State of radiology in undergraduate medical schools in Colombia. A curriculum analysis

¿Cómo está la radiología en los pregrados de medicina de Colombia? Un análisis de los planes de estudio

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Summary

Introduction*:** Despite how indispensable radiology is for medicine, it's not a prioritized subject when it comes to curriculum design for undergraduates. Because of this, many students finish their career without enough competence in the area. ***Objectives: To evaluate the representation of radiology in undergraduate medicine in different Colombian universities. ***Materials and methods:*** A cross-sectional study to determine the presence of classes related to radiology and diagnostic imaging in undergraduate medicine programs of Colombian universities. Descriptive statistics were used for data analysis. ***Results:*** Only 29 % of all the medicine programs offered the subject of radiology. Of the faculties that offer the subject, 74 % are private institutions while 26 % are public. ***Conclusion:*** There is a small representation of radiology and diagnostic imaging in the curriculums of Colombian medicine undergraduates. It´s important to change the way radiology is taught.

Resumen

Introducción: A pesar de que la radiología es parte indispensable de la medicina, es una asignatura que no se prioriza al diseñar los currículos de la carrera. Esto ha causado que muchos estudiantes al finalizar los estudios no cuenten con suficientes competencias en el área. ***Objetivos:*** Evaluar la representación que tiene la radiología en el pregrado de medicina en diferentes universidades de Colombia. ***Materiales y métodos:*** Estudio transversal para determinar la presencia de asignaturas relacionadas con radiología e imágenes diagnósticas en los pregrados de las diferentes universidades de Colombia. Se utilizó estadística descriptiva para el análisis de los datos. ***Resultados:*** El 29 % de los programas de medicina cuentan con una asignatura de radiología. El 74 % de las facultades de medicina que ofrecen una asignatura en radiología son del ámbito privado y el restante 26 % son del ámbito oficial. ***Conclusiones:*** Hay una baja representación de la especialidad de radiología e imágenes diagnósticas en los planes de estudios de los pregrados de medicina en Colombia. Es importante renovar la educación en esta materia.

Introduction

X-rays were discovered by Professor Wilhelm Conrad Röntgen in Room 119A at the Institute of Physics at the University of Würzburg in 1895. News of this discovery reached Colombia in 1896 in a letter written by Ángel Augusto Cuervo to his friend Rafael Pombo. In 1901, the first X-ray machine arrived in the country, brought by Juan Bautista Montoya y Flórez, but it was not until July 1902 that the first X-ray in Colombia was taken (1). Later, in 1928, Gonzalo Esguerra was appointed director of the Radiology Department at Hospital San Juan de Dios and began teaching a radiology course, which was incorporated into the sixth year of the medical curriculum (1).

Since its discovery and technological development, radiology has been an invaluable asset to medicine, as it has provided a new perspective on patients' conditions. Despite its importance, it has been found that many medical students do not receive sufficient exposure to radiology education (2) and, as a result, lack a solid understanding of the subject matter or of how to interpret basic images used in daily practice. Regardless of students' specific areas of interest, having sufficient skills to perform a basic interpretation of any imaging modality is essential, not only for educational purposes but, above all, to provide better patient care (3,4). Globally, especially in rural areas, the availability of radiologists is insufficient to meet all needs (5). This situation is also observed in Colombia; therefore, if general practitioners in rural areas had adequate training in image interpretation, patients could access higher-quality care.

It has been noted that experts in medical and radiological education attribute the lack of knowledge

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in this area largely to the limited inclusion of related content in undergraduate curricula and to the low priority traditionally given to such topics (6). In the United Kingdom, only 15% of medical schools have an established curriculum for this specialty (7), reflecting the lack of academic opportunities in this field, even in developed countries, where access to various forms of education is greater than in low- and middle-income countries (8). Although some schools include radiology in their curriculum, only 54% of medical schools in Europe offer it as a standalone course, while in the rest it is addressed as a component of larger subjects such as internal medicine or surgery (9).

More than 91% of undergraduate medical students in Canada believe that radiologists are indispensable to a healthcare team, but 83% also believe that the radiology education they receive is insufficient or lacking (10). Furthermore, it was found that a large proportion of students are indeed interested in receiving high-quality radiology education to be able to interpret images and, in this way, understand patients' conditions; they emphasize that this has not been achieved due to the lack of emphasis placed on radiology in the curricula (11).

The issue of radiology education is a challenge that affects all medical students worldwide. However, it has not been thoroughly explored in Latin America; therefore, this study evaluates the current status of radiology as part of medical education in Colombia with the aim of identifying potential shortcomings and proposing improvements. Exposure to the specialty of radiology and diagnostic imaging beginning in undergraduate studies not only benefits the student's training but also encourages them—through contact with and knowledge of the specialty—to consider it as an option for their future training as a specialist.

Materials and methods

Design

A descriptive cross-sectional study was conducted to identify courses related to radiology and diagnostic imaging in current medical school programs in Colombia.

Data collection method

The information was obtained from the public database of academic programs maintained by the Sistema Nacional de Información de la Educación Superior (SNIES) using the keyword "medicine" in the "Program Name" search field. Only undergraduate programs in medicine were selected, excluding those in veterinary medicine and including only those that were active at the time of the search.

Subsequently, the curricula available on each university's official website were reviewed, and information was extracted regarding the names of courses related to radiology and diagnostic imaging, the number of academic credits assigned, and the semester in which the course was scheduled within the curriculum.

Analysis

The collected data were organized into a database and analyzed using descriptive statistics, employing absolute and relative frequencies for categorical variables and measures of central tendency for quantitative variables.

Results

The search revealed that there are 64 active medical programs in Colombia, 56 of which are members of the Asociación Colombiana de Facultades de Medicina (Ascofame), which is responsible for evaluating the quality of medical education in the country and its impact on public health. Twenty-nine percent (n=19) of the medical programs are public, and 71% (n=45) are private. Sixty-five percent (n=21) of Colombia's departments have a medical school. Forty percent (n=26) of the programs are located in the country's major departmental capitals, 18% (n=12) in Bogotá D.C., 7% (n=5) in Medellín and Santiago de Cali, and 6% (n=4) in Barranquilla (Table 1). In some other capital cities such as Pasto, Bucaramanga, Tunja, and Valledupar, only 3% to 4% of all the country's programs are concentrated per city, which amounts to 38.5% of all programs. The remaining 21.5% (n=12) represent 1% per city and are located in other departmental capitals such as Bucaramanga, Villavicencio, and Ibagué, or in large cities near the capitals such as Palmira, Envigado, Pamplona, and Tuluá (Table 1).

The study also found that 29% (n=19) of medical programs include a course in radiology. Approximately 47% (n=9) of the programs offering radiology are academic programs accredited as high-quality. 74% (n=14) of the medical schools offering a radiology course are private, and the remaining 26% (n=5) are public. 94% (n=18) of medical programs with a radiology course are located in capital cities, with the highest concentrations in Bogotá and Pasto, each accounting for 15% (n=3), followed by Bucaramanga and Medellín, with 10.5% (n=2) (Table 2).

The names of the programs vary. Among the programs that include a course, it has an average credit load of 2.35 credits, ranging from a minimum of 1 credit to a maximum of 6. Generally, these courses are taught in the fifth semester; their inclusion in the curriculum varies, ranging from as early as the fourth semester to as late as the tenth semester. This course is elective in only one of the faculties that offer it, and there is only one program that offers two courses in two consecutive semesters (Table 3).

Of the universities that offer a radiology course as part of their curriculum, only 16% (n=3) have a specialization program in radiology and diagnostic imaging. This means that 84% (n=15) of the universities offering a specialization program in radiology and diagnostic imaging do not include a radiology course or similar subjects in their undergraduate medical curriculum.

In Colombia, there are 18 active graduate specialization programs in radiology and diagnostic imaging, representing 28% of medical schools. Of these, 15 programs are registered with Ascofame. Thirty-nine percent (n=7) of the programs are located in Bogotá and 17% (n=3) in Medellín. With the exception of Chía, the remaining academic programs are located in capital cities, with a maximum of two programs per city (Table 4).

Table 1. Location of undergraduate medical programs in Colombia

Department	City	n	%
Antioquia	Medellín	5	7.81
Antioquia	Sabaneta	1	1.56
Antioquia	Envigado	1	1.56
Atlántico	Puerto Colombia	2	3.13
Atlántico	Barranquilla	4	6.25
Bogotá, D. C.	Bogotá, D. C.	12	18.75
Bolívar	Cartagena de Indias	3	4.69
Boyacá	Tunja	2	3.13
Caldas	Manizales	2	3.13
Cauca	Popayán	1	1.56
Cesar	Valledupar	2	3.13
Córdoba	Montería	1	1.56
Cundinamarca	Chía	1	1.56
Huila	Neiva	2	3.13
Magdalena	Santa Marta	2	3.13
Meta	Villavicencio	1	1.56
Nariño	Pasto	3	4.69
Norte de Santander	Pamplona	1	1.56
Norte de Santander	San José de Cúcuta	1	1.56
Quindío	Armenia	2	3.13
Risaralda	Pereira	2	3.13
Santander	Bucaramanga	3	4.69
Sucre	Sincelejo	1	1.56
Tolima	Ibagué	1	1.56
Valle del Cauca	Santiago de Cali	6	9.38
Valle del Cauca	Palmira	1	1.56
Valle del Cauca	Tuluá	1	1.56
Total		64	100,00

Table 2. Location of undergraduate medical programs offering courses in radiology or related fields in Colombia

Department	City	n	%
Bogotá, D. C.	Bogotá, D. C.	3	15.79
Nariño	Pasto	3	15.79
Santander	Bucaramanga	2	10.53
Antioquia	Medellín	2	10.53
Atlántico	Barranquilla	1	5.26
Meta	Villavicencio	1	5.26
Magdalena	Santa Marta	1	5.26
Bolívar	Cartagena de Indias	1	5.26
Atlántico	Puerto Colombia	1	5.26

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Córdoba	Montería	1	5.26
Caldas	Manizales	1	5.26
Huila	Neiva	1	5.26
Valle del Cauca	Santiago de Cali	1	5.26
Total		19	100.00

Table 3. Radiology Courses in Undergraduate Medical Programs in Colombia

Department	City	n	Course Title	# credits	# semester	Course Type (required / elective)
Bogotá, D. C.	Bogotá, D. C.	1	Introduction to Diagnostic Imaging	3	6	Required
			Diagnostic Imaging	2	7	Required
Bogotá, D. C.	Bogotá, D. C.	1	Imaging	3	5	Not provided
Bogotá, D. C.	Bogotá, D. C.	1	Diagnostic Imaging	2	5	Required
Nariño	Pasto	1	Diagnostic Aids	4	5	Not provided
Nariño	Pasto	1	Clinical Laboratory and Imaging	2	4	Required
Nariño	Pasto	1	Imaging	1	6	Required
Santander	Bucaramanga	1	Radiology	1	10	Elective
Antioquia	Medellín	1	Radiology	2	6	Required
Antioquia	Medellín	1	Diagnostic aids	3	5	Required
Antioquia	Medellín	1	Imaging	1	4	Required
Atlántico	Barranquilla	1	Diagnostic Imaging	2	10	Required
Meta	Villavicencio	1	Diagnostic and Imaging Aids	2	6	Required
Magdalena	Santa Marta	1	Diagnostic and Imaging Aids	2	6	Required
Bolívar	Cartagena de Indias	1	Radiology and Imaging	2	Not provided	Required
Atlántico	Puerto Colombia	1	Diagnostic Imaging	2	10	Required
Córdoba	Montería	1	Diagnostic Imaging	3	5	Required
Caldas	Manizales	1	Diagnostic Imaging	2	5	Required
Huila	Neiva	1	Diagnostic Imaging	1	5	Required
Valle del Cauca	Santiago de Cali	1	Diagnostic Aids	6	6	Not provided
Total programs		19	Average credits	2.3	6	

Not provided: Information not provided in the curriculum.

Table 4. Location of medical schools offering graduate programs in radiology in Colombia

Department	City	*n*	%
Bogotá, D. C.	Bogotá, D. C.	7	38.89
Antioquia	Medellín	3	16.67
Bolívar	Cartagena de Indias	2	11.11
Valle del Cauca	Santiago de Cali	2	11.11
Santander	Bucaramanga	2	11.11
Cundinamarca	Chía	1	5.56
Atlántico	Barranquilla	1	5.56
Total		18	100.00

Discussion

This study demonstrated that the specialty of radiology is underrepresented in undergraduate medical programs in Colombia, at least as a course.

Just as there are classes and workshops dedicated to learning about the interpretation of laboratory tests, it is common for there to be some classes on the interpretation of diagnostic images, given that these have become an indispensable tool for the practice of medicine (10). However, although there are courses and even entire semesters dedicated to certain specializations, this is not often the case with radiology, despite the fact that 92% of students in Kuwait consider a radiologist to be an indispensable part of a medical team (2).

Teaching radiology to undergraduate students is necessary because having basic image interpretation skills benefits clinical practice and raises awareness of the utility of different imaging modalities (12). However, there are various challenges to providing adequate teaching opportunities; among the main ones is the curriculum design, in which radiology typically occupies less time than other specialties, and that time focuses more on passive exposure to clinical practice than on active participation, as is the case in other areas (12).

In a survey of Canadian medical students, 63% felt that the radiology education offered in the curriculum was inadequate, and when asked about their ability to interpret images, only 7% felt confident in their skills, while 91% felt they needed more training (10). Additionally, 54% of Kuwaiti medical students consider radiology-related education to be insufficient, and 11% consider it to be highly inadequate and failing to meet their academic expectations (2). Further groups of medical students who believe that high-quality education in radiology is necessary for their development as healthcare professionals concluded that they need more educational opportunities such as classes or assessments and that clinical rotation opportunities should be improved (11).

As for professionals from different specialties, they believe it is important for undergraduate students to have a sufficient understanding of diagnostic imaging to develop effectively as clinicians; they also acknowledge that in recent years, the emphasis on learning anatomy has diminished and that studying radiology could serve as a suitable substitute for these subjects, rather than eliminating them (13). It is essential that radiologists be actively involved in the training of medical students (7,4). Even so, specialists willing to teach must be prepared to incorporate various teaching techniques, including technological tools, dynamic classes, demonstrations of different imaging modalities, and clinical case-based learning, among others, to ensure greater engagement and interest among students (14).

It is also important for instructors to have training in teaching, which enables them to clearly communicate content and design learning methodologies that facilitate the transfer of knowledge in radiology, thereby optimizing the limited time students have to engage with the subject (15).

The 5C technique (standing for curriculum, coaching, collaborating, career, and commitment) has been described as a framework for evaluating how exposure to radiology influences medical students' education and what should be included to ensure effective teaching in radiology (16). To provide a good radiology education, the following must be taken into account: the fundamental topics that must be included in the curriculum; the available resources provided by radiology departments and their staff for training in the field; interdisciplinary collaboration between radiology and other specialties; what it means to have a career in radiology; and the commitment of professionals to teaching (16).

Finally, the European Society of Radiology (ESR) proposes a radiology education curriculum for medical students as a guide to integrating the specialty throughout undergraduate studies (17). This curriculum is based on two modules: the first covers topics related to radiation, radiation protection, and imaging modalities; the second addresses fundamental principles of radiology and imaging support for the most common pathologies, as well as the most frequently used imaging modalities.

The purpose of this curriculum guide is to ensure that students complete their degree with sufficient knowledge of diagnostic imaging modalities to provide quality care to their patients, regardless of whether a qualified radiologist is readily available. Similarly, the document "Undergraduate Education in Radiology: A White Paper by the European Society of Radiology" (18) offers recommendations regarding the teaching of radiology at the undergraduate level. One of the main recommendations concerns the minimum number of hours dedicated to radiology instruction, which ranges from 20 to 25 theoretical hours, corresponding to approximately 2–3 ECTS (European Credit Transfer and Accumulation System) credits. A fundamental recommendation for the teaching of radiology is to complement it with clinical rotations and seminars distributed throughout the degree program, as well as to integrate it across the curriculum with other clinical subjects (18).

Limitations

Among the limitations of this study is that it did not examine whether undergraduate academic programs include radiology teaching and learning activities during clinical rotations or within the microcurricula of other courses, therefore, further investigation is needed to determine whether these activities take place and how the specialty is taught and learned, particularly in undergraduate programs where it is not offered as a separate course. The information was obtained from each university's publicly accessible websites; however, the fact that it is unclear whether the presented information is up to date can be considered a limitation.

Conclusions

In conclusion, the specialty of radiology and diagnostic imaging is underrepresented in the curricula of undergraduate medical programs in Colombia. This can be attributed to the curricular reforms implemented in recent years, which have impacted students' knowledge of and exposure to the specialty. It is also important to update the ways in which radiology is taught to ensure the production of well-rounded, competent healthcare professionals and to maintain interest in the specialty.

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