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Finnish optometrists' competence to recognize, assess, and manage trochlear nerve palsy: A cross-sectional study

Anna Pietilä[a], **Seija Säynäjäkangas**[a], **Arja Rantala**[b,*]

[a] *MOptom, Oulu University of Applied Science, Kiviharjuntie 4, Oulu 90220, Finland*
[b] *Oulu University of Applied Science, Kiviharjuntie 4, Oulu, 90220, Finland*

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Abstract
Purpose: To investigate both Finnish optometrists' self-assessed competence in trochlear nerve palsy care and needs for development.
Methods: A total of 196 Finnish optometrists or opticians participated in the study. The data were collected during April–May 2024 using an online questionnaire and analyzed using descriptive statistical methods.
Results: The Finnish optometrists and opticians rated their total competence in trochlear nerve palsy as moderate (mean 2.05 ± SD 0.53) using a Likert scale ranging from 1(poor) to 4 (excellent). Taking an anamnesis received the highest rating (mean 2.65 ± 0.61) among the subareas of competencies, while knowing test methods was perceived as the weakest subarea (mean 1.58 ± 0.51). The results indicate that educational level (all $p \leq 0.003$, except management), working place (all $p \leq 0.005$), additional training (all $p \leq 0.001$), cooperation with ophthalmologists (all $p \leq 0.029$, except assessment/test methods), and available time (all $p \leq 0.031$, except test methods) had a statistically significant difference compared to the responders' self-assessed competence in almost all subareas of competencies. A master's degree was associated with higher competence and showed a significant difference compared with a bachelor's degree or college-level opticians (both $p < 0.001$).
Conclusions: The results underscore the significance of continuous competence development and higher education in trochlear nerve palsy care. With additional training, recognizing and examining ocular nerve palsies would become easier and more familiar, lowering the threshold for examining ocular nerve damage or reacting to it. This first study on optometrists' competencies in Finland can help identify clinical competencies and target educational resources.

* Corresponding author. Oulu University of Applied Sciences, Kiviharjuntie 4, Oulu, 90220, Finland.
E-mail addresses: aepiet84@gmail.com (A. Pietilä), seija.saynajakangas@oamk.fi (S. Säynäjäkangas), arja.rantala@oamk.fi (A. Rantala).

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Introduction

Trochlear nerve palsy (i.e., superior oblique muscle palsy) is a neurological condition primarily characterized by vertical diplopia. The trochlear nerve, also called the fourth cranial nerve, only innervates one muscle, the suberior oblique muscle, which turns the eye into incyclotorsion, depression and abduction.[1] Diagnostic criteria of trochlear nerve palsy include ipsilateral hyperdeviation in the primary head position, worsened by contralateral gaze and ipsilateral head tilt and excyclotorsion of the affected eye.[2] In the case of isolated fourth cranial nerve palsy, patients often complain of vertical or diagonal diplopia that may be corrected with a compensating head tilt.[3]

Isolated trochlear nerve palsy is rare, but it is a very common cause of vertical strabismus.[1,4,5] Trochlear nerve palsies are most commonly congenital, secondly acquired due to head trauma or local ischemia resulting from microvascular damage (diabetes, hypertension, atherosclerosis).[3-6] If ischemic, trochlear nerve palsy often resolves itself in a few weeks and only needs observation.[3,4,7] If the palsy is congenital, further investigation is not needed, but treatment could be prism glasses or strabismus surgery if symptoms start disturbing vision during adulthood because of decompensation.[2,8]

The investigation of trochlear nerve palsy

When investigating trochlear nerve palsy, one should pay attention to the patient's history, test monocular and binocular eye movements test diplopia in different gazes, the effect of head tilt and turn with the Parks-Bielschowsky three-step test, and test cyclotorsion with the Double Maddox rod test or with a fundus examination.[1,3] Trochlear nerve palsy is the most challenging extraocular palsy for ophthalmologists, neurologists and optometrists to diagnose.[9] The neurological assessment conducted by an optometrist is a screening tool that helps identify possible dysfunction. This allows the clinician to perform further testing or refer the patient to a specialist if needed. By conducting a cranial nerve assessment, the clinician can identify any dysfunction, determine the affected neurological region, assess the likely severity, and consider potential treatment options.[10] Diplopia can be a symptom of an emergent condition (like a stroke, an aneurysm, or an inflammation).[7,11] When a patient experiences binocular diplopia, it is important to assess the anatomical localization of the lesion and the degree of urgency.[12,13]

Optometrist́s competence profile

Competence definition is complex, but previous reports[14-16] have defined as the knowledge, skills, abilities, judgments, attributes, and attitudes that are essential for optometrists to effectively perform their roles and responsibilities within healthcare settings. So, Optometrists are primary eye care providers trained to recognize and manage various eye conditions including a fourth nerve palsy.

Optometrists do not treat systemic diseases, but they may identify them during routine eye examinations. A timely referral in such cases could potentially prevent serious health issues. Therefore, it is important for optometrists to properly assess the overall health of their patients. During a regular eye examination, optometrists test a patient's overall neurological state and the functions of several cranial nerves, either directly or indirectly. These aspects of the examination process are known as *neurological assessment* and *ocular cranial nerve assessment*. Optometrists should be able to recognize the clinical symptoms of various neurological conditions and conduct the appropriate tests. Thus, a solid understanding of cranial nerves and the assessment and treatment of cranial nerve diseases are crucial parts of optometric education.[10]

The study content of the optometrist degree program in Finland is based on the European Council of Optometry (ECOO) recommendations. Based on the content of the optometrist degree program in Finland and the recommendations of the Finnish Ethical Council of Optometry (OEN) ,[17] optometrists should be capable of recognizing, examining, and managing patients with ocular motor nerve damage and, if necessary, they should refer such patients to an ophthalmologist or prescribe them prism glasses if already diagnosed. According to OEN guidelines, the preliminary examinations of a good optometrist's examination practice include anamnesis, a cover test, testing ocular fixation and eye movements and an examination of pupil reactions.

Opticians with college-level education are not required to have the same competence as optometrists, but the competence requirement is based on the education received. In Finland opticians prescribe eyeglasses but do not have education or a limited right to prescribe medication, and because of this, they have a limited ability to assess eye health.[18]

In this study, we first mapped the competencies optometrists or opticians need in recognition, assessment and management regarding trochlear nerve palsy in order to create the online questionnaire. The recognition, assessment, and management of trochlear nerve palsy require many different competencies, including anamnesis skills, recognition skills, examination skills, method knowledge, and management skills (see Table 1). The neurological assessment includes, among other things, taking an anamnesis (history, symptoms)[1,3,4,11,13,18,19]; the evaluation of ocular motility and the Parks-Bielschowsky three-step test, which help distinguish trochlear nerve palsy from other conditions[1,3]; pupils assessment,[1] evaluating diplopia[11,13] and the use of special tools such as Maddox lenses to measure rotational strabismus.[1,13] Management of patients with trochlear nerve palsy includes for example prescribing prism to compensate diplopia and referral to get appropriate diagnosis.[1,3,4,11,12,20]

The study objectives and context

Optometrists' knowledge about ocular cranial nerve palsies has not been researched before in Finland. While research has been done on other optometrists' professional competency areas, no studies were found on optometrists' competence in recognizing, assessing, and managing ocular motor nerve palsies. The purpose of this study was to investigate Finnish optometrists' and opticians' self-assessed competence levels regarding the recognition, assessment, and management of trochlear nerve palsy and investigate whether there is a need for development of their competence. Additionally, the study aimed to identify the factors associated with optometrists' competence in this area.

Table 1 A description of the competencies in trochlear nerve palsy care detailing: the subarea, the number of statements, Cronbach's alpha and a description of the subarea.

Subarea	The number of statements	Cronbach's α	A description of the subarea
Anamnesis	12	0.879	Competencies needed in anamnesis include the ability to ask about the patient's history, symptoms, general illnesses, eye surgeries, and traumas; the ability to assess the patient's appearance; and based on the anamnesis the ability to decide whether to immediately send the patient for further examinations or to continue the examination.[1,3,4,11-13,18,19]
Recognition	5	0.832	Competencies needed in recognition include the ability to recognize symptoms related to trochlear nerve palsy: vertical (torsional) diplopia, worsened when looking down and inward; a compensatory head tilt.[2,3,5]
Assessment	20	0.940	Competencies needed in assessment include the ability to examine diplopia, ocular motility strabismus (horizontal/vertical/torsional strabismus), fusional vergencies and fundus; the ability to evaluate the amount and direction of strabismus; the ability to examine if the amount of strabismus is changing in different gazes or distances; the ability to examine the effect of tilting or turning the patient's head on the amount of strabismus (Bielshowsky); and the ability to examine pupil reactions, relative afferent pupillary defect and difference in pupil size or shape.[1,3,4,11,13,19,20]
Test methods	12	0.888	Competencies needed in test methods include the ability to trace the causes of trochlear nerve damage with the help of anamnesis (ischemic, traumatic or congenital cause), the ability to use an eye movements test to examine ductions or vergences and to differentiate strabismus from nerve damage or to determine which nerve is damaged, the ability to notice vertical strabismus with the cover test, the ability to evaluate torsional strabismus (by evaluating fundus or with the double Maddox test), the ability to use red—clear or red—green lenses to measure strabismus at different distances, the ability to use the Bielschowsky head tilt test or the Parks-Bielschowsky three-step test, the ability to localize the cause of double vision based on tests (cataract or corneal origin, muscle or nerve origin, mechanical origin)[1,3,11,13,20]
Management	9	0.882	Competencies needed in management include the ability to prescribe prism glasses or install a press-on Fresnel prism or cover patch on a patient's glasses, the ability to monitor the situation with follow-up visits, the ability for multi-professional cooperation, the ability to judge when to send the patient to an ophthalmologist if necessary and when to send the patient to the emergency room, and the ability to treat the patient under the consultation of an ophthalmologist.[1,3,4,11,12,20]
Total	58		

This study can potentially provide valuable insight into the current ability of Finnish optometrists to identify, assess, and manage trochlear nerve damage and identify areas for improvement.

Methods

Design

This study employed a descriptive cross-sectional design implemented by an anonymous self-administered online questionnaire.

The questionnaire

The survey was based on the areas of trochlear nerve palsy care competence and factors influencing that competence, identified in the literature search of this study[1-8,11,12] (see Fig. 1). The Finnish Optometrists' and opticians' self-assessed Competence in Trochlear Nerve Palsy care questionnaire (O—CTNP) was based on both earlier competence studies on different competence areas and the opinions of an expert panel that include three researchers (n = 3). The questionnaire was pre-tested by two optometrists (n = 2) before this study and used for the first time to assess optometrists' and opticians' competence in trochlear nerve palsy care. Based on feedback, some questions were removed, and some were modified for clarity.

The questionnaire consisted of 10 background questions, five questions measuring competencies, five questions about resources, two questions about referrals, two questions about additional training, and six open-ended questions at the end of each section (see Appendix 1). The measures created were based on five competence areas (subareas): anamnesis (12 statements), recognition (5 statements), assessment (20 statements), test methods (12 statements),

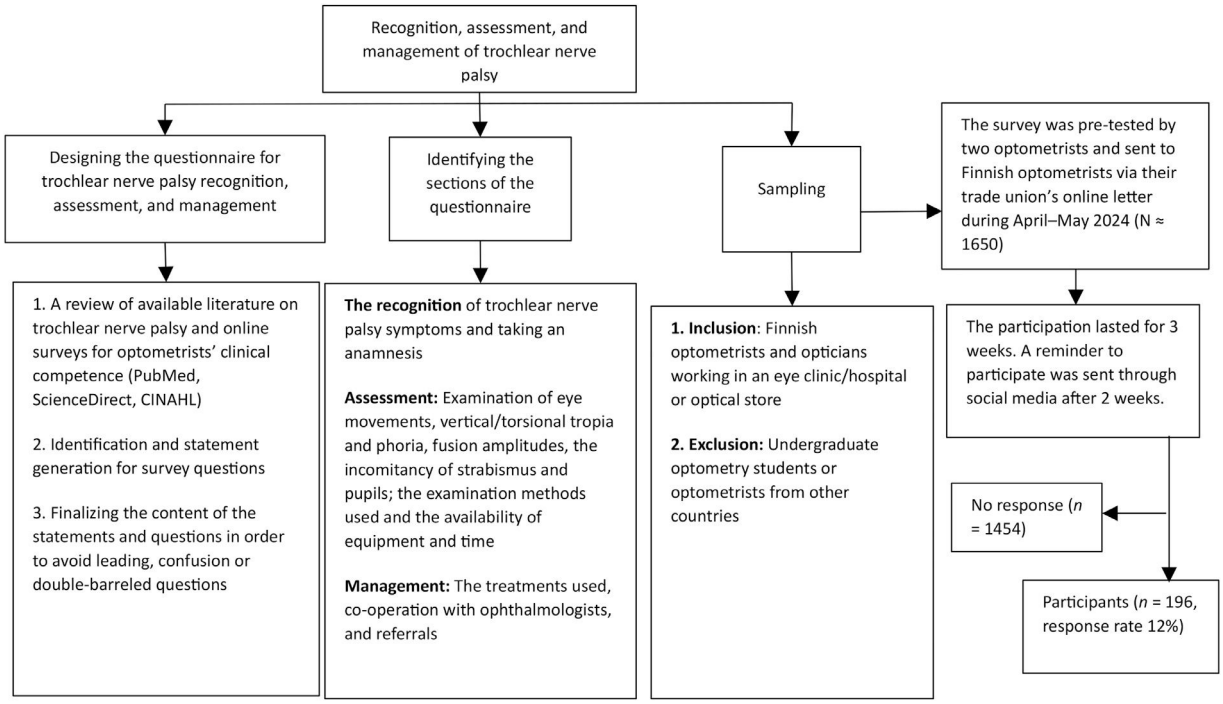

Fig. 1 A flowchart of the questionnaire process.

and management (9 statements) (see Table 1). The researcher determined the content of the measures so that the statements included in one subarea measure the same thing. The responders assessed their competence using a four-point Likert scale (1 = *poorly*, 2 = *moderately*, 3 = *well*, 4 = *excellently*), with a higher total score indicating a higher level of competence. In addition to the competence assessment, the survey included ten questions about the respondents' background information (see Table 2). Resources, the frequency of referrals and additional training needed in trochlear nerve palsy care were asked about in dichotomous-type questions or multiple-choice questions.

The participants

The data were collected from working optometrists and opticians in Finland. According to the Finnish Union of Private Sector Professionals (Erto), the estimated number of working-age optometrists and opticians in Finland is 1650. Finnish optometrists and opticians work in chain-driven or private optical stores, central hospitals, or private eye clinics. Participants were selected by convenience sampling, and the Finnish Professionals of Optometry (SOA) trade union was used to share the online questionnaire. The inclusion criterion was that the participants were all working Finnish optometrists or opticians. Optometrist students and optometrists or opticians working in any other nation than Finland were excluded. According to Finnish legislation this study did not require an approbation of any Ethic Committee. Study responders were informed that their participation was voluntary, and they gave their consent previously to answer the questionnaire. Study was conducted following the guidelines of the Finnish National Board on Research Integrity and the European Union's data protection legislation.

Data collection

The data were collected electronically through an online questionnaire during April—May 2024 (April 15 to May 6, 2024) using Webropol 3.0 software. A public online link to the survey was shared in the online letter of the trade union

Table 2 Sum variables of competencies and total competence on Likert scale 1—4 and on percentages.

Sum variables of competencies, Likert scale 1—4	N	M(±SD)[a]	Poor=1 % (*n*)	Moderate = 2 % (*n*)	Good = 3 % (*n*)	Excellent = 4 % (*n*)
Anamnesis	196	2.65 (0.61)	3.1 (6)	33.7 (66)	53.6 (105)	9.7 (19)
Recognition	195	1.92 (0.67)	31.8 (62)	49.7 (97)	14.4 (28)	4.1 (8)
Assessment	196	2.07 (0.58)	11.7 (23)	67.9 (133)	17.3 (34)	3.1 (6)
Test methods	195	1.58 (0.51)	51.8 (101)	42.6 (83)	4.1 (8)	1.5 (3)
Management	196	2.05 (0.65)	19.9 (39)	59.7 (117)	16.3 (32)	4.1 (8)
Total competence[b]	194	2.05 (0.53)	13.4 (26)	69.1 (134)	15.5 (30)	2.1 (4)

[a] M: mean (± SD: standard deviation).
[b] total competence from sum variables.

(SOA) and via Finnish optometrists' and opticians' social media channels (see Fig. 1). The data collection period lasted 3 wk.

Data analysis

The data were analyzed using IBM SPSS Statistics (version 29.0.1.0) and using descriptive statistical methods. A statistical expert was consulted during the data analysis phase. Missing data were identified before analysis. The results were presented using percentages, frequencies, mean and $\pm$ standard deviation (SD) values. The results were presented only as means, since the median values were very close to mean values and when comparing the mean and the median, the mean is more effective of these two measures of average. To simplify, age was categorized into four groups and working years and available time were grouped into two categories. The year of graduation was divided into three groups based on education level. Those who graduated before 1996 are considered college-level opticians, while those who graduated after 2015 have the right to use diagnostic drugs with their degree. Five sum variables were created from statements of each subarea of competencies (anamnesis, recognition, assessment, test methods and management). The sum of the values obtained from the statements was divided by the number of statements, resulting in the value scale being standardized to the same range as the original statements, that is, to the same value area from one to four. Thus, different sum variables are comparable to each other even though the sum variables contain a different number of statements. Each of the five competence subareas was analyzed as sum variables. The total competence was calculated from the sum variables so that each subarea had the same weight value. The statistically significant differences between the sum variables of competencies and the background variables were examined by using the chi-square test and the likelihood ratio. The competence of optometrists and opticians was examined from the point of view of educational level working place. The differences between the sum variables and education or workplace were analyzed using the Kruskal-Wallis test with a Bonferroni correction of the *p*-values. Time available in relation to the workplace was tested with a chi-square test. The differences between workplaces regarding the time available for an appointment were compared using the Kruskal-Wallis test with Bonferroni correction of the *p*-values. A *p*-value of <0.05 was considered statistically significant.

Results

The characteristics of the responders

One hundred ninety-six (n = 196) of a total of 1650 Finnish optometrists or opticians responded to the survey (response rate of 12 %). Most of the responders (87 %) were optometrists, of which 8 % with a master's degree, and 13 % were opticians). Most of the responders worked in optical stores (89 %), with almost two-thirds of them working in chain stores (63 %). Only one in ten (11 %) of them had additional training on ocular motor nerve palsies. Most of the responders (73 %) only had 30 mins or less time for each appointment.

Pre-validation of test results

After data collection the internal consistency of the sum variables (anamnesis, recognition, assessment, test methods and management) was verified with the Cronbach alpha test from participants answers. The Cronbach's alpha values of each subarea ranged from 0.832 to 0.940, indicating good reliability (see Table 1). Therefore, the internal consistency of the sum variables could be considered good. The sum variables were compared to each other using Friedman's Two-Way test with Bonferroni correction of p-values, which indicated that there was a statistically significant difference between all other sum variables (all $p < 0.001$) except between assessment and management (p = 0.210).

Optometrists' and opticians' self-assessed competence in trochlear nerve palsy care

The responders' total self-assessed competence level in trochlear nerve palsy care was reported as moderate (mean 2.05 $\pm$ 0.53) on a Likert scale ranging from 1, poor, to 4, excellent (see Table 2). The test methods received the lowest rating of all the sum variables (mean1.58 $\pm$ 0.51). Of the responders 51.8 % felt that their competence level in test methods was poor, only 5.6 % felt their level was at least good. The subarea with the highest level of competence was the subarea of taking anamnesis (with mean 2.65 $\pm$ 0.61). In this subarea, the competence level was perceived as good or excellent by 63.3 % of the responders, with only 3.1 % considering it poor. The other competence subareas (recognizing mean 1.92 $\pm$ 0.67, assessment mean 2.07 $\pm$ 0.58, or management mean 2.05 $\pm$ 0.65) were all rated as moderate. Almost all of the respondents (96.9 %, n = 189) responded that they needed additional training. The responders had a positive attitude toward training; 94.3 % (n = 183) of them answered they were willing to participate in additional training.

The statistically significant differences between the background variables and competence sum variables

Almost all of the background variables showed a statistically significant difference compared to the sum variables of competencies except for the background variable of the region of Finland in which responders work (see Table 3).

Because there was no statistically significant difference between the region and the sum variables of competencies, this background variable was left out from further analyses. The working place and additional training showed statistically significant differences compared to sum variables in all subareas of competencies (all $p \leq 0.005$). Hospitals or eye clinics as workplaces demonstrated higher competencies with statistically significant difference in all subareas (all $p \leq 0.012$) compared with chain stores. In private stores, the competence was better in anamnesis and management compared to those working in chains (p = 0.013 and p = 0.004 respectively). Additional training exhibited higher competencies in all subareas compared with those without

Table 3 Background variables compared to sum variable competence levels (n = 196).

Background variables and competence sum variables	% (n)	Anamnesis		Recognition		Assessment		Test methods		Management		Total
		M(±SD)[a]	p	M(±SD)[a]	p	M(±SD)[a]	p	M(±SD)[a]	p	M(±SD)[a]	p	M(±SD)[a]
Age			0.722		0.322		**0.004**		**0.019**		0.107	
<30 years	17.4 (34)	2.58 (0.51)		1.96 (0.70)		2.28 (0.62)		1.72 (0.55)		2.01 (0.70)		2.11 (0.57)
30–39 years	30.6 (60)	2.64 (0.57)		2.00 (0.66)		2.20 (0.54)		1.70 (0.53)		2.19 (0.61)		2.14 (0.50)
40–49 years	29.6 (58)	2.65 (0.65)		1.80 (0.61)		1.95 (0.47)		1.44 (0.38)		1.92 (0.62)		1.96 (0.49)
≥50 years	22.4 (44)	2.70 (0.68)		1.93 (0.73)		1.89 (0.67)		1.49 (0.52)		2.06 (0.70)		2.01 (0.59)
Education			**<0.001**		**0.003**		**<0.001**		**<0.001**		0.170	
Optician	13.3 (26)	2.50 (0.59)		1.81 (0.56)		1.77 (0.37)		1.33 (0.27)		1.94 (0.63)		1.87 (0.41)
Optometrist	78.6 (154)	2.60 (0.58)		1.87 (0.64)		2.05 (0.57)		1.55 (0.47)		2.02 (0.65)		2.02 (0.51)
Master's degree	8.1 (16)	3.33 (0.47)		2.60 (0.74)		2.73 (0.51)		2.24 (0.59)		2.51 (0.57)		2.68 (0.50)
Working years			**0.008**		0.249		**0.035**		0.066		0.697	
≤10 years	43.6 (85)	2.53 (0.53)		1.86 (0.62)		2.17 (0.56)		1.63 (0.48)		2.00 (0.64)		2.04 (0.51)
>10 years	56.4 (110)	2.73 (0.65)		1.97 (0.70)		1.99 (0.59)		1.54 (0.52)		2.08 (0.66)		2.07 (0.56)
Working place			**0.005**		**0.001**		**<0.001**		**0.002**		**<0.001**	
Chain store	63.3 (124)	2.49 (0.54)		1.76 (0.50)		1.93 (0.45)		1.46 (0.36)		1.86 (0.50)		1.90 (0.39)
Private store	26.0 (51)	2.83 (0.63)		2.05 (0.75)		2.17 (0.68)		1.65 (0.53)		2.26 (0.73)		2.19 (0.59)
Hospital/clinic	8.7 (17)	2.97 (0.58)		2.48 (0.79)		2.61 (0.65)		2.09 (0.74)		2.63 (0.79)		2.56 (0.63)
Other	2.0 (4)	3.71 (0.53)		2.95 (1.06)		2.74 (0.74)		2.25 (0.96)		2.75 (0.68)		2.88 (0.75)
University			0.639		0.439		0.969		**0.030**		0.276	
Metropolia University of Applied Science	55.1 (107)	2.60 (0.60)		1.85 (0.61)		2.06 (0.58)		1.52 (0.48)		1.99 (0.66)		2.01 (0.52)
Oulu University of Applied Science	32.5 (63)	2.75 (0.62)		2.06 (0.70)		2.16 (0.57)		1.73 (0.55)		2.15 (0.68)		2.17 (0.55)
Other	12.4 (24)	2.59 (0.66)		1.92 (0.79)		1.90 (0.65)		1.45 (0.44)		2.05 (0.55)		1.98 (0.55)
Year of graduation			0.288		0.847		**0.017**		**0.019**		0.789	
1983–1995	7 (13)	2.59 (0.76)		1.83 (0.73)		1.81 (0.64)		1.43 (0.59)		2.12 (0.81)		1.96 (0.65)
1996–2015	46 (89)	2.59 (0.59)		1.89 (0.63)		1.96 (0.49)		1.46 (0.37)		1.97 (0.63)		1.98 (0.47)
2016–2024	46 (89)	2.72 (0.62)		1.96 (0.71)		2.23 (0.63)		1.73 (0.58)		2.11 (0.66)		2.15 (0.57)
Additional training on ocular motor nerve palsies			**<0.001**		**<0.001**		**<0.001**		**<0.001**		**0.001**	
Yes	11.3 (22)	3.33 (0.53)		2.82 (0.78)		2.78 (0.65)		2.24 (0.70)		2.66 (0.70)		2.76 (0.60)
No	88.7 (172)	2.56 (0.57)		1.81 (0.56)		1.98 (0.51)		1.50 (0.41)		1.98 (0.61)		1.97 (0.45)
Co-operation with ophthalmologist			**0.009**		**0.029**		0.180		0.429		**0.016**	
Yes	67.5 (131)	2.74 (0.61)		1.99 (0.72)		2.10 (0.61)		1.61 (0.55)		2.13 (0.70)		2.12 (0.57)
No	32.5 (63)	2.43 (0.54)		1.80 (0.52)		2.01 (0.52)		1.52 (0.40)		1.88 (0.52)		1.93 (0.42)
Time available			**0.019**		**0.031**		**0.003**		0.150		**<0.001**	
30 min or under	73.2 (139)	2.55 (0.56)		1.82 (0.57)		1.97 (0.49)		1.49 (0.42)		1.91 (0.54)		1.95 (0.44)
Over 30 min	26.8 (51)	2.87 (0.64)		2.16 (0.80)		2.30 (0.74)		1.79 (0.64)		2.40 (0.79)		2.30 (0.65)

Note: Bold values denote statistical significance at the $p < 0.05$ level.

[a] M: mean (±SD: standard deviation).

additional training proved with statistically significant difference (all $p \leq 0.001$). The responders with master's level degrees showed statistically significant difference (all $p \leq 0.003$) compared to sum variables in all subareas of competencies except for management ($p = 0.170$). Master-level optometrists demonstrated better self-assessed competence with statistically significant difference in anamnesis, assessment, test methods (all, $p < 0.001$), and recognition ($p = 0.003$).

The time available showed statistically significant differences in all subareas of competencies (all $p \leq 0.031$) except for test methods. Those who had over 30 mins of time available for appointments self-assessed their competencies as better in anamnesis ($p = 0.019$), recognition ($p = 0.031$), assessment ($p = 0.003$), and management ($p < 0.001$). Most (73 %) of respondents replied that there is not enough time to assess the trochlear nerve palsy during appointments. When comparing the available time to the workplace, a statistically significant difference was found ($p < 0.001$). In a chain-driven optical store, there was the least time available with statistically significant difference compared to a hospital/eye clinic and a private store (both $p = 0.000$). No statistically significant difference was found between those working in hospitals/eye clinic and those working in private stores. Co-operation with ophthalmologists resulted in better competencies with statistically significant differences in anamnesis ($p = 0.009$), recognition ($p = 0.029$), and management ($p = 0.016$). Younger optometrists who had graduated after 2016 had slightly better competence in assessment and test methods than others with statistically significant difference (all $p \leq 0.019$) but were still at the *moderate* level.

The routine use of test methods (the eye movements test and cover test) was compared with the competence of using these methods. There was a statistically significant difference ($p < 0.001$) showing that using these test methods increases the self-assessed competence level regarding the use of these test methods. Based on the survey, 61 % replied that there was enough time to assess the ocular motility (with the eye movements test) test during appointments. However, most of the participants (82 %) did not do the eye movements test as part of a routine examination.

Master's level optometrists had higher competence among the responders, which proved statistically significantly difference compared with bachelor's level optometrists ($p < 0.001$) or opticians ($p < 0.001$) who had a lower level of education (see Fig. 2). There was a statistically significant difference between the workplace and the need for additional training ($p = 0.010$). Employees working in optical shops required additional training, more than those working in hospitals or eye clinics ($p = 0.007$). No difference was found between the chains and the private stores.

Discussion

Optometrists are often the first healthcare professionals to detect signs of eye diseases or general illnesses. This study aimed to map optometrists' self-assessed competence in trochlear nerve palsy care in five subareas and identified the background variables associated with these competencies.

Based on the content of the education plan, besides standard refraction skills, optometrists should possess techniques and skills appropriate for evaluating supranuclear oculomotor neuropathology, testing ocular fixation and motility, assessing neurological symptoms and signs, and referring the patient when needed or offering a

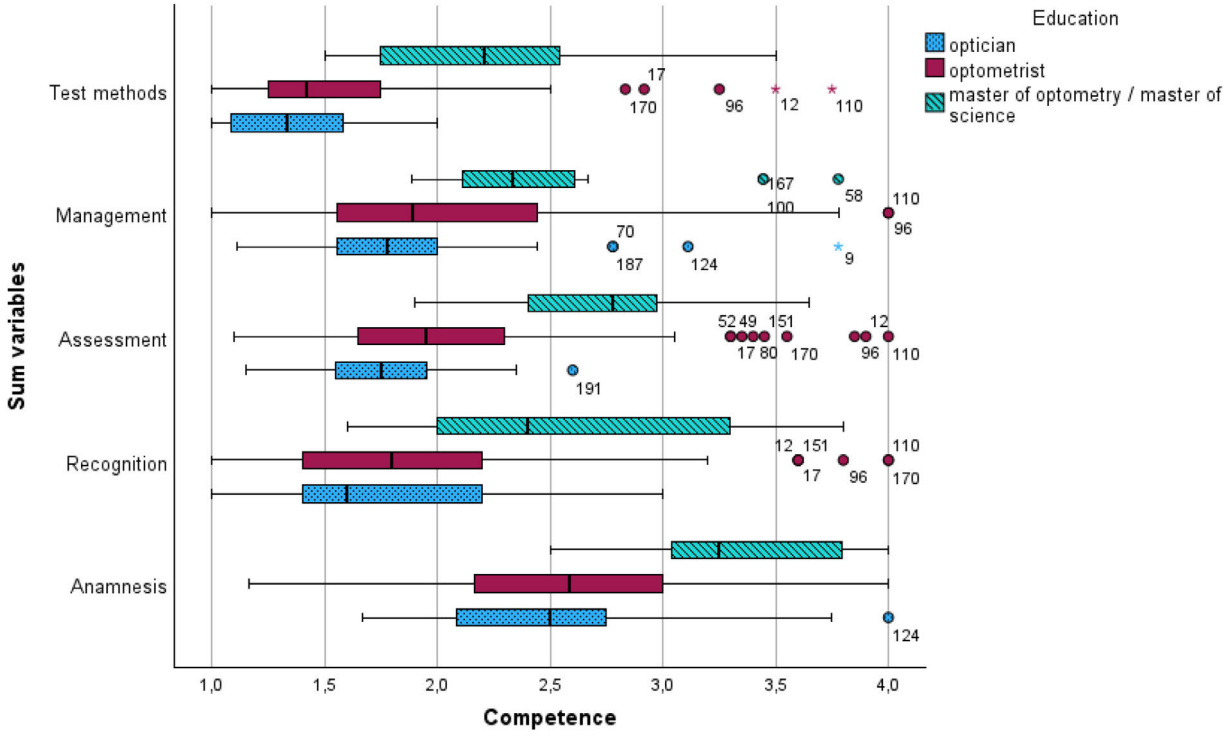

Fig. 2 Self-assessed competence by subarea (sum variables) described in Likert scale (1 = poorly, 2 = moderately, 3 = well, 4 = excellently) in terms of educational level.

management plan to patients who do not require a referral.[18,21] The overall competence in trochlear nerve palsy care was evaluated as *moderate* by the participants in this study. The participants rated their competence as *moderate* in all areas (recognition, assessment, management) other than anamnesis (which was considered *good)* and test methods (which was rated as *poor)*. These results differ from some previous findings concerning optometrists' clinical competencies [other reports found good optometrists' knowledge, attitudes, and practice in glaucoma[22] (or cataracts[23]) and indicate the need for training (96.9 %) as other studies that found inappropriate knowledge to examine, diagnose, and manage keratoconus patients[24] or to evaluate retinal images for diabetic retinopathy[25] that also suggest formal optometric training and continuing optometric professional education. The participants evaluated their anamnesis competence as their best competence area. Two-thirds of the responders assessed their competence in taking an anamnesis as *good* or *excellent* (63.3 %). This is an important finding because anamnesis has the greatest importance in discovering the true nature of a disease and affects the choice of the tests and methods used in an eye examination. Anamnesis competency does not require additional training as much as areas with less level of competency such as recognition (just 18.5 % answered as good or excellent), assessment (20.4 %), test methods (5.6 %) or management (20.4 %). So, further training must be focused on these subareas.

Based on this study, a master's degree takes knowledge to a more advanced level and can enhance personal development. Competence was better with additional or higher education. In particular, the effect of the master level education is emphasized in the results, which brought additional qualifications to clinical competence regarding trochlear nerve palsy. A master's degree and additional training had a statistically significant difference in all areas of competencies except management, which was only affected by additional training, possibly due to the responders' higher status and confidence in their expertise. Previous studies support the effect of education in improving clinical competence. In previous report participants with master's degrees scored higher than participants with bachelor's degrees ($p = 0.12$).[22] Other report showed that educational qualification (academic degree) ($p = 0.0233$) was a statistically significant variable with respect to the use or not of treatments for myopia control. However, there was no link between a higher academic degree and more active management of childhood myopia $p = 0.142$).[26] Based on a Portuguese optometrists' competence study, professional experience of 10 years or more and master's degree or a PhD give rise to more skills, higher levels of confidence, and lower training needs. A higher frequency of the execution of certain procedures translates into higher levels of confidence and less training needs in the area ($\rho < 0.001$). In this Portuguese study, there was a statistically significant difference ($\rho = 0.006$) in the area of ocular pathology that showed a greater training need for graduates when compared with those with a master's degree or PhD.[27]

Work experience only had a statistically significant effect on anamnesis and assessment. This is a somewhat unexpected result because previous studies have indicated that work experience affects the competence of healthcare professionals.[28] In previous findings the knowledge scores among optometry practitioners increased significantly with an increase in the years of clinical experience ($p < 0.001$),[22] in contrast to the results of this study, where years of work positively affected anamnesis but negatively affected assessment skills. In previous findings, optometrists who had practiced for less than five years were associated with a good knowledge of cataracts.[23] Better competence among young optometrists of this study may be attributed to their recent graduation from optometry training institutions. Therefore, older graduates might have lost some theoretical knowledge since graduation. This could also be explained by the fact that the educational content has changed over the years with more emphasis being placed on ophthalmology.

The responders assessed their ability to use test methods as their weakest competency, likely because trochlear nerve palsy is rare and infrequently used methods can be forgotten. Hospitals and eye clinics, where this condition is more commonly encountered, showed a significant positive effect on self-assessed competence in all areas, including test methods. Rare tests take more time without routine, and time constraints often leave them undone. However, the study found no statistically significant differences between available time and test method competence. The quick eye movement test's infrequent use is better explained by a lack of competence rather than time.

The health workforce must adapt to the population's changing demands, especially with an aging population and evolving healthcare environment, increasing the need for competence development in optometry. Optometrists and opticians may need a training program with both theoretical and practical components to address knowledge and skills gaps. An online module significantly improved optometry students' understanding of cranial nerve concepts.[10] Another study highlighted that the most critical training needs are in prismatic prescription and optometry for special needs populations.[27]

Time pressure can impact on the thoroughness of the patient examination. Previous research has indicated that the lack of training and time poses challenges in healthcare organizations.[29] In this survey, respondents indicated that there is not enough time to assess the trochlear nerve palsy during appointments. Lack of time can directly affect the quality of patient care. Organizations must ensure that optometrists have the necessary resources and qualifications to implement the methods needed in eye care.[17] It can be argued that dedicating more time to developing competence, providing additional training opportunities for optometrists, and recruiting more optometrists could also enhance optometrists' competence in ocular motor nerve palsy care. Organizations should take note that continuous education and competence development are essential in a changing healthcare environment. The advantages of being part of professional networks are improving one's professional skills and knowledge. Healthcare professionals in expert networks participate in social learning. The hospital environment supports this social learning in an expert network and can explain better results in competence levels. When comparing the workplace with the need for additional training, those working in private stores or retail chains required additional training more than those working in hospitals or eye clinics ($p = 0.007$). Organizations should enable multi-

professional and team working, support personnel competence development, and provide sufficient resources to maintain competencies.

Limitations

Despite the valuable insights gained from this study, some study limitations need to be acknowledged. First, the low response rate (12 %) and sampling method used may impact on the study's generalizability. However, it is higher than in previous international studies[30,31] on the management of keratoconus by optometrists, where the response rate was <3 %. This was a comprehensive study that gathered data from the entire population of interest (all working optometrists and opticians in Finland). This study resulted in a self-selected sample and partially followed convenience sampling. The sample created in this way usually is not a representative sample of the population. Some of the core group may never read the trade union's newsletter or follow social media channels. If those missing are different from those active in social media, then the sample does not give a true picture of the basic population. Second, to avoid the possibility of non-optometrists/opticians to answer this survey, we restricted the distribution of the open link to the closed optometrists' social media groups and trade union online newsletter. The questionnaire was quite long, which may have reduced the likelihood of the same professional responding more than once.

Third, the findings were derived from the subjective self-evaluation of responders' competence. This method is more vulnerable to biases, emotional judgments, and personal preferences than objective measures. Self-assessment requires the capacity to critically and honestly evaluate one's competence, and it always reflects an individual and personal perspective on the level of competence. Fourth, social desirability bias (respondents answer questions in a manner that will be viewed favorably by others) may have influenced the responders' self-reported answers, leading to potential underreporting of undesirable attributes and overreporting the more desirable ones. Fifth, because this was a voluntary survey, optometrists and opticians participating in the study may have been more interested in developing their skills than their non-participating peers, which could have biased the results. Sixth, the study specifically examined Finnish optometrists and opticians, which limited its geographical and cultural scope. As the recommendations and working cultures for optometrists vary internationally, the results of this study should only be generalized to other countries with caution. In this study, since the study's sample percentage is small and convenience sampling was used, generalization of the results must be done with caution.

Implications for practice

This study raises awareness of the fact that higher education raises optometrists' competence to work with patients with trochlear nerve palsy. This study also brings together and maps the skills that optometrists need in the care of trochlear nerve palsy. Examining these competencies helps to comprehensively understand the competencies needed in ocular motor cranial nerve palsy care. The results can be applied to practice in improving treatment pathways and supporting continuous professional and educational development. By identifying these factors, organizations and educational institutions can utilize optometrists' existing capabilities and effectively allocate limited resources to skill development and improvement. Based on the results, a longer time for each appointment must be enabled and invested in the development of cooperation skills between healthcare professionals. The results of this study can be used in optometrists' training planning. In addition, they can serve as a basis for further research in the field of optometry.

Further research

The newly developed measure created for this study could be used in future research to generate comparable survey data on the competencies of optometrists regarding trochlear nerve palsy care in other countries. In addition, comprehensive studies are needed to understand how trochlear nerve palsy competencies relate to other ocular nerve palsy care competencies as trochlear nerve palsy remains relatively unknown based on this study. Relying solely on self-assessment may not be a reliable way to judge a person's competence. Therefore, it is essential to develop additional methods to obtain more dependable information about the competence of optometrists in ocular motor nerve palsies.

In the future, it would be beneficial to conduct a more extensive examination of optometrists' ocular nerve palsy competence involving a diverse sample of optometrists from different organizations, countries, and healthcare systems. Future research could explore optometrists' ocular nerve palsy competence, for example, by having competence assessed from a more objective point of view, perhaps using methods such as peer assessment or assessment by a supervisor. This type of multi-person assessment could provide a richer, more comprehensive, and objective assessment of the state of optometrists' competence.

Conclusions

Finnish optometrists and opticians rated their competence in trochlear nerve palsy care as moderate, with anamnesis being their strongest skill and test methods their weakest. The study found that higher education levels, working in hospitals or eye clinics, additional training, cooperation with ophthalmologists, and longer appointment times were linked to higher competence. Optometrists with a master's degree showed significantly higher competence, highlighting the importance of advanced training. Cooperation with ophthalmologists improved competence in anamnesis, recognition, and management, while working in hospitals or eye clinics improved competence in all areas except test methods. These findings emphasize the need for improved cooperation among healthcare professionals and targeted training to enhance optometrists' skills, particularly in test methods. Continuous professional education and participation in expert networks are recommended to strengthen and maintain competence. The new master's degrees in optometry offer opportunities to develop expertise in Finland and Europe, supporting continuous learning in a changing healthcare environment.

CRediT authorship contribution statement

Anna Pietilä: Conceptualization, Data curation, Formal analysis, Writing—original draft, Seija Säynäjäkangas: Conceptualization, Writing—original draft, Writing—review and editing. Arja Rantala: Conceptualization, Writing—original draft, Writing—review and editing, Supervising. All authors have given their approval for the manuscript to be submitted in its present form.

Declarations of interest

None.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Copilot Microsoft 365 in order to ensure the linguistic accuracy and clarity of this manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Data statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. However, the data is not publicly available due to privacy or ethical restrictions

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.optom.2025.100541.

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