

RESEARCH

Mapping the landscape: A scientometric analysis of health professions education literature in Hispanic America

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Abstract

Context: Health professions education (HPE) scholarship is expanding but remains unevenly distributed by region and language. Scientometrics can guide efforts to strengthen bibliodiversity, particularly for Global South regions underrepresented in HPE meta-research.

Objectives: This study aims to characterise publications from Hispanic America across medicine, nursing, dentistry and veterinary medicine, examining productivity, venues, collaboration, gender and thematic evolution.

Methods: We analysed HPE journal articles (1992–2025) indexed in PubMed, Scopus and SciELO Citation Index (Web of Science), requiring ≥1 Hispanic American author affiliation. Records were merged, deduplicated and curated, and then analysed in Bibliometrix/Biblioshiny (Bradford concentration, author productivity, networks). Author gender was inferred from names using gender-guesser.

Results: We retrieved 3598 publications (annual growth 7.8%) authored by 11 240 individuals from 1563 institutions and published in 796 journals. Medicine accounted for most articles ($n = 2182$), followed by nursing ($n = 637$), dentistry ($n = 318$), veterinary medicine ($n = 68$) and mixed health sciences ($n = 403$). The year 2023 was most productive (319 articles). Four hundred thirty-seven papers were single-authored. Author productivity was long-tailed (83.4% published once; 1.2% published >5 articles). International co-authorship was 17.2%; collaboration formed cohesive clusters with limited bridging. Publishing was concentrated: 15 core journals (1.9%) produced 34% of articles. Chile, Mexico, Peru, Colombia and Cuba led the output. Two thousand three hundred and six (64%) were in Spanish, 1260 (34.9%) in English, and 42 (1.1%) in both. Gender was near balanced (female 50.7%, male 47.3%; 0.35% androgynous and 1.7% unclassified), but women were underrepresented among the most prolific authors. Keywords emphasised *teaching/learning* and *curricula/assessment*, with post-2020 prominence of *mental health* and *distance education/simulation training*.

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Conclusions: HPE scholarship in Hispanic America is growing, but expansion is occurring within an ecosystem marked by concentration and uneven connectivity ('growth with fragility') and centre-periphery dynamics in scholarly communication. Recognising multilingual evidence and investing in bibliodiversity through bilingual dissemination/metadata, open identifiers and equitable collaboration can broaden the evidence base and support educational impact.

1 | INTRODUCTION

Health professions education (HPE) scholarship is one of the ways educators 'join the conversation' about what counts as evidence, which educational problems deserve attention, and how health professionals should be trained.¹ HPE has grown in dedicated journals, methodological sophistication and meta-research that studies the field itself. Bibliometric and scientometric approaches, the quantitative study of scholarly communication, enable systematic analysis of large corpora to describe productivity, collaboration, dissemination venues and thematic evolution.² Such mapping makes visible whose voices shape the published record.

Yet the published HPE literature remains unevenly distributed across regions and languages. Meta-research has shown geographic concentration and limited multinational collaboration.^{3–5} These patterns matter because authorship 'voices' influence what becomes visible and valued in the field; lack of representational diversity can signal epistemic injustice, in which some ways of knowing are systematically less likely to enter high-visibility scholarly conversations.³ Critiques highlight how dominant publication norms can produce 'Northern ventriloquism', whereby scholars outside dominant centres feel pressure to adopt Northern conventions in order to be heard in internationally recognised venues.^{6,7}

To interpret these dynamics, we draw on a scholarly knowledge ecosystem lens: publishing is a coupled system of people (authors, reviewers, editors), institutions (universities, funders), infrastructures (journals, databases, indexing services) and incentives that shape what is produced and what becomes visible.⁸ Within this ecosystem, centre-periphery dynamics operate when evaluation systems and indexing infrastructures privilege 'core' venues and dominant languages, marginalising locally relevant work published in regional outlets.⁹ Language asymmetries further influence retrieval, readership, and citation of non-English scholarship.¹⁰ In contrast, bibliodiversity, developed within Latin American scholarly communication, emphasises the value of sustaining multiple languages, publication venues and non-commercial infrastructures to preserve epistemic plurality and equitable access.¹¹

However, much HPE meta-research still relies on corpora defined by relatively small sets of journals and by coverage in major databases, choices that can unintentionally reproduce centre-periphery effects. Delineating the field is not trivial,¹² even carefully designed approaches show that standard indexing and controlled vocabularies can miss substantial proportions of medical education scholarship,¹³

and journal sets can overrepresent English language.^{2–4} These limitations make it difficult to 'listen' to the full range of scholarly conversations, particularly those from regional publishing circuits.

Hispanic America (Spanish-speaking countries in Latin America) offers an analytically coherent case for studying how language and infrastructure shape knowledge circulation. The region has long-standing traditions in health professional training and a distinctive, largely open-access publishing infrastructure, yet there remains limited field-level synthesis of indexed HPE publication patterns. A regional scientometric map can serve as a baseline for monitoring growth, identifying core journals and collaboration structures, and tracing topic trends. For the broader medical education community, such evidence can inform strategies to strengthen equitable collaboration and knowledge exchange while sustaining bibliodiversity.

The goal of this study was to characterise HPE publications from Hispanic America in medicine, nursing, dentistry and veterinary medicine, using scientometric methods. Specifically, we asked:

1. How has HPE publication output from Hispanic America evolved over time, and how is it distributed across countries, institutions, languages and journal venues?
2. What are the patterns of authorship, collaboration and thematic evolution in the Hispanic American HPE literature?

2 | METHODS

2.1 | Study design and conceptual orientation

We conducted a scientometric analysis using bibliographic metadata to examine HPE scholarship from Hispanic America. Scientometrics is the quantitative study of scientific publications and their relationships.^{2,14,15} We used the conceptual frameworks of scholarly knowledge ecosystem, centre-periphery dynamics and bibliodiversity.^{8,11,16}

We defined regional as publications with at least one author affiliation in a Spanish-speaking country of Latin America. We conceptualised the corpus as a scholarly knowledge ecosystem because it includes knowledge producers (authors, institutions and countries), dissemination venues (journals and databases), indexing infrastructures, collaboration structures and knowledge content (author keywords).⁸ Bibliodiversity was operationalised through language of publication and inclusion of SciELO. Centre-periphery dynamics were operationalised through journal concentration, language, indexing source, publication in

high-visibility international HPE journals and international collaboration patterns. Expanded definitions are presented in Appendix S1, *Glossary of key concepts and scientometric terms*.

Our workflow was adapted from Scholz et al. protocol for scientometric analyses: planning/retrieval, migration/curation, analysis, visualisation and interpretation.¹⁷

2.2 | Regional and linguistic scope

We defined *Hispanic America*, as Spanish-speaking countries of Latin America, to preserve a coherent regional knowledge ecosystem shaped by shared language and publishing circuits. Language affects retrieval, citation and knowledge uptake by researchers, reviewers, editors and evidence synthesis authors.^{10,18} Centre-periphery analyses highlight how database infrastructures can reproduce asymmetries in visibility and symbolic capital.^{9,16,19}

Spain and Portugal were excluded because they belong to a different research ecosystem within the European space.^{9,19} Puerto Rico was excluded because it is a United States territory and Puerto Rican science is strongly coupled to the US system.²⁰ Brazil was excluded to avoid conflating Spanish- and Portuguese-language scholarly circuits; analyses suggest that Spanish and Portuguese circuits are related but not identical.¹⁹

2.3 | Data sources, search strategy and corpus definition

Searches were conducted between January 2024 and December 2025. We searched PubMed, Scopus and the Scientific Electronic Library Online (SciELO) Citation Index in Web of Science. SciELO is a Latin American open-access journal platform and indexing infrastructure; it was included to capture regional scholarship that is less visible in global databases, a dimension of bibliodiversity.^{16,21}

Search strategies were developed iteratively. We combined education-related terms with discipline terms and country terms for Hispanic America. Educational terms were searched primarily in the title field and through journal/source title filters; discipline and geographic terms were searched in title/abstract/keyword/topic fields. This title-field restriction was chosen to reduce false positives, but it may under-retrieve relevant articles that do not explicitly signal education in the title. Complete search strategies are provided in Appendix S2, including data sources, search strategy and corpus definition.

2.4 | Eligibility criteria

We included articles published between 1 January 1992 and 31 December 2025 that addressed education or training in medicine, nursing, dentistry or veterinary medicine and included at least one author affiliation located in a Spanish-speaking Latin American country. We included articles published in Spanish and/or English. We

excluded conference abstracts, editorials, letters, news items and articles focused on patient education.

2.5 | Data export, merging and curation

Records were exported to Zotero and Bibliometrix/Biblioshiny, merged and de-duplicated using unique identifiers. We normalised author names, institutional affiliations, countries and journal titles. Country assignment was derived from the affiliation field. Articles were retained if they included at least one Hispanic American affiliation.

2.6 | Scientometric indicators and analyses

We used Bibliometrix 5.0 and its Biblioshiny interface for analysis and visualisation.²² We generated indicators at several levels:

- Productivity and growth: annual publication counts, growth rate and distribution by profession, country, institution and language.
- Publication venues and concentration: journal productivity and identification of core journals using Bradford's law, which describes how literature on a topic concentrates in a small core of journals followed by a long tail of less frequent sources.²³
- Author productivity and citation-based descriptors: author productivity was described using publication counts and distribution predicted by Lotka's law, which describes the skew whereby many authors publish one paper and a small minority publish repeatedly.²⁴ We reported h-index and g-index as citation indicators for authors and/or journals.^{25–27} We did not use Journal Impact Factor (JIF) as an indicator, given limitations related to field comparability and database coverage.²⁸
- Collaboration and connectivity: we analysed co-authorship patterns and networks at author, institution and country levels.^{29,30} International collaboration was defined as an article with author affiliations from two or more countries.
- Knowledge content and thematic evolution: we analysed author keywords, as supplied by authors in metadata. We used co-word analysis and thematic mapping. In thematic maps, centrality reflects how strongly a theme connects to other themes, whereas density reflects the internal development of a theme. Themes were classified as motor, basic, niche or emerging/declining according to their position in the centrality-density map.³¹ Motor themes are both central and internally developed, indicating topics that are important and well consolidated within the field. We compared two periods, 2002–2014 and 2015–2025.

2.7 | Gender analysis

We used the gender-guesser Python library (<https://pypi.org/project/gender-guesser/>), which assigns probabilistic categories based on

TABLE 1 Scientometric indicators of journal productivity and impact.

Journal	Number of articles	H-index	Institution
Revista Cubana de Educación Médica Superior	266	18	University of Medical Sciences of Havana, Cuba
Revista Médica de Chile	173	52	Medical Society of Santiago, Chile
Investigación en Educación Médica	143	12	National Autonomous University of Mexico (UNAM), Mexico
Educación Médica	119	25	Complutense University of Madrid, Spain
Gaceta Médica de México	67	29	National Academy of Medicine, Mexico

given names. Results were reported as female-associated, male-associated or unclassified.^{32,33}

2.8 | Use of generative artificial intelligence

After drafting in Spanish and preparing a first English version of the manuscript, we used ChatGPT (OpenAI; GPT-5) as a language support tool to check translation. The authors reviewed edits and content changes and verified accuracy. ChatGPT did not generate study data, curate metadata, compute indicators or produce results.³⁴

2.9 | Ethical considerations

This study analysed publicly available bibliographic metadata. The project was approved by the National Autonomous University of Mexico (UNAM) Faculty of Medicine Research and Ethics Committees, with number FM/DI/074/2022.

3 | RESULTS

Three thousand six hundred and eight articles were identified. Annual growth rate was 7.8%, international collaboration was 17.2%. Medicine had the largest share ($n = 2182$), followed by nursing ($n = 637$), dentistry ($n = 318$), veterinary medicine ($n = 68$) and mixed categories ($n = 403$). Two thousand three hundred and six (64%) were in Spanish, 1260 (34.9%) in English and 42 (1.1%) in both languages. We identified 796 journals, 1563 institutions, and 11 240 authors contributing to the field. Single-authored papers were 437. The year 2023 was the most productive (319 articles).

3.1 | Scientometric indicators of journals

The most prominent journals are in Table 1. We did not use the JIF because it has limitations for evaluating many Latin American journals.²⁸ Most HPE Global South journals either lack a JIF or report low values that do not reflect quality or impact. We used the h-index, which can be derived from sources with broader coverage, such as Scopus or SciELO, and reflects productivity and citation impact (Table 1).²¹

According to Bradford's law, 15 journals (1.9% of 796) comprised Zone 1 or core, and concentrated 34% of the total articles

($n = 1227$)¹⁷ (Fig. 1). The remaining journals formed a long tail of low-frequency sources, indicating that HPE papers were dispersed across a wide range of clinical and discipline-specific journals. This dispersion is important for discoverability because relevant studies may be located outside conventional HPE outlets.

3.2 | Scientometric indicators of authors

The analysis identified 11 240 contributing authors. Consistent with Lotka's law, 83.4% of authors ($n = 9373$) published only once, 10.7% ($n = 1203$) published twice and only 1.2% ($n = 144$) published more than five articles, indicating concentration of sustained publishing among a small group.²⁴ Only one woman appears in the top 10 authors (Illesca Pretty Mónica).

Maggio et al. developed a set of 24 journals (MEJ-24) that represents the core of HPE publications.³ We found that Hispanic American authors published 151 papers in 19 (79.2%) of these journals, involving 803 authors. Only two authors (Melchor Sánchez-Mendiola and Adrián Martínez-González) appear in the top 10 of both listings. The complete list of Hispanic American scholarly output in MEJ-24 journals is detailed in Appendix S3.

Author collaboration networks showed distinct clusters, largely organised by shared national and institutional affiliations, and only a limited number of authors appeared to link otherwise separate collaborative communities. These bridging authors represent potential nodes for multi-centre or cross-profession research programmes. Overall, interconnections between the main clusters were limited, indicating fragmentation across collaborative communities.

3.3 | Gender analysis

Female-associated names accounted for 50.6% ($n = 5685$) of records and male-associated names 47.3% ($n = 5317$); 0.35% androgynous ($n = 40$) names and 1.7% ($n = 198$) unclassified.

3.4 | Scientometric indicators of affiliations

At institutional level, UNAM (Mexico) ranked first (490 articles), followed by Universidad de Chile (265) and Pontificia Universidad Católica de Chile (235). The most productive countries were Chile (2225 publications), Mexico (1684), Peru (1651), Colombia (1309) and Cuba (1131).

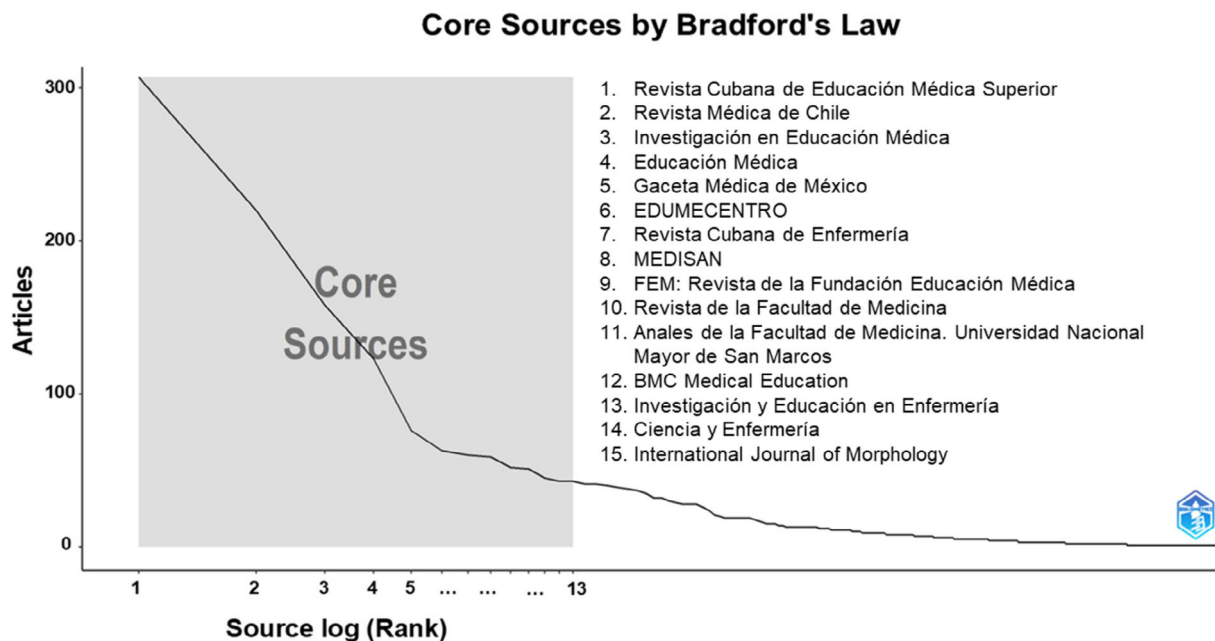


FIGURE 1 Core sources by Bradford's law.

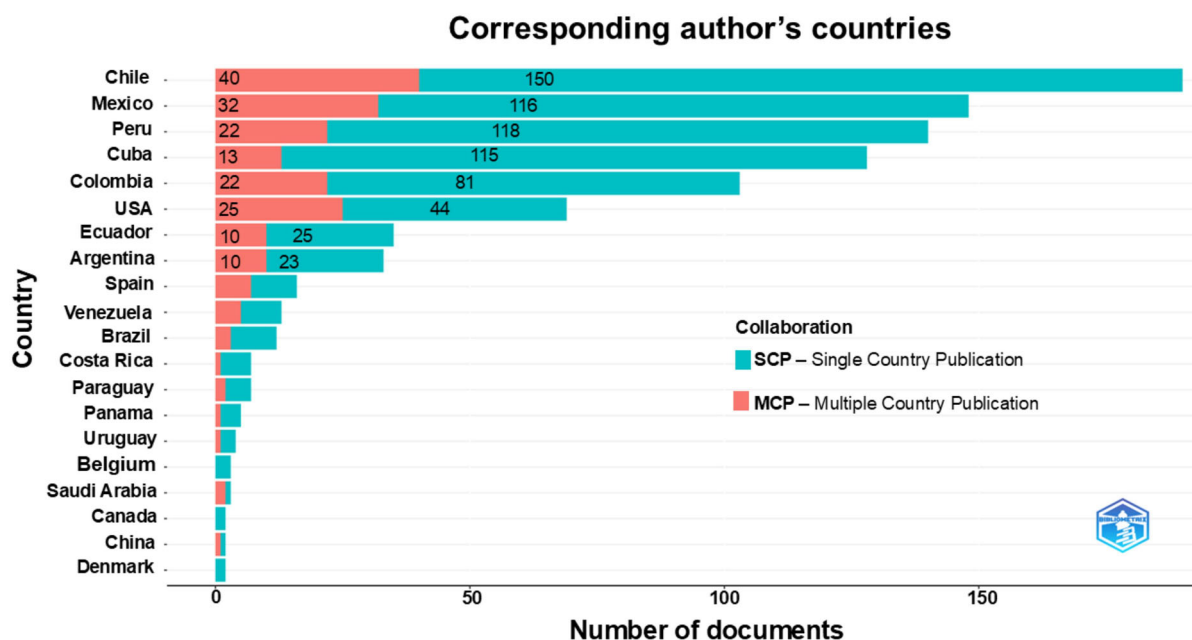


FIGURE 2 Corresponding author's countries. Blue bars represent single country publication (SCP), red bars multiple country publication (MCP).

International collaboration remained modest (17.2%). Mexico and Chile had the highest multiple-country publications (Fig. 2). The appearance of countries outside Hispanic America reflects participation as collaborators in eligible publications.

Country collaboration mapping showed Mexico and Chile as the key hubs, with visible networks for Colombia, Peru, Cuba and Ecuador (Fig. 3). Links extended to North America and Europe and, to a lesser extent, Asia.

3.5 | Scientometric indicators of documents and keywords

Keyword analysis (5780 authors' keywords) was used to identify trends. Themes were mapped using centrality (influence within the network) and density (degree of development), and bubble size represented frequency (Fig. 4). Thematic evolution was examined in two periods: 2002–2014 and 2015–2025.

Countries' collaboration world map

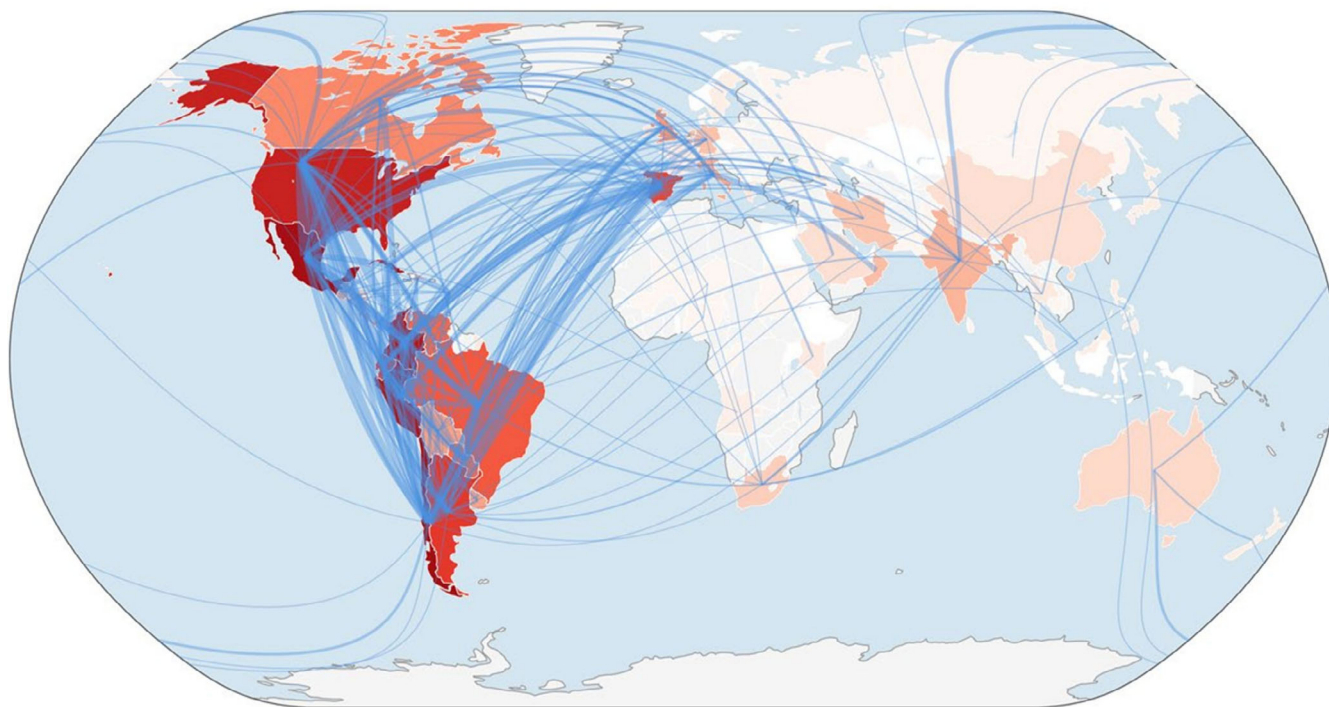


FIGURE 3 Country collaboration world map.

In the first period (Fig. 4a), motor topics, such as continuing education and professional development, dominated, along with basic topics including curriculum, attitudes and clinical competence. Learning styles, teaching processes and competencies appeared as niche topics, together with distance education and internationalisation; ethics and validation studies were emerging or declining themes.

In the second period (Fig. 4b), motor topics were COVID-19 pandemic, health promotion and professional training. Among basic topics, validation and cross-sectional studies, surveys and questionnaires, and qualitative research were prominent. Mental health, psychological stress and burnout appeared as niche topics. Learning styles and simulation were identified as emerging or declining themes.

4 | DISCUSSION

This scientometric analysis maps HPE scholarship from Hispanic America. Output grew steadily but expansion occurred alongside strong concentration in a small group of countries, institutions and journals, a long-tail pattern of author productivity, modest international collaboration and limited bridging across co-authorship clusters. Compared with earlier regional analyses, our corpus indicates broader growth while retaining structural unevenness.³⁵ These findings support the interpretation of 'growth with fragility', the field is expanding, but its capacity, connectivity and international visibility remain uneven.

Spanish-language publication, regional journals and limited representation in high-visibility Anglophone HPE venues shape what is

retrievable, cited, synthesised and recognised as part of the global field. Nearly two-thirds of the corpus was published in Spanish, while just over one-third was published in English. The predominance of Spanish-language publications suggests that much HPE scholarship from Hispanic America circulates through a regional linguistic ecosystem, reinforcing the importance of bibliodiversity while simultaneously creating challenges for discoverability in English-language evidence syntheses and international publishing venues. HPE scholarship in Hispanic America is not simply underrepresented in global literature; it circulates through partially distinct language and indexing infrastructures. This matters because global evidence syntheses, journal searches, editorial decisions and citation practices privilege English-language databases and search terms, potentially excluding locally relevant HPE knowledge.^{10,18,19} The consequence is that 'global' conversations may be narrower than they appear if Spanish-language evidence is systematically harder to find or cite. The Core-24 journals comparison suggests that Hispanic American HPE scholarship is not absent from internationally visible journals; most of it circulates through a regional publishing circuit that remains partially connected to dominant Anglophone HPE spaces.

A scholarly knowledge ecosystem lens helps interpret these patterns.⁸ The Bradford core indicates that a small set of journals functions as the main entry point for HPE scholarship. This concentration has advantages: core journals provide stable publishing venues, editorial familiarity with local systems and accessible outlets for authors. However, if visibility depends heavily on a small number of journals, the field may be more susceptible to indexing changes, uneven editorial capacity and limited methodological diversity. The long tail of

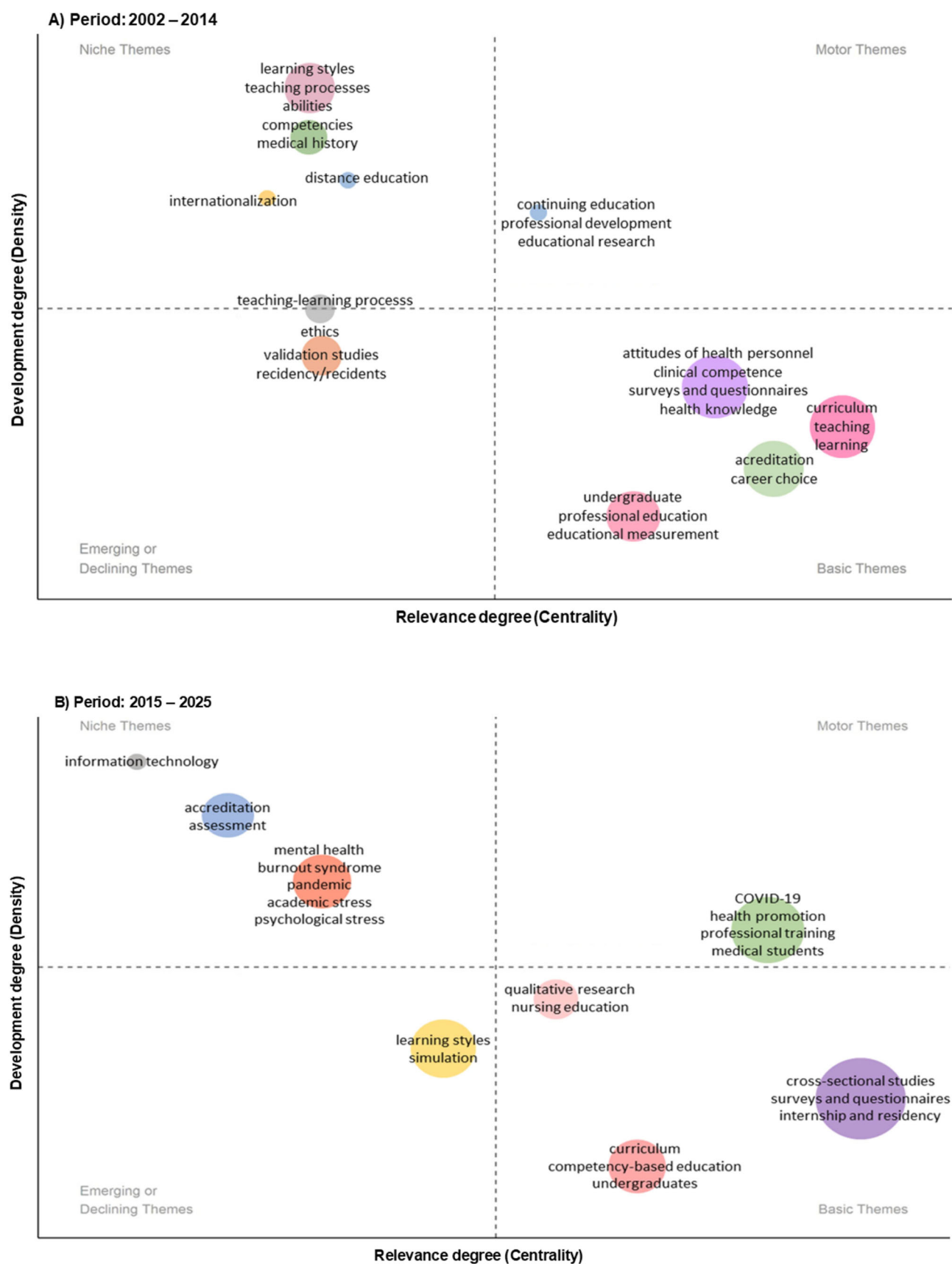


FIGURE 4 Thematic evolution map. (a) First period: 2002–2014. (b) Second period: 2015–2025.

lower-frequency journals suggests that relevant HPE work is dispersed across clinical and general health journals, which makes the literature harder to retrieve for educators and synthesis teams.

Consistent with Lotka's law, most authors appeared only once, while a small group accounted for sustained output. Non-recurrent authorship reflects structural conditions in HPE scholarship: limited protected time for education research, uneven access to mentorship, few formal HPE research pathways, and the fact that many faculty conduct scholarship alongside demanding clinical, teaching and administrative roles. A large proportion of non-recurrent authors may signal a field that is broadening participation while still developing the institutional and collaborative infrastructures necessary for sustained scholarly trajectories. If the goal is to move from isolated educational projects to cumulative knowledge, the region needs capacity-building strategies like research methods training, writing groups, cross-institutional mentoring, protected time and recognition of educational scholarship in promotion.

Latin America's open access infrastructures demonstrate that open dissemination can be built through public-interest models.²¹ Yet the global shift towards author-pays open access can reproduce inequities. A cross-sectional study found that many open access venues have limited waiver/discount transparency, and the cost burden is disproportionately high for authors based in lower-income settings.³⁶ These cost structures narrow the range of voices in high-visibility venues and intensify centre-periphery dynamics.^{11,36}

International collaboration was 17.2%, and author/country networks showed cohesive local clusters but limited bridging across clusters. These patterns suggest that Hispanic American HPE scholarship is not isolated, but its connections are uneven. Local cohesion is valuable because it supports contextually grounded research communities. However, when clusters remain weakly connected, methods and innovations circulate slowly across countries and institutions. Bridging authors and institutions can connect national communities, support multicentre studies and facilitate comparative work. The priority should be equitable collaboration with shared agenda-setting, transparent authorship practices, and recognition of local expertise. International partnerships can reproduce asymmetry when questions, methods, analysis and authorship are shaped primarily by better-resourced partners.^{29,37}

Centre-periphery dynamics refers to a relational structure in scholarly communication in which particular journals, languages, databases and metrics become 'central' because they confer visibility, legitimacy and citation advantage.^{9,16} Hispanic American HPE scholarship occupies a productive but partly bounded circuit, strong enough to sustain a growing regional literature, but not positioned to influence the dominant Anglophone HPE conversation. Epistemic injustice occurs when some groups are disadvantaged as knowers, when their knowledge is treated as less credible, less generalisable or less worthy of uptake.³⁸ Scholars outside dominant centres feel pressure to adopt Northern frames and publication conventions in order to be recognised.^{6,7} Global South HPE scholars describe these tensions as a form of 'border-crossing', where authors may need to reshape their scholarly voice to fit dominant expectations.³⁹

Strengthening regional journals and Spanish-language scholarship is important for bibliodiversity and epistemic plurality. Latin America's open-access tradition shows that non-commercial, public-interest publishing infrastructures can support broad access to local knowledge.^{11,21} Hispanic American scholars should also be able to participate in, shape and challenge high-visibility international HPE conversations. These aims are not mutually exclusive, but they require deliberate action.

Hispanic American journals can strengthen discoverability through bilingual titles, abstracts and keywords; consistent DOI assignment; ORCID use; structured metadata; and indexing strategies. International HPE journals can support bibliodiversity by encouraging submissions from non-Anglophone contexts, diversifying editorial boards and reviewer pools, offering language support, and valuing contextual contributions rather than treating them as merely 'local'. Evidence synthesis teams should search regional databases such as SciELO. Institutions and professional societies can create multicountry HPE research networks that support mentorship, methods training and collaborative projects. Responsible metrics frameworks reinforce that indicators should be interpreted in relation to context and language.²⁷

Name-associated gender distribution was nearly balanced. However, only three women were represented in the 20 most prolific authors. This pattern aligns with international HPE literature showing progress towards parity in authorship but persistent gaps in senior and editorial positions.^{40,41} Participation parity should not be mistaken for influence parity. Future analyses should examine author position, editorial leadership and intersectional patterns across country and language. Because our gender analysis relied on name-based inference, results should be interpreted cautiously.³²

The thematic evolution results show a field that has matured around teaching, learning, curriculum and assessment while increasingly engaging with mental health, burnout, stress, COVID-19, distance education and simulation. These themes indicate the educational problems around which regional HPE communities are organising.^{42–45} The rise of mental health and burnout suggests a concern with trainees' well-being. Distance education, simulation and pandemic-related terms reflect the field's adaptation to contemporary disruptions and digital learning environments. The next step is to move beyond documenting themes towards evaluating which educational interventions work, for whom and in which contexts.

This study has strengths: it uses multiple databases, includes SciELO to improve regional capture and covers four health professions for several decades. However, its limitations are important. First, database coverage is incomplete. PubMed, Scopus and SciELO Citation Index do not capture all local scholarship, especially non-indexed journals, institutional reports, books, theses, conference proceedings and local innovations. Second, the search strategy prioritised education-related title terms; this may have excluded relevant HPE articles that did not explicitly signal education in the title. Third, we did not classify publications by study type. Consequently, the study cannot determine the different forms of knowledge production. Fourth, although our analysis includes some citation-related

descriptors, it does not examine citation flows between regional and international journals; such analyses would be important for directly testing knowledge circulation and centre-periphery dynamics. Fifth, metadata inconsistencies may affect author, affiliation, country and language assignment. Finally, our operational definition excluded Brazil, Portugal, Spain and Puerto Rico; the findings should not be generalised to all Latin America or Ibero-America.

Future work could involve comparative analyses with Portuguese-speaking Brazil and broader Ibero-American scholarship; citation-flow studies between Spanish-language regional journals and leading international HPE journals; classification of article types and methodological designs; analysis of first- and last-authorship patterns; and qualitative studies with authors, editors and reviewers to understand how language, incentives and editorial expectations shape publication choices.

5 | CONCLUSION

This study shows that HPE scholarship in Hispanic America is growing, structured and thematically responsive. The challenge is that much of this knowledge circulates through language and infrastructure pathways that remain partially connected to dominant global HPE venues. For the broader medical education community, the implication is that broadening the evidence base requires rethinking search practices, editorial norms, collaboration models, language expectations and metric systems so that multilingual and regionally grounded scholarship can be found, valued and used.

The high proportion of non-recurrent authors and the limited connectivity among collaboration clusters suggest opportunities for faculty development initiatives that support engagement in scholarship, research methods training, writing groups, protected scholarly time and multicentre networks. Strengthening HPE research requires fostering global communities capable of generating cumulative, collaborative and theoretically informed scholarship.

AUTHOR CONTRIBUTIONS

MSM conceptualised the study, analysed and interpreted the data, drafted and revised the manuscript, gave final approval and agreed to be accountable for all aspects of the work. RSS, DBC and VLL substantially contributed to the study design; performed the bibliometric data search, collection, visualisation, analysis and interpretation; critically revised the manuscript, gave final approval; and agreed to be accountable for all aspects of the work. CGC and AMG substantially contributed to the study design, analysis and interpretation of data; critically revised the manuscript; gave final approval; and agreed to be accountable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

ETHICS STATEMENT

The project was approved by the National Autonomous University of Mexico (UNAM) Faculty of Medicine Research and Ethics Committees, with number FM/DI/074/2022.

PREVIOUS PRESENTATIONS

Preliminary study results were presented at the AMEE 2025 Conference in Barcelona, Spain, August 27, 2025.

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