Med & Health Jul 2026; 21(2): 830-841 https://doi.org/10.17576/MH.2026.2102.16

ORIGINAL ARTICLE

Association between Confidence in Performing Direct Ophthalmoscopy and Retinoscopy with Eye and Hand Dominance: A Cross-sectional Survey Study

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Received: 09 July 2025 / Accepted: 25 September 2025

ABSTRAK

Oftalmoskopi langsung dan retinoskopi merupakan kemahiran klinikal asas dalam latihan optometri yang perlu dikuasai sebelum pelajar melangkah ke tahun klinikal. Oleh itu, penilaian keyakinan pelajar dalam kemahiran ini sangat penting kerana ia memerlukan pemahaman kognitif serta kemahiran praktikal. Kajian ini bertujuan untuk menentukan tahap keyakinan pelajar optometri praklinikal dalam melaksanakan oftalmoskopi langsung dan retinoskopi dengan mengambil kira faktor mata dan tangan dominan. Populasi kajian terdiri daripada pelajar program ijazah sarjana muda optometri dalam tahun praklinikal. Tahap keyakinan dalam melaksanakan oftalmoskopi langsung dan retinoskopi dinilai menggunakan soal selidik yang telah disahkan. Keyakinan dalam melakukan oftalmoskopi langsung adalah lebih tinggi apabila dilakukan dengan mata dominan (72.1%) berbanding mata bukan dominan (25.6%), serta dengan tangan dominan (74.4%) berbanding tangan bukan dominan (27.9%). Terdapat hubungan yang sangat signifikan antara tahap keyakinan dalam oftalmoskopi langsung dengan kedua-dua dominasi tangan ($\chi^2(1) = 18.615$, $p < 0.001$) dan dominasi mata ($\chi^2(1) = 18.615$, $p < 0.001$). Peratusan pelajar yang tidak yakin ketika menjalankan retinoskopi dengan mata bukan dominan dan dengan tangan bukan dominan adalah rendah (masing-masing 28% dan 22%), dengan hubungan yang signifikan antara tahap keyakinan dengan dominasi tangan ($\chi^2(1) = 17.993$, $p < 0.001$) dan dominasi mata ($\chi^2(1) = 14.492$, $p < 0.001$). Kurang daripada 50% pelajar yakin untuk membezakan refleks retinoskopi yang berkaitan dengan astigmatisme. Kesimpulannya, sebahagian besar pelajar praklinikal kurang yakin untuk melaksanakan oftalmoskopi langsung dan retinoskopi menggunakan tangan dan mata yang bukan dominan. Pengajaran klinikal seharusnya perlu memupuk ambideksteriti dalam kalangan pelajar praklinikal bagi meningkatkan keyakinan dalam melaksanakan kemahiran klinikal yang penting ini.

Kata kunci: *Kemahiran klinikal; keyakinan; mata dominan; oftalmoskopi langsung; retinoskopi; tangan dominan*

ABSTRACT

Direct ophthalmoscopy and retinoscopy are essential clinical skills in optometry training that must be mastered before students progress into their clinical year. Thus, assessing their confidence in these skills' acquisition is crucial as they require both cognitive understanding and practical proficiency. The purpose of this study was to determine the confidence of preclinical year optometry students in performing direct ophthalmoscopy and retinoscopy, with consideration of eye and hand dominancy. The participants consisted of students enrolled in the undergraduate optometry program in their preclinical year. Confidence levels in performing direct ophthalmoscopy and retinoscopy were assessed using validated questionnaires. Confidence in direct ophthalmoscopy was higher when performed with the dominant eye (72.1%) compared to the non-dominant eye (25.6%), and with the dominant hand (74.4%) compared to the non-dominant hand (27.9%). There were highly significant associations between confidence in direct ophthalmoscopy and both hand dominancy ($\chi^2(1) = 18.615$, $p < 0.001$) and eye dominancy ($\chi^2(1) = 18.615$, $p < 0.001$). Similarly, a low proportion of students reported confidence when retinoscopy was performed with their non-dominant eye (28%) and dominant hand (22%), with highly significant associations between confidence level and hand dominancy ($\chi^2(1) = 17.993$, $p < 0.001$) and eye dominancy ($\chi^2(1) = 14.492$, $p < 0.001$). Fewer than 50% of students were confident in discriminating retinoscopy reflexes associated with astigmatism. In conclusion, a large proportion of preclinical students lacked confidence in performing direct ophthalmoscopy and retinoscopy using their non-dominant hand and eye. Clinical teaching should nurture ambidexterity among preclinical students to enhance confidence in performing these crucial clinical skills.

Keywords: Clinical skills; confidence; direct ophthalmoscopy; eye dominance; hand dominance; retinoscopy

INTRODUCTION

The World Council of Optometry (WCO) outlines the WCO Competency Framework for Optometry which includes core competencies across five curriculum domains: refractive error management and assessment, visual function assessment, ocular health and ocular disease, public health and professional practice (WCO 2024). Among the curriculum elements outlined are objective refraction using retinoscopy and the assessment of ocular adnexa and the eye through ophthalmoscopy.

Within these competencies, direct ophthalmoscopy is emphasised as a key skill since it provides a monocular, non-stereoscopic examination of the fundus with 15 magnification. It requires significant practice to achieve proficiency, particularly in detecting ocular findings in undilated eyes due to its narrow field of view. Despite its clinical usefulness, many students report a lack of confidence in their findings (Ayub et al. 2021; Gupta & Lam 2006), which may limit the effectiveness of ocular fundus examinations in patient care (Mackay et al. 2015).

Complementing this, retinoscopy plays a central role in the objective assessment of refractive error. Its primary functions include the objective determination of refractive error (Bharadwaj et al. 2014), assessment of accommodative function, and provision of diagnostic clues for ocular diseases affecting the cornea and crystalline lens (Chukwuyem et al. 2023). However, the accuracy of retinoscopy results can also be a concern, as it depends heavily on the examiner's skill and observation (Bharadwaj et al. 2014).

Both direct ophthalmoscopy and retinoscopy are fundamental components of clinical skill training in optometry and ophthalmology curricula. Assessing student confidence in acquiring these skills is essential in educational research, particularly in healthcare, as it requires both theoretical understanding and hands-on proficiency. Confidence not only influences the learning process but also impacts the application of skills in real-world clinical situations (Akbari & Sahibzada 2020). Measuring confidence offers insights into students' self-efficacy, which is closely tied to motivation and engagement in learning. Higher confidence levels can enhance performance by encouraging deeper engagement with material and more persistent practice (Manjarres-Posada et al. 2020).

Previous studies on retinoscopy and direct ophthalmoscopy training have shown mixed findings. Retinoscopy is recognised as a key skill in optometry, but there are few structured training programs that evaluate both competency and confidence together. Most studies have emphasised competency improvement, with limited focus on confidence. Estay et al. (2023), for instance, reported that longer structured simulation-based training significantly improved retinoscopy performance, showing a clear learning curve, but the study did not measure confidence. In contrast, Kim et al. (2024) compared training with a 3D-printed schematic eye model and direct patient practice, both groups improved in speed and accuracy, but only the real-patient group reported increased confidence. These findings suggest that while simulation-based training is effective for skill acquisition, confidence development may require direct patient interaction.

For direct ophthalmoscopy, studies have been more balanced, with some evaluating competency alone and others assessing both competency and confidence. Simulation-based training methods such as model eyes, Eyesi simulators and matching tasks have been widely studied. Evidence shows that Eyesi and structured simulation enhance both accuracy and self-confidence (Abbas et al. 2024; Liu et al. 2024; Tso et al. 2021), while other studies reported improvements in competency without parallel gains in confidence (Milani et al. 2013). Taken together, these findings highlight a shared challenge across both retinoscopy and direct ophthalmoscopy. Competency can often be improved through structured practice, but building lasting confidence may require more comprehensive approaches that integrate simulation with real patient experience.

The purpose of this study was to determine the confidence of the preclinical year optometry students in performing direct ophthalmoscopy and retinoscopy, with conderation of eye and hand dominance. Evaluating student confidence provides insights into the effectiveness of educational interventions and highlights areas where additional support may be necessary.

MATERIALS AND METHODS

Participants

The study population included preclinical undergraduate optometry students (Semester 2 to Semester 6) enrolled in an optometry program at a university in Malaysia. Students were invited via email to participate in the study. To be eligible, participants must have completed both the theory and practical modules on direct ophthalmoscopy and retinoscopy. Semester 1 students were excluded as they had not yet undertaken any clinical skills training. Students who had repeated the theory or practical components of these were excluded. The study population recruited using convenience sampling. Students were chosen from the same institution to ensure consistency in curriculum and teaching methods, thereby minimising variability in baseline knowledge and clinical exposure that could arise from institutional differences. This approach enhances the reliability of outcome measures.

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Interested students were provided with a Google form link containing the Participant Information Sheet and Consent Form. Upon providing consent, participants were asked to complete the confidence assessment questionnaires via the same form. Students were instructed to respond to the questionnaire items based on their prior experiences of performing retinoscopy and direct ophthalmoscopy while being fully corrected with their habitual optical correction.

Questionnaires

Confidence in performing direct ophthalmoscopy was assessed using a previously published questionnaire (Gupta & Lam 2006). For retinoscopy, a new questionnaire was developed by adapting items from Gupta & Lam (2006) and subsequently validated through content validity analysis. Seven expert optometry lecturers evaluated the content, and all items achieved a Content Validity Ratio (CVR) between 0.86 and 1.00.

The questionnaires covered specific skill components for each procedure. For direct ophthalmoscopy, items measured confidence in performing the examination with dominant and non-dominant hands and eyes, and in focusing on the optic nerve head, fovea, following arteries and veins, examining dilated and undilated pupils and using apertures and filters. For retinoscopy, items assessed confidence in performing the procedure with dominant and non-dominant hands and eyes on both model and human eyes, as well as confidence in discriminating reflexes (direction, meridian, neutral, with and against movements) and identifying reflexes associated with simple hyperopic and myopic astigmatism.

Both questionnaires used a 5-point Likert scale: (i) not at all confident; (ii) a little confident; (iii) somewhat confident; (iv) quite confident; and (v) extremely confident. Data were collected and compiled using Microsoft Excel.

The self-reported confidence scale was then dichotomised into two categories: "Not Confident" and "Confident." Specifically, ratings of 1 (not at all confident), 2 (a little confident) and 3 (somewhat confident) were grouped as "Not Confident," while ratings of 4 (quite confident) and 5 (extremely confident) were grouped as "Confident." Chi-square analysis was used to determine associations between confidence levels and hand/eye dominance. A *p*-value less than 0.05 was considered statistically significant.

Ethics approval was obtained from Universiti Kebangsaan Malaysia's Research Ethics Committee (UKMREC) (UKM PPI/111/8/JEP-2023-472), where the researcher was enrolled and from SEGi University Research Ethics Committee (SEGiEC/StR/FOVS/20/2021-2022 and SEGiEC/SR/FOVS/41/2022-2023), where the study was conducted.

The sample size was estimated using the G*Power (Erdfelder et al. 1996) version 3.1.9.7 analysis program for Chi-square goodness-of-fit or test of independence. The sample size was determined to be 32 students for both groups for repeated measures, on a large effect size (w = 0.30), an alpha level of 0.05, power of 0.80, and 1 degree of freedom. The effect size of 0.30 was chosen following Cohen's (1988) guidelines, where w = 0.10, 0.30 and 0.50 represented small, medium and large effects respectively. Since previous studies in optometry education reported moderate to large effects when evaluating changes in student confidence and competency (Abbas et al. 2024; Gupta & Lam 2006), a medium-to-large effect size was considered appropriate for this study. An an additional 20% added to account for a potential dropout, leading to a final sample of 38. Therefore, each group would have a minimum of 19 subjects.

Statistical Analysis

All data were compiled and coded in Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS), version 23 (IBM Corp., Armonk, NY, USA). Internal consistency reliability of the confidence questionnaires was assessed using Cronbach's alpha. Normality of continuous variables was tested with the Shapiro-Wilk test.

Descriptive statistics (frequencies, percentages, means and standard deviations) were used to summarise demographic characteristics and confidence levels. For categorical comparisons of confidence between dominant versus non-dominant hand and eye, Chi-square tests of independence were performed. Confidence scores from the 5-point Likert scale were dichotomised into two groups: "Not Confident" (scores 1-3) and "Confident" (scores 4-5). Comparisons of confidence between retinoscopy performed on model and human eyes were also assessed using Chi-square analysis for the dominant and non-dominant hand categories and the dominant and non-dominant eye categories. A *p*-value less than 0.05 was considered statistically significant. Items that did not represent binary categorical comparisons (confidence in identifying specific reflexes) were analysed descriptively.

RESULTS

Description of Sample

Fifty students completed the retinoscopy self-confidence questionnaire, while 42 students completed the direct ophthalmoscopy questionnaire. The difference in participant numbers was due to the voluntary nature of the survey, with fewer students opting to complete the direct ophthalmoscopy questionnaire. Among those who volunteered, the response rate was 100%, as all students who consented to participate completed the respective questionnaires. A majority of respondents were female for both direct ophthalmoscopy (59.5%) and retinoscopy (58%). Table 1 showed the demographic information of the respondents. When stratified by semester, no significant associations were found between semester level (early preclinical = semesters 2, 3 and 4) and late preclinical = semesters 5, 6) and confidence level (all $p > 0.05$). Therefore, the participants were

TABLE 1: Demographic information of the respondents of the study

Variables	Characteristics	n (%)
Survey on direct ophthalmoscopy		
Sample		42
Gender	Male Female	17 (40.0) 25 (60.0)
Age	Mean ± SD	22.5 ± 2.7
Hand dominance	Right Left	37 (95.0) 5 (5.0)
Eye dominance	Right Left	28 (70.0) 14 (30.0)
Semester of study (%)	2 3 4 5	6 (14.3) 15 (35.7) 7 (16.7) 14 (33.3)
Survey on retinoscopy		
Sample	n	50
Gender	Male Female	21 (55.5) 29 (44.5)
Age (Years)	Mean ± SD	21.2 ± 2.4
Hand dominance	Right Left	50 (100.0) 0 (0.0)
Eye dominance	Right Left	41 (66.7) 9 (33.3)
Semester of study (%)	2 3 4 5 6	3 (6.0) 15 (30.0) 7 (14.0) 13 (26.0) 12 (24.0)

combined as a single group for further analysis.

The reliability of the questionnaire for confidence level assessment for both skills showed a resulting Cronbach's alpha score of 0.944. Normality of the data was assessed using the Shapiro-Wilk test, which confirmed that the distributions of continuous variables met normality assumptions. Associations between confidence levels and hand or eye dominancy were analysed using the Chi-Square test because these variables represented categorical comparisons (dominant vs non-dominant). For retinoscopy, comparisons were also made between model and human eyes for both the dominant and non-dominant hand and eye categories. Other confidence items were not subjected to Chi-Square analysis, as they were descriptive in nature and not structured as binary categorical comparisons. For these, descriptive analysis provided a clearer summary of students' confidence patterns.

Confidence with Direct Ophthalmoscopy

Figure 1 showed the students' confidence when performing direct ophthalmoscopy on human eyes using both dominant and non-dominant hands and eyes. Confidence was higher when performed with the dominant eye (72.1%) versus the non-dominant eye (25.6%), and with the dominant hand (74.4%) compared to the non-dominant hand (27.9%). Chi square results showed significant associations for both hand ($\chi^2(1) = 18.615$, $p < 0.001$) and eye dominancy ($\chi^2(1) = 18.615$, $p < 0.001$).

Figure 2 presented the proportion of students who reported being quite or extremely confident in specific components of direct ophthalmoscopy. Confidence was highest when examining dilated pupils (74.4%), and lowest for undilated pupils (32.6%). Confidence levels were also low when focusing on the optic nerve head (39.5%), the fovea (20.9%), following arteries and veins (46.5%), and using apertures and filters (27.9%).

Confidence with Retinoscopy

Figure 3 illustrated students' self-confidence in performing retinoscopy on model and human eyes using both their dominant and non-dominant eyes and hands. When performed on model eyes, students were more confident using their dominant eye (66%) compared to their non-dominant eye (28%). Similarly, 64% reported confidence using their dominant hand compared with 22% using their non-dominant hand. Chi square results showed significant associations

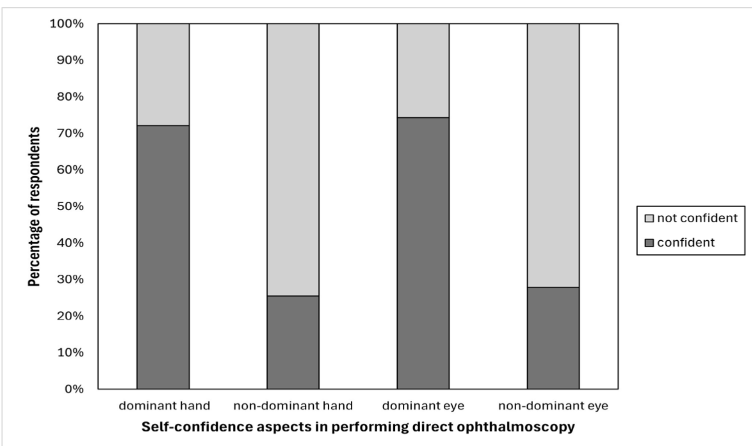

FIGURE 1: Students' self-confidence (% responded that they are confident or not confident) when performing direct ophthalmoscopy with their dominant hand, non-dominant hand, dominant eye and non-dominant eye on human eyes

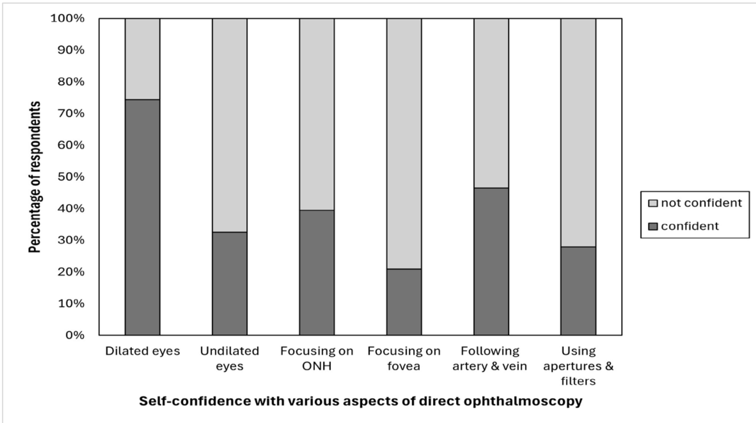

FIGURE 2: Students' self-confidence (% responded that they are confident or not confident) when performing direct ophthalmoscopy on dilated eyes, undilated eyes, for focusing on the optic nerve head (ONH), focusing in the fovea, following artery & vein, and using apertures and filters

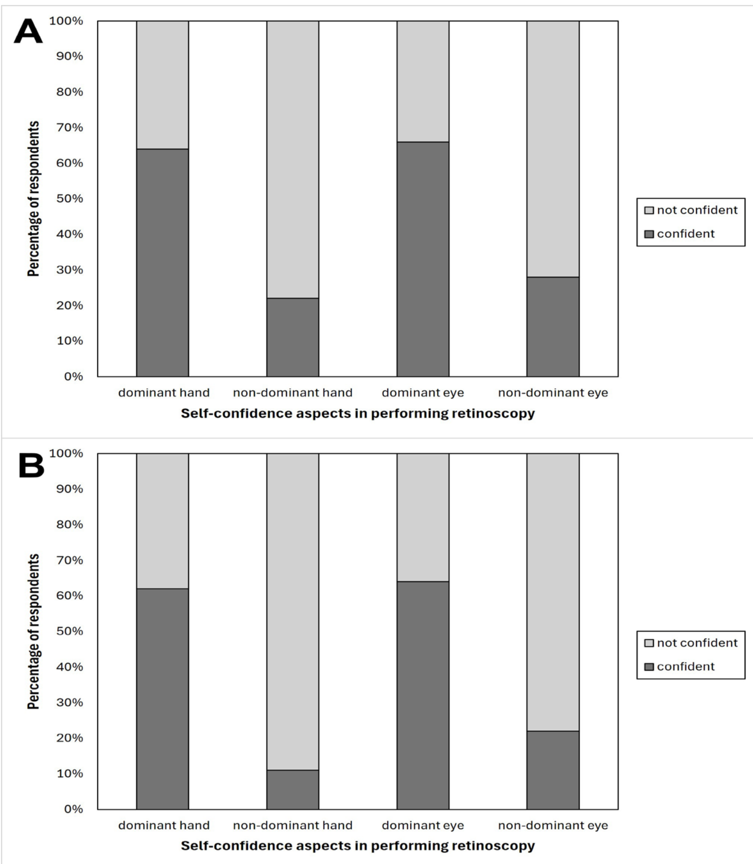

FIGURE 3: Students' self-confidence level (% responded that they are confident or not confident) when performing retinoscopy with their dominant hand, non-dominant hand, dominant eye and non-dominant eye on (a) model eyes and (b) human eyes

between confidence and hand dominancy ($\chi^2(1) = 17.993$, $p < 0.001$) and eye dominancy ($\chi^2(1) = 14.492$, $p < 0.001$). Comparable trends were observed for retinoscopy on human eyes, with significant associations between confidence and both hand ($\chi^2(1) = 16.420$, $p < 0.001$) and eye dominancy ($\chi^2(1) = 17.993$, $p < 0.001$).

Figure 4 showed students' confidence in discriminating retinoscopy reflexes: direction, meridian, neutral movements, with movements, against movements, reflexes associated with simple hyperopic astigmatism (SHA) and reflexes related to simple myopic astigmatism (SMA). More than 50% of them were confident only in discriminating simple reflex directions (neutral, with and against movements). Fewer than 50% were confident in discriminating reflexes associated with astigmatism. These items were analysed descriptively because they did not represent binary categorical comparisons suitable for Chi-square testing. No significant associations were found between these confidence levels and the type of eye (model or human) examined ($p > 0.05$ for all).

DISCUSSION

The WCO Competency Framework for Optometry (WCO 2024) defines the competencies required by optometrists to deliver

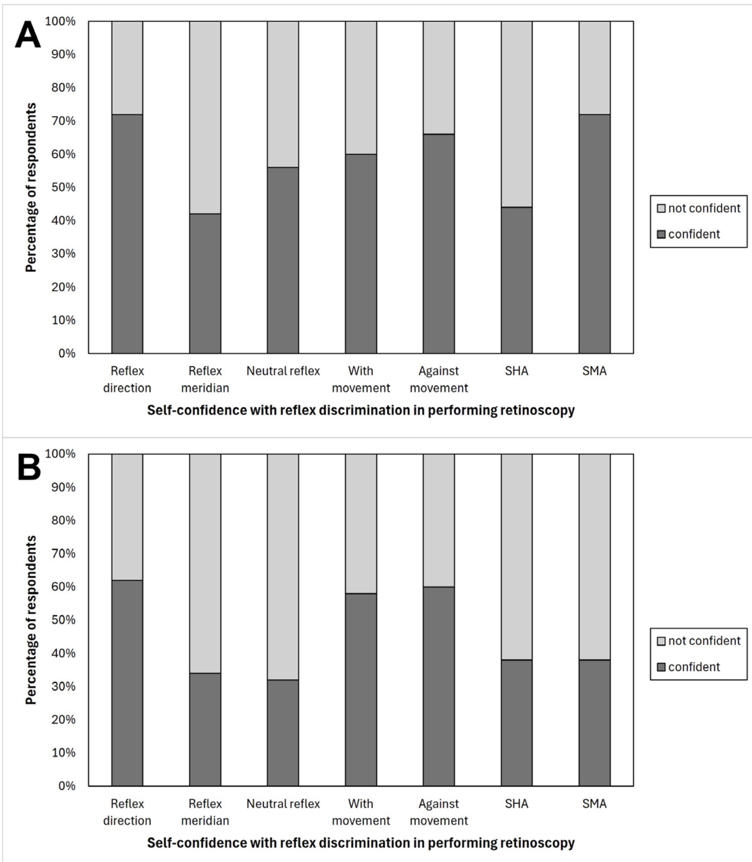

FIGURE 4: Students' self-confidence level (% responded that they are quite or extremely confident) in discriminating reflex direction, meridian, neutral movements, with movements, against movements, reflexes associated with simple hyperopic astigmatism (SHA) and reflexes related to simple myopic astigmatism (SMA) on (a) model eyes and (b) human eyes.

eye care across different levels of health services, primary (basic vision screening and refraction, and referral of common eye conditions), secondary (management of more complex ocular conditions) and tertiary (specialised diagnostics and advanced interventions). Thus, adequate competency in direct ophthalmoscopy for ocular health assessment and retinoscopy for refractive error determination are crucial for all optometrists in training. In our view, confidence assessments complement competency evaluations by providing a more comprehensive picture of a student's readiness to perform clinical tasks.

The present study also reports that a large proportion of preclinical year optometry students are not confident in performing direct ophthalmoscopy with their non-dominant hand and non-dominant eye. Less than half of them were also not confident when tasked with focusing on the optic nerve head, focusing on the fovea, following artery and vein and using the ophthalmoscope's built-in apertures. For important clinical skills such as direct ophthalmoscopy, measuring confidence together with actual clinical competency is crucial as it encourages reflective practice, where students critically evaluate their learning processes and outcomes (Colomer et al. 2020). Reflective practice is a basic of professional development, particularly in fields like healthcare, where continuous improvement and adaptation to new techniques are essential. Indeed, it has been reported that the discrimination of optic disc parameters increases as students progress into their clinical year (Hairol & Lee 2022). This aligns with previous findings that structured training in direct ophthalmoscopy improves technical performance but may not always lead to parallel gains in confidence (Milani et al. 2013). However, simulation methods such as Eyesi and model eyes have been shown to enhance both confidence and competence (Abbas et al. 2024; Liu et al. 2024), suggesting that integrating these tools into preclinical teaching could help address the confidence gaps we observed.

The present study further reports that a large proportion of preclinical optometry students are not confident in performing retinoscopy with their non-dominant hand and non-dominant eye when performed on either the model eye (laboratory practice) or on a peer's eye, which served as the 'human eye' condition. Students were also less confident in discriminating reflexes in astigmatic eyes. This is consistent with the literature, which highlights that while structured training can improve retinoscopy performance, confidence outcomes are often overlooked. For instance, Estay et al. (2023) demonstrated a clear learning curve with increased training duration but did not assess confidence. In contrast, Kim et al. (2024) showed that while both simulation and real-patient training improved accuracy and speed, only the real-patient group demonstrated a significant increase in confidence. Our findings therefore support the notion that confidence development in retinoscopy may require strategies beyond simulation, such as supervised patient encounters, to close the gap between perceived and actual ability.

Although confidence does not necessarily correlate with competency, evaluating confidence alongside competency helps identify discrepancies between students' self-perceptions and their actual abilities (Gabbard & Romanelli 2021). This discrepancy represents the "gap" between perceived confidence and actual skill performance, which can guide the design of targeted interventions. For example, students who overestimate their skills might benefit from additional feedback and practice, while those who underestimate their abilities might need encouragement and opportunities to improve themselves. Such approaches are supported by the literature, which consistently emphasises the need for training frameworks that evaluate and address both competency and confidence simultaneously rather than in isolation.

Understanding how confident students are in performing clinical skills can help educators plan better lessons and improve the curriculum (Gottlieb et al. 2022). Educators could adapt their teaching plan to boost confidence in subjects where students feel less sure of themselves. For example, using step-by-step learning and tests that give feedback can help students feel more confident over time as they succeed in small steps. Simulation-based training has been shown to enhance students' confidence and competence (Elendu et al. 2024) by providing repetitive practice and immediate feedback. However, it may not fully replicate the complexities of human interactions and real-life clinical environments (Saleem & Khan 2023).

For example, simulation-based training for direct ophthalmoscopy has gained attention due to its ability to provide consistent and controlled practice opportunities. Key simulation tools include eye models and mannequins (Paik et al. 2025) with realistic retinal images that enable students to practice ophthalmoscopy techniques, recognise normal fundus features, and identify common ocular pathologies, thereby strengthening their clinical competence. Simulation-based training further improves students' diagnostic skills and confidence by offering repeated practice and immediate feedback.

It has been reported that skills in performing ocular examination and surgical procedures are more proficient among ambidextrous ophthalmologists, that is, those who are able to use both hands efficiently (Ramesh et al. 2023). Interestingly, despite clinical training being generally designed for right-hand individuals, left-handed clinicians show a greater degree of ambidexterity than their right-handed counterparts (Lombana et al. 2021). Besides ambidexterity, clinical proficiencies are known to progress with experience (Hairol & Lee 2022; Ramesh et al. 2023). Clinical skill teaching syllabi should also nurture ambidexterity among preclinical optometry students to increase their confidence in performing these crucial clinical skills and ensure smooth progression into their clinical year.

Limitations of the Study

An important limitation of this study is that participants were drawn from different preclinical semesters (Semester 2 to Semester 6). Students in higher semesters (Semester 5 and Semester 6) may have had more practice and exposure to retinoscopy and direct ophthalmoscopy compared to those in earlier semesters (Sem 2 to 4), which could have contributed to differences in confidence levels. Future studies may benefit from stratifying results by semester or comparing confidence longitudinally within the same cohort.

Another limitation is that the study population was restricted to students from a single university. This may limit the generalisability of the findings to the broader population of optometry students in Malaysia or other contexts. Future research could include students from multiple universities to provide a more representative pictu

In this study, we did not formally evaluate students' actual competency with the direct ophthalmoscope and retinoscope, and confidence with these instruments was self-rated using questionnaires. However, studies have demonstrated the efficacy of questionnaires in capturing self-reported data on competencies (Chan & Luk 2021), confidence levels (Palenzuela-Luis et al. 2022) and perceived areas of deficiency (Kang & Ngissah 2020). For instance, a study (Carneiro & Jorge 2020) utilised questionnaires to assess optometrists' training needs and also their competencies. In future studies, confidence level could be evaluated simultaneously with actual competency and as part of a longitudinal design to determine if confidence in performing clinical skills increases as students progress into their clinical year.

CONCLUSION

A higher proportion of preclinical year students are confident in performing retinoscopy and direct ophthalmoscopy with their dominant hand and eye than with their non-dominant hand and non-dominant eye. Students are also less confident in discriminating reflexes in astigmatic eyes and certain aspects of direct ophthalmoscopy for assessing ocular health. The clinical skill teaching syllabus should nurture ambidexterity among preclinical year optometry students to increase their confidence, alongside competency assessment, in performing these crucial clinical skills.

Author contributions: All authors contributed to the conception, design, data collection, analysis and interpretation of the study. IM led the manuscript writing process, while all authors critically reviewed and approved the final version.

Funding: This work was supported by a research grant from the Research & Innovation Management Centre (RIMC), SEGi University, Malaysia [grant number: SEGIiRF/2023-Q1/FoOVS/030].

Conflict of interest: The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Acknowledgement: The authors thank the students for participating in the study and both UKM and SEGi University for their support in conducting this research.

Ethics statement: Ethics approval was obtained from SEGi University Research Ethics Committee (SEGiEC/StR/FOVS/20/2021-2022 and SEGiEC/SR/FOVS/41/2022-2023) and UKMREC (UKM PPI/111/8/JEP-2023-472).

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