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RESEARCH ARTICLE
URL article: http://jurnal.fkmumi.ac.id/index.php/woh/article/view/woh9308

Comparative Visual Acuity in Indonesian Myopic Students: Spectacles versus Contact Lenses

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ABSTRACT

Myopia, a leading cause of correctable visual impairment worldwide, is primarily managed with spectacles and contact lenses. In West Java, Indonesia, refractive error affects up to 18.4% of junior high school students, with myopia accounting for 94.4% of cases. Despite the widespread use of both correction modalities, direct comparisons of their visual acuity outcomes in adolescents, particularly in developing countries, remain limited. This study compared best-corrected visual acuity (BCVA) achieved with habitual spectacles and soft contact lenses among myopic Indonesian adolescents using an aggregated subject-level analytical approach.
A cross-sectional observational study was conducted at a public vocational school in Tasikmalaya, West Java. Thirty-four myopic students (33 females, 1 male; aged 16–18 years) who regularly used both spectacles and soft contact lenses were recruited through purposive sampling. Monocular visual acuity was measured with a Snellen chart at six meters under standardized indoor illumination. To avoid inter-eye correlation, monocular Snellen fractions were converted to a linear scale, averaged for each participant, and transformed into logMAR values for subject-level paired analysis using the Wilcoxon signed-rank test.
Half of the participants (50.0%, n=17) demonstrated identical visual acuity with both correction modalities. Among those with discordant outcomes, significantly more participants achieved better visual acuity with soft contact lenses (35.3%, n=12) than with spectacles (8.8%, n=3). Mean logMAR values were significantly better with contact lenses than spectacles (0.10±0.12 vs. 0.15±0.13; p=0.024).
Soft contact lenses provided superior distance visual acuity compared with spectacles in adolescents showing discordant outcomes. This finding is consistent with optical theory, as eliminating vertex distance reduces retinal image minification and improves focal precision. The small subgroup performing better with spectacles may reflect individual ocular surface characteristics or tear film instability affecting contact lens performance. These findings emphasize the importance of accurate refraction, routine prescription verification, and professional contact lens fitting to optimize visual outcomes in adolescent myopic patients.

Keywords : Contact lens wearer; myopia; spectacle wearer; visual acuity

PUBLISHED BY :
Faculty of Public Health
Universitas Muslim Indonesia
Address :
Jl. Urip Sumohardjo Km. 5 (Campus II UMI)
Makassar, Sulawesi Selatan.
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Article history
Received 2 February 2026
Received in revised form 30 June 2026
Accepted 23 July 2026
Available online 24 July 2026

INTRODUCTION

As reported by the World Health Organization (1), Approximately 2.2 billion individuals worldwide suffer from near or distant vision impairments. It is estimated that at least 1 billion people, which is nearly half of the total affected population, have preventable vision impairments or require treatment. This group includes individuals with moderate or high myopia (88.4 million) and those with untreated blindness due to refractive errors. High myopia may result in severe pathological changes and consequent visual impairment (2,3), and myopic individual could exhibit stereopsis dysfunction at an early stage (3). Correcting refractive error in children and adolescents is therefore important not only for restoring clear vision but for supporting normal binocular visual development (4). Spectacles and contact lenses are the two most widely used devices for correcting myopia, both functioning by refracting incoming light so that images are focused on the retina (5).

People choose contact lenses or spectacles for overlapping practical and emotional reasons. Contact lenses are frequently chosen because they change how wearers look and feel. Many studies indicate that cosmetic reasons and improved peer perception are primary motivations for contact lens use, particularly among younger individuals and students (6). The ability of contact lenses to enhance the wearer's appearance or eliminate the visible frame of glasses contributes to increased self-esteem and social acceptance among adolescents and young adults (7). However, comfort, maintenance burden, and ocular safety are significant factors that influence patient preferences. Many individuals opt for contact lenses due to concerns about side effects, handling, and infection risks (8–10), while spectacles are perceived as safer and more user-friendly (11). Cross-sectional surveys and reviews report that contact lens avoidance is frequently driven by worries about complications and maintenance requirements, whereas spectacles are preferred for their lower perceived risk and simpler care (11,12).

Patient-reported outcomes and objective clinical measures capture different dimensions of vision correction, and the literature on spectacles versus contact lenses has so far concentrated almost entirely on the former. In a study conducted by Husna, et.al (13), assessed visual function in spectacle and contact lens wearers using the VF-14 and found that spectacles performed better for distance and detailed tasks, while contact lenses performed better for intermediate-distance activities. Kanonidou et al. (10) similarly used the VF-14 in young myopes and reported that although both correction methods produced satisfactory functional vision for daily activities, spectacle wearers reported higher personal satisfaction than contact lens wearers, particularly for night driving and fine handwork. Uzunel et al. (10), by contrast, found that contact lens wearers reported higher satisfaction than spectacle wearers across most daily activities in a population with mild-to-moderate myopia and myopic astigmatism. These opposing findings are not necessarily contradictory: they involve different refractive profiles (uncomplicated myopia versus myopia with astigmatism) and different activity weightings within the VF-14, suggesting that reported satisfaction is sensitive to refractive error type rather than reflecting a stable preference for one correction method.

These studies share a commonality: satisfaction and visual function are self-reported constructs influenced by comfort, convenience, and expectation, not the eye's actual resolving power. Visual acuity is a measure of the functional capacity of the eye (14,15). In humans, visual acuity can be determined by measuring the smallest image formation in the retina that can be seen from a certain distance (16). The visual acuity measurement indicates the ability to distinguish two stimuli that are separated by an interval. The minimum separable visual angle represents a spatial discrimination function that indicates the smallest visual angle from which two objects can be distinguished (17). Visual acuity measurement can be employed to assess refractive errors, screen for ocular health, determine ocular disease history, evaluate the efficacy of medical treatment and surgery, prescribe visual aids, and determine vision standards for working and driving (18). Best-corrected visual acuity (BCVA) should, in principle, be applied consistently across vision aid modalities, as it provides a standardized, quantifiable outcome measure less susceptible to the self-report and preference biases described above. In the spectacle literature, VA is commonly treated as a primary or co-primary outcome alongside comfort and visual quality measures. In contrast, within pediatric and adolescent contact lens studies emphasizing wearing experience or self-perception, VA is often relegated to a secondary or baseline variable rather than treated as the primary comparative outcome (19). Those who are categorized as suffering from refractive errors have images that do not fall on the retina (14). Accordingly, there are terms such as myopia, hyperopia, presbyopia, and astigmatism. Those individuals may have clear vision with the aid of vision aids, including spectacles and contact lenses, which refract light, thereby allowing the image to fall on the retina (5).

The satisfaction of spectacle and contact lens wearers can be assessed from visual acuity and visual function. Research about visual function has been conducted in previous research. Therefore, this paper focuses on visual acuity between those who wear spectacles or contact lenses. Visual acuity can be measured using printed charts such as the Snellen Chart for daily measurement and the ETDRS (Early Treatment Diabetic Retinopathy Study) LogMAR Chart for clinical measurement (20).

This is a meaningful gap, because there is direct evidence that correction method can affect measured acuity independent of what wearers report. Bailey et al. (15) found that Rigid gas-permeable contact lens wearers exhibited significantly poorer habitual high-contrast visual acuity compared to spectacle wearers. However, this disparity vanished under best-corrected conditions, suggesting that real-world visual acuity outcomes between the two groups are not necessarily equivalent, even though best-corrected visual acuity theoretically should be. Taken together, prior work has established that spectacles and contact lenses both support satisfactory subjective visual function, but whether they produce equivalent *objective* visual acuity in everyday (as opposed to idealized best-corrected) conditions remains empirically unresolved. This gap motivates the present comparison.

Despite the substantial body of work on visual function and patient satisfaction, objective comparison of measured visual acuity between spectacle and contact lens wearers remains comparatively rare, and none of the studies discussed were conducted in an Indonesian population. The existing Indonesian data merely describes the prevalence of myopia, not how effectively it is corrected using different modalities. However, none of this epidemiological literature addresses whether spectacles and contact lenses produce equivalent corrected visual acuity within these populations. If spectacles and contact lenses do not produce equivalent visual acuity outcomes in practice, this has direct relevance to the everyday functioning of myopic students, independent of how satisfied they report being with either correction method. The present study, therefore, aimed to compare the best-corrected visual acuity of myopic vocational school students when using spectacles versus contact lenses.

METHOD

This study employed an observational, cross-sectional design to compare visual performance between two refractive correction modalities. The research was conducted at a public vocational school in Tasikmalaya, West Java, Indonesia, over a two-week period in 2023. Ethical clearance was officially granted by the Medical Research Ethics Commission (KEPK) of Universitas Bakti Tunas Husada (Reference Number: 072/E.01/KEPK-BTH/V/2023). Prior to data collection, written informed consent was obtained from all participants, or their legal guardians where applicable, in accordance with the tenets of the Declaration of Helsinki.

A total of 34 participants (33 females, 1 male; age range: 16–18 years) were enrolled using a purposive sampling strategy. Recruitment was confined to a single academic class, where dual-modality users (individuals who concurrently use both spectacles and soft contact lenses in daily life) were highly concentrated. This specific approach was chosen due to the logistical challenges of recruiting a sufficient sample size of dual-wearers from the broader student population.

The inclusion criteria required participants to have documented monocular or binocular myopia, regular habitual experience with both single-vision spectacles and soft contact lenses (either daily or monthly disposables), and a complete absence of active ocular complications or systemic diseases affecting visual function. The participants' refractive profile (low-to-moderate myopia) was initially identified via self-report and subsequently verified through subjective refraction. In cases where a discrepancy emerged between the self-reported prescription power and the subjective refraction results, the latter was established as the baseline threshold. Given the exploratory nature of this study, no formal a priori sample size or statistical power calculations were performed; the cohort represents the total eligible consensus within the target cluster.

Visual acuity (VA) was assessed monocularly for both eyes under standardized indoor illumination conditions (~100 cd/m2). Measurements were taken at a fixed distance of six meters using a standard Snellen chart. To maintain consistency, a fixed testing sequence was implemented: spectacle-corrected VA was measured first, followed by contact lens-corrected VA, with the right eye (OD) invariably tested prior to the left eye (OS). Subjective over-refraction was performed prior to VA testing to ensure optimal correction, and all clinical measurements were executed by a single certified examiner to eliminate inter-observer variability.

As a logistical constraint of the field setting, contact lens wear time prior to testing, specific lens materials (hydrogel vs. silicone hydrogel), and individual cleaning compliance were not systematically standardized or recorded. The potential confounding impacts of chart-memorization effects and time-dependent tear film changes on the lens surface are acknowledged as inherent procedural limitations.

Snellen fractions obtained from the physical chart were converted into Logarithm of the Minimum Angle of Resolution (logMAR) units to facilitate quantitative statistical comparison since Snellen fractions are not directly suited to parametric or rank-based statistical comparison (14,21), utilizing the standard transformation formula:

$$LogMAR = -Log\ (Decimal\ Acuity)$$

Statistical analyses were executed using SPSS v.27. To prevent the compounding error of binocular pseudoreplication arising from the high biological and genetic correlation between the right and left eyes of the same individual, the monocular data were aggregated into a single representative value per participant (N=34). The normality of the aggregated data was evaluated using the Shapiro-Wilk test. Due to the non-parametric distribution of the visual acuity scores, a paired Wilcoxon signed-rank test was applied to evaluate the differences in mean logMAR visual acuity between the soft contact lens and spectacle modalities across the 34 subjects. The threshold for statistical significance was established a priori at $\alpha=0.05$.

RESULTS

The study was conducted in accordance with the established protocol, which included the preparation and data collection stages. In the initial phase of the study, the researcher obtained ethical clearance from the KEPK Universitas Bakti Tunas Husada and a research permit from the educational institution. Once all the requisite permits had been obtained, the researchers were prepared to commence data collection. Prior to the commencement of the study, written informed consent was obtained from all participants. All data were duly recorded in the patient's medical records. The visual acuity measurement was conducted in an indoor setting, utilizing a Snellen chart at a distance of six meters from the seated clients. The visual acuity with spectacles was initially measured, followed by the contact lenses. The right eye was measured first, and the left eye was subsequently measured. The students were instructed to call out the optotype letter from the highest row to the bottom (row 7) until their eyes could no longer read the letter.

A total of 34 myopic students participated in this study, comprising 33 females (97.1%) and one male (2.9%), with ages ranging from 16 to 18 years. All enrolled participants were habitual wearers of both single-vision spectacles and soft contact lenses (daily or monthly replacement schedules) and presented with no active ocular pathology or media opacities at the time of examination. Table 1 presents the descriptive statistics of visual acuity measurements under both correction conditions.

Table 1. Visual Acuity Measurements for Spectacle and Contact Lens Wearers

Parameter	Spectacle Wearers	Contact Lens Wearers
Mean ± SD (LogMAR)	0.10 ± 0.13	0.16 ± 0.14
Mode (LogMAR)	0.00	0.10
Equivalent Snellen	6/7.5	6/7.5
p-value	0.024*	

**Statistically significant* ($p < 0.05$)

As shown in Table 1, spectacle wearers achieved a mean visual acuity of 0.10 ± 0.13 LogMAR, compared to 0.15 ± 0.13 LogMAR for contact lens wearers. The Wilcoxon signed-rank test revealed a statistically significant difference between the two conditions (p = 0.024). While both mean logMAR scores structurally approximate a standard Snellen equivalent of 6/7.5, the logMAR scale provided the necessary per-optotype resolution to capture fine, sub-row disparities across the modalities. The mean difference of 0.05 logMAR indicates that, on average, participants correctly identified approximately two to three additional optotype characters when corrected with spectacles compared to soft contact lenses.

Analysis of the individual response profiles revealed a distinct, symmetrical partition across the cohort regarding comparative performance. Exactly half of the participants (55.9%, n=19) exhibited completely identical logMAR visual acuity values regardless of whether spectacles or soft contact lenses were worn. Conversely, discordant visual acuity outcomes were documented in the remaining 15 participants (44.1%). Within this discordant sub-group, the distribution was asymmetric: 8.8% (n=3) of the total cohort demonstrated superior visual acuity when using their habitual spectacles, whereas 35.3% (n=12) achieved better visual performance with their soft contact lenses. The descriptive metadata regarding these individual variations serve as observational baselines, as no objective clinical verification of contact lens fitting parameters or lens surface conditions was performed during this field screening.

DISCUSSION

The statistical analysis revealed a detectable difference in mean visual acuity between the two modalities (p=0.024), with spectacle wearers achieving a slightly superior mean score (0.10±0.12 logMAR) compared to soft contact lens wearers (0.15±0.13 logMAR). While both values translate to an identical Snellen equivalent of 6/7.5, the use of the logMAR scale allowed the capture of subtle sub-row discrepancies that standard Snellen fractions fail to resolve (22,23). This capacity stems from the geometric progression and identical optotype count per row inherent to logMAR charts, which balances the task difficulty at every acuity level (21). International bodies, including the International Council of Ophthalmology (ICO) and the World Health Organization (WHO), strongly recommend logMAR as the gold-standard outcome measure in ophthalmic research due to its linear scoring properties and compatibility with parametric or rank-based statistical tests (22,24).

Despite the statistical significance, the clinical significance of a mean 0.05 logMAR difference requires critical contextualization. In clinical practice, a change of 0.10 logMAR correspond to one full line or five optotype letters, is universally established as the minimum threshold for a clinically meaningful variation in visual function (21,22,25). The LogMAR scale can be used to transform the angular scale of the Snellen chart into a linear scale (20). The value of each optotype in LogMAR is 0.02 log units (16,26). Thus, a value of 0.05 LogMAR signifies that only three of the five words in a given row can be read. The modest 0.05 logMAR margin documented in this study indicates that, in real-world environments, the visual performance offered by habitual spectacles and soft contact lenses remains highly comparable for the majority of these young myopic individuals.

The researchers conducted an identification of the similarity of the visual acuity for each vision aid per person. At the individual level, the high proportion of identical results (55.9%, n=19) aligns with the optical principle that vertex distance effects are negligible for low-to-moderate myopia below ±4.00 D (27). It is frequently assumed that visual acuity with spectacles and contact lenses will be comparable. Nevertheless, this may not always be the case due to a number of factors. Such factors include vertex distance (28), prescription difference (29), peripheral vision, and optical aberration (30). In the case of spectacle lenses, they are typically positioned at a distance of approximately 12–14 mm from the eyes. This distance can impact the reactive power of the lenses, particularly in cases where the prescription is higher. In contrast, contact lenses are positioned directly on the cornea, thereby eliminating the vertex distance and often providing a more precise correction. It is possible that there may be a slight discrepancy between the power of contact lenses and spectacles due to the vertex distance.

For spectacle and contact lenses with a power of less than 4 diopters, the effect of vertex distance on vision will be insignificant (27). It can thus be concluded that the power of the spectacle and the contact lens will be identical. However, if the spectacle lens or contact lens has a power of more than four diopters, the power will differ. For high prescriptions (e.g., above ±4.00 diopters), this difference can be more significant, necessitating adjustments in the lens power (29). For individuals with myopia, the power of contact lenses is less than that of spectacles. Conversely, for those with hyperopia, the power of contact lenses is greater than that of spectacles.

Individuals with better visual performance were obtained by contact lens wearers. Contact lens wearers benefit from the lenses resting directly on the surface of the eye, which is in the range of tens of a millimeter, and their positioning on the cornea, which can provide a more natural visual experience (32,33). Contact lenses are a prevalent form of vision correction among myopic adolescents, offering convenience and superior visual and cosmetic outcomes compared to spectacles (34). Moreover, contact lenses were selected as an alternative visual aid due to their provision of a wide visual field and lack of limitation on activities (35). However, the utilization of contact lenses was followed by the emergence of risks such as dry eyes and conjunctivitis (36). Despite these risks, the subject continued to utilize contact lenses due to their aesthetic and therapeutic functions, although only for a limited time.

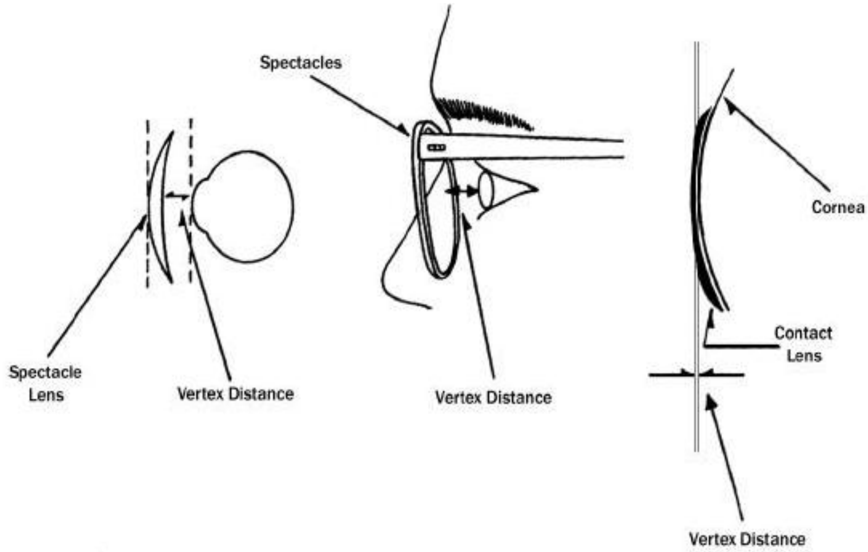

Figure 3. Vertex distance for spectacle and contact lens (Source: (Rash et al., 2002))

The rationale behind the subject's choice to wear spectacles was identified as being based on their usage and comfort. The visual acuity of spectacle wearers is contingent upon the quality of the lenses and their fit on the individual's face. Some of the limitation included that the frames and edges of the lens can restrict peripheral vision, and lens curvature may result in distortion at the edges, particularly in higher prescriptions (30). Some individuals may adapt better to one form of correction over the other, affecting their perceived visual acuity. It is therefore crucial that both spectacles and contact lenses are fitted properly and that the lenses themselves are of an appropriate quality. Poorly fitting lenses or suboptimal lens quality can result in less-than-ideal visual acuity.

The transition from spectacles to contact lenses can present challenges for myopes, particularly when engaging in tasks that require close vision, as wearing contact lenses necessitates enhanced accommodation and increased convergence (37). Given that the refractive error of the majority of contact lens wearers falls within the range of ±1.0 to ±5.0D, the alteration in accommodative convergence among contact lens wearers is not substantial. Spectacles are optimal for activities requiring distant vision and accuracy, whereas contact lenses are best suited for tasks that necessitate vision at intermediate distances (13). Nevertheless, the transition from spectacles to contact lenses may present certain challenges for myopes, particularly when engaging in near-vision tasks. This is due to the fact that wearing contact lenses necessitates increased accommodation and greater convergence (37). Given that the refractive error of the majority of contact lens wearers falls within a range of ±1.0D to ±5.0D, the change in accommodative convergence in contact lens wearers is not significant. Spectacles are suitable for activities requiring far vision and accuracy, whereas contact lenses are suitable for vision at medium distances (13).

From a clinical and public health perspective, these findings highlight a vital educational need for adolescent contact lens wearers. Adolescents who choose contact lenses, especially for cosmetic or lifestyle reasons, should be strongly advised about the importance of professional fitting and routine prescription validation, as they are more likely to engage in behaviors that increase the risk of lens-related complications (38). Ensuring proper optical fit — including base curve, diameter, and centration — is critical to minimizing complications such as corneal hypoxia, staining, and microbial keratitis (39). Verifying that lens power precisely matches the refractive error remains essential to optimizing visual performance (40).

Several methodological limitations restrict the generalizability of this study and must be explicitly acknowledged: The study employed a non-probability purposive sampling strategy, limiting its scope to a single vocational school in Tasikmalaya, West Java. This resulted in an asymmetric gender distribution (97.1% female) and a highly localized cohort. Another limitation was the absence of objective fitting and parameters. No objective clinical fitting assessments using a slit-lamp biomicroscope were performed, leaving the exact physiological interaction between the lens and the cornea unverified. Additionally, contact lens wear time prior to testing, specific lens materials, and replacement schedules were not standardized or recorded. Furthermore, the functional assessment was restricted to high-contrast distance visual acuity. Essential visual parameters, such as near/intermediate visual acuity, contrast sensitivity, and patient-reported outcomes via validated quality-of-life instruments (e.g., VF-14 or NEI-RQL-42), were outside the scope of this investigation. Future research should utilize a larger, multi-centered randomized sample, deploy objective fitting evaluations alongside cycloplegic refractions, and incorporate contrast sensitivity metrics to construct a comprehensive profile of real-world visual quality between these two common correction modalities.

CONCLUSIONS AND RECOMMENDATION

In conclusion, this study demonstrates that soft contact lenses and spectacles provide functionally comparable distance visual acuity for the majority of school-aged myopic students, with half of the cohort exhibiting identical logMAR scores across both modalities. However, among the remaining participants with discordant results, a significantly higher proportion achieved superior visual acuity with contact lenses (44.1%) than with spectacles (8.8%), yielding a statistically detectable difference that favors the contact lens modality (p=0.024). This finding aligns with optical theory, as the elimination of vertex distance with contact lenses minimizes retinal image minification and enhances optical precision. Conversely, the minor subgroup performing better with spectacles suggests that individual variations, such as sub-optimal lens fit or tear film fluctuations, may occasionally compromise contact lens performance in real-world settings. These findings emphasize the clinical prudence of professional contact lens fitting and routine prescription verification to ensure optimal visual outcomes. To improve generalizability, future research should incorporate larger, gender-balanced cohorts, randomized sampling, cycloplegic refraction, standardized objective fitting assessments, and broader visual quality metrics such as contrast sensitivity and near-vision performance.

ACKNOWLEDGEMENT

The authors thank the principal, teachers, and students of the participating vocational school in Tasikmalaya for their cooperation and willingness to take part in this study. Ethical approval was granted by KEPK Universitas Bakti Tunas Husada (Ref: 072/E.01/KEPK-BTH/V/2023).

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