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ASSESSMENT OF KNOWLEDGE ON RISK AND DANGERS OF RADIATION AND PREVENTIVE MEASURES AMONG PATIENTS ON RADIOLOGICAL EXAMINATION IN SOME SELECTED HOSPITALS IN BAUCHI METROPOLITAN, NIGERIA

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A B S T R A C T :

Radiological examinations play a crucial role in modern healthcare; however, exposure to ionizing radiation poses potential health risks. This study assessed patients' knowledge, awareness, and attitudes toward radiation risks and safety measures in selected hospitals in Bauchi. A cross-sectional survey design was employed, utilizing structured questionnaires distributed to 120 patients undergoing radiological procedures, with 105 valid responses (87.5% response rate) analyzed. Results showed that 80.9% of respondents acknowledged the use of ionizing radiation in hospitals, while 70.4% recognized its production in laboratories. However, only 44.7% were aware of natural radiation sources. Awareness of radiation-related health risks was high, with 85.7% associating radiation with genetic mutations and 95.2% linking it to skin cancer. Regarding radiation safety, 92.3% recognized restricted access to radiation rooms, while 85.3% confirmed the availability of personal protective equipment. However, only 63.8% reported the presence of multilingual safety signs. Attitudinal findings indicated that 88.6% of patients believed medical imaging was necessary for accurate diagnosis, though 89.5% expressed concerns about health risks. The statistical analysis (Chi-square tests) revealed significant differences in knowledge ($\chi^2 = 243.4$, $p < 0.05$), awareness ($\chi^2 = 692.3$, $p < 0.05$), and attitudes ($\chi^2 = 486.4$, $p < 0.05$) across demographic groups. The study concludes that while patients demonstrate moderate knowledge of radiation risks and preventive measures, gaps persist in safety awareness. Therefore, targeted educational interventions and improved communication strategies are recommended to enhance patient understanding and compliance with radiation safety guidelines. Keywords: Ionizing radiation, patient awareness, radiation safety, radiological examinations, Bauchi hospitals.

1. I N T R O D U C T I O N

1.1 Background of the Study: Radiation exposure in medical settings poses significant health risks to medical workers, particularly those performing interventional radiology and cardiology procedures (Baudin *et al*., 2021). The growing use of medical imaging and interventional procedures has increased occupational radiation exposure, emphasizing the need for effective control measures. Ionizing radiation's biological effects, including increased cancer risk and genetic alterations, can have severe consequences (Lopes *et al*., 2022). Rigorous monitoring and control are essential, even with low-level exposure (Wang *et al*., 2021). Protection methods, such as lead barriers and shielding materials, are crucial (Campolo *et al*., 2022), and real-time monitoring devices enable instant feedback and adjustments during procedures (Picano *et al.,* 2014). Staff training on radiation safety is also vital (Baudin *et al*., 2021). However, challenges persist, including varying safety precaution effectiveness and higher exposure linked to specific X-ray beam angles (Wang *et al*., 2021; Li *et al*., 2022). This study aims to comprehensively investigate radiation exposure in patients undergoing various interventional procedures.

1.2 Research Gap: Despite existing research, a comprehensive study is needed to investigate specific factors contributing to radiation exposure in various interventional procedures and patient populations. Current literature highlights the importance of radiation safety, but gaps exist in understanding exposure levels in different medical specialties and procedures. This study bridges this gap by providing an in-depth analysis of radiation exposure levels and associated factors.

1.3 Literature Review: A comprehensive review reveals that radiation exposure is a significant concern for medical workers and patients undergoing interventional procedures. Ionizing radiation can have detrimental health effects, including increased cancer risk and genetic alterations (Lopes *et al*., 2022). Lead barriers, lead aprons, and shielding materials reduce exposure, while real-time monitoring devices and staff training on radiation safety are also crucial (Baudin *et al*., 2021; Picano *et al.,* 2014). However, the effectiveness of these measures can vary, highlighting the need for further research.

2. M E T H O D S

2.0 Research Design: This study adopts a survey method and employs a cross-sectional research design to assess patients' knowledge of radiation exposure in selected government and private radiological examination centers in Bauchi town, Nigeria. This design enables the collection of data at a single point in time, providing a snapshot of patients' knowledge levels.

2.1 Setting for the Study: Bauchi is a local government area in Bauchi state, Nigeria, with a diverse population of approximately 670,000 people, comprising various ethnic groups such as Fulani, Hausa, Jarawa, Sayawa, and Ngas, with over 60% of the population being Muslims, and the area is known for its agrarian activities.

2.2 Inclusion Criteria: The target population consists of individuals who have recently undergone or are scheduled for medical procedures involving ionizing radiation within the selected radiological examination centers in Bauchi town, focusing on adults aged 18 years and above, both male and female, who provide informed consent for voluntary participation.

2.3 Exclusion Criteria: Individuals excluded from the study include those without recent medical procedures involving ionizing radiation, those below 18 years old, individuals with language barriers or cognitive impairments, those who decline to provide informed consent, and patients outside the specified radiological examination centers.

2.4 Sampling Procedure and Sample Size: A purposive sampling method was used to select participating hospitals, while a simple random sampling technique was employed to select 120 patients from the target population, with 20 subjects from each of the six selected radiological examination centers (three government-owned and three private), ensuring representativeness and generalizability of the findings.

2.5 Method of Data Collection: Data collection was conducted using a tailored questionnaire aligned with the research objectives. Both questionnaires and interviews were employed to gather information from participants. Questionnaires were administered onsite by enumerators, ensuring respondent anonymity, while interviews were used to clarify responses provided in the questionnaires.

2.6 Method of Data Analysis: Data analysis involved several steps. First, data entry and cleaning were performed to ensure data accuracy. The data was then analyzed using SPSS version 20. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were used to summarize participants' demographic profiles and knowledge levels. Inferential statistical methods, including chi-square tests, were employed to explore associations between demographic variables and knowledge levels.

2.7 Ethical Approval: This study obtained ethical approval from the National Open University of Nigeria's ethical review committee. Participants were informed about the study's purpose, assured of confidentiality, and notified of their right to decline participation. Measures were taken to maintain the confidentiality of the gathered information.

3. R E S U L T S

Table 1: Distribution of the respondents based on questionnaire distributed

S/N	Hospital	Distributed	Returned	Invalid	Analyzed
1	ATBUTH	20	20	2	18
2	Specialist Hospital Bauchi	20	19	1	18
3	Town Maternity Bayan Fada	20	15	0	15
4	Newlife Hospital	20	20	2	18
5	Rimi Clinic	20	20	1	19
6	Assalam Hospital	20	17	0	17
	Total	**120**	**111**	**6**	**105**

Source: Survey, 2024

Table 2: Distribution of the respondents by Gender

Gender	Female	Male	Total
Frequency	55	50	105
Percentage (%)	52.38%	47.61%	100%

Source: Survey, 2024

Table 3: Distribution of the respondents by Age

Age	18-25yrs	26-35yrs	36yrs and above	**Total**
Frequency	38	43	24	**105**
Percentage (%)	36	**41**	**23**	**100**

Source: Survey, 2024

Table 4 Distributions of Respondents by Marital status

MARITAL STATUS	**FREQUENCY**	**PERCENTAGE (%)**
Single	30	27%
Married	75	73%
Total	**105**	**100**

Source: Field Survey, 2024

Table 5: Distribution of the respondents by Qualification

Qualification	**Non-formal**	**Primary**	**Secondary**	**Tertiary**	**Total**
Frequency	13	34	41	17	105
Percentage (%)	12.38	32.38	39.05	16.19	100%

Source: Survey, 2024

Table 6: Distribution of the respondents by Profession

Profession	**Doctor**	**Radiologist**	**Others**	**Total**
Frequency	10	15	80	105
Percentage (%)	9.52	14.28	76.19	100

Source: Survey, 2024

Table 7: Responses on the answer to the research question one

SN	**STATEMENTS**	**SA**	**A**	**N**	**D**	**SD**	**TOTAL**	**EX**	**DECISION**
1	Ionizing radiations are used in the hospitals to ascertain the body parts of patients.	34	63	5	1	2	105	3.54	Agreed
2	Ionizing radiations have penetrative abilities	36	57	7	5	0	105	3.11	Agreed
3	Ionizing radiations are electromagnetic radiations that do not require material media for their transportation	74	24	3	3	1	105	2.92	Agreed
4	Some ionizing radiations are naturally occurring in the universe	13	34	6	38	14	105	2.19	Disagree
5	Ionizing radiations can be produced in the laboratory	14	29	1	43	18	105	2.82	Agreed

Source: Field Survey, 2024

Table 8: Responses to the answers on research question two

SN	**STATEMENTS**	**SA**	**A**	**N**	**D**	**SD**	**TOTAL**	**EX**	**DECISION**
1	Ionizing radiations cause change in gene arrangement (mutation)	52	38	5	6	4	105	3.59	Agreed
2	Ionizing radiations can cause skin cancer and other skin-related diseases	78	22	0	4	1	105	3.63	Agreed
3	Ionizing radiations can reduce the lifespan of an individual	36	42	5	12	10	105	3.63	Agreed
4	Ionizing radiations are hazardous to soft spots in the human body such as the eyes	82	12	0	8	3	105	3.23	Agreed
5	Improper application of ionizing radiations in the course of treatment can bring about	13	34	6	38	14	105	3.23	Agreed

	complications

Source: Field Survey, 2024

Table 9: Responses to the answers on research question three

SN	STATEMENTS	SA	A	N	D	SD	TOTAL	EX	DECISION
1	Radiation rooms are only open to authorized persons only in the hospital	74	23	2	5	1	105	3.23	Agreed
2	Personal Protective Equipment for the art of radiography are available in the radiology of the hospital	52	37	3	10	3	105	4.00	Agreed
3	Safety signs and warnings present in the radiography wards pass adequate information concerning radiations safety	78	22	0	3	2	105	2.85	Agreed
4	Safety inscriptions in the hospitals are written in various languages	36	42	4	13	10	105	2.74	Agreed
5	The staff of the radiology department seldom give orientation to the patients on radiation safety	82	12	3	6	2	105	2.85	Agreed

Source: Field Survey, 2024

Table 10: Responses to the answers on research Question four

SN	STATEMENTS	SA	A	N	D	SD	TOTAL	EX	DECISION
1	I believe that medical imaging procedures using ionizing radiation are necessary for accurate diagnosis.	72	20	2	9	2	105	3.57	Agreed
2	I am concerned about the potential health risks associated with exposure to ionizing radiation during medical procedures.	64	29	10	2	0	105	3.65	Agreed
3	I trust that healthcare professionals adequately inform me about the risks and benefits of procedures involving ionizing radiation.	30	53	5	10	7	105	2.88	Agreed
4	I am willing to undergo a medical procedure involving ionizing radiation if recommended by my healthcare provider.	63	25	12	5	0	105	2.92	Agreed
5	I actively seek information about ionizing radiation and its associated risks before undergoing medical procedures.	51	31	9	9	5	105	2.92	Agreed

Source: Field Survey, 2024

Table 11: level of knowledge of patients on risk of radiation

Response	1	2	3	4	5	Total
Strongly Agree	34	36	74	13	14	**171**
Agree	63	57	24	34	29	**201**
Undecided	5	**7**	**3**	**6**	**1**	**22**
Disagree	**1**	**5**	**3**	**38**	**43**	**90**
Strongly Disagree	**2**	**0**	**1**	**14**	**18**	**35**
Total	**105**	**105**	**105**	**105**	**105**	**519**

Table 12: Hypothesis One Result

Observable	Expected	O – E	$(O – E)^2$	$\frac{(O - E)2}{E}$
171	**105**	**66**	**4356**	**41.5**
201	**105**	**96**	**9216**	**87.7**
22	**105**	**-83**	**6889**	**65.6**
90	**105**	**-15**	**225**	**2.14**
35	**105**	**-70**	**4900**	**46.6**
Total				**243.4**

Calculated Chi square (x^2) = 243.4; DF = k – 1 (5 – 1) = 4; Level of significance = 0.05; Tabulated value = 9.49

Table 13: Patients' knowledge on ionizing radiations

Response	1	2	3	4	5	Total
Strongly Agree	52	78	36	82	13	**261**
Agree	38	22	42	12	34	**148**
Undecided	5	0	5	0	6	**16**
Disagree	6	4	12	8	38	**68**
Strongly Disagree	4	1	10	3	14	**32**
Total	**105**	**105**	**105**	**105**	**105**	**525**

Table 14: Hypothesis Two Result

Observable	Expected	O – E	$(O – E)^2$	$\frac{(O - E)2}{E}$
261	**105**	**156**	**24336**	**231.7**
148	**105**	**43**	**1849**	**17.6**
16	**105**	**-89**	**7921**	**75.4**
68	**105**	**-37**	**1369**	**13.0**
32	**105**	**-73**	**5329**	**50.7**
Total				**388.4**

Calculated Chi square (x^2) = 388.4**;** DF = k – 1 (5 – 1) = 4**;** Level of significance = 0.05**;** Tabulated value = 9.49

Table 15: Patients level of awareness about safety measure.

Response	1	2	3	4	5	Total
Strongly Agree	74	52	78	36	82	**322**
Agree	23	37	22	42	12	**136**
Undecided	2	3	0	4	3	**12**
Disagree	5	10	3	16	6	**40**
Strongly Disagree	1	3	2	10	2	**18**
Total	**105**	**105**	**105**	**105**	**105**	**528**

Table 16: Hypothesis Three Result

Observable	Expected	O – E	$(O – E)^2$	$\frac{(O - E)2}{E}$
322	**105**	**217**	**47089**	**488.5**
136	**105**	**31**	**961**	**9.1**
12	**105**	**-93**	**8649**	**82.4**
40	**105**	**-65**	**4225**	**40.2**
18	**105**	**-87**	**7569**	**72.1**

Total				**692.3**

Calculated Chi square (x^2) = 692.3; DF = k – 1 (5 – 1) = 4; Level of significance = 0.05; Tabulated value = 9.49

Table 17: Patients attitudes toward ionizing radiation exposure

Response	1	2	3	4	5	Total
Strongly Agree	72	64	30	63	51	**280**
Agree	20	29	53	25	31	**158**
Undecided	2	10	5	12	9	**38**
Disagree	9	2	10	5	9	**35**
Strongly Disagree	2	0	7	0	5	**14**
Total	**105**	**105**	**105**	**105**	**105**	**525**

Table 18: Hypothesis Four Result

Observable	Expected	O – E	(O – E)^2	$\frac{(O - E)2}{E}$
280	**105**	**175**	**30625**	**291.6**
158	**105**	**53**	**2809**	**26.7**
38	**105**	**-67**	**4489**	**42.7**
35	**105**	**-70**	**4900**	**46.6**
14	**105**	**-91**	**8281**	**78.8**
Total				**486.4**

Calculated Chi square (x^2) = 486.4; DF = k – 1 (5 – 1) = 4; Level of significance = 0.05; Tabulated value = 9.49

4. D I S C U S S I O N S

First hypothesis, which asserts Using the pearson chi square approach, it was shown that there is no discernible difference in the current level of awareness between male and female patients on the risks and dangers associated with radiation exposure. The findings indicated that the present degree of knowledge on the hazards and dangers associated with radiation exposure varied significantly between male and female patients. It might be because women don't have formal schooling. This result is consistent with the findings of Nuthana and Yenagi (2009), who discovered a substantial difference in the amount of knowledge of risks and consequences connected with radiation exposure between patients who were male and female. The pearson chi square method was used to assess the second hypothesis, which claims that there is no significant difference between male and female patients' awareness of basic ionizing radiation concepts. The findings demonstrated a substantial disparity in the patients' understanding of basic ionizing radiation concepts between the male and female groups. This conclusion is consistent with the findings of Barnawi et al. (2018), who discovered a substantial difference in the patients' understanding of basic concepts linked to ionizing radiation between the male and female groups. It might be because women don't have formal schooling. The majority of male patients stated that they were aware of various ionizing radiation side effects, including mutation, skin cancer.

The majority of male patients stated that they were aware of some of the negative effects of ionizing radiation, such as mutations, skin cancer and related infections, skin irritations, and the death of essential body cells, whereas the majority of female patients were unaware of these effects. The importance of education and accessing top-notch facilities in enabling individuals to take appropriate measures against radiation exposure was highlighted by the participants. Health decisions may be impacted by education's ability to raise awareness of radiation dangers (Al Ewaidat *et al*., 2018). Some researchers, however, disagreed with this conclusion and found no connection at all between radiation awareness and education (Al-Mallah *et al*., 2017; Brun *et al*., 2018; Schnitzler *et al*., 2017). Using the Pearson Chi Square method, the third hypothesis—that there is no discernible difference in the level of awareness among male and female patients regarding safety precautions during radiation-related medical procedures—was examined. According to the results, which are consistent with those of Abalo et al. (2021), there was a significant difference between the knowledge of safety precautions during radiation-related medical operations between male and female patients.

Patients were also aware of the safety precautions taken by the hospital to prevent excessive radiation exposure, such as the fact that radiation rooms are only accessible to authorized individuals and that personal protective equipment is available in the radiology department. Safety signs and warnings were also present in the radiography wards, providing adequate information about radiation safety as well as safety inscriptions written in multiple languages. These results are consistent with Cohen's (2019) findings. The pearson chi square method was used to evaluate hypothesis four, which claims that the views that patients, both male and female, now have regarding ionizing radiation exposure are consistent and do not differ significantly. The findings indicated that the views that patients, both male and female, had at the time regarding ionizing radiation exposure differed significantly. This result is consistent with the findings of Alavi et al. (2016). Patients are concerned about radiation safety. Radiation damage can be lessened by having a high degree of awareness and a positive attitude regarding radiation. Additionally, a few research (Wang *et al*., 2021; Gupta *et al*., 2021) indicate that there may be an equal risk for patients and medical personnel. According to our research, women have the majority of negative attitudes about radiation safety, but men have high standards when it comes to radiation safety, according to prior studies by Lopes et al. (2022). One first step in minimizing radiation's negative side effects could be to improve the attitude of doctors, nurses, staff, and technicians toward radiation safety. Thus, while a study by Campolo et al., (2022) found that physicians had the highest score regarding the attitude toward radiation safety, physician's assistants (nurses staff) had the lowest. Our study also found that the majority of low-level attitude was among physicians, and the majority of high-level attitude was among nurses and staff.

Furthermore, Brower & Rehani (2021) discovered that nurses' understanding of radiation safety is lacking. Physicians were shown to be statistically significantly more knowledgeable about radiation safety in another study done in Turkey. Numerous fields, including orthopedic surgery, urology, plastic surgery, neurosurgery, interventional radiology, and interventional cardiology, are deemed high risk due to increased exposure. The majority of women in our survey had a low-level attitude, which was statistically significant. However, according to other studies (Li *et al*., 2022), urologists, orthopedics, and neurosurgeons had positive attitudes for wearing radiation protection equipment. Several scholarly investigations have examined the frequency with which healthcare workers (HCWs) use protective measures. In our research, 91% of participants felt strongly about wearing a lead apron, around half felt strongly about wearing a thyroid shield, and only 12% felt strongly about wearing lead goggles. According to a research by Campolo et al. (2022), only 31.3% of the participants used lead goggles, while 78.5% of them wore thyroid shields. According to a controversial study by Wang et al. (2021), 40% of electrophysiologists wear eye lead glasses. Our survey revealed that over 67% of respondents had never used a dosimeter. However, according to a different survey, 38% of doctors have used dosimeters. Surprisingly, when it came to radiation safety knowledge, most participants with low attitudes knew about the ideal thickness for a lead apron as well as potential radiation side effects like leukemia, lymphoma, cataracts, and birth defects that could result from radiation exposure.

5. S U M M A R Y

This study investigated patients' knowledge and awareness of radiation exposure risks and preventive measures in selected hospitals in Bauchi. The study found that patients demonstrated basic understanding of ionizing radiation, including its use in hospitals and potential side effects. However, misconceptions regarding exposure risks were prevalent, and attitudes toward protective measures were generally poor.

5.1 C O N C L U S I O N

The study concludes that patients have satisfactory knowledge but negative attitudes toward radiation protection. Further efforts are necessary to integrate radiation protection as a vital component of professional competencies for healthcare professionals. The study's findings can contribute to raising awareness of radiation risks among patients and empowering them to make informed decisions about their care. Future researchers should employ additional quantitative approaches to validate the outcomes. Subsequent investigations could explore the impact of the study's findings on patients' choices regarding medical procedures involving radiation. Quantitative analyses could assess the significance of these findings, and a study conducted in a different context could corroborate or supplement the findings of this research.

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