Evidence-based practice in Ophthalmology: a cross-sectional study in a Brazilian training center

Prática baseada em evidências em Oftalmologia: um estudo transversal em um centro de treinamento brasileiro

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ABSTRACT

Objective: To compare knowledge, perceptions, and competencies in Evidence-Based Practice among first- and third-year ophthalmology residents in Brazil.

Methods: Thirty-one residents (16 in the first year, 15 in the third year) completed a 13-item questionnaire and the ACE Tool, assessing five Evidence-Based Practice domains (Ask, Acquire, Appraise, Apply, Assess).

Results: Overall performance was intermediate, with no significant difference in total ACE scores (46.7 versus 53.3; p = 0.509). Third-year students scored higher in Appraise (p = 0.032), while first years students scored higher in Apply (p = 0.013). Both groups reached a median of 100 in Assess, showing heterogeneity and a possible ceiling effect. Attitudes toward Evidence-Based Practice were positive, although third-year students reported more frequent practical application (53% versus 19%). Lack of time was the main barrier.

Conclusion: Residents showed moderate Evidence-Based Practice competence with domain-specific differences, highlighting the need for targeted training to strengthen critical appraisal and practical application skills.

RESUMO

Objetivo: Comparar o conhecimento, as percepções e as competências em Prática Baseada em Evidências entre residentes de primeiro e terceiro ano de Oftalmologia no Brasil.

Métodos: Responderam a um questionário de 13 itens e ao instrumento ACE, que avalia cinco domínios da PBE (Perguntar, Buscar, Avaliar, Aplicar e Analisar), 31 residentes (16 do primeiro ano e 15 do terceiro).

Resultados: O desempenho geral foi intermediário, sem diferença significativa nas pontuações totais do ACE (46,7 versus 53,3; p = 0,509). Residentes do terceiro ano obtiveram maiores escores em Avaliar (p = 0,032), enquanto os do primeiro ano se destacaram em Aplicar (p = 0,013). Ambos alcançaram mediana de 100 em Analisar, indicando heterogeneidade e possível efeito teto. As atitudes em relação à Prática Baseada em Evidências foram positivas, embora os do terceiro ano relatem aplicação mais frequente (53% versus 19%). A falta de tempo foi a principal barreira.

Conclusão: Os residentes apresentaram competência moderada em Prática Baseada em Evidências, com diferenças específicas por domínio, indicando necessidade de capacitação direcionada para aprimorar a avaliação crítica e a aplicação prática.

INTRODUCTION

Evidence-Based Practice (EBP) is a clinical approach that integrates the best available scientific evidence, the clinician's expertise, and the patient's values, aiming to improve decision-making and optimize patient outcomes.[1,2] In Ophthalmology, in which therapeutic decisions have a direct impact on visual prognosis and quality of life, EBP plays a crucial role in ensuring safe and effective care. The process of EBP involves multiple steps, including formulating clinical questions, searching for relevant literature, critically appraising the evidence, applying it in practice, and assessing its impact on patient outcomes.[1-3]

Despite its recognized importance, incorporating EBP into daily clinical routines remains a challenge, particularly during residency training.[2,4-6] While knowledge of EBP concepts is often introduced early in medical education, many residents struggle to translate this knowledge into consistent practice. Several factors contribute to this gap, such as limited curricular integration, time constraints, and insufficient emphasis on the practical application of evidence. Moreover, the ability to evaluate the impact of evidence on patient care is frequently neglected, hindering the consolidation of EBP as a habitual component of clinical decision-making.[4,5]

In Ophthalmology Residency Programs, identifying gaps in EBP knowledge and practice is essential to strengthen training strategies and promote lifelong learning. Understanding how residents at different stages of training perceive and apply EBP can inform targeted educational interventions, enhance critical appraisal skills, and ultimately improve patient care.

The integration of EBP into the medical residency curriculum faces several barriers, both at the individual and institutional levels. These barriers are widely documented in the literature. Sadeghi-Bazargani et al.[7] consistently identified lack of time and work overload as the main obstacles. In addition, the review pointed to significant challenges related to the lack of adequate skills for searching and critically evaluating the literature, as well as limited access to information resources and technical support systems. These global findings reinforce the need to investigate how such barriers manifest themselves in specific contexts, such as medical residency in ophthalmology in Brazil, which motivated the present research.

Therefore, the aim of this study was to compare knowledge, perceptions, and competencies in EBP among first- and third-year ophthalmology residents in Brazil.

METHODS

A cross-sectional observational study was conducted among first- and third-year ophthalmology residents at the *Fundação Altino Ventura* (FAV). All residents regularly enrolled in the first and third years of the residency program who worked in outpatient clinics and elective surgeries in 2024 and provided written Informed Consent were included. The inclusion of residents from the first and third year was deliberate, aiming to capture potential differences in EBP knowledge, perceptions, and application between the early and advanced stages of training. The study was approved by the Institutional Review Board of the FAV (IRB Approval: 7.119.980; CAAE: 83483924.0.0000.5532).

Data collection was performed in person using printed questionnaires and the Assessing Competencies in Evidence-Based Medicine (ACE) tool. The first component consisted of a 13-item, author-developed questionnaire assessing sociodemographic data (age, sex, year of residency), research experience background, previous training in EBP, perceived importance and frequency of formulating clinical questions, sources and frequency of literature searches, confidence in critically appraising studies, and perceived barriers to implementing EBP. Additionally, this questionnaire included items specifically designed to explore the residents' knowledge of EBP principles and their application in daily clinical practice, enabling a more comprehensive understanding of their familiarity with and integration of EBP into routine care.

To develop this questionnaire, the authors conducted a prior bibliographic review to ensure that the items adequately explored residents' knowledge of the principles of EBP and their application in daily clinical practice. This process aimed to allow for a more comprehensive assessment of residents' familiarity with EBP and its integration into routine clinical care.

Additionally, the questionnaire was completed by the authors themselves as part of a preliminary validation process, with the objective of assessing the clarity, relevance, and coherence of the items developed. This instrument was designed to identify factors potentially influencing residents' EBP performance, providing contextual information to support the interpretation of the ACE Tool results.

We used the Brazilian Portuguese validated version of the ACE Tool (15 items; five domains: Ask, Acquire, Appraise, Apply, and Assess), validated by Maia et al.[8], based on the original ACE development. The "Ask" domain evaluates the ability to formulate structured clinical

questions using the PICOT framework. "Acquire" assesses skills related to identifying appropriate information sources and retrieving relevant evidence efficiently. "Appraise" examines the capacity to critically evaluate the methodological quality, validity, and relevance of research findings. "Apply" focuses on integrating evidence into clinical decision-making while considering patient context and preferences. Finally, "Assess" evaluates the ability to reflect on and measure the outcomes of evidence-based decisions in clinical practice.

Participants read a standardized hypothetical clinical trial abstract and then completed the ACE Tool to identify PICOT elements, appraise validity, and judge applicability.[3,9] Administration and application of the instrument followed the original protocol as described in the validation studies.

Each correct answer is awarded a predefined number of points, and the total is converted into a percentage scale from zero to one hundred, with higher scores indicating better EBP competency. On this scale, a score of one represents no correct answers, indicating a complete absence of the assessed competencies, while a score of one hundred indicates all answers correct, reflecting maximum performance and full mastery of the evaluated skills. This scoring system allows for the assessment of both domain-specific performance and overall proficiency. The questionnaire was administered according to the guidelines of the original protocol. It was conducted by a trained evaluator, blinded to the year of residency, following a pre-established script for clarifying doubts. Consultation of external materials was not permitted.

Variables included sociodemographic characteristics and EBP-related measures. ACE Tool scores were analyzed both as total scores and by domain. Data analysis was performed using Jamovi software (version 2.3.28). Categorical variables were expressed as absolute and relative frequencies. The Shapiro–Wilk test was applied to assess the normality of continuous variables. Group comparisons between first- and third-year residents were performed using the Student's t test for normally distributed continuous variables, the Mann-Whitney test for nonparametric continuous variables, and Pearson's Chi-squared test for categorical variables. A significance level of $p < 0.05$ was adopted.

RESULTS

A total of 31 ophthalmology residents participated in the study, including 16 first-year residents (51.6%) and 15 third-year residents (48.4%). The mean age was 27.2 ± 3.9 years for first-year residents and 28.5 ± 2.0 years for third-year residents. Sex distribution was similar between groups.

No statistically significant differences were observed between groups of first- and third-year residents for any variable (all $p > 0.05$) (Table 1). Both groups reported high relevance of EBP and similar previous research experience (87% in the first year and 100% in the third year). Attendance at EBP training was more frequent among third-year residents compared to first-year residents (73% versus 38%, respectively), and both relied mainly on scientific articles/databases to answer clinical questions. Database use was predominantly monthly in both groups (68% versus 80%, first and third years, respectively). Third-year residents more often reported frequent application of research results compared to first-year residents (53% versus 19%, respectively), while lack of time was the main barrier in both years (69% versus 46%, first and third years, respectively).

Table 1. Comparison of the use and Perception of Evidence-Based Practice among first- and third-year ophthalmology residents

Variable	Category	First year ophthalmology residents	Third year ophthalmology residents	p-value*
		n (%)		
Previous experience with scientific research?	Yes	14 (87)	15 (100)	0.484
	No	2 (13)	0	
Attended course or training in evidence-based practice?	Yes	6 (38)	11 (73)	0.073
	No	10 (62)	4 (27)	
Main source used to answer clinical questions	Scientific articles (databases)	11 (68)	12 (80)	0.221
	Textbooks	2 (13)	1 (7)	
	Colleagues' guidance	0	2 (13)	
	Other	3 (19)	0	
Frequency of use of scientific databases	Rarely	4 (25)	1 (7)	0.454
	Daily	0	1 (7)	
	Weekly	5 (31)	4 (27)	
	Monthly	7 (44)	9 (59)	
Criteria used to assess study validity	Study design	3 (19)	3 (20)	0.820
	Statistical significance	13 (81)	11 (73)	
	Sample size	0	1 (7)	
Frequency of applying research results in clinical practice	Rarely	3 (19)	0	0.105
	Occasionally	9 (56)	6 (40)	
	Frequently	3 (19)	8 (53)	
	Always	1 (6)	1 (7)	
Main barriers to applying evidence-based practice	Limited access to resources	0	3 (20)	0.288
	Difficulty understanding literature	1 (6)	1 (7)	
	Lack of time	11 (69)	7 (46)	
	Resistance to change	4 (25)	4 (27)	

*Chi-squared test.

The comparison of EBP competency domains measured by the ACE Tool between first- and third-year ophthalmology residents is shown in Table 2. Median total scores were 46.7 for first-year residents and 53.3 for third-year residents, with no statistically significant difference ($p > 0.05$). Considering the ACE Tool range of zero to one hundred, both groups demonstrated intermediate overall performance.

Table 2. Comparison of the Evidence-Based Practice competency domains between first- and third-year ophthalmology residents

Variable	First-year ophthalmology residents Median (IQR)	Third-year ophthalmology residents Median (IQR)	p-value*
Ask	100 (0-100)	100 (0-100)	0.623
Acquire	50 (0-100)	50 (50-50)	0.325
Appraise	25 (12.5-62.5)	50 (12.5-100)	0.032
Apply	100 (33.3-100)	66.7 (33.3-100)	0.013
Assess	100 (0-100)	100 (0-100)	0.891
Total	46.70 (26.70-66.70)	53.30 (26.70-80)	0.509

* Mann-Whitney test.
IQR: interquartile range.

Domain-specific analyses revealed distinct patterns: third-year residents scored significantly higher in the "Appraise" domain ($p = 0.032$), indicating more advanced critical appraisal skills likely developed through cumulative clinical exposure and engagement with the scientific literature. First-year residents achieved significantly higher scores in the "Apply" domain ($p = 0.013$), which may reflect recent participation in structured EBP training and greater facility in integrating research into the care of patients.

In the Assess domain, both groups reached a median score of one hundred, with a wide interquartile range (zero to one hundred). This clustering of maximum scores suggests a potential ceiling effect, indicating limited discrimination of performance differences between training levels within this domain and highlighting substantial variability in residents' ability to evaluate the outcomes of evidence-based interventions.

DISCUSSION

This study investigated the knowledge, perceptions, and application of EBP among first- and third-year ophthalmology residents in a Brazilian training center. No statistically significant differences were observed in the total ACE Tool scores between the groups; however, the median scores indicate an intermediate level of performance in both groups, considering the zero to one hundred scale, suggesting substantial room for improvement in the assessed competencies. Domain-specific differences revealed that third-year residents more frequently reported applying EBP in clinical practice, whereas first-year residents demonstrated higher performance in the Apply domain of the ACE Tool.

The absence of a statistically significant difference in total EBP scores suggests that the fundamental principles of EBP are introduced early in residency and retained throughout training. This aligns with previous studies showing that early exposure to structured EBP curricula fosters a baseline competence that can be sustained over time.[5,10] The stronger performance of first-year residents in the Apply domain may be associated with recent participation in formal EBP instruction and reduced clinical workload, facilitating greater focus on standardized application tasks. Similar findings have been reported by Wang et al.,[11] who demonstrated that integrated EBP courses significantly enhance information literacy and the immediate application of evidence-based decisions among medical trainees.

Conversely, the superior performance of third-year residents in the "Appraise" domain likely reflects the cumulative benefit of repeated exposure to clinical cases, active participation in journal clubs, and greater familiarity with the critical evaluation of scientific literature.[11] This progressive improvement in appraisal skills is consistent with the notion that certain EBP competencies, particularly those related to study validity assessment, mature through longitudinal clinical engagement rather than through short-term educational interventions.[12]

Although both groups reached the maximum possible median score in the "Assess" domain, the wide variability (zero to one hundred) suggests inconsistent competence and insufficient curricular emphasis on outcome evaluation. Moreover, the discrepancy between residents' self-reported frequent application of EBP and their only intermediate objective performance may reflect an overestimation of skills. This misalignment can be conceptually interpreted through the lens of the Dunning-Kruger effect, which describes a tendency for individuals with lower levels of competence to overestimate their abilities.[13] Importantly, metacognitive bias was not directly assessed in this study, and the Dunning-Kruger effect is referenced solely as a theoretical framework to aid interpretation, rather than as a measurable construct within the present analysis.

This step is often neglected in clinical routines, likely due to limited curricular time, lack of structured follow-up on implemented interventions, and the complexity of outcome measurement in real-world settings.[10,12]

Addressing this gap is critical, as the ability to assess the effects of evidence-based decisions is essential for closing the EBP cycle and ensuring continuous improvement in patient care.

These findings highlight the need for residency programs to adopt a longitudinal, integrated approach to EBP education, one that not only introduces concepts early but also reinforces and deepens competencies at successive stages of training. Interventions such as embedding EBP assessment activities into routine case discussions, fostering mentorship in critical appraisal, and integrating outcome evaluation into clinical audits could help strengthen underdeveloped domains. The development of EBP skills requires systematic integration into the curriculum over time, emphasizing continuous reinforcement and practical application.[14]

Some methodological aspects of this study may be considered limitations, including its single-center design, reliance on self-reported measures for certain variables, and the relatively small sample size. Nevertheless, strategies were adopted to mitigate these limitations: a validated assessment instrument (ACE Tool) was used, residents from different stages of training were included, and the standardized nature of ophthalmology residency curricula in Brazil supports the applicability of findings to similar training settings. Furthermore, triangulating self-reported data with objective assessments, as performed in this study, strengthens the reliability of the results.

Future studies should explore multi-center designs, longitudinal follow-up of EBP skill development, and the impact of specific curricular interventions aimed at enhancing neglected domains such as outcome assessment. In practice, program directors may consider revising educational strategies to balance early conceptual instruction with ongoing reinforcement through clinically embedded EBP activities, ultimately promoting a complete and continuous EBP cycle.

CONCLUSION

The findings of this study indicate that ophthalmology residents demonstrate an intermediate level of competence in Evidence-Based Practice, with no significant differences in overall performance between training years, but with meaningful variations across specific domains. While critical appraisal skills appear to improve with training progression, the practical application of evidence does not follow a consistent developmental pattern. Furthermore, the discrepancy between self-perceived competence and objective performance, combined with time constraints as the main barrier, highlights gaps in the effective integration of EBP into clinical practice. These results underscore the need for longitudinal, competency-based, and integrated educational strategies to ensure balanced development across all EBP domains and to promote its consistent incorporation into clinical decision-making.

AUTHORS' CONTRIBUTION

Rolim RD and Narciso KN contributed equally to the study design, analysis, and interpretation of the results, as well as to the writing and critical revision of the manuscript content; Ventura CV contributed to the interpretation of the results, writing, and critical revision of the manuscript content; Soares AKA contributed to the conception and design of the study, analysis and interpretation of the results, as well as to the writing and critical revision of the manuscript content. All authors approved the final version of the manuscript and are responsible for all its aspects, including ensuring its accuracy and integrity.

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