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Research Article

Radiation Perception and Knowledge among Patients at Referral and District Hospitals in Rwanda

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ABSTRACT

Background and objectives: The prevalence of cancer is on the rise, and radiation therapy is an essential part of treatment. However, patients frequently have a limited grasp of radiation therapy, which can result in anxieties and misconceptions. This study's main purpose was to investigate patients' radiation perceptions at both referral and district hospitals in Rwanda by examining patients' knowledge, attitudes, and concerns related to medical radiation.

Materials and Methods: The study employed a quantitative approach where data were collected through structured questionnaires and administered to a diverse sample of patients at referral and district hospitals in Rwanda. The quantitative data collected was analyzed using IBM SPSS software, version 27.0, which was released in 2015. The relationship between the variables was measured using a chi-square test from SPSS. Descriptive statistics were employed, utilizing percentages and frequencies.

Results: Findings revealed significant misconceptions among patients, with many lacking awareness of radiation dangers despite undergoing radiological procedures (C.I=3.50, x= 4.78, dF=0.013, $p<0.05$). Factors such as education level influence knowledge levels with higher-educated individuals rating their understanding more positively.

Conclusion: Significant exposure differences, knowledge and awareness gaps among selected respondents with varying educational levels regarding medical radiation dangers were found

in this study conducted on radiation perceptions among patients in Rwandan hospitals.

Keywords: Knowledge; Medical Imaging; Patients; Perception; Radiation

INTRODUCTION

Radiations can be naturally occurring or man-made. Due to the widespread nature of natural background radiation, human exposure is unavoidable [1]. Radiation is permanently present throughout the environment in the air, water, food, soil, and all living organisms. A large proportion of the average annual radiation dose received by people results from natural environmental sources [2]. People are commonly exposed to radiation, whether knowingly or unknowingly, with a significant portion of exposure stemming from natural sources [3]. Additionally, cosmic radiation, originating from processes in the sun, stars, and throughout the universe, also contributes to natural radiation exposure [4].

Besides that, significant portion of radiation exposure arises from medical sources, particularly diagnostic and treatment machines [5]. In the context of patients' perceptions, the focus lies on clinical radiation, especially those encountered during medical procedures.

Radiation technology plays a crucial role in modern medical diagnostics and treatment, offering significant benefits in terms of accurate diagnoses, targeted therapies, and effective disease management [6,7]. Meanwhile, patients' perceptions and attitudes towards radiation are crucial in ensuring optimal patient care, informed decision-making, and effective communication within the healthcare system. Understanding patient perceptions of radiation, particularly in the context of different hospital settings, is vital for addressing concerns, improving patient education, and enhancing the overall patient experience [8]. Even though radiation is of importance in the medical field, it may pose potential risks to patients [3]. Previous study showed that patients are not seriously concerned with radiation risks [9]. The healthcare system in countries like Rwanda has made significant strides in expanding cancer care services, particularly through the establishment of referral and district hospitals. These facilities play a vital role in providing essential healthcare services, including cancer diagnosis and treatment, to communities that may lack access to specialized care [7]. In developed clinical sectors, medical sources contribute up to 50% of radiation exposure [10]. Diagnostic procedures such as X-rays and CT scans are frequently used for injury and disease diagnosis, while radiation therapy is employed in cancer treatment [11].

Despite the benefits of radiation therapy in cancer treatment, patients often harbor apprehensions and misconceptions about it. These perceptions can significantly impact treatment decisions, adherence, and overall well-being. Radiation therapy serves as a cornerstone of cancer treatment, offering both curative and palliative options for various malignancies. However, patient perceptions of radiation therapy and radiation exposure in general can be influenced by fear and misconceptions, potentially leading to reluctance or avoidance of treatment. Understanding and addressing these perceptions are crucial for healthcare providers to deliver patient-centered care, alleviate concerns, and optimize treatment outcomes [7,10].

Mostly, patients lack understanding and awareness, leading to fear, anxiety, and misconceptions [12]. This is a knowledge gap, and effective delivery of healthcare services is hindered by this gap, consequently leading to patients' refusal of necessary procedures, and compromising healthcare outcomes. According to the study conducted regarding radiation knowledge and perceptions of patients, referring physicians and medical students, many of the patients were not informed about the radiation risks, and even physicians and medical students demonstrated misconceptions about ionizing radiation use in various radiologic examinations [12]. There is a need to educate the general public; patients, medical students and referring health workers about radiation exposure and its (documented) associated risks. This will make patients requiring multiple radiological imaging tests to be aware of radiation; and physicians to promote receiving informed consent through oral interaction in Rwandan language patients understand [12-14]. This study was conducted to investigate the awareness of the current perceptions, knowledge gaps, and barriers related to radiation in Rwanda's hospitals as there is no similar study conducted in Rwanda. The study assesses the level of radiation perception and knowledge among patients at referral and district hospitals in Rwanda, and benchmark points for improvement in patient education and awareness.

MATERIALS AND METHODS

The study was conducted at CHUK and Kibagabaga District Hospital in their Radiology Departments. CHUK is the Teaching hospital that is in Kigali City in Nyarugenge District, and Kibagabaga Hospital is in Gasabo District. These sites were selected to represent others because of the number of populations of different lifestyles they serve. The study duration took 4 months between October 2023 and March 2024. There was no inducement to research, coercion and all participants were adults above 18 years of age. Patients who are unwilling or unable to offer informed consent as well as those experiencing cognitive impairments or communication challenges that would impede their ability to participate in the survey or respond to the questionnaire were exempted. At CHUK we discovered the Radiology Department performs an average of 50 radiological exposures daily including weekend days, we planned to collect data in 3 days/week within a period of one month which is 12 days/month; 102 patients were examined within a 2 -week period (outside the duration of the pilot study). At Kibagabaga Hospital, we found that they received an average of 10 patients daily including weekends in their radiology department. We planned to collect data 1 day per week which is 4 days per month, also eighty percent were considered excluded. After calculation, we got 128 patients (see Yamane's formula below) as our study population from both hospitals excluding the patients with exclusion criteria from our study. A simple random technique was employed to select a sample from a larger population to eliminate bias. We used an open approach to eliminate chances of bias, our team were dispatched to different hospitals to complete the survey of inpatients and outpatients included in this study. A quantitative method was employed. The data collection process involved randomly approaching eligible patients at the selected hospitals. Explaining the purpose and nature of the study, obtaining informed consent, and

administering/reading the questionnaire. The participants were allowed to ask questions while they were responding; then the participants' data entries were recorded by us the researchers and transcribed from the paper questionnaires to electronic (computer) input.

A cross-sectional design was utilized in this research to evaluate the population of interest. There was no longitudinal tracking of study participants after completion. On the other hand, the radiological perception among patients may be inhibited, due to saturation of requests, unjustified imaging requests or unorganized hospital management or work- flow. Management support and Confidence Interval of some participants are included in the tables below.
The sample size was determined by Yamane's formula (1967) [14] as indicated below:

$$n = \frac{N}{1+NE^2} = \frac{128}{1+128\times0.0025} = 97$$

Where: n= Sample size, 97patients
N= Study Population, 128patients
E= Margin Error, 5%

We considered using appropriate multivariate analysis techniques to explore factors associated with radiation perceptions. IBM SPSS software, version 27.0 released in 2015 was employed to analyze collected quantitative data; a chi-square test from SPSS was used to measure the variables' relationship. Descriptive statistics was used using percentages and frequencies. P values less than 0.05 were taken to be statistically significant. Participant consent was sort and Ethical approval was granted by University Teaching Hospital, Kigali (CHUK); with reference numbers (EC/CHUK/013/2024) and (CMHS/IRB/411/2023) respectively.

RESULTS

The considered demographic information was gender, age, and experience of the study participants. This was included to show the characteristics of the participating population. Table 1 represents the summary of the frequencies and percentages of the age groups in which 31(32%) were in the age of 18-16 years followed by 24(24.7%) in the age group 27-35 years.

Table 1: Age distribution of study participants

Age (Years)	Frequency	Percentage
18-26	31	32.0
27-35	24	24.7
36-44	17	17.5
46-53	7	7.2
54 and above	18	18.6
Total	97	100.0

Table 1 reveals that the total number of participants was 97 of whom 55 (56.7%) were males and 42(43.3%) were females.

Table 2: Gender-wise distribution of study participants

Gender	Frequency	Percentage
Male	55	56.7
Female	42	43.3
Total	97	100.0

Table 3 shows the frequencies at different level of education from primary to tertiary institution where maximum of the respondents 38(39.2%) had secondary education followed by primary education 30(30.9%) respectively.

Table 3: Educational level of study participants

Educational level	Frequency	Percentage
University	13	13.4
Secondary	38	39.2
Primary	30	30.9
No formal education	16	16.5

Table 4: Level of knowledge of the patients about diagnostic radiations

Knowledge about diagnostic radiation	Frequency	Percentage
Not dangerous at all.	52	53.1
Extremely dangerous, possible protection.	6	6.1
Extremely dangerous to the human body, and impossible protection.	2	2.0
Exposure to them reduces exposed individual's lifetime	24	24.5
Dangerous exposure to the human body.	14	14.3

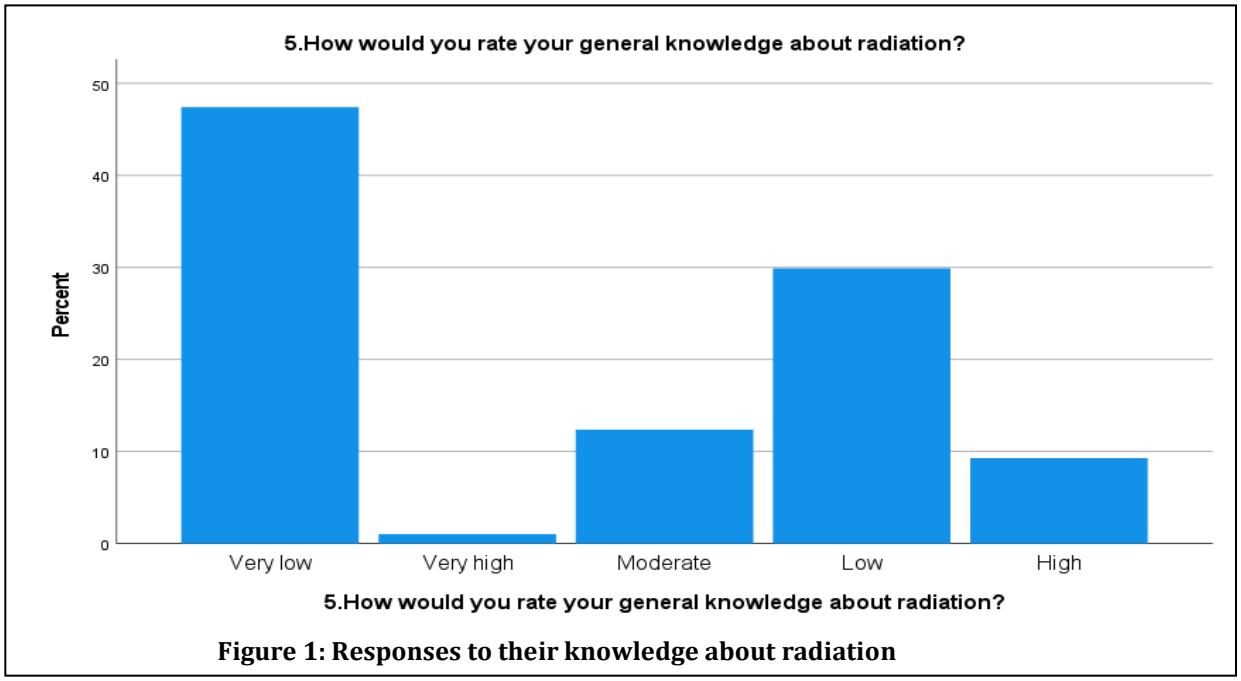

Figure 1: Responses to their knowledge about radiation

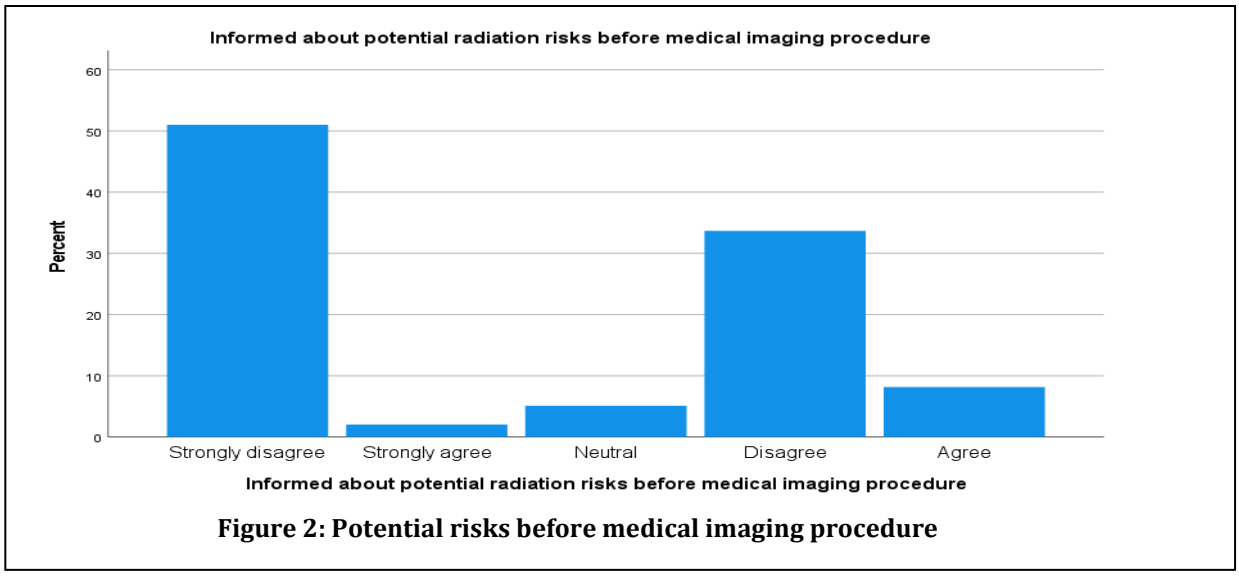

Figure 2: Potential risks before medical imaging procedure

Table 4 depicts the level of knowledge the patients have regarding radiations**.** All the participants had received at least one radiation imaging procedure. Concerning how the hospital staff takes appropriate measures to ensure patients' safety, 2 patients strongly disagree, 16 strongly agree, 26 are neutral, 6 disagree and 48 patients agree that there are measures either knowingly or unknowingly taken by the staff to protect them from radiation risks (Fig.2).

Table 5 depicts that there was no statistically significant relationship between age group and self-rated knowledge about radiation at a 95% confidence level. Table 6 indicated that there was no statistically significant association between sex and self-rated knowledge about radiation at a 95% confidence level. Table 7 reports indicating a statistically significant association between educational level and self-rated knowledge about radiation at a 95% confidence level.

Table 5: Correlation with radiation knowledge and age and radiation knowledge

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.858[a]	16	.395
Likelihood Ratio	19.080	16	.265
Linear-by-Linear Association	1.014	1	.314
N of Valid Cases	97		
a. 17 cells (68.0%) have an expected count of less than 5. The minimum expected count is .07.			

Table 6: Correlation of Gender and knowledge on radiation risk

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.945[a]	4	.413
Likelihood Ratio	4.364	4	.359
Linear-by-Linear Association	1.796	1	.180
N of Valid Cases	97		
a. 3 cells (30.0%) have an expected count of less than 5. The minimum expected count is .43.			

Table 7: Correlation of Education and knowledge on diagnostic radiation

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33.496[a]	12	.001
Likelihood Ratio	39.083	12	.000
Linear-by-Linear Association	18.269	1	.000
N of Valid Cases	97		
a. 14 cells (70.0%) have an expected count of less than 5. The minimum expected count is .13.			

DISCUSSION

Of the 97 targeted and expected number of participants, all participated voluntarily in the study and had received at least one radiological imaging procedure; 55 participants (56.7%) were males, and 42 participants (43.3%) were females (Table 2). Overall majority of patients receiving examinations that use ionizing radiation were aware they would be receiving radiation (53%, Table 4). However; some (20%) were unaware of the associated radiation involved. According to our study, procedures that deliver the greatest amount of radiation; depending on the medical procedure may be associated with a greater risk of cancers. Our patients seem to have varied opinions about the relative amounts of radiation that they would receive before their examination. 6% thought they would receive lower doses of radiation from radiography in comparison to computer tomography, similar to recorded literature by O'Sullivan in 2010 [15]. The majority of the patients ($p < 0.05$) explained that radiation risk was not explained to them (Table 5); this is similar to the results of Lee et al [16] who had previously postulated the ratio of respondents to radiation perception. Goske et al [17] recommended the use of educational tools for patients; and informed consent may be a useful aid for mitigating patients' anxiety; thereby elevating patients objective knowledge concerning imaging modalities. A number of subjects (Table 2 &Table 5: Df = 4, male to female, 56.7 to 43.3%) were unaware that diagnostic imaging test use ionizing radiation. Although higher number of participants (Figure 2, Tables 6 & 7) correctly identified diagnostic imaging tests (barium studies, angiography and CT), are among those using the most radiation.

Accordingly, based on our result analysis; misconceptions regarding radiation risk was associated with high dose radiation; a paradox for health workers referring their patients for multiple high dose examinations in a short period of time rather than low-dose exposure. In a study conducted by Borgen et al [18], 58% of physicians and patients were conscious of referral guidelines for medical imaging and approximately 1/5 of doctors made use of the protocols. We discovered some clinicians believe their patients may refuse pertinent diagnostic imaging tests; if they are made aware of its associated risks. In a postulation by Larson et al [19]; a total of 100 patients from a CT study were surveyed on their knowledge of radiation risk. Based on our results (irrespective of gender, Table 2) or occupation (Figure 3) patients had minimal knowledge of relative amounts of radiation associated with radiographic studies.

Concerning participants' self-assessment of their general knowledge about radiation, the majority reported a very low level, while only a small minority rated their knowledge as very high (Figure 1). This aligns with findings from related studies [20], indicating a significant knowledge gap regarding radiation, particularly in diagnostic and therapeutic contexts. Also, many of the patients, 40.8% were not at all concerned about the radiation issues as they were poorly informed about them only a few were worried. This is in agreement with the study conducted titled" Analysis of public perception about ionizing radiation" which showed that only 15% of participants showed their concern about radiation [3].

Participants who had never had discussions related to his/her concerns with healthcare professionals in radiology or other departments account for 85.7%, entirely in almost all the participants; only 14.3% are very concerned. We cannot confirm that there are no discussions related to radiation between patients and healthcare providers as there is a small portion of patients who discussed their concerns with their healthcare provider but as it is demonstrated, the majority of participants are not informed and had never discussed with them. The study assumes that this may be the factor to the patients' low knowledge/misconceptions to radiations. 55 of 97 participants noticed that cleanliness and comfortability are good in radiology departments and 37.8% said it is very good, 3% of the participants noticed poor cleanliness, 2% were neutral, only 1% said there is very poor cleanliness and comfortability in radiology department; as most of them rated it "good" we can say that they are comfortable with the department and this may be the factor of not being concerned with the radiation exposure issue and not considering their risks. Of 97, 49% of all the participants agree that there is a way of protecting them from receiving unwanted exposure, 26.5% were neutral, 16.3% strongly agree, 6% agree and 2% disagree that there is radiation protection for them. This may be the reason why they are not concerned about the radiation risks and are discouraged from seeking further information from healthcare providers. The exposure experience to radiation does not have a direct relationship with individual radiation knowledge as confirmed by researchers' observation; all participants (100%) already have had prior radiation exposure but still, most of them were not aware of the radiation benefits and risks as well as the meaning. This agrees with the research conducted between September 2020 and January 2021 to assess patients' knowledge, perceptions, and concerns regarding radiation therapy (RT) as asserted by Novac et al in 2021 [7]. Around 52% of participants strongly disagreed that they are informed about diagnostic radiation procedures and associated risks. This has a direct relationship as many participants 47.4% have very little knowledge about them. Based on the chi-square test results, there is no significant association between age group and self-rated knowledge about radiation; in parallel with similar findings by Michelle et al [20]. Also, for sex and knowledge about radiation; No significance in gender-based perception. Unlike, the data suggests a clear association between educational level and self-rated knowledge about radiation. Respondents with higher educational levels (University and Secondary) tend to rate their knowledge higher compared to those with lower educational levels (Primary and No formal education) (Table 3). According to the researchers' observation, the educated ones had the desire to discuss with the healthcare providers about the issues of radiation exposure and consequently their perceptions were different from the rests. In essence, like similar studies by Michelle et al [20], this study about radiation perceptions of patients at referral and district hospitals reveals a knowledge gap about radiation among the patients. We recommend the development and execution of comprehensive patient education programs aimed at increasing awareness of the risks associated with medical radiation. Besides that, fostering open, clear, consistent, and transparent communication between healthcare professionals and patients concerning radiation risks and benefits is equally important. Approval and guarantee of ethical

clearance, limited funds, challenges in transportation logistics and difficulty in obtaining educational level data are some of the limitations encountered during this study.

CONCLUSION

Radiation perceptions among patients in Rwandan hospitals revealed significant gaps in knowledge and awareness regarding medical radiation risks. Despite receiving radiological imaging procedures, a considerable portion of participants exhibited limited understanding and awareness of radiation dangers. The majority expressed minimal concern about radiation issues, potentially influenced by a lack of information and discussions with healthcare professionals. Interestingly, while exposure experience to radiation did not directly correlate with individual knowledge levels, educational attainment emerged as a significant factor. This study found that there were significant gaps in knowledge about risks to radiation exposure among patients who had been subjected to different imaging modalities.

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Author's Contribution: Conceptual framework, analysis of data- **LT, YU, EK, AMA;** edited the revised version, reference management- **MM, AOA, MAM.** The final submission was approved for publication by each author.

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