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Understanding Patient Knowledge and Participation in Radiological Examinations: A Study on Women of Childbearing Age

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Abstract

Over the years, patients have been called upon to play a more active role in their health processes. An increase in radiological examinations has also been observed, which leads to increased exposure of the most sensitive population (women of childbearing age) to X-rays and subsequent stochastic effects. Therefore, it is important to understand what knowledge this group has about radiology, if they intend to increase/know more about exposure to radiation, as well as to understand their participation in their radiological process. For a month, and with the help of three Portuguese associations, it was possible to disseminate the data collection instrument (questionnaire) adapted to the Portuguese reality on all its digital platforms. In this way, it was possible to obtain 502 responses from women between the ages of 18 and 57. Through the data obtained, it was noticed that participation and knowledge are reduced, but there is a willingness on the part of the sample to obtain more information and participate more in the entire radiological process. For greater participation of users in their radiological process (before the radiological examination, during the procedure, and after the procedure), it is important to provide tools that help to increase knowledge in this area. Stimulating interaction between health professionals in the field of radiology and users is equally important.

Keywords: Literacy; Empowerment; Women; Radiology.

1. Introduction

Currently, words like empowerment are on the agenda, mainly in health services [1]. Empowerment can be defined as "a health process committed to the transformation of reality and the production of health and healthy subjects, with effective and concrete social participation established as an essential objective of health promotion" [2, 3]. Throughout the healthcare process, the user is often asked about health literacy and the right decisions to be made. But it happens that several times the user does not understand the concepts related to their health status that led to the decision to make, which is not always the best one [4–6]. Health literacy empowerment is needed, and the concept is related to the mobilization of a set of "cognitive and social skills and the ability to access, understand, and use information in order to promote and maintain good health", according to the World Health Organization (WHO) [7, 8]. It is a concept that relates to several individual and collective variables, such as education, age, the presence of chronic diseases, and income [4, 7]. Portugal is one of the countries with the lowest percentage of people (8.6%) with an excellent level of literacy compared to the European Union (16.5%). Furthermore, with regard to the problematic level of literacy, Portugal has a higher level compared to the European average (38.1% vs. 35.2%, respectively) [7].

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It is known that good levels of health literacy are related to good health outcomes [1, 4, 6, 9]. But low levels of health literacy are associated with high figures of chronic diseases and increased health resources [4, 6, 9]. Translating this concept to radiology, it becomes important to understand the knowledge that users have regarding this topic. Mainly because it is an area that, over the years, has grown in terms of equipment, examination protocols, and clinical indications, which has led to an increase in the number of people exposed to ionizing radiation [5, 10, 11]. Health literacy in radiology and understanding the risks associated with ionizing radiation are important for women of childbearing age, particularly because they may require medical imaging procedures that involve exposure to radiation.

Frequently, they do not have enough information to ensure the needed X-ray protection [5, 11-16]. While the risks of radiation from medical imaging are generally low for adults, it is still important to understand the potential effects on the developing fetus [17, 18]. Some previous studies [19–23] had noted this knowledge gap or very basic/reduced knowledge at the level of radiology, as well as low levels of communication between Healthcare Professionals and users. Topics such as identifying exams that use ionizing radiation (do not identify CT as an exam that uses ionizing radiation [19, 20] or do not consider that the dose level associated with this exam is higher than that of radiography [19–21]), the risks associated with exposure to ionizing radiation [19, 20], radiation doses, and radiological protection measures [21, 22] prove to be points that represent the greatest difficulties of the studied samples.

When a medical imaging procedure is recommended, it is essential to have a discussion with the medical doctor about the benefits of the procedure versus the potential risks of radiation exposure [18, 19]. This discussion should consider the necessity of imaging, alternative options, and potential non-radiation-based alternatives if available [24–27]. If radiological procedures are indeed needed, it is expected that radiologists and radiographers follow a specific protocol to minimize radiation exposure during imaging procedures. It is important for women of childbearing age to ensure they receive the appropriate imaging technique for their condition, using the lowest possible radiation dose necessary to obtain diagnostically useful images [18, 24, 25, 28].

One other relevant issue for health literacy in radiology is ensuring radiology facilities should provide appropriate shielding to protect sensitive areas of the body from unnecessary radiation exposure. For example, lead aprons and shields can be used to protect the abdominal area during imaging procedures that do not involve the pelvic region. Because women are a population that frequently uses health services (either as users or as companions) and because they are biologically more sensitive to ionizing radiation (greater probability of stochastic effects) (18), it is important to understand the knowledge (radiology literacy) that women of childbearing age have regarding ionizing radiation protection. If we know their literacy about this topic, it will be easier to promote health care/radiological literacy oriented towards women of childbearing age needs [28-31].

We established as the general objective of this study:

- Understand the importance that women of childbearing age give to radiological examinations.

As specific objectives it was intended to:

- Check whether they are aware of the existence of a risk associated with ionizing radiation (radiology literacy);
- Identify which sociodemographic variables influence the importance that women attribute to their radiological process.

2. Research Methodology

In order to achieve the previously outlined objectives, a cross-sectional, retrospective, and exploratory-descriptive study was designed. Based on studies on this topic, a questionnaire (Appendix I) was adapted to the Portuguese reality [4, 5, 13, 14, 32, 33]. Before the dissemination of the questionnaire, a pre-test was carried out with a group of 10 women. This pre-test was intended to understand whether there were phrases, words, or concepts that hindered the understanding of the questions, thus ensuring the face validity of this data collection instrument.

The questionnaire was aimed at women of childbearing age with an age range between 18 and 57 years, and their participation was voluntary (it did not follow any sampling process). All terminology used in the questionnaire (interval between years and denomination of geographic areas) is in accordance with NUTS II (used in the Portuguese National Health Survey) [34]. In order to reach as many women of childbearing age as possible, three Portuguese Associations helped disseminate the questionnaire on their digital platforms:

- APAMCM (Portuguese Association to Support Women with Breast Cancer) is dedicated to health promotion with a special focus on women with breast cancer;
- EVITA (Association of Support for Carriers of Changes in Genes Related to Hereditary Cancer): Its mission is to inform, raise awareness, and support health users in making shared health decisions [35];
- NUCLIRAD (Development Nucleus of Radiographers): Has a main objective to value and help projects developed by radiographers [36].

The questionnaire was available online for 1 month (from January 13, 2020, to February 13, 2020). Taking into account the objectives outlined, it was stipulated that the sample size should be greater than 500 participants. In order to be able to understand the process of constructing the questionnaire until it is made available online, a flowchart was created that describes the process in time (Table 1).

Table 1. Questionnaire construction flowchart

Time / Task	Research/ Reading	Writing	Construction of the questionnaire	Pre-test	Availability of the online questionnaire
October					
November					
December					
January					

A statistical analysis was done using the software Statistic Package for the Social Sciences IBM (SPSS 24 Version), first in a univariate way and then through a statistical test called the Chi-Square Test. For all statistical analysis, a significance level of 5% (α=0.05) was considered.

3. Results

Results are from a sample of 502 female respondents. Most of the women who participated in the study were in the 18–27 age group (41%), living in the Lisbon region (57.8%), and with a high level of education (university, 66.1%) (Figures 1 to 3).

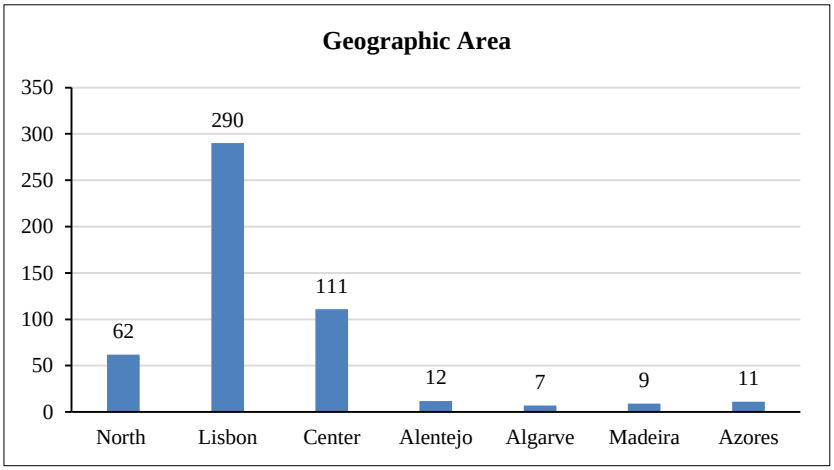

Figure 1. Geographic representation of the sample

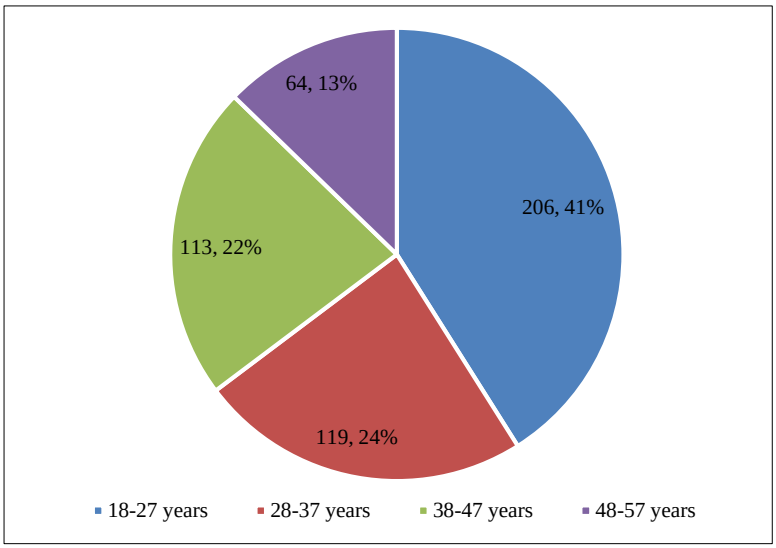

Figure 2. Sample Age

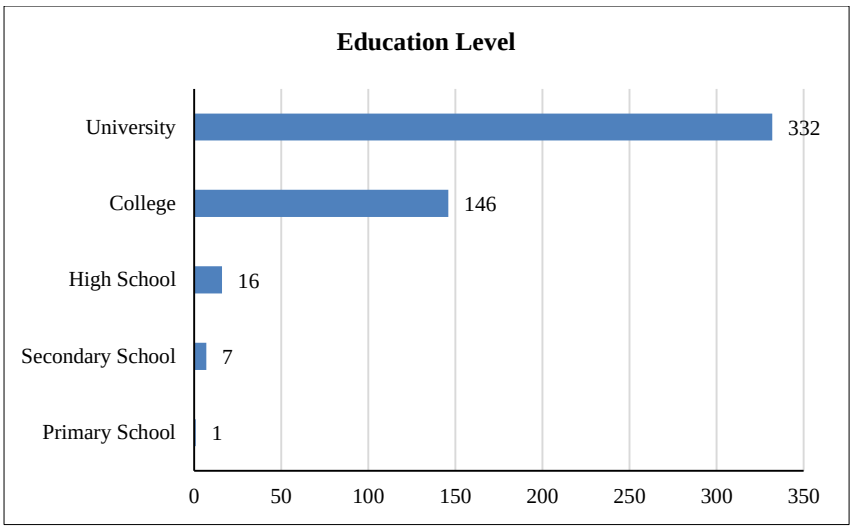

Figure 3. Sample Schooling

It was possible to verify that 44 women (8.76%) reported that they had never performed a radiological examination. Of the 458 women who reported having had contact with radiological exams, 92.4% (n=423) reported that the reason why they would have to undergo the prescribed exam was previously explained to them. But 7.6% (35 women) indicated that they did not have access to the reason that triggered the prescription of the exam or did not know if this information was provided to them.

Still referring to women who have had contact with radiological examinations, the vast majority of them (70.7%) reported that the information provided by their doctor was understand, but 29.3% reported some difficulty or not having had at all contact with any type of information (Figure 4).

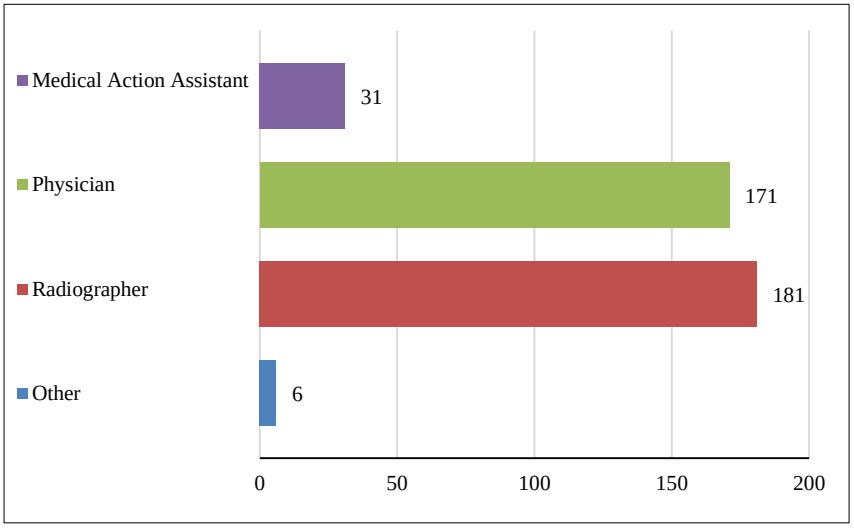

Figure 4. Understanding the information provided by the attending physician

It was possible to confirm that the understanding of the information provided by the attending physician is influenced by the woman's level of education ($p=0.027<0.05$). It was possible to notice that women with lower educational qualifications had more difficulty understanding the information provided (15.1%). However, women with higher levels of education reported that they were not provided with any type of information (21.2%).

Neither age nor other sociodemographic variables proved to be statistically significant in the way information is perceived ($p>0.05$). A large part of the sample (59.8%) reported that they had been asked by a Healthcare Professional about performing radiological examinations previously, instead of 40.2% of respondents. Those that indicated this question was asked were sent to another question that tends to find out which Healthcare Professional asked about the previous exams. Of the various options available in the question, radiographers were the professionals most selected as those asking more questions about performing previous radiological exams (Figure 5).

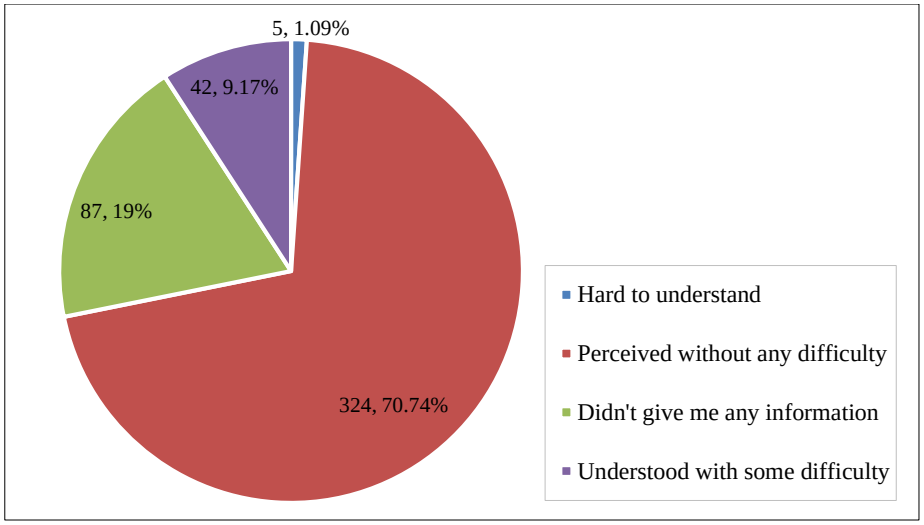

Figure 5. Which Healthcare Professional asked about performing previous exams?

When questioned about requesting information from a Health Professional about exposure to ionizing radiation before carrying out a radiological examination, the vast majority of the sample (56.2%) would not question these professionals.

None of the sociodemographic variables proved to be statistically significant in this question. However, crossing these responses with the variable "Literary Qualifications", revealed that 45.8% of women with Higher Education would ask a Healthcare Professional about this topic. Despite this, the majority (54.2%) of women with education equivalent to "Higher Education" would not do it, as well as 60% of women with qualifications equal to "Basic Education/Secondary Education". Regarding to the variable "Age", all the age groups have rates above 50% with regard to not questioning the Health Professional. But, it would be women aged between 38 and 57 who would ask a Healthcare Professional about this topic (47.5%). However, 97.2% (n = 488) of participants indicated that there should be information/training aimed at women on X-ray exposure and protection against ionizing radiation used in Medical Radiology.

Addressing the radiological knowledge of the sample more directly, in the question that intends to evaluate the influence of ionizing radiation on their health, most women (84.7%) indicated that there is an influence on their health. It was possible to understand that the level of education influences the answers to this topic ($p = 0.004$). Women with higher levels of education found it easier (88%) to indicate the influence of X-rays on health. The variables "age" and "geographic region" did not prove to be statistically significant ($p>0.05$) at this point of analysis. When questioned about whether they consider that X-rays may be contraindicated for a pregnant woman, the vast majority of the sample (96.4%) indicated that exposing a pregnant woman to X-rays is not recommended. It was possible to observe that the sociodemographic variable "age" is statistically significant ($p = 0.029$) in this question. Older women were the ones who more easily indicated (98.9%) the contraindication to exposure to X-rays by a pregnant woman. However, in the younger age groups, this lack of understanding was also well identified by this sample group (95.1%).

The next question sought to understand whether, for the sample, a woman who is considering becoming pregnant in the coming months can be exposed to X-rays. 50.6% of the participants responded that they "did not agree" with the exposure. However, a close percentage (49.4%) of the female respondents indicated that they agreed (partially or totally) with the exposure of a woman of childbearing age who is thinking of becoming pregnant in a short period of time. It was possible to observe that no sociodemographic variable statistically influenced the answers provided in this question ($p>0.05$). Table 2 shows the answers given to the radiological literacy questions.

Table 2. Radiological Literacy Results

Question	Answer	N
Which of these exams use ionizing radiation?	Ultrasound	29
	Conventional Radiology	274
	Computed Tomography (CT)	286
	Magnetic Resonance Image (MRI)	176
	Mammography	212
	Bone density	158
	I don’t know	166

Which of these measures can be adopted to minimize the effects of exposure to ionizing radiation?	Cover sensitive areas of the body with lead material	328
	Follow the Radiographer instructions to avoid repeating the exam	329
	Wear thick clothes	4
	Leaving the examination room when the X-ray is taken on a family member	312
	Wearing clothes with metal accessories	10
	Do not touch the walls of the room where the exam is carried out	25
	I don't know	77
Identify, in the following questions, the relationship between the X-radiation dose of a CT scan compared to a plain chest X-ray.		
a) CT Chest has a higher dose of X-radiation than Chest Radiograph of…	2 times	92
	40 times	192
	100 times	86
	300 times	17
	I don't know	115
b) Skull CT has a higher X-radiation dose compared to Chest Radiograph of…	2 times	75
	40 times	160
	100 times	129
	300 times	22
	I don't know	116
c) Abdominal and Pelvic CT have a higher X-radiation dose than Chest Radiograph of…	2 times	86
	40 times	161
	100 times	98
	300 times	39
	I don't know	118

With regard to the identification of radiological exams that use ionizing radiation, it was possible to observe that the three most indicated by the sample were: Computed Tomography (22%), Conventional Radiology (21.1%) and Mammography (16.3%). However, it is also noted that the difference in identification of Magnetic Resonance Imaging (MRI) (13.5%) as an examination that uses ionizing radiation and the Bone Density (12.1%) examination is slight, with MRI being more identified as an examination based on ionizing radiation. At the level of identification of radiological protection measures, the three most selected are the correct answer options.

As for the dose topic, most of the sample indicated the correct option (39%) in the first paragraph. Unlike the other paragraphs, in which the sample mostly chose the wrong option. The answer "I don't know" maintained a constant, regular behaviour in all questions, and in some of them, it corresponded to the second option most selected by the sample.

The Chi-Square Independence Test revealed that the variable "Literacy Qualifications" proved to be a statistically significant variable in the choice of the answer ($p>0.05$). That is, it is women with a higher level of education who better select tests that use ionizing radiation, what the radiological protection measures are, and the right dose level for comparison between exams. The "Age" variable proved to be statistically significant ($p>0.05$) in the identification of the tests that use ionizing radiation and in radiological protection measures. It was women aged between 18 and 37 years old who best identified the answers at these points of analysis. As for the topic of dose, age did not appear to have an influence on the answers indicated in this point of analysis.

4. Discussion

The sample of this study has sociodemographic characteristics that are slightly different from those of the Portuguese population (high level of education, and most participants are younger) [37]. This participation of people with a high level of education was also recorded in a Portuguese study carried out after data collection for this work [19]. This feature may represent a bias in this work. For example, with regard to the understanding of information by the attending physician, most of the sample clearly understood the information provided [20]. This easy clarification may not represent how the majority of the population understands the information. The fact that the participants level of education is high (most with a university degree) may be one of the reasons that explains this ease in understanding the information provided [20].

The percentage (92.4%) relating to sample contact with information regarding the radiological examination to be performed was high in this study, a fact also described in a study carried out in 2022 in the Portuguese context [19]. However, it is still demonstrated in the most recent international bibliography, in percentages greater than 50%, that information about the radiological examination or the risks inherent in exposure to ionizing radiation is not addressed [20].

In this study, it was possible to accept that a percentage of 29.3% of the participants reported difficulty understanding the information provided. This fact may be due to the difficult translation of technical language by Healthcare Professionals, into a clear language that is simple to understand [23, 28, 38]. This difficulty may translate into a misunderstanding of the information transmitted and increase the degree of confusion between the previous information that the user already had and the new information provided [23, 28, 38]. This difficulty is observed in this study and in practice in the responses given by the sample. The indication that Magnetic Resonance is an exam with ionizing radiation still demonstrates a lack of knowledge about this image acquisition technique [13, 19, 21, 22].

The wrong selection of the dose levels and the behaviour of the variable "I don't know" when comparing dose levels demonstrate another gap in radiological knowledge. This situation has already been described in articles prior to this work [16, 39], but in recent articles, it is still portrayed [21, 22]. The workflow of Healthcare Professionals is often high, making the process of communication with the user difficult (ending up not establishing any type of communication relationship between these actors) [20, 28].

With regard to seeking information from the Healthcare Professional before exposure to ionizing radiation, it was observed that most participants (56.2%) would not ask for clarification before performing a radiological examination about exposure to X-rays. This fact is also observable in a study from 2022 in which the percentage of users who would not ask for information regarding exposure to X-radiation is higher than that described in this study (84.53%) [19].

A reason for this high value of percentages may be the rooting of the Paternalistic Paradigm, which is still very present both in women of childbearing age and in Healthcare Professionals [2]. In the bibliography consulted, there is an increasing emphasis that Healthcare Professionals should promote the education of users and the mobilization of their skills, but this theme is not included at a curricular level in the training of professionals, leading to a lack of concern for user education [2, 21, 22, 40]. Also, often the nature of the relationship between the Healthcare Professional and the user is very organizational/institutional, oriented towards the process, and based on formalities that do not promote proactivity between these two actors in the search for information and provision of knowledge in this area [16, 21, 41]. Another reason for not questioning may be related to the fact that they never thought of asking, and on several occasions the presentation of the exams is done in an exhaustive way, leading the user to believe that if the Healthcare Professional did not take the initiative to talk about the associated risks, it was because they did not exist [4, 21] and, moreover, not all users want to have information about the associated risks, adopting a more passive attitude throughout the process [4].

However, it is important that 97.2% of the sample consider the existence of information and training aimed at women on exposure and protection against X-rays used in the medical field important. Respondents refer to this measure as something relevant; a similar value was recorded in other studies (95%) [14, 19, 21, 38, 42]. At an international level, the bibliography indicates that there is an increasing interest in this area. It is noted that users want more specific information, taking into account their case, their characteristics, and everything that is inherent to the prescribed procedure [19, 21, 39]. However, values as high as those obtained in this work are not found in all studies. There is a study in which only 39% of the sample considers the existence of training and information on the subject of exposure to X-radiation to be important, with this concern being more pronounced in older men and younger women [43].

5. Conclusion

At a time when services/institutions are increasingly geared towards placing the user at the center, it becomes important to understand the variables that influence behaviour and the way in which information is perceived and understood. It was possible to understand that sociodemographic variables influence some aspects of the behaviour and knowledge of the sample represented in this study, with the influence of literary skills being more expressive at some levels of knowledge and in the way, information is understood. However, there are other factors that also exert their influence, for example, clinical context, the adoption of proactive conduct, among other situations. Through this study, it was possible to observe that although the sample did not ask questions to Health Professionals regarding exposure to X-rays, there is an interest in obtaining more information in this area. That's why, in order to increase the population's levels of knowledge and awareness regarding exposure to X-rays, it is becoming increasingly important to stimulate the relationship between Healthcare Professionals in the field of Radiology and users, as well as to create tools that produce clear information. And simple information that helps increase levels of radiology literacy, such as, for instance, open online patient health/radiology information systems.

6. Declarations

6.1. Author Contributions

Conceptualization, B.B.; methodology, B.B. and F.S.; writing—original draft preparation B.B.; writing—review and editing, F.S.; visualization, B.B. and F.S.; supervision, F.S. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

The participants provided their written informed consent to participate in this study.

6.6. Declaration of Competing Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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Appendix I

Informed Consent

Dear Participant,

Understanding the real radiological knowledge of a population so sensitive to the effects of ionizing radiation is extremely important. As such a central objective, it is intended to assess the level of information that women have about radiological examinations and about radiological protection measures. The answers are multiple choice, totally anonymous and the completion time corresponds to less than 5 minutes. Thank you for your participation in the preparation of this study and all participation is essential.

Do I agree to participate in the study described above?

Yes No

Sociodemographic Variables

1. *Age*

18-27 years old

28-37 years old

38-47 years old

28-56 years old

2. Education level

Primary School

Secondary School

High School

College

University

3. Marital status

Single

Married

Divorced

Widow

4. Geographic Area

North

Lisbon

Center

Alentejo

Algarve

Azores

Madeira

5. Have you ever performed any radiological examination?

Yes No

I. Information

6. If so, did your physician explain the reason for doing this test?

Yes No

7. The information your physician gave you about the exam procedure was…

Hard to understand

Understood with some difficulty

Easy to understand

Perceived without any difficulty

Didn't give me any information

8. Were you asked if you had previously performed radiological examinations?

Yes No

II. Healthcare Professional

9. Which health professional asked you about the previous exams?

Physician

Radiographer

Operational assistant/medical action assistant

Other

III. Radiological Exams

10. Which one(s) of these radiological examinations have you had in the last 5 years (Can you select more than one answer)?

Ultrasound

Computed Tomography (CT)

Conventional Radiology

Magnetic Resonance Image (MRI)

Bone Density

Mammography

IV. Radiological Literacy

11. Before performing the radiological examination, did you ask a health professional for information about exposure to ionizing radiation?

Yes No

12. Do you think radiological exams can influence your health?

Yes No

13. Do you think that X-ray may be contraindicated for a pregnant woman?

Yes No

14. Can a woman who is thinking of becoming pregnant in the coming months be exposed to X-rays?

Totally agree

Agree with some reservations

Partially disagree

Totally disagree

15. Do you think there should be training/information for women about exposure and protection to X-radiation used in medical radiology?

Yes No

16. Is the Body Mass Index (BMI-ratio between weight and height) related to levels of absorbed radiation dose?

Yes No

17. Is there any relationship between exposure to ionizing radiation and the risk of cancer?

Yes No

18. If the doctor asks you to repeat a radiological exam, within a week, do you agree?

Totally agree

I agree with some reservations

Partially agree

Partially disagree

19. Which of these exams use ionizing radiation? (You can choose more than one option)

Ultrasound

Conventional Radiology

Computed Tomography (CT)

Magnetic Resonance Image (MRI)

Mammography

Bone density

I don't know

20. Which of these tests can be performed by a pregnant woman? (You can choose more than one option)

Mammography

Ultrasound

Magnetic Resonance Image (MRI)

Computed Tomography (CT)

Conventional Radiology

Bone density

I don't know

21. Which of these measures can be adopted to minimize the effects of exposure to ionizing radiation? (You can choose more than one)

Cover sensitive areas of the body with lead material

Follow the Radiographer instructions to avoid repeating the exam

Wear thick clothes

Leaving the examination room when the X-ray is taken on a family member

Wear clothes with metal accessories

Do not touch the walls of the room where the exam is carried out

I don't know

22. Identify, in the following questions, the relationship between the X-radiation dose of a CT scan compared to a plain chest X-ray.

	2 times	**40 times**	**100 times**	**300 times**	**I don't know**
a) CT Chest has a higher dose of X-radiation than Chest Radiograph of…					
b) Skull CT has a higher X-radiation dose compared to Chest Radiograph of…					
c) Abdominal and Pelvic CT have a higher X-radiation dose than Chest Radiograph of…					

Thank you very much for your collaboration.