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ORIGINAL

Research competencies and barriers to research among radiology professionals in Sucre, Bolivia: an explanatory sequential mixed methods study

Competencias investigativas y barreras para la investigación en profesionales de radiología de Sucre, Bolivia: un estudio mixto secuencial explicativo

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ABSTRACT

Introduction: Research in radiology requires competencies that enable clinical problems to be transformed into scientific evidence; however, their development may be constrained by educational and organizational factors. Objective: To analyze research competencies and barriers to research among radiology professionals in Sucre, Bolivia, during 2025. Methods: An explanatory sequential mixed methods study was conducted. The quantitative phase used a census of 150 professionals and two validated questionnaires: research competencies, 45 items, Aiken's V=0.95 and Cronbach's α=0.912; and research barriers, 30 items, Aiken's V=0.92 and α=0.906. The qualitative phase included interviews with four managers and a focus group of 10 professionals. Results: Overall research competencies were low in 53% of participants. The greatest weaknesses were scientific collaboration and scientific production. Institutional barriers reached 93% in high/very high levels, structural barriers 91%, and interinstitutional articulation barriers 89%. Qualitative findings linked these patterns to clinical workload, lack of protected research time, insufficient methodological training, limited resources, and weak hospital-university collaboration. Conclusions: Strengthening research capacity requires multilevel interventions combining training, mentoring, protected time, funding, and collaborative networks.

Keywords: research competencies; radiology; health services research; research barriers; mixed methods.

RESUMEN

Introducción: La investigación en radiología requiere competencias que permitan transformar problemas clínicos en evidencia científica; sin embargo, su desarrollo puede verse limitado por factores formativos y organizacionales. Objetivo: Analizar el nivel de competencias investigativas y las barreras para investigar en profesionales de radiología de Sucre, Bolivia, durante la gestión 2025. Métodos: Se realizó un estudio mixto secuencial explicativo. La fase cuantitativa incluyó censalmente a 150 profesionales y utilizó dos cuestionarios validados: competencias investigativas, 45 ítems, V de Aiken=0,95 y α=0,912; y barreras, 30 ítems, V de Aiken=0,92 y α=0,906. La fase cualitativa comprendió entrevistas a cuatro directivos y un grupo focal de 10 profesionales. Resultados: El 53% presentó nivel global bajo de competencias. Las mayores debilidades correspondieron a colaboración científica y producción científica. Las barreras institucionales alcanzaron 93% en niveles alto/muy alto, las estructurales 91% y las de articulación interinstitucional 89%. La fase cualitativa vinculó estos resultados con sobrecarga asistencial, falta de tiempo protegido, formación metodológica insuficiente, recursos limitados y débil articulación hospital-universidad. Conclusiones: El fortalecimiento requiere intervenciones multinivel que combinen formación, mentoría, tiempo protegido, financiamiento y redes de colaboración.

Palabras clave: competencias investigativas; radiología; investigación en servicios de salud; barreras para la investigación; métodos mixtos.

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INTRODUCTION

Modern radiology occurs in a context of rapid technological innovation, high volume of generated data, and growing demand for evidence-based decisions. Evidence-based practice, which allows integrating the best available scientific information with clinical experience and patient needs, is a relevant component for the quality and safety of imaging services [1]. Within this framework, the radiology professional cannot remain solely in the operational mastery of equipment and diagnostic protocols; they need capabilities to search the literature, formulate questions, design studies, analyze data, and communicate results in order to incorporate them into clinical practice.

Research competencies integrate knowledge, methodological skills, critical thinking, information management, and scientific communication abilities. In health professionals, their development depends both on university training and on opportunities for continuing education and on the existence of institutional environments that allow research [2]. In medical imaging, previous studies have shown that research competence may remain limited even when technical-care performance is adequate, especially when methodological training and opportunities for professional development are insufficient [3].

The problem is particularly relevant in Bolivia. National scientific production in health has shown growth, but it remains strongly linked to international collaboration and presents limited participation of local institutions and authors compared with more consolidated scientific systems [4]. In addition, in health sciences production visible in SciELO Bolivia, universities and health services participate significantly, although the capacity to generate and sustain research continues to be heterogeneous among institutions and regions [5]. In this scenario, having specific evidence on radiology professionals is necessary to guide training and management decisions.

The international literature describes a consistent pattern. In Nordic countries, radiographers' participation in research activities was low despite a positive valuation of research and evidence-based practice [6]. Among the factors that favor participation, support from colleagues and other professionals, confidence in their own skills, and an organizational culture oriented toward research stand out; conversely, lack of knowledge and skills and the absence of a research culture act as barriers [7]. These observations suggest that the problem cannot be explained solely by individual motivation.

Similar results have been documented in other contexts. In Saudi Arabia, lack of time, insufficient institutional support, and deficiencies in research skills were identified as obstacles [8]. In five Arab countries, professionals showed interest in research but reported limitations of time, resources, support, and skills, along with reduced participation in publications and conferences [9]. Studies conducted in clinical services have also described discrepancies between expectations of incorporating research into the professional role and the real possibility of developing it within the workday [10], whereas the allocation of specific time, managerial support, and clinical relevance of projects have been identified as important incentives for initiating scientific activities [11].

Evidence synthesis confirms the multicausal nature of the phenomenon. An international systematic review in radiography grouped barriers into professional and personal obligations, motivation and organizational culture, knowledge and skills gaps, resources and opportunities, and institutional governance [12]. Subsequent studies in Saudi Arabia have reiterated the influence of research culture, training, support groups, and allocated time [13]. An international survey among diagnostic and therapeutic radiographers indicated that lack of time, funding, experience, and mentorship remain among the most frequent reasons for not participating in research [14]. Consistently, one national study from the United Kingdom identified protected time, funding, support from managers, and access to supervision as central conditions for incorporating research into practice [15].

Limitations are especially visible in systems where scientific infrastructure is still consolidating. In sub-Saharan Africa, participation in magnetic resonance research was low and was associated with advanced training, availability of opportunities, and resources [16]. A review of primary care professionals indicated that overload, system constraints, and an unfavorable environment hinder participation, whereas an academic environment, partnerships, and the involvement of institutional actors can facilitate it [17]. In Tanzania, low experience and confidence in conducting research were observed, along with barriers related to funding, time, skills, opportunities, and infrastructure [18]. In Latin America, clinical workload and lack of time have also been described as relevant obstacles to the development of clinical research [19].

Despite this evidence, specific empirical information remains scarce regarding the level of research competencies and the barriers to conducting research among radiology professionals

working in public and private services in the municipality of Sucre. This gap limits the design of actions tailored to the local context and the ability to determine whether difficulties are concentrated in individual capacities, working conditions, or the articulation between health institutions, universities, and national science structures. Therefore, the objective of this study was to analyze the level of development of research competencies and the main barriers to research among radiology professionals in the health services of Sucre, Bolivia, during the 2025 management period, integrating quantitative and qualitative evidence through an explanatory sequential mixed design.

METHODS

The study used an explanatory sequential mixed-methods design. The quantitative phase was descriptive and cross-sectional and was conducted during 2025 in public and private health services in the city of Sucre, Bolivia. After the quantitative phase, a qualitative phase was conducted to deepen the interpretation of the patterns found in the surveys. The phases were integrated by comparing convergences, divergences, and complementarities between both research phases.

The quantitative population consisted of 150 radiology professionals: 100 from public services and 50 from private services. Given the accessible size of the population, a census was conducted, and all 150 professionals participated. The qualitative phase included 4 directors or individuals responsible for third-level health services, selected through non-probabilistic convenience sampling, and 1 focus group composed of 10 radiology professionals. The focus group participants were considered informants to explore experiences, barriers, and strengthening proposals, and not as 1 independent quantitative sample.

2 5-option Likert-type questionnaires were administered. The first assessed research competencies through 45 items distributed across 9 dimensions: information search and management; theoretical and conceptual construction; methodological construction; data processing, analysis, and interpretation; written communication; oral communication; technological competencies; scientific collaboration; and scientific production. Content validity reached an average Aiken's V of 0.95, and internal consistency reached a Cronbach's alpha of 0.912. The second questionnaire included 30 items across 6 barrier dimensions and obtained an average Aiken's V of 0.92 and a Cronbach's alpha of 0.906.

In the quantitative phase, the data were coded and cleaned using Excel 2016. Absolute frequencies and percentages were calculated for each level and dimension. No causal inferences were made. In the qualitative phase, semi-structured interviews and a focus group guide were used. The information was organized through open and axial coding, thematic grouping, and pattern identification, and was subsequently triangulated with the quantitative results to construct a joint interpretation.

The study received prior ethical approval. Participation was voluntary and anonymous. The confidentiality of the information was protected, and the results were analyzed in aggregate form. In the qualitative phase, personal identifiers were avoided in the presentation of testimonies and categories.

RESULTS

The quantitative phase included the planned 150 professionals. The overall profile showed a concentration of responses at low levels in several critical stages of the research process. The greatest weaknesses were observed in scientific collaboration, scientific production, methodological construction, and data processing, whereas oral communication and written communication were relatively more concentrated at intermediate levels.

Scientific collaboration showed the highest concentration at very low and low levels, with 68% overall; 60% of participants were specifically at the very low level. Scientific production showed a similar pattern: 63% were at low or very low levels and 57% at the very low level. These dimensions represent the stage in which individual capacities must be transformed into effective participation in networks, projects, publications, and scientific products.

Methodological dimensions also showed notable weaknesses. In methodological construction, 62% of professionals were at low or very low levels, whereas in data processing, analysis, and interpretation, this proportion was 60%. In information search, selection, and management, it was 56%, and in theoretical and conceptual construction, it reached 59%. In contrast, oral

communication showed 31% at the medium level and 25% at high or very high levels, suggesting that presentation skills are in a comparatively less unfavorable situation than capacities to design, analyze, and produce research.

Table 1. Distribution of research competencies by dimension (n=150)

Dimension	Low + very low	Medium	High + very high	No response
Search, selection, and management of information	56%	25%	18%	1%
Theoretical and conceptual construction	59%	20%	21%	0%
Methodological construction	62%	16%	22%	0%
Data processing, analysis, and interpretation	60%	22%	17%	1%
Written communication	49%	34%	16%	1%
Oral communication	44%	31%	25%	0%
Technological competencies	52%	26%	22%	0%
Scientific collaboration	68%	19%	12%	1%
Scientific production	63%	19%	18%	0%

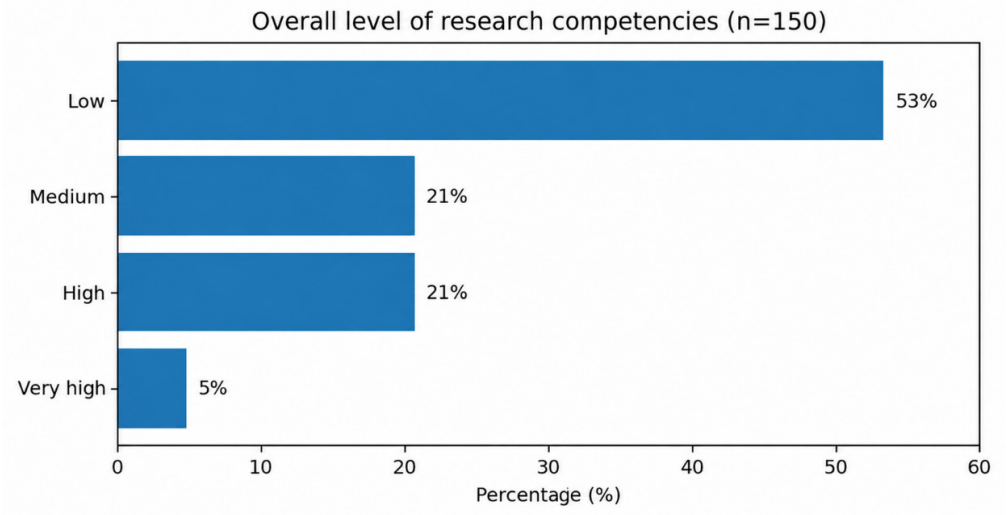
Note. Prepared from the survey administered to radiology professionals. The low + very low and high + very high categories were grouped to facilitate comparison between dimensions.

When integrating the nine dimensions into a global measure, 79 of 150 professionals (53%) presented a low level of research competencies. The medium and high levels each comprised 32 participants (21% each), and only seven professionals (5%) reached the very high level. The predominance of the low level confirms that the deficiencies observed are not restricted to a single skill, but rather accumulate across different phases of the scientific process.

Table 2. Global level of development of research competencies (n=150)

Level	Absolute frequency	Relative frequency
Low	79	53%
Medium	32	21%
High	32	21%
Very high	7	5%
Total	150	100%

Figure 1. Overall level of research competencies



Note. Percentages calculated based on 150 radiology professionals.

The barrier analysis showed a distribution inverse to that observed in the competencies: responses were concentrated at the high and very high levels. Institutional barriers had the highest perceived severity, with 93% at high or very high levels, followed by structural barriers (91%) and interinstitutional articulation barriers (89%). Barriers related to adaptation to technological and institutional changes (79%), those of the immediate environment (76%), and individual barriers (72%) also reached high proportions.

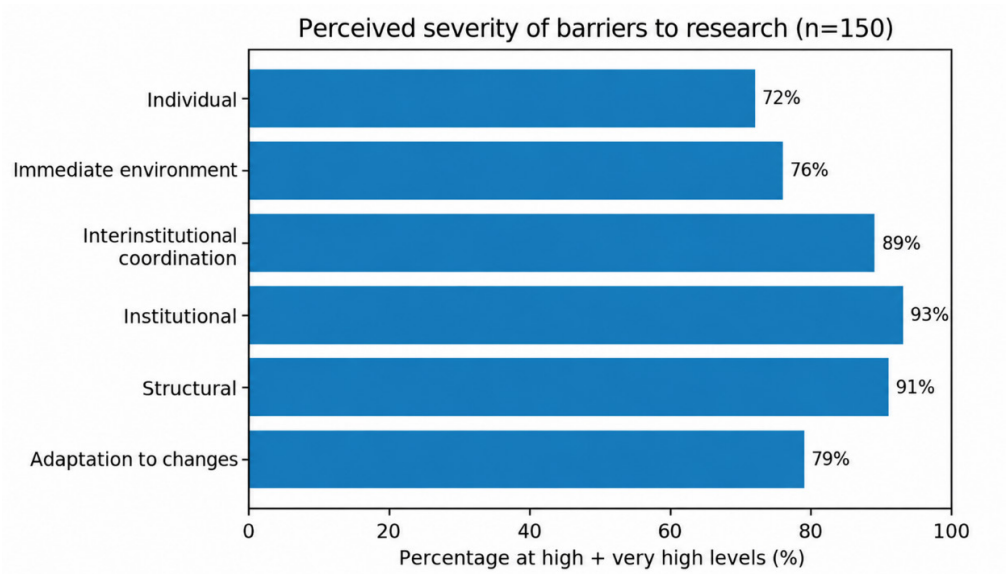
Institutional barriers included limitations related to internal research policies, availability of funding, administrative procedures, incentives, and management stability. Structural barriers reflected restrictions of the regulatory, political, and economic context. Interinstitutional articulation, for its part, captured difficulties in the relationship among hospitals, universities, and other scientific actors. The concentration of these three dimensions at high levels indicates that the perceived obstacles transcend the professional's personal preparation.

Table 3. Grouped distribution of barriers to research (n=150)

Dimension	Low + very low	Medium	High + very high	Rounding difference
Individuals	14%	13%	72%	1%
Immediate environment	8%	16%	76%	0%
Inter-institutional articulation	3%	8%	89%	0%
Institutional	2%	5%	93%	0%
Structural	4%	5%	91%	0%
Adaptation to technological and institutional changes	5%	15%	79%	1%

Note. The figures come from the original 5-level categories. In some dimensions, the sum may differ from 100% by a point due to rounding of the percentages published in the results database.

Figure 2. Perceived barriers at high and very high levels



Note. The high and very high categories were combined to show the relative severity of the six barrier dimensions.

Interviews with directors and institutional managers made it possible to explain the quantitative results. Participants indicated that numerous professionals enter professional practice with insufficient training in research methodology and little experience in project formulation. Although some hospitals develop courses or training activities, participation is limited when there is no time within the workday, contractual stability, or incentives linked to scientific production. The absence or insufficiency of specific budget for research and the scarce generation of proposals from the services themselves were also reported.

The focus group of 10 professionals confirmed these observations. Participants linked their difficulties to predominantly technical undergraduate training, lack of confidence in formulating protocols, limitations in statistical analysis, and dependence on external support.

At the workplace level, they identified clinical overload, permanent prioritization of patient care, and lack of protected time. At the interinstitutional level, they highlighted the weak connection between hospitals and university and the absence of specialized radiology networks. At the structural level, they mentioned insufficient resources, institutional instability, and difficulties in sustaining projects over time.

The integration of findings showed, however, that professionals did not raise only problems. The recurring proposals were to allocate protected hours for research, create funding mechanisms, implement mentoring and methodological support, strengthen biostatistics and scientific writing, and have organized databases that allow clinical information to be transformed into evidence. Table 4 summarizes the link between the quantitative patterns and their qualitative explanation.

Table 4. Integration of quantitative and qualitative findings

Finding	Quantitative evidence	Qualitative explanation	Implication
Global competencies	53% at low level	Predominantly technical undergraduate training; insecurity when formulating projects.	Strengthen applied training and accompaniment from real clinical problems.
Methods and analysis	62% low/very low in methodological construction; 60% in data analysis.	Difficulties in biostatistics, study design, and protocol development.	Methodological tutoring and practical training in data analysis.
Collaboration and production	68% low/very low in collaboration; 63% in production.	Limited participation in projects, publications, conferences, and co-authorships.	Hospital-university networks, research groups, and publication support.
Institutional environment	93% of institutional barriers and 76% of the immediate environment at high/very high.	Excessive clinical workload, lack of protected time, incentives, and budget.	Allocate formal time, funding, and incentives linked to products.
Articulation and structure	89% interinstitutional and 91% structural in high/very high.	Weak hospital-university coordination, changes in leadership, and insufficient systemic support.	Specific agreements, stable governance, and sustainable research policies.

Note. Joint matrix prepared through triangulation of surveys, interviews with 4 managers, and a focus group with 10 radiology professionals.

DISCUSSION

The main finding was the predominance of a low level of research competencies in 53% of professionals, accompanied by a high perception of institutional, structural, and interinstitutional barriers. This pattern is consistent with international evidence showing interest in research but limited effective participation among radiographers [6-16]. The contribution of this study lies in showing that, in Sucre, skill gaps and low scientific production appear simultaneously with an environment perceived as unfavorable for research. Therefore, interpreting the results as an exclusively individual deficiency would be insufficient.

The most pronounced weaknesses in collaboration and scientific production are especially relevant. One person may recognize the importance of research or partially grasp methodological concepts and still not progress toward projects, networks, or publications when lacking support, time, and opportunities. International results show a similar sequence: research is valued positively, but participation decreases when clinical work competes with scientific time and when there are no supervisors, funding, or research culture [12-17]. In Sucre, qualitative evidence added that scarce hospital-university articulation reduces possibilities for mentoring and multidisciplinary work.

The high severity of institutional (93%), structural (91%), and inter-institutional coordination (89%) barriers reinforces a systemic interpretation. Reviews on strengthening research capacity in the health professions recommend coordinated strategies at the individual, team, organizational, and system levels, rather than isolated interventions [20]. The health capacity-building framework also emphasizes that sustainability depends on skills, linkages, infrastructure, leadership, and opportunities to apply what has been learned [21]. The data from this study precisely reflect this interdependence: training loses its effect when clinical workload, administrative processes, and lack of resources prevent its application in practice.

Protected time emerges as a direct implication. Experiences among allied health professionals have shown that temporarily freeing clinicians from certain care burdens and supporting that availability with methodological support promotes research activity and the generation of outputs [22].

This aligns with the perception of professionals in Sucre, who identified formally allocated time as a priority condition. It is not only about reducing clinical hours, but about linking them to verifiable objectives, mentoring, data access, and clear institutional pathways for project approval and execution.

Organizational culture represents another critical point. Assessments of research capacity and culture in health services have shown that individual competencies develop more easily when an institutional structure recognizes research as part of the work [23]. Likewise, models of intermediation and accompaniment through embedded researchers or mentors can help interested professionals move from motivation to participation and project leadership [24]. This evidence supports the focus group's proposals related to mentoring in methodology, biostatistics, data analysis, and scientific writing.

Nor should motivation be interpreted as a stable or exclusively personal trait. Studies of health professionals show that prior experience, career stage, and perceived clinical usefulness influence willingness to participate in research [25]. In radiography, advanced academic training and the existence of career paths linked to research help consolidate profiles capable of connecting practice and scientific production [26]. Therefore, a local strategy should combine gradual training, mentorship, and professional recognition, creating pathways that enable progression from participation in data collection to the formulation, analysis, authorship, and leadership of studies.

The results must also be read within the Bolivian context. Scientific production in health has shown growth, but with a strong dependence on international collaboration [4], and national publications show significant participation by universities and health services, which can still be strengthened [5]. Within this framework, radiology services represent a potential source of clinical questions, image databases, and healthcare improvement problems that could become local research if adequate mechanisms for governance, data protection, support, and funding exist.

The study has limitations. The quantitative competencies and barriers were measured by self-perception, so response biases may exist. The cross-sectional design allows characterization of the 2025 situation, but it does not establish causality or evaluate temporal changes. The qualitative phase included 4 directors and 1 focus group of 10 professionals, which favors contextual depth but is not intended to represent all possible experiences. Nevertheless, the convergence among surveys, interviews, and the focus group strengthens the interpretation that the problem combines competency gaps with organizational and structural constraints. Future studies can evaluate interventions with protected time, mentoring, and hospital-university networks through longitudinal designs.

CONCLUSIONS

The diagnosis revealed that radiology professionals in Sucre show insufficient development of research competencies. 53% were at a low overall level, and the main weaknesses were scientific collaboration, scientific production, methodological construction, and data analysis. This pattern indicates that technical mastery specific to radiological practice does not by itself ensure the ability to transform clinical problems into systematic projects, rigorously analyze information, and communicate results through scientific outputs.

The most severe barriers were not only individual. The institutional, structural, and inter-institutional articulation dimensions reached high or very high levels in 93%, 91%, and 89%, respectively. Qualitative evidence showed that clinical workload, the absence of protected time, limited resource allocation, institutional procedures, and the weak relationship between hospital and university limit the continuity of scientific activities. Therefore, strengthening competencies entails simultaneous changes in training and organizational conditions. The combination of quantitative and qualitative methods made it possible to identify specific actions: dedicating time to research, establishing funding mechanisms, methodological guidance, applied training in biostatistics and scientific writing, facilitating access to information, and creating organized clinical databases. These actions should be articulated within an institutional program rather than as isolated courses. Their objective should be to progressively accompany professionals from the identification of clinical questions through the design, execution, analysis, publication, and participation in research networks.

The findings provide a baseline for the health services of Sucre during the 2025 management period and can guide decisions by hospitals, universities, and research leaders. The priority is to make research a recognized function within professional work, with defined responsibilities, resources, and support. Subsequent evaluations should be conducted to determine whether these

measures increase participation in projects, scientific output, and the use of evidence in radiological practice, avoiding attributing changes solely to individual training.

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