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Jimma University, Collage of Public Health and Medical Science, Department of Radiology.

MEGA PROJECT: Diagnostic Imaging methods, Development and Evolution

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RESEARCH TOPIC: Knowledge on Ionizing Radiation Associated Hazards and Protective Measures during Medical Imaging among Patients Waiting for Common Radiologic Imaging in Jimma University Specialized Hospital.

KNOWLEDGE ON IONIZING RADIATION ASSOCIATED HAZARDS AND PROTECTIVE MEASURES DURING MEDICAL IMAGINGS AMONG PATIENTS WAITING FOR COMMON RADIOLOGIC IMAGING IN JIMMA UNVERSITY SPECIALIZED HOSPITAL

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A THESIS TO BE SUBMITTED TO JIMMA UNIVERSITY COLLEGE OF PUBLIC HEALTH AND MEDICAL SCIENCE; DEPARTMENT OF RADIOLOGY AS PARTIAL FULFILMENT OF THE REQUIRMENT FOR SPECIALITY CERTIFICATE IN RADIOLOGY

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Knowledge on Ionizing Radiation Associated Hazards and Protective Measures During Medical Imaging Among Patients Waiting for Common Radiologic Imaging In Jimma University Specialized Hospital.

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Summary

Radiologic Diagnostic and therapeutic procedures using ionizing radiation carries well-known potential health risks.

The knowledge of the referring physician and patients on modalities of diagnostic imaging and procedures that use ionizing radiation varies widely. Their knowledge was generally inadequate. Patients' radiation knowledge strongly influences their acceptance and preference of diagnostic imaging types.

Objective: The main objective of the study is to assess knowledge on ionizing radiation associated hazards and protective measures during medical imaging among patients waiting for common radiologic imaging in Jimma University Specialized Hospital (JUSH), Ethiopia.

Methods: Hospitals based cross sectional study design were conducted on 388 patients waiting for common radiologic imaging and procedures in JUSH, at radiology department. A structured questionnaire was used to collect data from voluntary patients. Data was cleaned, edited and entered to SPSS version 16.Data was expressed as frequency distribution and percentages. Categorical variables were compared using the chi-square test for association. A P value of less than 0.05 was considered statistically significant.

Results: A total of 386 voluntary patients were included, of which 225(58.3%) of them were male. Their age range was from 14 years to 85years. In 28.2 % importance of imaging and likely associated harmful effects of radiation were discussed with referring physician. All of imaging unit referral was by the physician. An half of the respondents 193(50%) had back ground information about radiation. The majority of the participants, 356(92.2%) responded that they knew conventional x-ray. Twenty nine (7.5%) patients did not indicate any one of the equipment.

Only 203 (52.6%) patients indicated the association health hazard with radiation. Sixty five (16.8%) were incorrect in their assumption that ultrasound examinations uses of ionizing radiation and 32 (8.3%) of them were not aware of ionizing radiation free nature MRI imaging. Majority of the patients 152(39.4%) had indicated infertility followed by cancer, 130 (33.7%) as specific health effect of ionizing radiation. About 122(31.6%) of patients indicate gonads as highly sensitive organ. Ultrasound and MRI indicates as safe modality during pregnancy in 32(8.3%) and 4 (1%) respectively, where as plain abdominal x-ray and CT as safe for pregnant mother in 4(1%) and 5 (1.3%) respectively.

More than 95% of the respondents had no idea about background radiation and radiation protection symbol was known only among 15 (3.9%) patients. A large number of patients 292 (75.6%) responded that they had no idea about protective measures while diagnostic imaging. Most of (96.1%) the patients had no idea about the application of radiation rather than for their imaging purpose use.

An association of effect the education and information on patients' knowledge about radiation was revealed.

Conclusion

This study has shown the inadequacy of patients' knowledge on possible radiation associated health hazards, radiation protection measures and applications of radiation that is in general agreement with the results of other similar surveys. Thus intervention should be done on the line of improving our patients' knowledge about radiation issue.

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TABLE OF CONTENTS

Lists of tables

Acronyms and Abbreviations and Units

ALARA AS LOW AS REASONABLY ACHIEVABLE
CT COMPUTERIZED TOMOGRAPHY
DNA DEOXYRIBONUCLEIC ACID
GY GRAY
IAEA INTERNATIONAL ATOMIC ENERGY AGENCY
ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION
JUSH JIMMA UNIVERSITY SPECIALIZED HOSPITAL
MRI MAGNETIC RESONANCE IMAGING
mSV MILLISIEVERT
NASCBEIR NATIONAL ACADEMY OF SCIENCES COMMITTEE ON THE BIOLOGICAL EFFECTS OF IONIZING RADIATION
NCRPM NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENT
PET POSITRON EMISSION TOMOGRAPHY
SNNNPR SOUTHERN NATION, NATIONALITIES AND PEOPLES' REGION
SPSS STATISTICAL PACKAGE FOR SOCIAL SCIENCES
SPECT SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY
SV SIEVERT
UNSCER UNITE NATION SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION
USG ULTRASONOGRAPHY
UNSCEAR UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION

Chapter One: Introduction

1.1 Back ground

Radiation has always been & is present around us. All life has evolved in an environment filled with radiation. Radiation is energy that propagates through matter or space. (1, 2) Radiation energy can be in the form of wave or particulate. (2)

Radiation is usually classified into non-ionizing and ionizing radiation. Non-ionizing radiation has less energy than ionizing radiation; it does not possess enough energy to produce ions. Examples of non-ionizing radiation are visible light, infrared, radio waves and microwaves. Ionizing radiation has the ability to knock electrons off of atoms, changing its chemical properties. This process is referred to ionization (hence the name, ionizing radiation). (2-4)

There are four main types of ionizing radiation: these are Alpha radiation (α), Beta radiation (β), Photon radiation (gamma [γ] and X-ray) and Neutron radiation (n). (4)

Scientists have known about radiation since the 1890s. They have developed a wide variety of applications. Today, to benefit humankind, radiation is used in medicine, academics, and industry, as well as for generating electricity and energy. In addition, radiation has useful applications in such areas as agriculture, archaeology (carbon dating), space exploration, geology (including mining) as well as material analysis(security)and many others.(6)

Ionizing radiation includes the radiation that comes from both natural and man-made materials. (4, 5) The *United Nations Scientific Committee on the Effects of Atomic Radiation* (UNSCEAR) identifies four major sources of public exposure to natural ionic radiations: Cosmic radiation, Terrestrial radiation, Inhalation and Ingestion. The total worldwide average effective dose from natural radiation is approximately 2.4 mSv per year; in Canada, the average effective dose is 1.8 msv.(4) Normally, there is little we can do to change or reduce ionizing radiation that comes from natural background sources like the sun, soil or rocks.(4)

The *National Council on Radiation Protection and Measurement* (NCRPM) in United State had reported, in 18% of manmade radiation, around 15% of radiation exposures are due to the medical x-rays and nuclear medicine imaging. (7, 8)

The ionizing radiation that comes from man-made sources and activities need to be controlled more carefully. There are two types of photon radiation of interest for the purpose of this document: gamma (γ) and X-ray. Photon radiation can penetrate very deeply and sometimes can only be reduced in intensity by materials that are quite dense, such as lead or steel. (4, 5)

Ionizing radiation is the main concern for health effects since it can change chemicals' properties in the human body or tissue. (2-4) Biological effects of radiation are derived principally from damage of ionizing to DNA. It results in either single stranded breaks or double stranded break. 2

Single stranded breaks are usually well repaired with minimum bio effects. Breaks in both strands of DNA are more problematic to repair and underlie disruptive function that can result in cell death (deterministic) or in impaired cellular function resulting in the development of cancer (stochastic). The inappropriate repairs with resultant stable aberrations can initiate one of the multi-step processes in radiation induced carcinogenesis. (3, 4)

The occurrence of particular health effects from exposure to ionizing radiation is a complicated function of numerous factors including radiation type, dose, doses rate, Part of the body exposed, age and biological differences. (5) The radio susceptibility of cells, tissues, and organs of individuals totally differ. Cell radio sensitivity is directly proportional to the rate of cell division and inversely proportional to the degree of cell differentiation. As a person ages, cell division slows and the body is less sensitive to the effects of ionizing radiation. This also means that a developing embryo is most sensitive to radiation during the early stages of differentiation, and an embryo or fetus is more sensitive to radiation exposure in the first trimester than in later trimesters. (5, 9)

The cancer risks associated with radiation exposure have been known since long time. Its potential for harm has been demonstrated by the deaths of early radiation workers. (10) From previous epidemiological studies, the lowest dose of ionizing radiation which has a good evidence of carcinogenicity is between 10-50 mSv. (11) All doses, however low, have the potential to cause harm. Data acquired from atomic bomb survivors in Japan and victims of the Chernobyl nuclear accident in Ukraine show that comparatively smaller dose of radiation used in medical imaging could also increase the risk of cancer. (13)

The radiation exposure dose for one chest radiograph is 0.02 mSv and for an abdominal CT it is 9 mSv (11). The radiation dose received from one chest radiograph is less than that received from background radiation per day (12).

The lifetime cancer risk for children exposed to diagnostic radiation is substantially higher than for adults.(8) In February 2001Brenner et al.(15) they reported that a young child undergoing CT has an increased lifetime risk of fatal cancer of approximately 1 in 1,000 (0.18% for CT abdomen, 0.07% for CT head) . Generally the lifetime cancer risks of radiation were different among individuals. (14-18)

Modern imaging equipment allows adjustment for patient size and anatomy to allow closer adherence to the As Low As Reasonably Achievable (ALARA) principle (e.g. using adjusted CT settings in children compared to adults, the amount of radiation is reduced by a factor 6-7. (19)

The International Commission on Radiological Protection (ICRP) began to develop the risk versus benefit concept since 1977. It recommended all patient exposures must be justified, kept as low as possible and doses should be limited. (20) So following the ICRP principles during work with radiation is highly recommended to reduce radiation exposure doses. 3

1.2 Statement of the problem

Radiology department uses different imaging modalities which uses both ionizing radiation (such as x-ray, fluoroscopy, mammography, nuclear medicine and computer tomography) and non ionizing radiations (such as ultrasound, magnetic resonance imaging) for diagnostic and therapeutic intervention purposes. Exposure to ionizing radiation cannot be avoided totally in medical imaging facilities but is possible to decreases exposure by following the International Commission on Radiological Protection (ICRP) recommendations. This is possible only if the patients the treating physician and the radiation workers familiar with the recommendation.

Increasing concern has recently been expressed in the literature that the patients undergoing diagnostic imaging examinations have inadequate knowledge and awareness about radiation. (35) The knowledge on the radiation protection measures of the clients affects the chances of their exposure for ionizing radiation. There are many researches done on the knowledge and awareness of radiation hazards and protective measures worldwide. Most of the researchers focus on the health professionals. The studies show the knowledge of the health professionals about radiation is not adequate. (24-34) Regarding the knowledge assessment about radiation, only few studies have been conducted on patients.

According the research done in India (35) which has made an in-depth interview on patients' knowledge about ionizing radiation risks has revealed the patients' perception on radiation was not adequate. The patients perceived x-ray has no harm, thought x-ray was the only way to detect their problem and without x-ray they will not be cured. Similarly cross sectional research conducted in Turkey (34) which focuses more on hazards of ionizing radiation, majority of the patients do not consider radiation associated cancer risks. Several other studies have been done in different parts of the world demonstrated similar trends about patients' knowledge on radiation hazards. (34-39) Because of the low level knowledge on the radiation, unsafe application of it in imaging has been rampant. In the recent survey it is reported that approximately 30% of all radiological exams prescribed by the medical doctors are not clinically indicated. (21) Some of the imaging were done on the requests of the patients. (37) This should be discouraged.

The patients knowledge of the radiological imaging equipment in detail help them to prefer one type of imaging techniques over the other like ultrasound and MRI over CT or other imaging modalities that uses ionizing radiation. That also helps to avoid unnecessary examination which exposes them to high radiation unnecessary.

Patients, family or attendants of the client should know how to protect themselves from radiation exposure. It was advisable that patient or attendant should know the symbol for medical radiation emitting sources at the unit of imaging. They should know the importance of keeping themselves away from area of radiation sources. The request should be justified, do not be on the request of the patient or the family or not for psychological satisfaction. They should know that the part of 4 their body not under examination should be covered with the protective shield like lead. Additionally they should know that they don’t have to wonder within imaging rooms while other patients are under examination. (20) This is only practical if patients have knowledge on the ICRP recommendation.

Generally it is the responsibility of the treating physician and the radiation workers to inform the patients about radiation. A number of studies show that it is less practiced. (37)

Advancement in Medical imaging equipment using ionizing radiation, unsafe application without clinical indication and patients’ self-requests all increases unnecessary radiation exposure. This fact makes assessment of the current level of patients’ knowledge about ionizing radiation and protective measure is advisable in order to take appropriate interventions.

As far as I know, regarding patients’ level of knowledge about risks of radiation and protective measures have not been studied in Ethiopia until now. With these facts in mind, this study aims to undertake a survey to assess patients’ knowledge about the radiation hazards and protective measures during diagnostic radiological imaging and procedures at JUSH. 5

Chapter Two: Literature Review

2. 1 Literature review

In spite of the biological hazards of x- ray and gama rays, enormous benefits were derived from its application in the medical imaging. The increasing amount of ionizing radiation that is received from controllable artificial radiation resources on work gives rise to possible risks of developing cancer over the course of a lifetime and hence constitutes a threat to public and patients health.(18,21) Radiation exposure over a long period of time (years) produces stochastic effects (NCRPM, 1980).(22) All diagnostic imaging (CT, nuclear medicine, and radiography and fluoroscopy) radiation doses are at the levels which are stochastic. (22, 23) There is no threshold level of radiation exposure below which it could be said with certainty that cancer or genetic effects will not occur. Doubling the radiation dose doubles the probability that a cancer or genetic effect would occur (Kondo, 1993). (24)

From the literature and our own experience, it is extremely important to thoroughly and carefully educate patient about radiation exposure levels and perceived or actual health risks. Treating physician and radiation workers should explain the imaging procedure to the patient and explain the benefit vs risk of radiation which is very essential in any healthcare setup. One study conducted in Port Harcourt, Nigeria highlights the deficiency of treating physician which might affect the expected benefits compared to the risks involved in diagnostic imaging. It has reported that 60% of the patients were not explained about the diagnostic procedure by the radiation workers (37).Another study from Hong Kong, China shows most patients (98.2%) were told the indications, and only 42.7% were told the associated radiation dose and risks. (38)

There are different studies carried out to assess clinician knowledge on ionizing radiation uses. According to survey in Northern Ireland, non-radiologic clinicians have poor knowledge of the radiation doses and radiologists have good knowledge of radiation doses and risks (30).Other studies on the Iranian (32) and Ethiopia physicians (33) also show deficiency in knowledge. Both studies recommended the need for training on radiation doses required for diagnostic imaging to reduce the patients' radiation dose and risks.

Several studies have been done worldwide to assess clinician knowledge on non-ionizing nature of ultrasound and MRI. The above mentioned study done in Ethiopia, at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa University (AAU), has studied on physicians’ knowledge on the risk free nature of both Ultrasound and MRI. Those who responded that both use ionizing radiation were 5.3% and 7.1% respectively. (33) Another study in TASH, AAU, which included 350 medical students shows 71.4% and 79.3% incorrectly believed that ultrasound and MRI, emit ionizing radiation or they do not know whether they emit radiation or not, respectively. (40)

A cross-sectional survey done to assess Knowledge about Ionizing Radiation and Radiation Protection among Patients awaiting Radiological Examinations carried out in the university hospital Turkey on 224 patients. The majority of patients (91.5%) had had previous radiological examinations. Many of patients knew that x-ray could cause cancer (73.2%) and fetal anomaly (69.2%). About 46.9% of them knew what radiation means. While 68.3% of patients knew that radiography use x-ray, only 33% of them knew that mammography uses x-ray. They responded that conventional radiography (72.8%) and CT (71.4%) were harmless during pregnancy. Additionally 44.6% of them also believed MRI uses x-ray and 66.5% avoided this examination during pregnancy. While 20.5% of them knew that CT contained more x-ray than radiography, 73.2% had no idea about this issue. Interestingly, 22.3% of patients declared that thick cloths could protect them from harmful effects of x-ray. Comparison of the patients who knew that radiation could cause cancer and who did not significantly differed according to educational levels. (P=0.032). (34)
Another cross sectional research done On 173 local patients at Medical and Geriatric Department, Kwong Wah Hospital, Hong Kong, China. The study shows Patient radiation knowledge is not adequate. From the study 60.7% and 32.7% were not aware of the radiation-free nature of MRI and USG, respectively. The misconception that Barium enema and Barium swallow studies do not involve radiation was 45.4% and 43.5%, respectively. Moreover, 77.6% and 87.9% were aware of the radiation risk from CT and plain X-rays, respectively. Furthermore, 34% think that they are not exposed to radiation at home. Regarding the fatal cancer risk from CT, 62% underestimated the risk. 32.2% correctly estimated the equivalent dose of CT in terms of number of conventional X-rays and 43.2% underestimated the dose. Most (98.2%) were told of the indication, and 42.7% were told the associated radiation dose. Finally the author suggested the need to increase patient radiation risk awareness, and to provide them with the necessary information. (38)
Additional radiation safety awareness survey among radiation workers and patients conducted at Mulago Hospital, Kampala, Uganda. The study included 70 individuals, 50 patients and 20 radiation workers. This study shows a large number of the patients were of the view that x-rays were dangerous (43%) while some thought they were not dangerous and 14% of them have no idea. The investigator also noted a large number of the patients were ignorant of the radiation symbols (95.7%) and this implies that they could innocently walk into a radiation field. Many did not mind standing in areas where they could be exposed and saw no danger working with radiation. Half (50%) reported that x-rays reduce or affect the life span in some way. 83.3% of the patients had no idea on how to protect themselves from radiation. None of the patients knew about background radiation (39)
Similarly radiation safety awareness study among patients and radiographers in three hospitals in Port Harcourt, Nigeria on one hundred and fifty (150) patients (70 individuals) and radiographers (80 individuals) carried out. This study has shown the patients' awareness of the dangers of ionizing radiation is very poor while level awareness by the radiographers is unacceptable. Only 7

44 (58.7%) of the radiographers reported that they were aware of the dangers of ionizing radiation. Eight (13.0%) of the patients were aware while 52 (86.7%) were not aware.
The percentage (86.7%) of patients who did not know that X-rays were dangerous was very high and unacceptable. This placed a big responsibility on the radiation workers to explain and protect them. (37)
The same study further showed that majority (85.7%) of the examinations were requested by the physician although there were a few cases (14.3%) of self-requests. This researcher concluded Less than 50% of the radiographers and less than 40% of the patients were aware of the dangers of ionizing radiation and protective measures. Finally, he recommended hospital managements should design a program which would emphasize patient education like introductory talks every morning before work begins. Information posters should be displayed throughout the hospital, and brochures that explain safety procedures and common concerns should be made available to all patients. Author also suggested the need for more monitoring of regulatory bodies. (37)
Further Cross-sectional study had done on 100 patients (55 female, 45 male) at Kufa University, Iraq to assess Patients' awareness of Cancer Risk from Radiation in Computerized Tomography. The study shows the radiation's risk issue needs to be taken seriously and urgent actions with dedicated programs are recommended to educate patients (mainly by media) and to establish a reasonable patient-informing system. It shows majority (86%) of patients have no any awareness about the high radiation dose implied to the patient by CT, while only 18% (18 patients) have adequate awareness. About 63% of the study groups were not informed about risk from CT radiation neither by referring medical personnel. Female appeared to be more aware of high radiation dose (CT radiation) risk than male. This study recommended the necessity of further large-sample studies that assess awareness of patients as well as health care providers for that risk. (36) 8

2.2 Significance of the study

For the last two decades, the world has observed advancement in technology of medical equipment. Together with the advancement of technology, the ionization radiation risks from x-rays and gamma rays used in CT, PET, SPECT imaging and procedures become the concern of the treating physician, radiation associated workers and patients.

Knowledge about radiation associated risks and protective measures from medical imaging (radiographies) have been well studied in the rest of the world. Regarding knowledge, studies done so far in Ethiopia are a few. Even those studies which tried to assess the problem did not consider patients' knowledge and do not indicate possible and convenient way of increasing our patients knowledge.

So, with recent progressively increasing introduction and use of advanced medical imaging technology in the country, Ethiopia, justifies the need for knowing the current level of knowledge of patients at the local as well as the national level. This is very important in designing the possible interventions.

This study will also contribute to the studies available on the subject matter and will serve as baseline for other researches.

Based on the findings of the study, at an institutional level, interventions could be taken.

The finding of the study could be also used to design similar interventions at the zonal, regional and national levels.

Chapter Three: Objective

General objective:

- To assess patients' knowledge on ionizing radiation associated hazards and protective measures during medical imaging among patients waiting for diagnostic imaging and procedures in JUSH.

Specific objective:

- To assess knowledge of patients on imaging modalities using ionizing and non- ionizing radiation (eg. x-ray, U/s MRI, CT etc..) among patients waiting for diagnostic imaging and procedures in JUSH.
- To assess knowledge of patients about radiation hazards among patients waiting for diagnostic imaging and procedures in JUSH.
- To assess knowledge of patients on preventive measures during medical imaging using ionizing radiation among patients waiting for diagnostic imaging and procedures in JUSH.
- To assess knowledge of patients on benefits of radiation among patients waiting for diagnostic imaging and procedures in JUSH.
- To assess the factors associated with poor knowledge of patients on radiation associated hazards and protective measures during medical imaging among patients waiting for diagnostic imaging and procedures in JUSH.

Chapter Four: Methods and Material

4.1 Study Area and Study Period This cross sectional hospital based study was conducted on patients waiting to have diagnostic imaging at radiology department , Jimma University Specialized Hospital (JUSH), from December, 25 2014 G.C to January, 25 2015 G.C. The hospital is the only referral hospital for over 15million people in the southwest Ethiopia (JUSH archive, 2000). JUSH located in Jimma Zone, Jimma town, Oromia region, south west Ethiopia which is at about 355Km from Addis Ababa. At the same time it is a teaching hospital with various other public health services. The radiology department is one of the busiest working areas. It gives services for all patients referred from different specialty departments, OPD and ward admitted patients. There are two x- ray machines, one fluoroscopy and three functional ultrasounds (one Doppler ultrasound) in the department. Approximately More than 20,000 thousands of patients referred to this department for imaging per year which means around 1660 patients per month and about 60 patients per day.

4.2 Study design A cross sectional hospital based study was conducted.

4.3 Population 4.3.1Source population All patients who referred to the radiology department for diagnostic radiologic imaging.

4.3.2 **Study population** All patients referred for diagnostic imaging using ionizing radiation full filling the inclusion criteria and volunteer for participation were included until the sample size was met.(388 in this study)

4.4 Eligibility criteria 4.4.1 Inclusion criteria Any patients referred for diagnostic imaging using ionizing radiation is taken eligible for the study provided that he/she is willing to be enrolled.

4.4.2 Exclusion criteria

Critically ill, emergency cases and psychotic patients were excluded as they need prompt care. A patient who is not convenient for communications on interview like child, speech disability was excluded. Additionally patient who referred for second time over study time and non respondents were exempted.

4.5 Sample size determination and sampling technique 4.5.1 Sample size determination
The minimum sample size needed for the study was calculated by using the single population proportion formula of calculating the minimum sample size. 95% confidence interval assumption will also be used.
The sample size was calculated using the formula
n = Z 2 p (1-p) / w2 where: n= the minimum sample size required Z=the normal standard score corresponding to 95% CI=1.96 P=proportion of responding knew and aware ≈40% from previous study (37) W=degree of accuracy required So, n = (1.96) (1.96) (0.4) (0.6) / (0.05) (0.05) = 369 With 5% approximation of non-respondents for calculated value, the study sample included 388 individual.
4.5.2 Sampling technique
A convenient sampling technique was used including all eligible participants until the required total sample size was achieved.
4.6. Data collection procedures (Variables, Instrument, personnel, data quality control) **4.6.1 Study Variables** Patients' knowledge On ionizing radiation hazard, protection measures and application of radiation, back ground radiation hazard, radiation symbol, Age, sex, Level of education, employment, places of residences, ethnicity, and religion**.**
4.6.2 Data collection Instrument A structured English, Amharic and Afan Oromo language version questionnaire addressing the socio demographic characteristics, age, sex educational level etc. and questions which assess the patients' knowledge on radiation associated hazard, protective measures and radiation applications were used to collect data. **4.6.3 Data collection personnel** For data collection, two individuals from department hired for the study period. One day demonstration were given for the data collectors on how to proceed with the study, detail explanation of questionnaires, meaning of medical terminologies and ideas to be addressed for patient under interview and how to fill the questionnaire before data collection was started. Orientation was also be given to the data collectors on how to retrieve important information for completeness of questioner from the patient under study. The investigator supervised & followed the data collectors intermittently during the study period.

4.6.4 Data collection technique Data were collected by using structured questionnaires, interviewing the patient waiting for diagnostic radiological imaging before any intervention or procedure. The communication with the patient for the interview was conducted as much as possible by the language the patient understood well.

4.6.5 Data quality control

Prepared questioner was pre tested on other patients who were not part of the study before it was administered to actual study group. During the data collection procedure, the investigator was checked whether information was recorded correctly & completely. The collected data were checked for completeness, accuracy & clarity as well.

4.7 Data analysis procedures Data was cleaned, edited and entered to SPSS version 20 for analysis. Distribution of variables was assessed using descriptive statistical analysis. In addition, parametric tests were performed Categorical variables were computed using the chi-square test for their association to examine differences between different patient groups in their responses to knowledge and awareness questions provided . P value of less than 0.05 was considered statistically significant.

4.8 Ethical Considerations

Ethical clearance was sought from Jimma University, College of Public health and Medical sciences Ethical Review Board and Radiology department. Everyone who referred for imaging has a full right to participate or refuse. Verbal and written consent for voluntariness of participation in the interview for data collection were obtained after informing all the patients being refusal will not affect the usual services they got from department. The result of the research will not affect the participants; it will be used for study and intervention will be done accordingly. Name will not be included in the data collection tool and all the information retrieved will be kept confidential between the data collector and the investigator. Patients with life threatening conditions were exempted from the study and were linked for appropriate care 13

4. 9 Definitions

Absorbed dose: The amount of energy absorbed by irradiated matter per unit mass. This reflects the amount of energy deposited by ionizing radiation as it passes through a medium (such as air, water or living tissue) Unit: gray. Symbol: Gy.

ALARA: (AS LOW AS REASONABLY ACHIEVABLE): An optimization principle in radiation protection used to keep individual, workplace and public doses as low as reasonably achievable, social and economic factors being taken into account. ALARA is not a dose limit; it is a practice that aims to keep dose levels low

Artificial radiation: Radiation created by human activities and that adds to naturally occurring background radiation.

Cosmic rays: A source of natural background radiation that originates in outer space

Deterministic effects: Changes in cells and tissues that are certain to occur after an acute dose of radiation (above a threshold value of at least 1000 mSv), below which the radiation effect is not detected.

Dose: A general term used to refer to the amount of energy absorbed by tissue from ionizing radiation

Ionizing radiation: A form of radiation that is capable of adding or removing electrons as it passes through matter (such as air, water, or living tissue). Examples are alpha particles, gamma rays, X-rays and neutrons

Natural background radiation: A constant source of radiation present in the environment and emitted from a variety of sources. These sources include ambient air (radon), terrestrial sources (radioactive elements in the soil), cosmic rays, and internal sources (food and drink).

Non-ionizing radiation: Radiation with lower energy than ionizing radiation; i.e., it does not possess enough energy to produce ions. Examples are visible light, infrared, and radio waves

Stochastic effects: A term used to group radiation-induced health effects (such as cancer or inheritable diseases) the probability of their occurrence increases proportionally with the radiation dose received: the higher the dose, the higher the probability of occurrence. The severity of the effect is not proportional to the dose.

4.11 Communication of Results

The result of this study was submitted to the department of Radiology ,Jimma University and its publication will be worked up on eventually.

5 Chapter Five: Results

Socio-demographic characteristics

From the total of 388 samples only 2 individuals were found not willing to participate in the interview, making the response rate 99.5%.

Responses from the survey reveals that 225(58.3%) of the respondents were male while 161 (41.7%) were female. The age distribution range from 14years to 85years.The mean age for the patient was 35 years and median 30 years. Age range of 20-29yrs accounts for maximum distribution,154 (39.9%).(Table 1).

The highest frequency distribution of education level belonged to primary school educated participants 164, (42.5%) and only 51(13.2%) had attended college and above. In contrary 24.1% had no formal education or no education at all.(Table 1).

Self-business employed patients 112(29%) frequency distribution was the highest among the employment category. Muslim religion followers, 260 (67.4%) were more frequent than the cumulative sum of other groups. The Oromo ethnic group frequencies the highest 263,(68.1%) followed by Amhara ethnic groups,70 (18.1%) among the respondents. (Table 1) 15

Table 1. Socio-demographic characteristics of clients in radiology unit, JUSH, 2014G.C. Variables	**Frequency(n)**	**Percent (%)**
Gender	225	58.3
Male	161	41.7
Female		
Age	51	13.2
< 20 yrs	154	39.9
20-29yrs	73	18.9
30-39yrs	56	14.5
40-49yrs	52	13.5
>50yrs		
Educational status	93	24.1
Illiterate/no education	164	42.5
Primary school(1-8)	78	20.2
Secondary school(9-12)	51	13.2
Collage and above		
Employment	61	15.80
Official	112	29.02
Self-employed	85	22.02
House wife	79	20.47
Faemer	31	8.03
Student	18	4.66
Others		
Religion	72	18.7
Orthodox	52	13.5

Protestant	260	67.4
Musilim	2	0.5
Others		
Ethnicity	263	68.1
Oromo	70	18.1
Amhara	30	7.8
Kefa	10	2.6
Gurage	13	3.4
Others		