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Level of knowledge about radioprotection, risks and benefits of ionizing radiation in Dentistry students

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ABSTRACT

Objective: To determine the level of knowledge about radiological protection, risks and benefits of the use of ionizing radiation in undergraduate students of Dentistry at a Peruvian university. **Materials and methods:** Cross-sectional study, where participants completed a validated survey on a scale from 0 to 20. The results were statistically analyzed using Fisher's exact test and the chi-square test. **Results:** The level of knowledge of 90.67% (n = 68) of the students was intermediate. Regarding radiation protection, 77.33% (n = 58) have an intermediate level of knowledge; regarding risks, 53.33% (n = 40) have a low level; and, regarding radiation benefits, 50.67% (n = 38) have an intermediate level. **Conclusions:** Undergraduate students have an intermediate level of knowledge in radiological protection, risks, and benefits of radiation. There was no significant evidence of statistical association between the level of knowledge and the variables sex and continuity of the academic program.

Keywords: knowledge; radiological protection; radiation risks; ionizing radiation.

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INTRODUCTION

Since Wilhelm Röntgen discovered X-rays in 1895 (1), their use in dental radiography has increased significantly. Each year, around 480 million diagnostic radiographic examinations in dentistry are performed worldwide (2), aiming to contribute to the accurate identification of conditions, as well as the planning and development of appropriate treatments (3-5). As this number increases, so does the potential risk of radiation exposure for both patients and healthcare professionals (6). Although radiation exposure in dentistry is significantly low, we must consider that during the professional training of future dentists, the rate of repetition and re-exposure when taking intraoral X-rays is higher compared to more experienced professional or technical staff (7-9).

It is known that ionizing radiation, at high doses, can cause harmful biological effects, such as deterministic and stochastic effects (10, 11). Therefore, there is a global effort to reduce radiation doses in diagnostic imaging. The International Commission on Radiological Protection (ICRP) has proposed three principles of radiological protection: justification, optimization, and individual dose limitation (12-15). Above all, in the field of imaging, it is crucial that the radiographic technique be performed responsibly and thoughtfully (4), thus minimizing radiation doses but maximizing diagnostic benefits. This approach aligns with the principle of ALARA (As Low As Reasonably Achievable), which seeks to keep radiation exposures as low as possible, considering social and economic factors (2, 4, 6, 16).

Currently, the images obtained at the Faculty of Stomatology of the Universidad Peruana Cayetano Heredia (UPCH) incorporate the ALADA principle, which means 'As Low As Diagnostically Acceptable'. This new approach aims to reduce x-ray repetition rates, which in turn helps lower the cumulative dose for both operators and patients (13). To achieve this, it is crucial that future dentistry professionals acquire in-depth knowledge of the biological risks associated with radiation and the way to avoid unnecessary exposure during their training (16). This is particularly important since the proper use of imaging techniques, protective measures and risks associated with radiation tends to be underestimated (17).

In different dental schools in our nation, a radiology course is usually offered during the second, third or fourth academic semester (18-22). In this context, this research aimed to determine the level of knowledge about radioprotection, risks and associated benefits among Stomatology students at a Peruvian university.

MATERIALS AND METHODS

This was a cross-sectional study that obtained authorization from the Academic Department of Oral Medicine, Oral and Maxillofacial Surgery, and the Directorate of the Stomatology Program at the UPCH. In addition, we coordinated with the professor in charge of one of the department's courses to facilitate its implementation. Data collection was completed at a single point in time through in-person surveys, using a convenience sampling approach. A total of 75 students enrolled in the fifth undergraduate semester of Stomatology in 2023 were surveyed. Participants met the inclusion criteria, which required them to attend class on the scheduled day, and they expressed willingness to participate in the study.

The variables considered in the research instrument included knowledge about radiation protection, sex and continuity in the academic program. The latter refers to those students who completed the course with or without interruptions. These variables were previously validated by Kusch (23) through an expert judgment process, which revealed significant results with an Aiken's V coefficient of 0.79. In addition, reproducibility was assessed using a Pearson coefficient of 0.89, and reliability was established with a Cronbach's alpha coefficient of 0.79.

The survey was structured around eleven questions related to the dimension of radiological protection. Of these, two questions addressed general knowledge, six questions focused on radiation risks, while three questions were centered on the benefits. For the participants' scoring, an *ad-hoc* scale was implemented, classifying scores as follows: 0 to 6 as low, 7 to 13 as intermediate, and 14 to 20 as high. This approach allowed us to effectively categorize participants' knowledge levels based on their results.

The data collected was entered into Microsoft Excel 2019 and underwent a descriptive analysis using STATA version 17. Participants' responses were analyzed using frequency tests, and chi-square and Fisher's exact test were applied to assess the association between variables whose results were presented in tables for further analysis.

Approval was obtained from the Institutional Ethics Committee in Human Research of UPCH (Certificate No. 464-43-22), and anonymous and voluntary

participation of the respondents was guaranteed through a pre-study information sheet, which detailed the purpose and procedure of the study. Since the instrument did not include sensitive or confidential data, and did not allow participant identification, the use of an informed consent was not considered necessary. The data collected were used exclusively for research purposes and for the improvement of programs related to radiological protection.

RESULTS

Of the 75 students surveyed, 66.67% (n = 50) were male, 33.33% (n = 25) were female, and 96.00% (n = 72) were in the regular semester of the academic program. Regarding the level of knowledge on radiological protection, risks and benefits of the use of ionizing radiation, 4.00% (n = 3) showed a low level; 90.67% (n = 68) showed an intermediate level, and 5.33% (n = 4) showed a high level (Table 1).

Table 1. Level of knowledge about radiological protection, risks and benefits of the use of ionizing radiation among undergraduate stomatology students at a Peruvian university.

Level of knowledge	Total	
	n	%
Low	3	4.00
Intermediate	68	90.67
High	4	5.33
Total	75	100.00

No significant differences were found in terms of the level of knowledge on radiological protection based on sex (p = 0.90) and continuity in the academic program (p = 0.99). 77.33% (n = 58) obtained an intermediate level; 17.33% (n = 13) obtained a low level; and 5.33% (n = 4) obtained a high level in relation to both variables (Table 2).

Table 2. Level of knowledge on radiological protection according to sex and continuity in the academic Stomatology program among undergraduate students at a Peruvian university.

Variables	Level of knowledge on radiological protection						Total		p
	Low		Intermediate		High				
	n	%	n	%	n	%	n	%	
Sex									
Man	5	6.67	19	25.33	1	1.33	25	33.33	0.90
Woman	8	10.67	39	52.00	3	4.00	50	66.67	
Continuity									
Regular	13	17.33	55	73.33	4	5.33	72	96.00	0.99
Irregular	0	0.00	3	4.00	0	0.00	3	4.00	
Total	13	17.33	58	77.33	4	5.33	75	100.00	

Fisher's exact test (significance: p < 0.05).

Regarding knowledge of risks, no significant difference was found based on sex (p = 0.58) and continuity in the study program (p = 0.99). 53.33% (n = 40) scored a low level; 44.00% (n = 33) scored an intermediate level; and 2.67% (n = 2) scored a high level in relation to both variables (Table 3).

Regarding knowledge about the benefits of radiation use, no significant difference was found based on sex (p = 0.17) and continuity in the study program (p = 0.99). 50.67% (n = 38) obtained an intermediate level; 38.66% (n = 29) obtained a high level; and 10.67% (n = 8) obtained a low level in relation to both variables (Table 4).

Table 3. Level of knowledge about the risks of ionizing radiation use according to sex and continuity in the Stomatology program among undergraduate students at a Peruvian university.

Variables	Level of knowledge about risks						Total		p
	Low		Intermediate		High				
	n	%	n	%	n	%	n	%	
Sex									
Man	15	20.00	10	13.33	0	0.00	25	33.33	0.58
Woman	25	33.33	23	30.67	2	2.67	50	66.67	
Continuity									
Regular	38	50.67	32	42.67	2	2.67	72	96.00	0.99
Irregular	2	2.67	1	1.33	0	0.00	3	4.00	
Total	40	53.33	33	44.00	2	2.67	75	100.00	

Fisher's exact test (significance: $p < 0.05$).

Table 4. Level of knowledge about the benefits of ionizing radiation according to sex and continuity in the Stomatology program among undergraduate students at a Peruvian university.

Variables	Level of knowledge about benefits						Total		p
	Low		Intermediate		High				
	n	%	n	%	n	%	n	%	
Sex									
Man	5	6.67	11	14.67	9	12.00	25	33.33	0.17*
Woman	3	4.00	27	36.00	20	26.66	50	66.67	
Continuity									
Regular	8	10.67	36	48.00	28	37.33	72	96.00	0.99**
Irregular	0	0.00	2	2.67	1	1.33	3	4.00	
Total	8	10.67	38	50.67	29	38.66	75	100.00	

* Chi-square test (significance: $p < 0.05$).
** Fisher's exact test.

DISCUSSION

In the context of the health emergency caused by the COVID-19 pandemic (24), it is necessary to recognize the efforts made by dental educational institutions to reassess and adapt their teaching methods, and ensure continuity and quality of education, prioritizing the health of faculty, students, and administrative staff. In line with this imperative, UPCH adapted the course Principles of Imaging in Stomatology from the fourth semester to a virtual format. With the reintroduction of in-person learning and the transition to the fifth semester in 2023, the need emerged to comprehensively evaluate students' competence in radiological protection, risks and benefits associated with ionizing radiation. This approach is essential, as previous research has revealed significant deficiencies in knowledge and safety protocols about ionizing radiation among dental professionals and students (3, 17, 23, 25).

The findings of this study support these concerns by showing that a significant proportion of respondents present deficiencies in the understanding of key aspects of radiological protection. Notably, 80% of participants were unable to identify the type of radiation that causes damage to body tissues, highlighting the existing knowledge gap. This situation raises questions about

the effectiveness of current educational strategies in addressing this issue, especially in comparison with previous research studies that reported significantly higher percentages (23, 25).

It is noteworhty that only 32% of respondents were aware of the technical exposure parameters in oral radiology (Kv and mA), a figure consistent with previous studies conducted at UPCH (23, 25). These deficiencies could have direct consequences in clinical practice, as inadequate understanding of these parameters could lead to unnecessary radiation exposure for both patients and professionals.

The low percentage of knowledge regarding the imaging technique that produces the highest dose of radiation in the dental field, along with the high proportion of respondents who scored low in their understanding of the general risks of ionizing radiation, raises concerns about the ability of future stomatology professionals to make informed decisions in the clinical setting. Therefore, this area of study should be expanded in future research to address the gaps in understanding the risks associated with ionizing radiation. This is essential to ensure the safety of both patients and clinical staff, and thus promote an ethical, evidence-based dental practice, considering the growing dependence on technology in modern dental care (26, 27).

One of the limitations of this research study could have been the impact of the transition from virtual to in-person lessons due to the COVID-19 pandemic, which introduced variations in the academic program and may have influenced the study results.

CONCLUSIONS

The study revealed that most participants have an intermediate level of knowledge in radiological protection, as well as of the benefits of ionizing radiation. In contrast, the majority showed a low level of understanding regarding the associated risks. No statistically significant association was found with the participants' sex or the stage of the academic program they were in.

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