplify discomfort in the presence of environmental irritants. These insights highlight the importance of selecting lens materials not only based on individual eye physiology but also on lifestyle and environmental exposure.

5. Conclusions

In conclusion, the results of this study highlight the importance of materials and their optical properties in SPCL manufacturing to improve both comfort and visual quality for wearers. Most of the SPCLs tested have an average RI of 1.406 ± 0.017, with a range of 1.374 to 1.430, values that do not fully align with the RI of the human cornea (1.33). This discrepancy is a key factor in the appearance of optical aberrations, affecting visual clarity and contributing to eye fatigue. In addition, lenses with high DK/t, with an average of 94.59 ± 55.73 and a range of 19 to 175, were found to be beneficial in reducing symptoms of ocular dryness and redness, especially when EWC % is kept within a range suitable for the type of wear. The average EWC was 50.33% ± 14.08%, with a range of 24% to 78%, with lenses with higher water content being preferred for daily wear, while those with lower EWC are suitable for extended wear due to their better oxygen permeability. Despite the variations, the results of an ANOVA test indicated no statistically significant differences in DK/t and EWC between the different materials (p-values of 0.153 and 0.327, respectively). These findings suggest that, in the development of SPCLs, it is essential to consider both oxygen permeability and IR fit, balancing material properties to improve the visual experience and reduce eye fatigue. In future research, the development of SPCLs with advanced features that address these needs will be critical to improving ocular health and user satisfaction. The Evaluating and promoting CL brands align with both improving public health and supporting sustainable practices. By assessing product effectiveness, safety, and sustainability. This study contributes to SDG 3 (Good Health and Well-being) by providing data that can help eye care professionals recommend contact lenses better suited to individual comfort, safety, and ocular health; potentially reducing complications such as dryness, fatigue, and redness. Additionally, the work aligns with SDG 12 (Responsible Consumption and Production) by highlighting how certain materials (e.g., those with higher Dk/t and lower EWC%) may support longer wear times and reduce the frequency of disposal. By identifying material profiles that maintain comfort while enabling extended use, the study offers insights that may help reduce unnecessary waste from daily lens replacement and support more sustainable lens choices.

6. Limitation of the study

This study faced several limitations related to the geographic scope of representation, brand diversity, and market coverage. First, the sample primarily includes responses from CL wearers in a limited geographic area, which may not fully reflect global trends in CL preferences and sales conditions, particularly in areas with distinct environmental or lifestyle factors. With respect to brand diversity, the study focuses on responses primarily associated with major global brands, such as Acuvue.Air Optix, Biofinity, Dailyes, and Bausch + Lomb. While these brands represent a large portion of the market, other regional brands and smaller manufacturers were underrepresented, which may overlook unique materials or lens technologies that are not widely available in larger markets. Additionally, the study relied on self-reported data from lens wearers, which may be subject to recall bias or differences in subjective perceptions of comfort and effectiveness. Additionally, results related to material properties such as oxygen permeability and water content were based on manufacturer specifications, which may vary slightly between batches or production methods. Finally, the use of consumer-reported data limits the study's ability to objectively assess CL efficacy and optical performance, especially since these characteristics often require laboratory testing for accurate measurement. These limitations highlight the need for more comprehensive, geographically diverse studies and controlled laboratory analyses to gain a complete understanding of CL performance in different environments and wearer demographics.

While our findings suggest potential material-specific benefits for certain user profiles, this study was not designed to prescribe clinical guidelines. Further controlled clinical trials are required to validate these associations.

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Conflict of interest

The authors declare that there is no conflict of interest.

Data availability statement

All data will be available when request from the authors.

Author contributions

The contributions for this research involved Lina M. Shaker and Wan Nor Roslam Wan Isahak in overlapping yet distinct roles. Lina was responsible for conceptualization, methodology, formal analysis, original draft writing, visualization, reflecting her active involvement in the study's core design, data handling, and initial documentation. Wan Nor Roslam contributed similarly across these areas but also took on additional responsibilities, including investigation, reviewing and editing the manuscript, supervising the research.

Ethical declarations

No clinical trials have been conducted on humans or animals.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.70645/3078-3437.-D-25-00013.

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