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ASSESSMENT OF KNOWLEDGE AND SAFETY PRACTICES OF RADIATION AMONG UNDERGRADUATE NURSING STUDENTS IN SOUTH-EAST NIGERIA

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ABSTRACT

This study assessed the knowledge of radiation, radiation safety practices, adherence to radiation safety measures, factors responsible for adherence among undergraduate nursing students in southeast Nigeria. Radiation though harmful are very essential medical diagnostic and therapeutic tool. To ensure that nurses in training and on clinical experience, working in different units where 3.744 billion radiation based diagnostic and treatment procedures are carried out (WHO,2016), are not causalities of the effects of radiation, this study became imperative. Moreover, these students are in their prime with longer life expectancy and years of practice, mostly female (91%) of child bearing ages, susceptible to radiation exposure all through practice, would have the society pay for the primary and secondary cost of these exposures. A descriptive cross-sectional study, among 308 undergraduate nursing students in south east Nigeria. Multistage sampling technique was used, randomly selecting one school from four randomly selected states in southeast Nigeria. Data were analyzed using SPSS version 27. Female respondents (73%) of child bearing ages (16-35 years) were 98.7%, this is the percent prone to the numerous effects of radiation. Only 22.7% of the students know medical modalities that emits radiation, 27.9% know tissues more susceptible to ionizing radiations while only 8.4% have high knowledge of radiation safety. A few (31.2%) could identify thermoluminiscent dorsimeters, 34.4% could identify lead apron and thyroid shield protective devices. 31.8% identified the minimum radiation safe distance. Factors like class, age and location determine only 2% of adherence to radiation safety, 24% of knowledge of radiation and 16% of knowledge of radiation safety measures. Nursing council and National University Commission need consider the inclusion of an introductory course in radiation studies into nursing training curriculum. Provision and equitable distribution of radiation

safety devices by training institutions are advised to maximally harness the limited workforce.

KERWORDS: Radiation, knowledge, undergraduate, safety practices, nursing, students, South East, Nigeria, assessment.

BACKGROUND

Ionizing Radiation, though a nuclear weapon, is essential in the diagnosis and treatment of diseases. To enhance diagnosis and cancer treatment, modern diagnostic and radiotherapy equipment like Computed Tomography (CT) scanners, X-ray machines, and medical linear accelerators (LINAC) are introduced intermittently in hospitals and clinics. These introductions raise concerns over radiation-related risks to workers and students in training.

In full awareness of radiation and its safety measures such as the use of distance (stay away during exposures); time (shorten the length of time) and shield (use lead aprons and lead shields). We can be sure the dose limit of 1 to 50 mSV / year and 20mSV / year over a period of five years for occupational exposures as set by the International Commission on Radiological Protection (ICRP) are not exceeded (Samson, Ibrahim, Usman and Abdullahi, 2020). This is the dose above which oxidative stress, DNA damage, cancer, and cardiovascular diseases are most likely to occur. Therefore, ignorance of radiation safety becomes a national and international public health concern militating against the protection of workers and trainees against radiation hazards to cells. Compliance with Nigeria's basic ionizing radiation regulations (NBIRR) is only possible if the workers and students are in the know.

Radiation is the energy emitted from an unstable atom to achieve a stable balance, given off in the form of rays or high-speed particles. In a bid to get rid of excess atomic energy, a quantity of energy is emitted called radiation. Radiation is hazardous to cells and requires adequate safety measures. Radiation has stochastic and non-stochastic effects. Stochastic effect is the possibility of an effect but not its severity, does not depend on the radiation dose but on the duration (Usman, Bashir, Dimas and Joseph, 2020). Therefore, they are called late-onset disorders. Non-stochastic effects are acute disorders and a deterministic effect that the symptoms appears by exposure above a threshold. An assessment of the level of knowledge about these stochastic and non- stochastic effects of radiation is very significant in ensuring the safety of healthcare workers from radiation accidents (Thomas and Symonds, 2016).

Scholars and researchers have carried out lots of research work in this field but have kept neglecting these important personnel in training, the undergraduate nursing students. It is pertinent to note that these assessments should not be limited to only radiology health personnel but extended to nurses who are consistent with the patients in the wards during ward radiological examinations, using mobile X-ray units in wards like intensive care unit (ICU), special care baby unit (SCBU), dental department, geriatric wards, and even the theater. To fully assess this knowledge with an enabling environment for corrections and prompt adjustments where necessary, nursing students become the choice sample population. Moreover, nursing students are majorly very young females of childbearing age mostly within the age bracket 16-30 years of age, and are more sensitive to radiation (higher radio sensitivity). Even the few males among them are quite young too and in their reproductive ages, with gonads highly sensitive to radiation. A comparison of the study in the different states would also be done to further analyze the factors responsible for a deviation in the different locations if there be any.

MATERIALS AND METHODS RESEARCH DESIGN

This study is an analytical cross-sectional study of the knowledge and safety practices of radiation among nursing students in South-East Nigeria. The study assessed the level of knowledge of radiation, and its safety practices, identified factors influencing knowledge of radiation, safety practices, and adherence to safety practices. Similarities and differences in data collected from the various southeast states were noted. An analysis of the findings were carried out and actionable recommendations made.

STUDY AREA

South-East Nigeria is the study area for this thesis. South-East Nigeria is one of the six geopolitical zones in Nigeria, formerly called Eastern Nigeria. The region borders Cameroon to the east, the river Niger to the west, north central to the north, and the Atlantic Ocean to the south. The region has 85 local government areas, and a population of about 36 million people, this is around 18% of the total population of the country and ethnically 99.7% Igbo (Wikipedia, 2023). The land is owned communally by kinship groups and made available to individuals for farming and building. Apart from agriculture, the zone is known as a commercial, local craft, waged labor, and trade zone with small and medium indigenous industries that manufacture goods and services. In the decades after Nigeria's independence, a literacy rate has helped the Igbo to become civil servants and business entrepreneurs. Igbo

women engage in trade and as well influential in local politics. South-east is made up of five states namely: Abia, Anambra, Ebonyi, Enugu, and Imo. Each of these states is highly market-oriented, industrious, and hospitable. Of the ninety (90) accredited College of Nursing in Nigeria, twenty-five (25) are located in the South-East.

Specific Study Sites

Four out of the five states in the southeast were used for the study: including Abia state, Anambra state, Ebonyi state, and Enugu State. Thereafter, one school of nursing was selected from each of the four states. College of Nursing Science, Mater Misericordiae Hospital is a missionary college of nursing established by the Irish missionaries (Saint Patrick's missionaries) in collaboration with Dr. Akanu Ibiam in the year 1946 during the war to meet the medical needs of the people. The hospital is a secondary health facility, now owned and managed by the catholic diocese of Abakiliki. The second study site is the College of Nursing Enugu State University of Science and Technology Teaching Hospital (ESUT-TH) Parklane. ESUT-TH, Parklane is a tertiary health institution established in 1930 for colonial masters, converted to a general hospital in 1967-1970 during the Nigeria Civil War, and became a teaching hospital in May 2006 (Wikipedia, 2013).

The School of Nursing NAUTH, Nnewi is the selected nursing school in Anambra state. NAUTH, just like ESUT-TH is a tertiary healthcare facility that offers medical care to students, the people of Nnewi, and her neighboring communities. The school of nursing is an integral part of NAUTH, located at Nnewichi, Nnewi north local government area. Over 400 undergraduate nursing students are being trained within the facility. College of Nursing Amachara is located in Amachara, a town in Umuahia-South local government area of Abia state. All these selected institutions are in the rainforest zones, in South- East Nigeria.

STUDY POPULATION

The study population included both male and female undergraduate nursing students of all classes except first years, in selected colleges of nursing sciences in South-East Nigeria

Sampling Technique

A multistage sampling technique was used in this study. This method ensured that all the undergraduate nursing students in the different classes of the study locations had equal possibility of being chosen, giving a good representation of the sample.

Stage 1: A simple random sampling technique was used in the selection of the 4 states out of

5 states in the South-East, of Nigeria.
Stage 2: Stratified random sampling technique ensured 4 colleges of nursing sciences were picked from 18 schools of nursing in the 4 study sites (states in the Southeast).
Stage 3: Stratified random sampling to ensure proportional allocation based on the number of students in each school.

Identify the population of interest: the population of interest in this study is both male and female undergraduate nursing students in South-East, Nigeria.

Divide the population into strata: Each school of nursing represented in this study served as a stratum. The college of nursing include the College of Nursing (ESUT-TH) Parklane Enugu, College of Nursing Science Mater Misericordiae Hospital Afikpo North, Ebonyi State, College of Nursing Nnamdi Azikiwe University Teaching Hospital (NAUTH) Nnewi, Anambra State and College of Nursing Science Amachara Umuahia Abia State.

Determine the sample size per stratum: The total number of participants in this study is 365. Participants were selected using proportional allocation based on the number of students in each class in each school, serving as a stratum. ESUT-TH Parklane College of Nursing has (a total of 100 students) 50 students each in 2nd and 3rd year, Mater Misericordiae College of Nursing (MMH) has a total of 392 students in 2nd and 3rd year, NAUTH College of Nursing has a total of 267 students while College of Nursing Amachara Umuahia Abia State have 75 students each in 2nd and 3rd years batch A. Total of 2nd year and 3rd year in the four schools of nursing: 100+392+267 +150 = 909. Therefore using proportional allocation, the 333 questionnaires were shared using proportional allocation, a total of $333.99 \approx 334$ students were studied.

Selection of participants from each class: A simple random sampling: pieces of papers having the required number of “YES” with the rest “NO” written on it were used to select 18 from 50 students in each class (200 and 300 level) for ESUT-TH, 72 from 392 students per class for Mater Misericordiae, 49 students per class were enrolled from 267 students in NAUTH while 27 students each: out of 150 students in Amachara College of Nursing.

To ensure that male nurses are in the sample, all males in each class were selected and a simple random sampling was performed to select X females from the remaining class population at the study site. X depends on the numbers already calculated above for each

class in the different schools minus the number of males in the class.

INSTRUMENT FOR DATA COLLECTION

A semi-structured self-administered questionnaire modified by researcher after reviewing severally pieces of literature. This questionnaire comprises 4 sections (I, II, III, and IV) and a total of 46 questions in all. Section I consists of Introductions and demographics, Section II: knowledge of radiation, Section III: Knowledge of Safety Practices, and Section IV: Adherence to radiation safety practices. This instrument is the original work of Han et al. (2012); Paolicchi et al., (2016); Salerno, Marchese, Magistrelli and Toma, (2015) but modified to archive the research objectives by the researcher.

Demographics were assessed using 6 questions consisting of questions to ascertain their school, gender, age, class/ level in school, marital status, and tribe. Knowledge of radiation were measured using true, false, and not sure, as well as used objective respondent questions. This section of the instrument consists of 15 questions. Knowledge of radiation safety practices were measured using this instrument which consists of 15 questions in total. Relevant questions were asked to ascertain how much they know about radiation protection shields and aprons, the use of film badges and thermoluminescent dosimeters, tissue radio sensitivity and its relationship with the genetic effects of radiation, annual exposure limit, health examination for radiation workers, the relationship between radiation intensity and distance from the source, the duration of time spent in radiation zones, the outcome of radiation exposure during pregnancy, the purpose of using radiation safety devices, recognition of radiation warning signs and symbols, types of legally designated personal dosimeters, the relationship between dose and irradiated area.

MEASUREMENT OF VARIABLE (VALIDITY OF INSTRUMENT)

Section I: Descriptive statistics like frequencies were used for each demographic variable.

Section II: Correct answers were scored 15 point while false, “not sure” and wrong answers are scored accordingly. The range of possible scores is 0-15 points, higher scores indicate better knowledge of radiation.

Section III: Likert scale was used in the scoring of each question from “right answer” (1 point) to “wrong answer” (0 point). The range of possible scores is 0 -1 points with scores indicating “all or none” knowledge of radiation safety.

Section IV: Adherence to radiation safety practices were measured using a total of 10 questions scored on a 5-point Likert Scale from "never performed' (10 point) to "always" (50 points). The range of possible scores is 10- 50 points, higher scores indicate a greater adherence to radiation safety rules. The instrument's reliability was shown by Cronbach's α = 0.85 at the time of development.

Sample Size Determination

The sample size was calculated using a cross-sectional study sample size formula (Shantikumar, 2018).

$N = z^2 \times p\,(1-p)$

D^2

Where: n = Sample Size

Z = Standard Normal deviate (5% type I error (P< 0.05) is 1.96 and 1% type I error (P< 0.001) is 2.58).

P = Expected proportion of the population based on previous studies or pilot studies (In this case the levels of knowledge of radiation, and its safety practices among undergraduate nursing students in south-east, Nigeria). According to the study among nurses in Calabar Nigeria 26.5% (0.265) inferred radiation is dangerous (Paulinus et al., 2016).

D = Absolute error or precision (I.e., the maximum margin of error the study tolerate) = 0.05

$N = 1.96^2 \times 0.265 \times 0.735$

0.05^2 N = 299.299056

Then corrected sample size (ns) = 332.554507

This gave approximately a total of 333 respondents. METHOD OF DATA COLLECTION

Training of Research Assistants:

Five research assistants were recruited and trained for a day to achieve the objectives of the study and to help in the administration of the questionnaires to a larger population of the study, for apt screening and a high degree of accuracy of the research. These assistants are qualified radiation officers who have prior background knowledge of radiation and a better understanding of the concept of study. They are male and female fluent in Igbo and English, are no indigene of the state/site of study, and are in no way students of any nursing college in Nigeria. They were trained and intimated on the subject of informed consent, clarification of

research process to participants, supervision of questionnaires for errors before collections, provision of detailed information about the study, reassurance of the respondents on the confidentiality of all information provided, as well as skills needed to ascertain participants' willingness to be part of the study.

Pretesting

Before the commencement of the administration of the questionnaires, a pilot study was conducted at a different nursing college from the study site in the same southeastern Nigeria: the University of Nigeria Teaching Hospital College of Nursing using a fraction(10th) of the actual sample size, n = 333/10 = 33. Therefore, 33 questionnaires were administered during the pilot study. This determined the lucidity, suitability of the questionnaire, duration of administration, level of preparedness of the research assistants, and the practicability of the sampling procedures.

Data Collection

Before the start of the study, principals or administrative heads of the selected nursing colleges were met with a signed proposal of the study, after which ethical clearance and approvals were obtained from the ethical committee/nursing colleges. The researcher and research assistants helped explain the objectives of the study and the processes of completing the questionnaires to the participants. Participants were informed that they could refuse to be part of the study or withdraw at any time and have no repercussions. Prepaid incentives (gala) was made available to increase the likelihood of survey responses.

Thereafter, questionnaires were distributed to all participants: undergraduate nursing students in the College of Nursing (ESUTTH) Parklane Enugu, College of Nursing Science Mater Misericordiae Hospital Afikpo North, Ebonyi State and College of Nursing Nnamdi Azikiwe University Teaching Hospital (NAUTH) Nnewi, Anambra State, College of Nursing Science Amachara, Abia State. Hard copies of the questionnaire were marked by participants, (either by shielding, ticking, or circling) the most apt option and by writing short answers where necessary. On collection, these questionnaires were cross-checked to be sure all the questions were answered, by the research assistants in the presence of each participant and unanswered questions solicited to be answered before the participants leave the study site. This study lasted for 5 months.

ETHICAL CONSIDERATIONS

Ethical approval were sought and obtained from the Ethics Committee of Mater Misericordiae Afikpo North, Ebonyi State, Nnamdi Azikiwe University Teaching Hospital College of Nursing Science (NAUTH), Nnewi Anambra State and Enugu State University Teaching Hospital College of Nursing, Parklane Enugu. A detailed explanation of the objectives of the study, and the respondent's freedom to opt out at any stage without any repercussions were adequately communicated, only those who obliged, participated in the study. Confidentiality is paramount hence names and personal details of respondents were left out of the questionnaires.

METHOD OF DATA ANALYSIS

The coding and analysis of Data were carried out, Statistical Package for Social Sciences (SPSS) IBM version 27 was used in data analysis. Percentages and proportions were used in analyzing categorical variables while mean and standard deviation used for continuous variables. The association between categorical variables was analyzed using the Chi-square test (or Fischer's exact when appropriate). P value ≤ 0.05 is statistically significant. Appropriate tables and charts were used in data presentation. The relationships between the dependent variables: knowledge of radiation, knowledge of radiation safety practices, adherence to safety practices, levels of knowledge of radiation among the states in the southeast, and levels of knowledge of radiation safety were analyzed using Pearson's correlation coefficient. The independent variables: factors affecting the knowledge of radiation, its safety practices, and adherence to safety practices were analyzed using ordinal logistics regression.

RESULTS

A total of 333 questionnaires were proposed to be administered but 308 questionnaires were administered to undergraduate nursing students in 2nd and 3rd years at Enugu State University of Science and Technology Teaching Hospital College of Nursing Sciences, Nnamdi Azikiwe University Teaching Hospital Nursing School, Amachara College of Nursing Sciences and Mater Misericordiae College of Nursing Sciences. All administered questionnaires (308) were retrieved, giving a response rate of 92.49%.

4.1.1. Socio-Demographic Characteristics

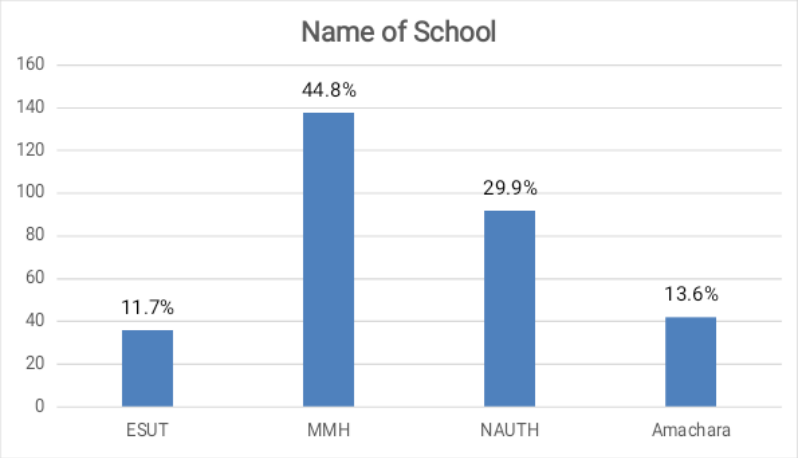

Figure 4.1: Even distribution of respondents based on the population of each school.

As shown in the chart above, the number of respondents from ESUT-TH was 36 (11.7%), the highest came from MMH 138 (44.8%). NAUTH was 92 (29.9%) respondents and Amachara 42(13.6%).

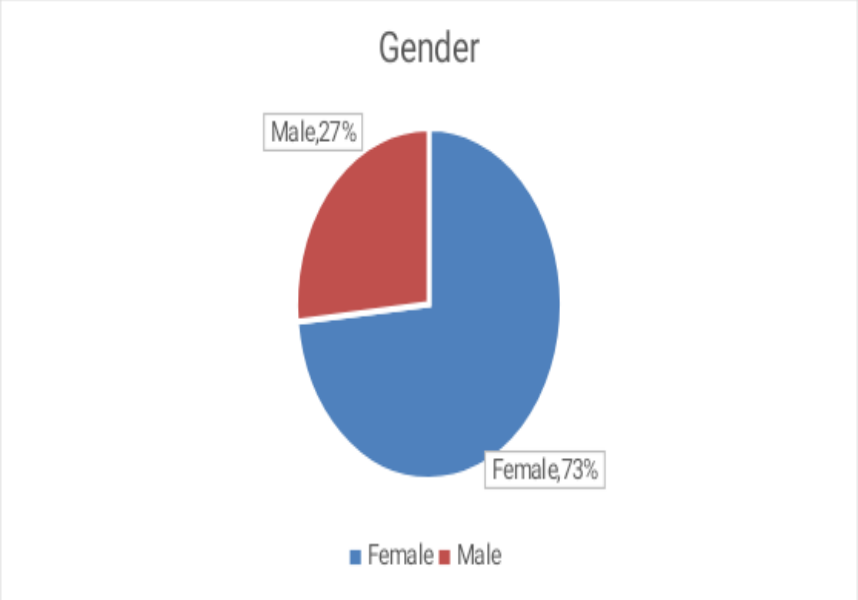

Figure 4.2: distribution of female to male respondents.

The gender distribution as shown in the pie chart above revealed that 223 (73.4%) respondents were female while 82 (26.6%) respondents were male.

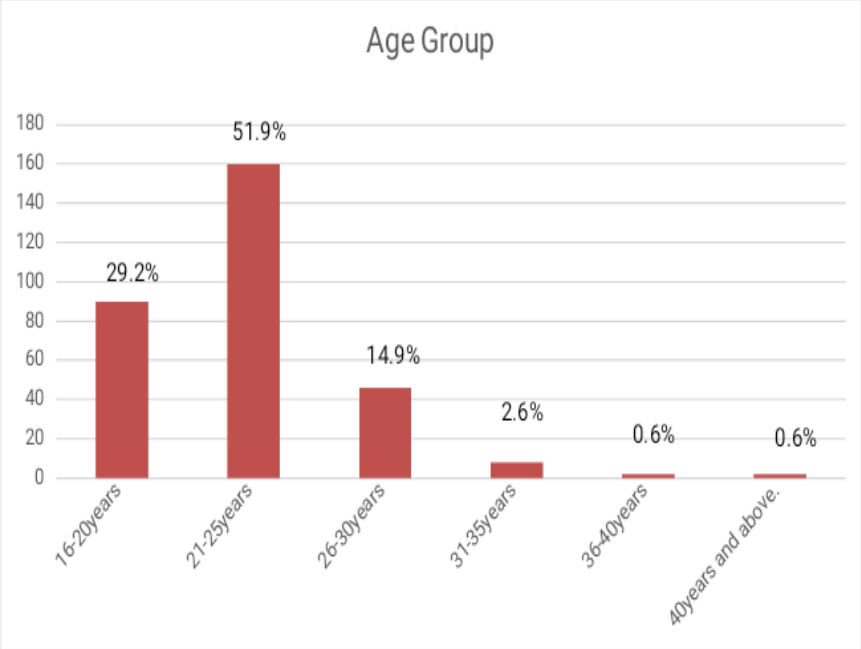

Figure 4.3: age distribution of respondents.

For the Age distribution, 90 (29.2%) respondents were between 16 – 20 years, 160 (51.9%) respondents were between 21 – 25 years, 46 (14.9%) respondents were between 26 – 30 years, 8 (2.6%) respondents were between 31 – 35 years, 2(0.6) respondents were 36 – 40 years while 2 (0.6%) respondents were 40 years and above.

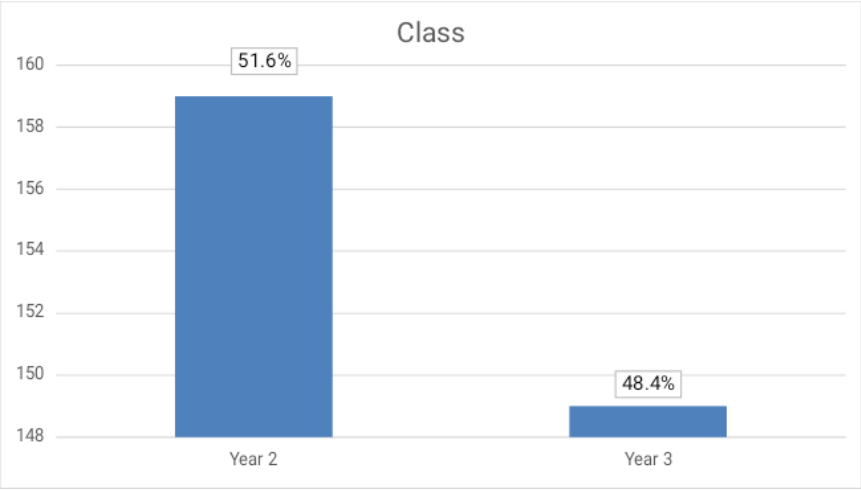

Figure 4.4: Year of study of participants.

In the distribution of class/level in school from the survey, 159 (51.6%) respondents were in year 2 while 149 (48.4%) respondents were in 3rd year.

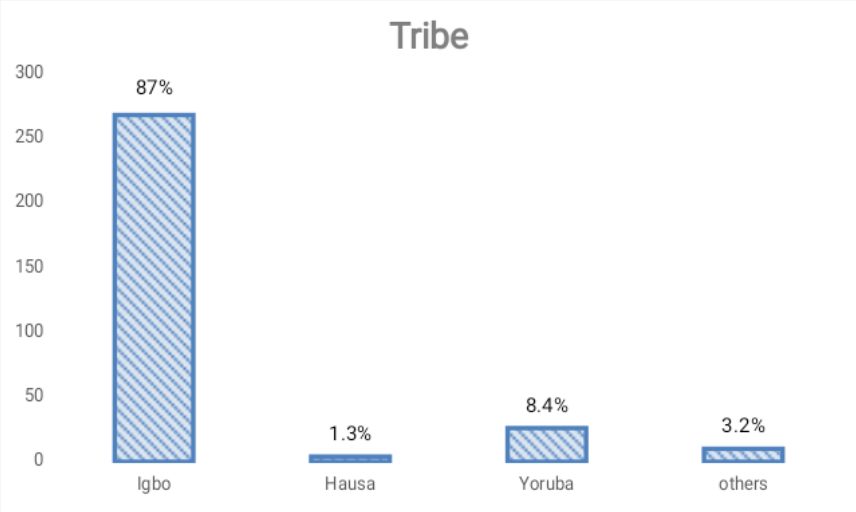

Figure 4.5: Distribution of respondents by tribe.

From the chart above, 268 (87.0%) of the respondents were of the Igbo tribe, representing the highest. 4 (1.3%) indicated Hausa, 26 (8.4) indicated Yoruba and 10 (3.2%) were of other tribes.

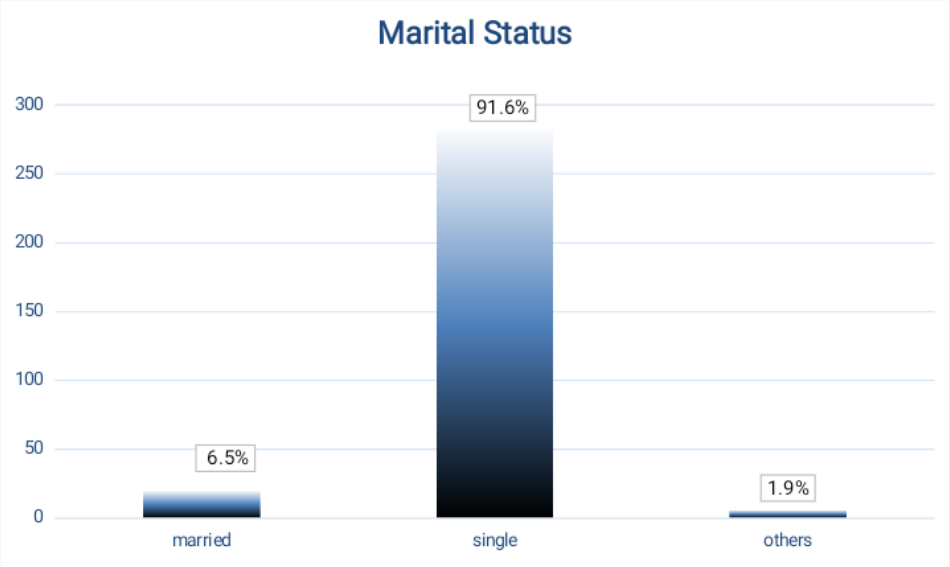

Figure 4.6: Distribution of respondents by marital status.

The figure presented above reflects the marital status of the respondents: 20(6.5%) were married; 282 respondents (91.6%) single; 6 respondents (1.9%) others including divorced and widowed.

Knowledge of Radiation among Nursing Students in South-Eastern Nigeria.

Table 4.2: Southeast Nigeria Nursing Students' Knowledge of Radiation.

Variable	Frequency	Percentage
Medical examinations that emits radiation.		
Magnetic Resonance Imaging (MRI)	170	55.2
Ultrasound	40	13.0
Electrocardiogram (ECG)	28	9.1
Computed Tomography (CT).	70	22.7
Total	308	100.0
Knowledge of weight as a factor in radiation dose.		
True	146	47.4
False	70	22.7
I am not sure	92	29.9
Total	308	100.0
Tissues more susceptible to ionizing radiation.		
(a) Kidney	32	10.4
(b) breast	86	27.9
(c) Bone	138	44.8
(d) Liver	52	16.9
Total	308	100.0
Outcome of stochastic radiation damages.		
(a) Dermatitis	56	18.2
(b) Leukemia	68	22.1
(c) Alopecia	52	16.9
(d) Cataract	24	7.8
(e) All answers are correct.	108	35.1
Total	308	100.0
X-rays penetrating power through the walls of a room.		
(a) true	116	37.7
(b) false	150	48.7
(c) I am not sure	42	13.6
X-ray as a form of ionizing radiation used in Radiology		
(a) true	274	89.0
(b) false	20	6.5
(c) I am not sure	14	4.5
X-ray dose in radiotherapy greater than dose in radio-diagnostics.		
(a) true	198	64.3
(b) false	64	20.8
(c) I am not sure	46	14.9
Radiation damage risks dependence on patient age and sex.		
(a) true	156	50.6
(b) false	136	44.2
(c) I am not sure	16	5.2
Non-medical sources of radiation.		
(a) true	116	37.7
(b) false	160	51.9
(c) I am not sure	32	10.4
ICRP is responsible for the control of radiation safety.		
(a) true	64	20.8
(b) false	154	50.0
(c) I am not sure	90	29.2
X-ray penetration through thick clothes.		
(a) true	176	57.1
(b) false	86	27.9
(c) I am not sure	46	14.9
Genetic and somatic effects of radiation.		
(a) true	220	71.4
(b) false	22	7.1

(c) I am not sure	66	21.4
Radiation exposure unit of measurements.		
(a) Mole	60	19.5
(b) Roentgen	118	38.3
(c) Candela	76	24.7
(d) Second	54	17.5
Occupational equivalent 5 years dose limit.		
(a) 20 mSv/year	78	25.3
(b) 40 mSv/ year	102	33.1
(c) 100 mSv/year	38	12.3
(d) 50 mSv/year.	90	29.2
ICRP occupational equivalent dose for a single year (50 mSv/year)		
(a) true	84	27.3
(b) false	126	40.9
(c) I am not sure	98	31.8
(a) true	84	27.3

From table 4.2 above, only 70 (22.7%) of nursing students know the modality in Radiology that emits radiation, the rest 238 (77.3%) do not know the medical equipment that emits radiation. Majority of the students 170 (55.2%) thinks Magnetic Resonance Imaging (MRI) machine, 40 (13.0%) Ultrasound machine and Electrocardiogram machine emits radiation. Assessing their knowledge of weight as a factor that determines radiation dose, only 146 (47%) respondents has this knowledge, while 162 (52.6%) lacked this knowledge. In identifying tissues more susceptible to ionizing radiation, only 86 (27.9%) student nurses could correctly identified the most radiosensitive tissue, others 222 (72.1%) do not know the tissues more prone to the effects of radiation. Their awareness of the diseases from stochastic radiation damage is in part as most of them 200 (65%) selected individual diseases instead of all the disease available to them, hence only 35% is fully aware of all the diseases. The identification of x-rays penetrating power through the walls of a room, show only 116 (37.7%) respondents correctly identified this, while 192 (62.3%) could not identify this property of ionizing radiation. Most nursing students know x-ray to be a form of ionizing radiation used in Radiology: 274 (89.0%), while 34 (11.0%), less do not know. In examining their knowledge of x-ray dose in radiotherapy for cancer patients being more than doses used in radiological examinations' 198 (64.3%) respondents accurately passed, on the other hand, 110 (35.7%) failed this test for knowledge. To test their understanding of radiation damage risks as being dependent on patient age and sex, 156 (50.6%) respondents understands this, while 152 (49.4%) do not understand this. In assessing their knowledge of non-medical sources of radiation, 116 (37.7%) respondents truly knows about the non-medical sources of radiation, while 192 (62.3%) do not know. Half of the students 154 (50.0%) incorrectly identified ICRP as not one of the bodies responsible for the control of radiation safety, while 154 (50%) correctly identifies as one of the radiation regulatory bodies.

While assessing their knowledge of X-rays penetrating power through thick clothes, 176 (57.1%) respondents have this knowledge, while 135 (42.8%) lack this knowledge. In addition, testing nursing students knowledge of genetic and somatic effects of radiation, 220 (71.4%) respondents showed good knowledge, while 88 (28.6%) showed poor knowledge. Lesser population of the respondents 118 (38.3%), knows Roentgen as the unit of measuring radiation exposure, the rest of the population (61.7%) are not in the know. Only 78 (25%) of the respondents rightly knows 20 mSv/year as the Occupational equivalent dose limit for 5 years, others 230 (75%) were evidently unaware. Furthermore, only a few could identify the occupational equivalent dose for a single year according to ICRP as not to exceed 50 mSv/year 84 (27.3%), while 224 (72.7%) do not know this.

Table 4.3: Knowledge of radiation using three point scale.

Variable	ESUT-TH	MMH	NAUTH	Amachara	Total	Percentage	T-Stat.	p-value
Low	10	20	22	8	60	19.5	X2 = 6.208	0.400
Moderate	24	104	62	32	222	72.1		
High	2	14	8	2	26	8.4		
Total	36	138	92	42	308	100.0		

T-Stat. means Test- Statistics.

From the above table 4.3, some (19.5%) of the respondents had low knowledge test scores meaning they had less than 40% knowledge of radiation, the majority (79.1%) of the respondents had moderate knowledge test scores meaning they had between 40%- 70% in the knowledge test of radiation and few (8.4%) of the respondents had high knowledge test score meaning they had greater than 70% in the knowledge test of radiation. The study found no statistically significant association between the school of the respondents and the level of knowledge of radiation ($\chi 2 = 6.206$, $p = 0.400$).

Nursing Student's Knowledge of Radiation Safety Measures in Study Site.

Table 4.4: Nursing students' knowledge of radiation safety measures.

Variable	Frequency	Percentage
Knowledge of the full meaning of ALARA principle.		
(a) As low as reasonably achievable	88	28.6
(b) Allowable administered radiation.	52	16.9
(c) Assurance limits applied to radiation.	122	39.6
(d) Not sure.	46	14.9
Identification of ALARA principle.		
(a) Dose parameters in Computed Tomography	34	11.0
(b) Estimation of organ dose	24	7.8
(c) Exact organ dose	82	26.6
(d) Minimum dose necessary to achieve the result.	168	54.5

Knowledge of radiation zones exposure risks.		
(a) Yes	66	21.4
(b) No	172	55.8
(c) I am not sure	70	22.7
Identification of radiation symbols.		
(A) Yes	128	41.6
(b) No	106	34.4
(c) I am not sure	74	24.0
Knowledge of relationship between developing radiation effects and length of time in radiation zones.		
(a) True	88	28.6
(b) false	148	48.1
(c) I am not sure	72	23.4
Knowledge of the relationship between distances from radiation source and irradiation.		
(a) true	214	69.5
(b) false	20	6.5
(c) I am not sure	74	24.0
Identification of preterm birth, fetal growth restriction, stillbirths and low birth weight as the effects of irradiation on pregnant women.		
(a) true	178	57.8
(b) false	50	16.2
(c) I am not sure	80	26.0
Identification of radiation protective devices (Image I).		
(a) Identity card	136	44.2
(b) Timer	18	5.8
(c) Thermoluminiscent dosimeter	96	31.2
(d) Image recorder	58	18.8
Identification of radiation protective devices (Image ii).		
(a) Radiation badge	52	16.9
(b) Heat expeller	14	4.5
(c) Road Traffic sign	12	3.9
(d) radiation warning sign	230	74.7
Identification of radiation protective devices (Images iii and iv).		
(a) Customized Face mask and ward apron	108	35.1
(b) Thyroid shield and lead apron	106	34.4
(c) Neck collar and lead apron	68	22.1
(d) Headrest and surgical coat	26	8.4
Identification of radiation protective devices (Image v).		
(a) Welder shield	32	10.4
(b) Standing Board	56	18.2
(c) ward screen	30	9.7
(d) lead shield	190	61.7
Knowledge of tissues more susceptible to ionizing radiation damages.		
(a) Spleen	44	14.3
(b) Thyroid	70	22.7
(c) Bone	164	53.2
(d) Urinary Bladder	12	3.9
(e) Tendons	18	5.8
Radio sensitivity of embryos.		
(a) true	132	42.9
(b) false	100	32.5
(c) I am not sure	76	24.7
Identification of the minimum safe distance without a protective barrier.		
(a) 6 feet or 2 meters	98	31.8
(b) 12 feet or 4 meters	106	34.4
(c) 24 feet or 8 meters	38	12.3
(d) I am of sure.	66	21.4

Knowledge of increased radiation dose on irradiated/ exposed area of the body.		
(a) true	86	27.9
(b) false	138	44.8
(c) I am not sure	84	27.3

From the above table 4.4, only 88 (28.6%) respondents got the full meaning of ALARA correctly which is As Low As Reasonably Achievable. Others 220 (71.4%) do not know the meaning of this important radiation principle. However, average number of the students 168 (54.5%) know that this ALARA principle refers to the Minimum dose necessary to achieve the desired result, others do not know what the principle entails. In examining their knowledge of radiation zones exposure risks and possibilities of irradiation, only 66 (21.4%) respondents knows this safety measure, 246 (79.8%) had ignorantly stayed in radiation zones while exposures were going on. More so, 128 (41.6%) respondents know, while 180 (58.4%) do not know the radiation symbols. In assessing their understanding of the likelihood of developing radiation effects with time, 160 (51.9%) of respondents lack this understanding, while 148 (48.1%) truly understands this. A good number of the students, 214(69.5%) understands that farther bodies are better safe than closer ones from radiation, while 94 (30.5%) lack this knowledge. In the identification of preterm birth, fetal growth restriction, stillbirths and low birth weight occurrence with the irradiation of pregnant women, 178(57.8%) respondents correctly identified with this, while 130 (42.2%) could not identify this a result of no safety measure. For the recognition of radiation safety devices, image I was wronged identified by 212 (68.8%), just 96 (31.2%) correctly identified the image as Thermoluminescent dosimeter. Image II was identified correctly as radiation warning sign by 230 (74.7%), 78 (25.3%) could not identify image ii. Images III and IV were identified rightly as Thyroid shield and lead apron by 106 (34.4%) while the rest thinks them to be Neck collar, Headrest and surgical coat. Image V was identified as wrongly identified as Welder shield 32 (10.4%), Standing board 56 (18.2%), Ward screen 30(9.7%), however, lead shield was rightly identified by 190(61.7%). In testing their knowledge of tissue susceptibility to ionizing radiation damage, mere 70 (22.7%) respondents knows the body tissues more susceptible to radiation.

Assessing the knowledge of these students in radio sensitivity of embryos, 132 (42.9%) respondents correctly knows this, hence their need for safety measures, while 176 (57.1%) neither have knowledge nor knows its implication. The minimum safe distance during radiation exposures without a protective barrier safety measure had only 98 (31.8%) respondents correctly knowing it to be 6 feet or 2 meters, others think it to be 12 feet or 4

meters 106 (34.4%), 24 feet or 8 meters 38(12.3%), the rest 66 (21.4%) were uncertain. An increase in radiation dose effects on irradiated/ exposed area on the body, had but 138 (44.8%) of the students in the know, however, 170 (55.2%) knew not that an increase in dose increases penetration, hence exposed area.

Table 4.5: Knowledge of radiation safety practices using three points scale.

Variable	ESUT-TH	MMH	NAUTH	Ama.	Total	%	Percent T- Stat.	p-value
Low	12	22	22	10	66	21.4	X2 =11.713	0.069
Moderate	22	92	50	28	192	62.3		
High	2	24	20	4	50	16.2		
Total	36	138	92	42	308	100.0		

Ama. means Amachara, Percent. means percentage, T-Stat. means Test- Statistics.

From the above table 4.5, some (21.4%) of the respondents had low test scores meaning they had less than 40% knowledge of radiation safety practices, the majority (62.3%) of the respondents had moderate knowledge test scores, they had between 40% - 70% knowledge of radiation safety practices and few (16.2%) of the respondents had high knowledge test score, they had greater than 70% in the knowledge test of radiation safety practices. The study found no statistically significant association between the school of the respondents and the level of knowledge of radiation ($\chi 2 = 6.206$, $p = 0.400$).

Level of adherence to radiation safety measures.

Table 4.6: Level of adherence to radiation safety measures and practice among undergraduate nursing students in Southeast Nigeria

S/N	Item Statements		Std. Dev.	Remark
1	I use a lead shield when applicable	4.05	1.44	Most times
2	I ensure radiation room doors are closed after me	4.46	1.14	Most times
3	I make sure my patient is as well protected during radiation procedures.	4.56	0.97	Always
4	I wear ionizing radiation measuring devices when in radiation zones	4.03	1.33	Most times
5	I don't suggest radiation procedures for slight symptoms	3.52	1.40	Most times
6	Once the alarm or red warning sign is on, I stay outside the radiation zone	4.24	1.24	Most times
7	I consider the risks involved when suggesting for radiation procedure.	4.34	1.08	Most times
8	The benefit from radiation procedures must be considerably higher than the risk involved.	3.83	1.45	Most times
9	I consider children and fetuses more vulnerable to radiation and ensure they are protected.	4.62	0.88	Always
10	I read articles related to radiation safety	2.68	1.36	I can't

Remember

Grand Mean and Standard Deviation 4.03 1.84 Most time

Note: = Mean, Std. Dev. = Standard Deviation

The above table 4.6 with a mean range of 3.52 – 4.62 shows that the nursing students most times adhere to the radiation safety rules and practices. However, to a low extent, they read articles related to radiation safety with a mean of 2.68. In addition, the standard deviations range between 0.88 – 1.45 which is below 1.50, indicating that the respondents are close to each other in their opinions and that their responses are not far from the mean.

The association between knowledge of radiation safety and adherence to radiation safety measures among undergraduate nursing students in Ebonyi, Enugu, Abia, and Anambra.

Table 4.7: Association between knowledge and adherence to radiation safety measures.

School Name		K- Score	Adherence Sum
ESUT-TH	Pearson Correlation		.390*
	Sig. (2-tailed)		0.019
	N	36	36
MMH	Pearson Correlation		.218*
	Sig. (2-tailed)		0.010
	N	138	138
NAUTH	Pearson Correlation		0.063
	Sig. (2-tailed)		0.548
	N	92	92
Amachara	Pearson Correlation		0.290
	Sig. (2-tailed)		0.062
	N	42	42

***. Correlation is significant at the 0.05 level (2-tailed). K-Score means knowledge score.**

The data in Table 4.7 shows the association between the knowledge of radiation safety practices and adherence to radiation safety measures among undergraduate nursing students in South-East Nigeria. The correlation coefficient yielded a significant low positive association between knowledge of radiation safety practices and adherence to radiation safety measures for ESUT-TH nursing students (r = 0.390); a significant very low positive association between knowledge of radiation safety practices and adherence to radiation safety measures for MMH nursing students (r = 0.219); a non- significant very low positive association between knowledge of radiation safety practices and adherence to radiation safety measures for NAUTH nursing students (r = 0.063); and a non-significant very low positive association between knowledge of radiation safety practices and adherence to radiation safety

measures for Amachara nursing students (r = 0.290). This implies that at a low rate, the higher the knowledge of radiation safety practices, the higher the adherence to radiation safety measures among undergraduate nursing students in South-East Nigeria.

Factors responsible for the knowledge of radiation, and knowledge of radiation safety practices among undergraduate nursing students in South-East Nigeria.

Table 4.8: Factors Responsible For the Knowledge of Radiation among These Students.

Categories	Estimate	Std.Error	Wald	Df	Sig	Lower Bound	Upper Bound	Exp B	Lower	Upper
Low	-.459	1.328	.120	1	.729	-3.062	2.143	.632	.047	8.525
Moderate	3.550	1.361	6.807	1	.009	.883	6.217	34.811	2.418	501.068
Age	.079	.153	.266	1	.606	-.222	.380	1.082	.801	1.462
Class Level School	1.548	.296	27.294	1	.000	.967	2.129	4.702	2.631	8.405
ESUT-TH	-.379	.509	.555	1	.456	-1.378	.619	.684	.252	1.857
MMH	.126	.407	.096	1	.757	-.672	.924	1.134	.511	2.520
NUATH	-.211	.414	.259	1	.611	-1.021	.600	.810	.360	1.823
Amachina	.000			0				1.000		
Gender										
Female	.355	.284	1.564	1	.211	-.201	.912	1.426	.818	2.488
Male	.000			0				1.000		
Tribe										
Igbo	-.021	.746	.001	1	.977	-1.484	1.442	.979	.227	4.227
Hausa	-2.493	1.266	3.881	1	.049	-4.973	-.013	.083	.007	.987
Yoruba	-.313	.881	.126	1	.722	-2.040	1.414	.731	.130	4.112
Others	.000			0				1.000		
Marital Status										
Married	-1.030	1.015	1.030	1	.310	-3.019	.959	.357	.049	2.610
Single	-1.468	.912	2.592	1	.107	-3.255	.319	.230	.039	1.376
Others	.000			0				1.000		

The table above examined the factors influencing knowledge of radiation among undergraduate nursing students. Starting with age, age had a non-significant positive association with knowledge level (B = 0.079, SE = 0.153, p = .606). The odds ratio of 1.082 implies that for each year increase in age, the odds of being in a higher knowledge category increase by approximately 8.2%. Though the effect was not statistically significant. Adding to this, class level had a significant positive association with knowledge level (B = 1.548, SE = 0.296, p < .001). The odds ratio of 4.702 means that individuals in a higher class level were approximately 4.7 times more likely to be in a higher knowledge category with a statistically significant effect. With regards to school, ESUT-TH students had a non-significant negative

association with knowledge level (B = -0.379, SE = 0.509, p = .456). The odds ratio of 0.684 shows that individuals who attended ESUT-TH were approximately 31.6% less likely to be in a higher knowledge category, but this effect was not statistically significant. Students who attended MMH had a non-significant positive association with knowledge level (B = 0.126, SE = 0.407, p = .757). The odds ratio of 1.134 means that individuals who attended MMH were approximately 13.4% more likely to be in a higher knowledge category, but this effect was not statistically significant. In a similar way, students of NUATH had a non-significant negative association with knowledge level (B = -0.211, SE = 0.414, p = .611). The odds ratio of 0.810 points out that individuals who attended NUATH were approximately 19% less likely to be in a higher knowledge category, but this effect was not statistically significant.

When it comes to gender, being female had a non-significant positive association with knowledge level (B = 0.355, SE = 0.284, p = .211). The odds ratio of 1.426 indicates that females were approximately 42.6% more likely to be in a higher knowledge category, but this effect was not statistically significant. Being Igbo or Yoruba had a non-significant negative association with knowledge level (B = -0.021, SE = 0.746, p = .977) and (B = - 0.313, SE = 0.881, p = .722) respectively. The odds ratio were 0.979 for Igbo and 0.731 for Yoruba while being Hausa had a significant negative association with knowledge level (B = -2.493, SE = 1.266, p = .049) with odds ratio of 0.083. Moving to marital status, being married had a non-significant negative association with knowledge level (B = - 1.030, SE = 1.015, p = .310). The odds ratio of 0.357 implies that individuals who were married were approximately 64.3% less likely to be in a higher knowledge category, but this effect was not statistically significant. Being single had a non-significant negative association with knowledge level (B = -1.468, SE = 0.912, p = .107). The odds ratio of 0.230 suggests that individuals who were single were approximately 77% less likely to be in a higher knowledge category, but this effect was not statistically significant.

In simple terms, the ordinal logistic regression analysis revealed that only class level and being Hausa had statistically significant associations with knowledge level.

Specifically, higher class levels were associated with increased odds of being in a higher knowledge category, while being Hausa was associated with decreased odds of being in a higher knowledge category. Other variables, such as age, school, gender, other tribes, and marital status, did not have statistically significant effects on knowledge level in this model.

Table 4.9: Factors Responsible For Knowledge of Radiation Safety Measures (KRSM) among Undergraduate Nursing Students.

Categories	Estimate	Std. Error	Wald	Df	Sig	Lower Bound	Upper Bound	Exp_B	Lowe r	Upper
Low	-2.158	1.264	2.912	1	.088	-4.636	.320	.116	.010	1.378
Moderate	1.106	1.266	.763	1	.382	-1.375	3.588	3.023	.253	36.167
Age	-.093	.142	.433	1	.510	-.372	.185	.911	.690	1.203
ClassLev el	.773	.248	9.683	1	.002	.286	1.260	2.166	1.331	3.525
School										
ESUT-TH	-.684	.480	2.029	1	.154	-1.625	.257	.505	.197	1.293
MMH	.755	.383	3.881	1	.049	.004	1.507	2.128	1.004	4.513
NUATH	.402	.388	1.075	1	.300	-.358	1.163	1.496	.699	3.200
Amachina	.000			0				1.000		
Gender										
Female	-.693	.269	6.643	1	.010	-1.220	-.166	.500	.295	.847
Male	.000			0				1.000		
Tribe										
Igbo	-1.769	.725	5.962	1	.015	-3.189	-.349	.170	.041	.705
Hausa	-3.927	1.250	9.877	1	.002	-6.377	-1.478	.020	.002	.228
Yoruba	-2.186	.842	6.733	1	.009	-3.837	-.535	.112	.022	.586
Others	.000			0				1.000		
Married	.262	.960	.074	1	.785	-1.619	2.142	1.299	.198	8.520
Single	.795	.862	.851	1	.356	-.894	2.485	2.215	.409	11.997
Others	.000			0				1.000		

From the above table, Age did not have a statistically significant impact on adherence level (B = -0.093, SE = 0.142, p = .510). The odds ratio of 0.911 suggests that for each year increase in age, the odds of being in a higher knowledge of radiation safety measure category decrease by approximately 8.9%. Class level had a statistically significant impact on the level of safety measure awareness (B = 0.773, SE = 0.248, p = .002). The odds ratio of 2.166 indicates that for each unit increase in class level, the odds of being in a higher knowledge of radiation safety measure category increase by approximately 116.6%. Attending ESUT-TH did not have a statistically significant impact on KRSM level (B = -0.684, SE = 0.480, p = .154). The odds ratio of 0.505 suggests that the odds of being in a higher KRSM category decrease by approximately 49.5%. Attending MMH had a statistically significant impact on KRSM level (B = 0.755, SE = 0.383, p = .049). The odds ratio of 2.128 indicates that the odds of being in a higher KRSM category increase by approximately 112.8%. Attending NUATH did not have a statistically significant impact on KRSM level (B = 0.402, SE = 0.388, p = .300). The odds ratio of 1.496 suggests that the odds of being in a higher KRSM category increase by approximately 49.6%. Additionally, Being female had a statistically significant impact on KRSM level (B = -0.693, SE = 0.269, p = .010). The odds ratio of 0.500

indicates that the odds of being in a higher KRSM category decrease by approximately 50% compared to males. Being Igbo had a statistically significant impact on KRSM level (B = -1.769, SE = 0.725, p = .015). The odds ratio of 0.170 shows that the odds of being in a higher KRSM category decrease by approximately 83% compared to the reference group. Being Hausa had a statistically significant impact on KRSM level (B = -3.927, SE = 1.250, p = .002). The odds ratio of 0.020 shows the odds of being in a higher KRSM category decrease by approximately 98%. Being Yoruba had a statistically significant impact on KRSM level (B = -2.186, SE = 0.842, p = .009). The odds ratio of 0.112 indicates that the odds of being in a higher KRSM category decrease by approximately 88.8% compared to the reference group.

Table 4.10: Determining factors for the Adherence to radiation safety measures radiation Among Undergraduate Nursing Students.

Categories	Estimate	Std.Error	Wald	Df	Sig	Lower Bound	Upper Bound	Exp. B	Lower	Upper
Strongly	-24.088	1.219	390.77	1	.000	-26.477	-	.000	.000	.000
Disagree			9				21.700			
Disagree	-23.202	1.179	387.612	1	.000	-25.512	- 20.892	.000	.000	.000
Agree	-21.793	1.155	355.81 9	1	.000	-24.057	- 19.529	.000	.000	.000
Strongly Agree	-19.520	1.145	290.59 1	1	.000	-21.764	- 17.275	.000	.000	.000
Age	.154	.134	1.319	1	.251	-.109	.417	1.167	.897	1.518
Class/Level	-.624	.234	7.119	1	.008	-1.082	-.166	.536	.339	.847
School										
ESUT-TH	.285	.445	.409	1	.522	-.587	1.156	1.329	.556	3.178
MMH	.803	.357	5.050	1	.025	.103	1.504	2.233	1.108	4.499
NUATH	.352	.364	.936	1	.333	-.361	1.065	1.422	.697	2.901
Amachina	.000			0				1.000		
Gender										
Female	-.409	.252	2.625	1	.105	-.904	.086	.664	.405	1.090
Male	.000			0				1.000		
Tribe										
Igbo	-19.951	.423	2226.077	1	.000	-20.780	- 19.122	.000	.000	.000
Hausa	.497	6564.301	.000	1	1.000	- 12865.297	12866.291	1.644	.000	
Yoruba	-19.467	.000		1		-19.467	-19.467	.000	.000	.000
Others	.000			0				1.000		
Marital Status										
Married	-.087	.986	.008	1	.930	-2.019	1.845	.917	.133	6.327
Single	.230	.868	.070	1	.791	-1.471	1.930	1.258	.230	6.893
Others	.000			0				1.000		

Age did not have a statistically significant impact on adherence to safety (Estimate = 0.154, p = 0.251). The odds ratio of 1.167 suggests a slight positive association. Specifically, for each year increase in age, the odds of being in a higher adherence category increase by approximately 16.7% (1.167 - 1 = 0.167). However, this effect is not statistically significant.

In another view, class level had a statistically significant negative impact on adherence to safety (Estimate = -0.624, p = 0.008). The odds ratio of 0.536 indicates that as class level increases, the odds of being in a higher adherence category decrease significantly. A decrease by approximately 46.4% (0.536 - 1 = -0.464).

School affiliation showed varying effects as can be seen as follows: The effect of attending ESUT-TH was not statistically significant (Estimate = 0.285, p = 0.522). The odds ratio of 1.329 suggests a positive association. Indicating an approximate 32.9% increase in the odds of higher adherence. However, this effect is not statistically significant. Attending MMH had a statistically significant positive impact on adherence to safety (Estimate = 0.803, p = 0.025). The odds ratio of 2.233 suggests that students in MMH have significantly higher odds of adhering to safety compared to those in the reference school (Amachara). More specifically, the odds of higher adherence are approximately 123.3% higher (2.233 - 1 = 1.233) for students in MMH compared to those in Amachara. The effect of attending NUATH was not statistically significant (Estimate = 0.352, p = 0.333). The odds ratio of 1.422 indicates a higher odds of adherence for students attending NUATH but is not statistically significant. Specifically, the odds of higher adherence are approximately 42.2% higher (1.422 - 1 = 0.422).

Another predictor is gender. Gender did not have a statistically significant impact on adherence to safety (Female: Estimate = -0.409, p = 0.105). The odds ratio of 0.664 suggests that females have slightly lower odds of being in a higher adherence category compared to males, but this difference is not statistically significant. The odds of a higher adherence category are approximately 33.6% lower (0.664 - 1 = -0.336) for females compared to males. Tribal affiliation showed significant effects for certain groups as follows: Belonging to the Igbo tribe had a statistically significant negative impact on adherence to safety (Estimate = -19.951, p < 0.001). The odds ratio of 0.000 indicates a very significantly lower odds of adhering to safety compared to the reference category. The effect of belonging to the Hausa tribe was not statistically significant (Estimate = 0.497, p = 1.000). The odds ratio of 1.644 is statistically insignificant. Belonging to the Yoruba tribe had a statistically significant negative impact on adherence to safety (Estimate = -19.467, p < 0.001). The odds ratio of 0.000 indicates a significantly lower odds of adhering to safety compared to the reference category. For married, (Estimate = -0.087, p = 0.930). The odds ratio is 0.917, indicating that married individuals have approximately 8.3% lower odds (0.917-1 = -0.083) of higher adherence, but

this is not statistically significant. For single (Estimate = 0.230, p = 0.791). The odds ratio is 1.258, indicating that single individuals have approximately 25.8% higher odds (1.258 - 1 = 0.258) of higher adherence, but this is also not statistically significant.

The findings indicate that class level and school affiliation (specifically attending MMH) are significant predictors of adherence to safety. Additionally, tribal affiliation (Igbo and Yoruba) shows a significant negative association with adherence to safety. The marital status, also does not appear to significantly influence adherence to safety.

Table 4.11: Knowledge of radiation and adherence to Radiation Safety Measures among the different undergraduate nursing classes in the different states in Southeast Nigeria School Sum of Mean.

School Name	Class		Sum of Squares	Df	Mean Square	F	Sig.
ESUT-TH	Year 2	Between Groups	248.606	5	49.721	.996	.451
		Within Groups	798.667	16	49.917		
		Total	1047.273	21			
	Year 3	Between Groups	395.381	3	131.794	6.782	.009*
		Within Groups	194.333	10	19.433		
		Total	589.714	13			
MMH	Year 2	Between Groups	451.326	8	56.416	1.482	.178
		Within Groups	2855.091	75	38.068		
		Total	3306.417	83			
	Year 3	Between Groups	417.005	8	52.126	2.836	.012*
		Within Groups	827.088	45	18.380		
		Total	1244.093	53			
NAUTH	Year 2	Between Groups	1193.456	6	198.909	3.419	.010*
		Within Groups	1861.467	32	58.171		
		Total	3054.923	38			
	Year 3	Between Groups	803.185	10	80.318	.660	.754
		Within Groups	5108.061	42	121.620		
		Total	5911.245	52			
Amachara	Year 2	Between Groups	435.429	4	108.857	1.944	.187
		Within Groups	504.000	9	56.000		
		Total	939.429	13			
	Year 3	Between Groups	533.086	7	76.155	.918	.513
		Within Groups	1659.629	20	82.981		
		Total	2192.714	27			

Table 4.11 above shows that statistically significant differences existed in the association between the knowledge of radiation and adherence to radiation safety measures among year 3 undergraduates in ESUT-TH (F =6.782, p = 0.009), year 3 in MMH (F = 2.836, p = 0.012) and year 2 in NAUTH (F = 3.419, p = 0.010). However, no statistically significant differences existed in association between the knowledge of radiation and adherence to radiation safety measures among year 2 in ESUT-TH (F =.996, p = 0.451), year 2 in MMH (F = 1.482, p = 0.178), year 3 in NAUTH (F = .660, p =0.754), and both year 2 and year 3

undergraduates in Amachara (F = 1.944, p = 0.187; F= .918, p = 0. .513).

Table 4.12: The Association between the Knowledge of Radiation Safety Practices and adherence to Radiation Safety Measures among the different undergraduate nursing classes in the different states in Southeast Nigeria.

School	Class	Squares		Df	Square	F	Sig.
ESUT-TH	Year 2	Between Groups	756.939	5	151.388	8.343	.000
		Within Groups	290.333	16	18.146		
		Total	1047.273	21			
	Year 3	Between Groups	264.714	4	66.179	1.833	.207
		Within Groups	325.000	9	36.111		
		Total	589.714	13			
MMH	Year 2	Between Groups	910.850	9	101.206	3.126	.003
		Within Groups	2395.567	74	32.373		
		Total	3306.417	83			
	Year 3	Between Groups	239.281	8	29.910	1.340	.249
		Within Groups	1004.811	45	22.329		
		Total	1244.093	53			
NAUTH	Year 2	Between Groups	552.923	7	78.989	.979	.464
		Within Groups	2502.000	31	80.710		
		Total	3054.923	38			
	Year 3	Between Groups	2323.038	9	258.115	3.093	.006
		Within Groups	3588.207	43	83.447		
		Total	5911.245	52			
Amachara	Year 2	Between Groups	409.929	6	68.321	.903	.541
		Within Groups	529.500	7	75.643		
		Total	939.429	13			
	Year 3	Between Groups	1677.081	7	239.583	9.293	.000
		Within Groups	515.633	20	25.782		
		Total	2192.714	27			

Table 4.12 above shows that statistically significant differences existed in the association between the knowledge of radiation safety practices and adherence to radiation safety measures among year 2 undergraduates in ESUT-TH (F = 8.343, p = 0.000), year 2 undergraduates in MMH (F = 3.126, p = 0.003), year 3 undergraduates in NAUTH (F = 3.093, p = 0.006) and year 3 undergraduates in Amachara (F = 9.293, p = 0.000). However, no statistically significant differences existed in the association between the knowledge of radiation safety practices and adherence to radiation safety measures among year 3 undergraduates in ESUT-TH (F = 1.833, p = 0.207), year 3 undergraduates in MMH (F = 1.340, p = 0.294), year 2 undergraduates in NAUTH (F = .979, p = 0.464), and year 2 undergraduates in Amachara (F = .903, p = 0.541).

Table 4.13: Levels of adherence to radiation safety practices among the different undergraduate nursing classes in the different states in South-East Nigeria.

Item Statements	Clas s		t	p- valu e		t	p- valu e		t	p- valu e		T	p- valu e
I use a lead	Yr 2	3.9	-	0.415	4.4	-	0.269	3.6	0.66	0.507	4.2	1.36	0.179
shield when		1	0.82		2	1.11		4	5		9	8	
applicable			5			0							
	Yr 3	4.2			4.6			3.4			3.5		
		9			1			0			7		
I ensure	Yr 2	4.3	-	0.599	4.5	-	0.140	4.0	-	0.379	4.4	-	0.847
radiation room		6	0.53		6	1.48		3	0.88		3	0.19	
doors are			1			6			3			4	
closed after me	Yr 3	4.5			4.8			4.2			4.5		
		7			0			8			0		
I make sure my	Yr 2	4.5	-	0.527	4.7	-	0.575	4.0	-	0.236	4.5	0.21	0.833
patient is as		5	0.63		7	0.56		3	1.19		7	2	
Well protected			9			2			4				
during radiation procedures.	Yr 3	4.7			4.8			4.3			4.5		
		1			3			6			0		
I wear ionizing	Yr 2	3.8	0.48	0.629	4.0	-	0.035	3.5	-	0.071	4.1	0.15	0.875
radiation		2	7		6	2.13		1	1.83		4	9	
measuring						5			0				
devices when in	Yr 3	3.5			4.5			4.0			4.0		
radiation zones		7			0			6			7		
I don't suggest	Yr 2	4.2	2.08	0.045	3.4	0.12	0.901	3.3	-	0.540	2.8	-	0.033
radiation		7	3		8	5		3	0.61		6	2.21	
procedures for									5			2	
symptoms		3			4			1		5			
Once the alarm	Yr 2	4.0	-	0.166	4.1	-	0.040	4.4	1.12	0.264	3.6 -		0.146
or red warning		0	1.41		2	2.07		4	4		4 1.48		
sign is on, I stay			5			3					4		
outside	The Yr 3	4.5	4.5			4.1			4.2				
radiation zone		7			6			3			5		
I consider the	Yr 2	4.2	-	0.097	4.5	-	0.011	4.1	1.15	0.250	3.8 -		0.511
risks involved		7	1.70		0	2.57		3	8		6 0.66		
when			7			0					4		
suggesting	for Yr 3	4.8	4.8			3.8			4.1				
radiation procedure.		6	5			3			4				
The benefit	Yr 2	3.8	-	0.521	3.8	-	0.555	3.6	-	0.598	3.7 0.32		0.750
From radiation		2	0.64		7	0.59		4	0.53		1 1		

The Table above shows that most of the mean for the item statements is above 3.5 and this implies that the level of adherence to radiation safety rules is high for all the classes in the

four schools of study. It also shows that the items t-value of item statement 5 for ESUT-TH, item statements 4, 6 and 7 for MMH, item statement 9 for NAUTH and item statement 5 for Amachara ranged from -2.570 – 2.082 and the p-value range of 0.011 – 045 which is lower than 0.05 alpha value implying that there was a statistically significant difference between the mean levels of adherence to radiation practices of year 2 and year 3 undergraduates. However, most of the p-values for the items are greater than 0.05 implying that there are no statistically significant differences between the mean levels of adherence to radiation practices of year 2 and year 3 undergraduates.

CONCLUSIONS

This study has shown that there are statistically significant differences generally in knowledge of radiation, knowledge of radiation safety practices, adherence to safety practices and the association between knowledge of radiation safety practices and adherence to radiation safety measures among undergraduate nursing students in Southeast, Nigeria. The level of knowledge of radiation was generally on the below average among the states in Southeast, Nigeria in this study. No statistically significant association between the school of the respondents in the different Southeast states and the level of knowledge of radiation was found. Only very few are aware of the radiology modalities that emit ionizing radiation.

Their knowledge of radiation safety was generally on average, with no statistically significant association between the schools of the respondents in all the states of southeast Nigeria. Almost all the respondents in this study have seen radiation safety signs though their knowledge of what the sign means varied significantly. The right use and timeliness of appropriate adherence to basic known safety practices was generally optimal among all the respondents in this study though most of them know a few of these safety practices implying that the burden of radiation hazards accruing from these average knowledge of safety practices might still be high in Southeast Nigeria.

This study showed that at a low rate, the higher the knowledge of radiation safety practices, the higher the adherence to radiation safety measures among undergraduate nursing students in South-East Nigeria. Moreover, adherence to radiation safety measures in this study is not dependent on the class, age and location of the undergraduate nursing students in Southeast Nigeria.

REFERENCE

1. Abdallah, L. (2023). Assessment of Nursing Students' Awareness toward Ionizing Radiation. Nursing Reports, 13(1), 75-85. Retrieved from https://doi.org/10.3390/nursrep13010075 on 06 March 2023.
2. Abuzaid, M. M., Elshami, W. and Hasan, H. (2019). Knowledge and adherence to radiation protection among healthcare workers at Operation Theater. Asian Journal of Scientific Research 12(1):54-59.
3. Adeyemo, W. L. (2022). Radiation protection awareness among Nigerian dental professionals. Journal of Dental Sciences, 17(1), 1-6.
4. Alshamranik, K. and Qurashi A. (2022). Radiation safety while providing bedside care during portable Radiography procedures: knowledge and attitude of Respiratory Therapists and ICU Nurses: a cross-sectional descriptive study. Journal of King Abdulaziz University Engineering Sciences. 20(2), 25-32.
5. Althubaiti, A. (2016). Information bias in health research: definition, pitfalls and adjustment methods. J Multidiscipline Healthcare. 9 (1), 211-217.
6. Anim-Sampong, S., Opoku, S. Y., Addo, P. and Botwe, B. O. (2015). Nurses' knowledge of ionizing radiation and radiation protection during mobile radio diagnostic examinations. International Research Journals, 6(3), 39-49.
7. Awosan, K. J., Ibrahim, M. T. O., Saidu, S. A., Maji, S. M. and Ige, T. A. (2016). Knowledge of Radiation Hazards, Radiation Protection Practices and Clinical Profile of Health Workers in a Teaching Hospital in Northern Nigeria: Cross- sectional Study. Journal of Clinical and Diagnostic Research, 27(6), 56-70.
8. Badawy, M. K., Mong, K. S., Lykhun, P. U. and Deb, P. (2016). An assessment of nursing staff's knowledge of radiation protection and practice. Journal of Radiological Protection, 36(1), 178-183.
9. Behzadmehr, R., Doostkami, M., Sarchahi, Z., Saleh, L. D. and Behzadmehr, R. (2020). Radiation protection among health care workers: knowledge, attitude, practice, and clinical recommendations: a systematic review. Reviews on Environmental Health, 35(3), 263-271.
10. Bwanga, O., Zimba, J., Chanda, E., Sichone, J. M. and Bwalya, M. (2023). Survey to assess the knowledge of nurses on basic radiation protection at the University Teaching Hospital in Zambia. African Journal Sabinet. ResearchGate 27(1):97. https://www.researchgate.net/publication/373247468_Survey_to_assess_the_ knowledge_of_nurses_on_basic_radiation_protection_at_the_University_Teachi

ng_Hospital_in_Zambia. 23 March 2023.

11. Center for Disease Control (CDC). (2024). Acute radiation Syndrome: information for clinicians. U.S. Center for Disease Control and Prevention.
12. Charan, J. and Biswas, T. (2013). How to calculate sample size for different study designs in medical research. Indian J Psychol Med: National Library of Medicine, 24(4), 121-126.
13. Cole, P., Hallard, R. and Broughton, J. (2014). Developing the radiation protection safety culture in the UK. Journal of radiological aparotection, 34(2), 469-484.
14. Deye, N., Vincent, F., Michel, P., Ehrmann, S., Da Silva, D., Piagnerelli, M. and Laterre, P. (2016). Changes in cardiac arrest patients' temperature management after the 2013 trial: Results from an international survey. Annals of Intensive 6(1). Retrieved from http://doi.org/10.1186/s13613-015-0104-6, on 8 April 2023.
15. Dong, Y., Shi, Y., He, L., Cui, X. and Su, P. (2017). Effects of metformin on survival outcomes of pancreatic cancer: A meta-analysis. Oncotarget, 5p.
16. Eddy, L. L. and Epeneter, B. J. (2002). The undergraduate perspective on community college nursing education: A report from the inside. Journal of Nursing Education, 41(7), 291-298.
17. Editorial team. (2022). Economic Cost of Treating Cancer: one of the effects of radiation. Retrieved from https://www.asbestos.com/featured- stories/highcost-of-cancer-treatment/ on March 31st 2023.
18. Fiagbedzi, E., Nii Gorleku, P., NYarko, S., Asare, A. and Ndede, G.A. (2022). Assessment of radiation protection knowledge and practices among radiographers in the central region of Ghana. Central region of Ghana: Medical Association Publishing.
19. Foray, N., Charvet, A., Duchemin, D., Favaudon, V. and Lavalette, D. (2005). The repair rate of Radiation-Induced DNA damage: a stochastic Interpretation based on the gamma function. Journal of Theoretical Biology: Pubmed. 15(9), 56-73.
20. Global Nursing workforce: Nursing and Midwifery. (2020). Retrieved from https://www.who.int/news-room/fact-sheets/detail/nursing-and-midwifery on March 21, 2023.
21. Goh, P. and Di Prosperol, L. (2017). The grey area: an exploration of the scope of practices for nurses and radiation therapists within the radiation Oncology program focusing on inter-professional collaboration competencies of role clarity, communication and team function. Medical Imaging Radiation Science, 48(1), 11-15.
22. Han, E. O., Kwon, D. M., Dong, K.R. and Han, S. M. (2012). A model for protective

behaviour against the harmful effects of radiation based on medical institution classifications. Journal of Radiation Protection, 35(1), 157-162.

23. Health Effects of Radiation (2022). Retrieved from https://www.cdc.gov/nceh/radiation/health.html on 31 March, 2023.
24. Hirvonen, L., Schroderus-Salo, T., Henner, A., Ahonen, S., Kaariainen, M., Miettunen, J. and Mikkonen, K. (2019). Nurses' knowledge of radiation protection: A cross- sectional study. ScienceDirect: The College of Radiographers. Retrieved from https://doi.org/10.1016/j.rad.2019.04.011 on 31 March 2023.
25. Housni, A., Es-Samssar, O., Saoud, B., El Amrani, N., Amazian, K., Essahlaoui A. and Labzour A. (2022). Radiation protection in the operating room: Need for training, qualification and accompaniment for the professionals. Radioprotection, 58(1), 37-42.
26. https://www.radioprotection.org/articles/radiopro/abs/2023/01/radiopro220051/radiopro220051.html. 29 March 2023.
27. International Atomic Energy Agency (IAEA). (2014). Bonn calls for action: 10 actions to improve radiation protection in medicine in the next decade (brochure). Retrieved from https://www.iaea.org/sites/default/files/17/12/bonn-call-for- action.pdf on 29 March 2023.
28. International Atomic Energy Agency Publication. (2015). Radiation in Everyday Life. Retrieved from https://www.iaea.org/publications/factsheets/English/radlife on 31 March 2023.
29. International Commission on Radiological Protection (ICRP). (2011). Statement on Tissue Reactions. Ottawa, Ontario, Canada: ICRP Press.
30. International Labour Organization (ILO). (2023). World Employment and Social Outlook: Trends 2023. ILO Flagship Report, 12p.
31. Jeyasugiththan, J., Dissanayake, D. M., Kohombakadawala, I. M. and Satharasingha, D. M. (2023). Assessment of the Awareness of Radiation Protection and Related Concepts among Nursing Staff Mainly Working in Diagnostic Imaging Units, Cath Lab and Operation Theatre in Sri. Lanka: A Survey-based study. Radiography: Science Direct, 319 – 326.
32. Jim-Frost, M. S. (2020). Introduction to statistics: an intuitive guide for analyzing data and unlocking discoveries. Journal of Statistics, 13(1), 978.
33. Kaplan, D. J., Patel, J. N., Liporace, F. A., Yoon, R. S. (2016). Intraoperative radiation safety in orthopaedics: a review of the ALARA (As low as reasonably achievable)

principle. Patient Safe Surgery, 10(1), 27.

34. Kim, O., Kim, M. S., Jang, H. J., Lee, H., Kang, Y., Pang, Y. and Jung, H. (2018). Radiation safety education and compliance with safety procedures- The Korea Nurses' Health Study. Journal of Clinical Nursing, 27(13-14), 2650-2660.
35. Krumpal, I. (2013). Determinants of social desirability bias in sensitive surveys: A literature review in Quality and quantity. GESIS Leibniz Institute for the Social Sciences, 47 (4), PP. 2025-2047. Retrieved from https://doi.org/10.1007/s11135-011-9640-9 on 2 June 2024.
36. Lopez, P. O., Dauer, L. T., Loose, R., Martin, C. J., Miller, D. L., Vano, E., Doruff, M., Padovani, R., Massera, G. and Yoder, C. Authors on behalf of ICRP. (2018). Occupational radiological protection in interventional procedures. ICRP Publication, 47(2), 39.
37. McMillan, L. R., Morgan, L. and Ament, P. (2008). Acceptance of male registered nurses by female registered nurses. Journal of Nursing Scholarship, 40 (1), 86-94.
38. Mohammed A. A. (2022). Radiation Safety Awareness among Healthcare Workers in King Saud University Medical City. Journal of Positive School Psychology, 6(9), 2717-7564.
39. Muhammad I. M.., Musa A. G., Adamu A., Adeniyi A. and Oladapo B. C. (2022). Financial Burden of Cancer on Patients Treated at a Tertiary Health Facility in South-West Nigeria. Journal of the West African College of Surgeons. 10(4): 23-29. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9267039/. 29 March 2023.
40. National Research Council (US) Committee on the Biological Effects of Ionizing Radiation (BEIR V). (1990). Health Effects of Exposures to Low Level of Ionizing Radiation: Genetic Effects of Radiation, Beir v. Washington (DC): National Academies Press (US). Retrieved from https://www.ncbi.nlm.nih.gov/books/NBk218706/ on 27 March 2023.
41. Nikolopoulou, K. (2023). What is recall bias? / Definition and examples. Scribbr. Retrieved from https://www.Scribbr.com/research-bias/recall-bias/ on 8 July 2023.
42. Ohno, K. and Kaori, T. (2011). Effective education in radiation safety for nurses. Radiation Protection Dosimetry, 147(1-2), 343. Doi: 10.1093/rpd/ncr342.
43. Park, S. and Yang, Y. (2021). Factors affecting radiation protection behaviours among emergency room Nurses: cross-sectional study. International Journal Environmental Res Public Health In: National Library of Medicine.
44. Paulinus, S. O., Mgbekem, M., Archiving, B., Ibe, B. and Paulinus, R. S. (2016).

Evaluation of Nurse's Knowledge of Radiation Protection Practices: A Case Study of Two Hospitals in Calabar, Nigeria: A Descriptive Survey. International Journal of Scientific & Engineering Research, 7(9), 2229 – 5518. Retrieved from https://www.researchgate.net/publication/3093550466_Evaluation_of_Nurses'

45. _Knowledge_of_Radiation_Protection_Practice_A_Case_Study_of_Two_Hospit als_in_Calabar_Nigeria, on 4 Januay 2024.
46. Qureshi, F., Ramprasad, A. and Derylo, B. (2022). Radiation Monitoring Using Personal Dosimeter Devices In Terms Of Long Term Compliance and Creating a Culture of Safety. National Center for Biotechnology Information in: Punmed Central.
47. Rose, A., Uebel, K. E. and Rae, W. I. (2018). Interventionalists' perceptions on a culture of radiation protection. South Africa Journal Radiology, 22(1), 1285.
48. Salerno, S., Marchese, P., Magistrelli, A. and Toma, P. (2015). Radiation risks knowledge in resident and fellow in paediatrics: A questionnaire survey. Italian Journal of Pediatric, 41(21), 12.
49. Salih, S., Nordin, M. N., Alkatheeri. A., Nasser, A., Saif, M., Abdallah, Z., Alderei, A., Faisal, L. A., Alhasan, M. and Hasaneen, M. (2023). Assessment of Nursing Students' Awareness towards Ionizing Radiation: cross-sectional study. National Library of Medicine. Research gate, 13(2), 855-864.
50. Samson, Y. D., Ibrahim, U., Usman, F.T. and Abdullahi, A. D. (2020). Assessment of knowledge and Attitude of Nurses in a specialist hospital towards Ionizing Radiation at Maiduguri, Borno State, Nigeria: Systematic Sampling. Asian Journal of Research in Nursing and Health, 42 (51), 57359.
51. Shantikumar, S. (2018). Understanding Sampling Techniques in Qualitative Studies. University of Central Florida: NUR 3165.
52. Shore, R. E., Beck, H.L., Caffrey E.A., Davis, S., Grogan, H.A., Mettler, F.A., Preston, R.J., Till, J.E., Wakeford, R., Walsh, L. and Dauer, L.T. (2018). Implications of Recent Epidemiologic Studies for the Linear Non-threshold Model and Radiation
53. Protection. Journal of Radiological Protection, 38(3), 1217-1233. DOI: 10.1088/1361-6498/aad348. 4 July 2023.
54. Sookkyoung, P. and Yang, Y. (2021). Factors affecting radiation behaviors among emergency room nurses. International Journal of Environmental Research and Public Health (IJERPH), 18(12), 6238.
55. Thaker, A., Navadeh, S., Gonzales, H. and Malekinejad, M. (2015). Effectiveness of policies on reducing exposure to ionizing radiation from medical imaging: a systematic

review. Journal of American College of Radiology, 12(12), 917-933.

56. Thambura, J. M., Conradie, I. V. and Klopper, S. (2019). Nurses' knowledge of ionizing radiation in Northern Gauteng state hospitals in South Africa. University of Pretoria. Journal of Radiology Nursing, 38(1), 16. DOI: 10.1016/j.jradnu.2018.11.002. 20 May 2023.
57. The population of Female Nursing students. Retrieved from https://Nigerianstay.gov.ng/download/1241062:NationalBureauofstatistics,Ni geriapercentageoffemalestudentsinnursingschools on 30 March 2023.
58. Thomas, G. A., Symonds, P. (2016). Radiation Exposure and Health Effect- is it Time to Reassess the Real Consequences? Clinical Oncology. PP 231-236. https://doi.org/10.1016/j.clon.2016.01.007. 4 January 2023.
59. Udogwu, F. (2015). Occupational and Hazard Related Nurses Working in Central Hospital Warri, Nigeria: Cross-sectional Study. Texila International Journal, 2(2), 4-5. DOI: 10.21522/TIJNR.2015.02.02.Art021. 10 April 2023
60. United States Environmental Protection Agency. (2023). Radiation Health Effects: Radiogenic Cancer Risks Models and Projections for the U.S population: (the blue book). EPA U.S Centre for Disease Control and Prevention (CDC).
61. Usman, S., Bashir, G., Dimas, S. and Joseph, D. Z. (2020). Evaluation of Occupational Radiation Exposure in a Radiation Diagnostic Facility in Katsina- Nigeria: Cross
62. -sectional Study. FUDMA Journal of Science, 4(2), 4.
63. Watmode, A., Yenkar, P., Zade, P., Bhalerao, P. and Lokhande, S. (2021). Assessment of Knowledge and Attitude towards Radiation Hazards among Nursing Students. Journal of Pharmaceutical Research International, 33(57B), pp 40-45. DOI:10.9734/jpri/2021/v33i57B34027. 10 April 2023.
64. Wikipedia. (2023). Ionizing radiation. Wikipedia.
65. World Health Organization (WHO). (2016). Ionizing radiation, health effects and protective measures. World Health Organization.
66. Yoshida, S. (2021). Knowledge and risk perception of radiation for Japanese nursing students after Fukushima Retrieved from https://www.preventionweb.net/publication/knowledge-and-risk-perception- radiation-japanese-nursing-students-after-fukushima on 30 March 2023.
67. Yousif, A. (2022). Investigation of the awareness level concerning radiation safety among radiology healthcare professionals in Saudi, Arabia. Journal of Research in medical and dental science, 10 (2), 24-32.

68. Yun, S. J., Oh, J. N. and Im, M. H. (2016). Knowledge, attitude, and education needs of radiation protection among nursing students and nurses. J. Korea Contents Association, 16(1), 343-354.
69. Yusuf, D. S., Umar, I., Tarfa, F. U. and Mundi, A. A. (2020). Assessment of Knowledge and Attitude of Nurses in a Specialist Hospital towards Ionizing Radiation at Maiduguri, Borno State, Nigeria. Asian Journal of Research in Nursing and Health, 3(1), 42-51.
70. Zuzana, B., Horvathova, M., Pincakova, K., and Budosova, D. (2021). The importance of public health in radiology and radiation protection. Journal of Public Health Research. 3370964