Medical Doctors' Knowledge about Patients' Ionizing Radiation Exposure Dose and Its Associated Risks at Jimma University Specialized Hospital, South West Ethiopia

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Abstract- In the present day scenario**,** ionizing radiation is widely used to diagnose many diseases both in developed and developing world. Excessive use of ionizing radiation has an increased risk of fatal cancer. It is believed that the awareness of medical doctors about hazards of ionizing radiation and radiation dose values is one of the first step in protecting patients from radiation exposure. The aim of this study was to assess medical doctors' knowledge about patients' ionizing radiation exposure dose and its associated risks at Jimma University Specialized Hospital.Descriptive cross- sectional study was conducted among 110 physicians working in Jimma University Specialized Hospital.A structured, self-administered and pre-tested questionnaire was used to collect data from sampled population.

A 122 self-administered questionnaire was circulated among physician randomly selected from the different categories of physicians; out of which 110 questionnaires were completed and used in this study giving a response rate of 90%. Almost one fourth of the study participants overestimated the average amount of radiation absorbed by a patient during a single chest X-ray examination. Among the respondents, 26 (23.6%) were incorrect in their assumption that abdominal ultrasound examinations involved theuse of ionizing radiation, whereas 11 (10%) mistakenly thought that an abdominal MRIused ionizing radiation.

Findings from this study show thatknowledge of doctors about radiation exposure and risks associated with diagnostic imaging modalities is limited.The results indicate a need for further education in the field in order to minimize unnecessary exposure to patients. A suggested target of better education regarding the risks of ionizing radiation associated with imaging modalities is needed to reach all practicing Doctors.

Index Terms- Physician Knowledge, Radiation Dose, Radiation Protection, Ethiopia.

I. INTRODUCTION

Ionizing radiation has been proven to have adverse biological effects on living organisms. These adverse effects vary according to dose and duration of exposure [1]. Previous studies in United Kingdom show that 100-250 death per year occurred because of harmful effects of medical radiation exposure [2]. Similarly, in USA, National Council on Radiation Protection and Measurement had reported that medical x-rays and nuclear medicine account for only 15% of all radiation exposures[3].

As reported by study in UK, CT has been shown to account for merely 6% of diagnostic procedures, yet represented 47% of the entire radiation dose received by patients [4]. A published study USA in 2002 reported that CT may account for only 15% of the procedures performed in a radiology department and it is responsible for up to 75% of the medically administered radiation dose to the population [5]. Another study in Norway show that, CT examination contribute 59% for the collective medical radiation dose to the population [6].

Furthermore, the number of referrals for paediatric CT studies has increased exponentially, raising substantial concerns regarding cancer risk in this highly radiosensitive population [7]. Not surprisingly, concerns are growing over the risks associated with these high levels of exposure, particularly the potential increased lifetime risk of cancer [8]. According to the recommendationby the European Council Eurotom directive of 1997,it is imperative that medical professionals are aware of the radiation exposures associated with diagnostic imaging investigations including CT [9].

Patients coming for radiological investigations are being referred by the referring doctors from various clinics, and study did however, show that there is lack of adequate knowledge of radiation among doctors concerning radiation doses received by patients when they undergo such radiological investigations. More so, it has been noted that most of the doctors are submitting their patients to a radiation dose that is 16 times larger than they thought it was and it has been shown that the average mean dose of irradiation is six times the quantity estimated by the doctors [10-12].

Therefore, based on the researchers' knowledge the situation in these centers might not be different from what is happening in the study locality, and it was the trigger of this study. There is shortage of literature regarding the level of doctor's knowledge on radiation received by patients during radiological examinations in developing countries. In Ethiopia, there is no documented literature on knowledge of physician about radiation dose and its risk to the best of our knowledge. The aim of this study was to assess medical doctors' knowledge

about patients' ionizing radiation exposure dose and its associated risks at Jimma University specialized hospital (JUSH).

II. MATERIALS AND METHODS

Study design and setting

Descriptive cross- sectional was conducted among physicians working in JUSH. The target population comprises all non-radiologist physicians (GP, medical interns, residents and different specialist physicians) working in all departments and wards during the study period

Sample size and sampling Technique

Systematic random sampling method was employed taking the physician in each department as a study unit. Accordingly, 110 physicians was sampled who was on duty during data collection from all departments and wards.

Data Collection procedure

Structured, standardized and self-administered questionnaires was designed and used by reviewing previous similar literatures [13, 14].The questionnaires was pre-tested at the study place on 15% of the respondents prior to the actual data collection to ensure quality, clarity, understandability and completeness of the data. Depending on the result of pre-test, correction and modification was made on the questionnaires before actual data collection on the study population was started. Various variables like socio-demographic data, field of specialty and specific questions to determine knowledge of radiation exposure, the dose and risks of various radiologic procedures to which a patient is exposed during various radiologic investigative modalities were included in the questionnaire.

Data Analysis Procedure

Obtained data was checked for error and then data entry was done using Epi Info version 3.5.2. The entered data was cleaned and analyzed by using SPSS version 20.0 software. Distribution of variables was assessed using descriptive statistics.

III. RESULT AND DISCUSSION

Respondent demographics & Practice characteristics:

Table 1-Qualification distribution of respondents, in JUSH,2016.

Qualification	Frequency	Percent
Intern	37	33.6
GP	14	12.7
Resident	43	39.1
Specialized	16	14.5
Total	110	100.0

Among the 122 questionnaires distributed 110 were filled andreturned giving a response rate of 90%.The age of the respondents ranged from 25 to 52years. Among the respondents 25 were female & 85 male. The responding doctors included 16 specialized, 43 residents, 37 medical interns & 14 GPs (Table1).

Table 2.Distribution of study participants according to descriptive features, JUSH, 20016

	Frequency	Percent
Gender		
Male	85	77.3
Female	25	22.7
Year of service		
Intern	37	33.6
<10 years	67	60.9
>10 years	23	20.9
Specialty		
Internal Medicine	4	3.6
Surgery	3	2.7
Gynecology/Obstetrics	5	4.5
Pediatrics	4	4.5
No specialty	94	85.5
Total	110	100.0

The number of years in practice ranged from one to fifteen, with an average time in practice of 7.8 years. Greater than half of respondents (60.9%) practicing less than ten years. Concerning the specialty of the respondents 4 were from internal medicine, 3 from Surgery, 5 from Gynecology/Obstetrics, 4 from Pediatrics, & 51 had no Specialty (i.e. Interns & GPs) (Table 2).

Knowledge of radiation exposure

Table-3: Knowledge of respondents about the radiation dose in a single Chest X-Ray, JUSH 2016

Absorbed Dose (mSv)	Frequency	Percent
0.2mSv	20	18.2
0.02mSv	13	11.8
2mSv	18	16.4
20mSv	11	10.0
Do not know	48	43.6
Total	110	100.0

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Knowledge of the radiation dose in a chest x-ray was given in (table 3).Less than fifteen percent 13 (11.8%) of respondents accurately estimated the average amount of radiation absorbed by a patient during a single chest x-ray.Most of the doctors 48 (43.6%) do not know the amount of absorbed dose in a single chest x-ray.Furthermore, the radiation dose from a single chest x-ray was overestimated by 29 (26.4%) of respondents.

Radiation dose received during radiological examinations and their equivalents to standard chest X-ray (0.02 mSv), in mSv units, were questioned in other studies; however, in our questionnaire (in order to facilitate responses) we asked about the ionizing dosefrom a single chest x-ray. This study demonstrated that the level of knowledge of the participantswas inadequate.

Table 4.Knowledge of the respondents about radiation exposure dose of radiological imaging examinations JUSH 2016.

Imaging Technique	Less than actual Dose n (%)	Equal to actual Dose n (%)	Greater than actual Dose n (%)	Do not know n (%)
Abdomen x-ray	36(32.7)	8(7.3)	39(35.5)	27(24.5)
Bone scan	41(37.3)	9(8.2)	28(25.5)	32(29.1)
Barium meal	38(34.5)	7(6.4)	26(23.6)	39(35.5)
Abdomen CT	42(38.2)	11(10.0)	31(28.2)	26(23.6)
PET San	53(48.2)	4(3.6)	19(17.3)	34(30.9)
Ankle x-ray	26(23.6)	8(7.3)	31(28.2)	45(40.9)

CT: computed tomography

Knowledge of ionizing radiation dose for different radiographs was given in (table 4). Correct estimates of the radiation dose were given for, abdominal x-ray, bone scan and ankle x-rays by 8 (7.3%) to 9 (8.2%) of respondents, while 36 (32.7%), 41 (37.3%) and 26 (23.6%) underestimated the radiation dose associated with these tests.The doses associated with PET scan, barium meal and Abdomen CT were also underestimated by 53 (48.2%), 41 (37.3%) and 42 (38.2%) of respondents and only accurately estimated by 4 (3.6%), 7 (6.4%) and 11 (10%).

Radiological examinations have an indispensable role in the diagnosis and treatment of disease, although radiationhas been proven to have adversebiologicaleffects on living organisms.Theseadverse effects vary according tothedose of radiation and duration ofexposure [15 &16].Annually,100–150peopledie as a result of cancer secondaryto medical radiation exposure [17].

Studies and surveys have shown that doctors havepoor knowledge of radiation doses of examinations that are ordered and performed in clinicalpractice (Kong, 2005). The current study revealed that doctors could not appropriately estimate radiation dosesin the field of plain radiography, contrast studies and CT examinations.Most of the doctors either under estimate the dose or did not know the dose. The estimated doses of some of the radiologicalexaminations are much lower than the correct ones. The gross underestimation of radiation doses associated withplain radiography, contrast studies and CT examinations are consistent with previous studies done on physicians in other countries [1,2, 18 &19]. ThisUnderestimation of the actual dose of ionizing radiation might leaddoctors to request radiological examinations more often than it is necessaryandsafe. This means increased risk forpatients.

Table 5.Knowledge of the respondents about radiation exposure dose of radiologicalimaging examinations that do not use ionizing radiation, JUSH, 2016.

Imaging Technique	Exposure to ionizing radiation		
	Present n(%)	Absent n(%)	Do not Know n(%)
Abdominal US	26 (23.6)	65(59.1)	19 (17.3)
Abdominal MRI	11(10.0)	88 (80.0)	11(10)

US: ultrasonography, MRI: magnetic resonance imaging

Knowledge of the respondents about radiation exposure dose of radiological imaging examinations that do not use ionizing radiation was given (table 5).Among the respondents, 26 (23.6%) were incorrect in their assumption that abdominal ultrasound examinations involved theuse of ionizing radiation, whereas 11 (10%) mistakenly thought that an abdominal MRI used ionizing radiation. 19 (17.3%) do not know whether abdominal US involve ionization radiation or not.

An alarming finding of both previous studies conducted on physicians as well as this study done on doctor's knowledge of radiation dose and associations risk is falsely associate non-radiating exams such as MRI and US with doses of ionizing radiation. This study found that 26 (23.6%) and 11(10.0%) of respondents wrongly indicated radiation doses with ultrasound and MRI, respectively. This result are consistent with previous studies which reported thatultrasound scanning and MRI were associatedwith radiation by 4%–11% and 8%–28% ofrespondents, respectively [21 & 22]This seems to reflect a deficit of knowledge of basic scientificprinciples. It may be explained by the fact that MRI was not available in the hospital during the study period and is not accessed by the doctors.

Furthermore, this study revealed that 65(59.1%) correctly associated the radiation dose of an abdominal US, and 88 (80.0%) of the doctors correctly indicated the radiation dose associated with MRI. This finding is slightly higher than findings in the literature on physicians. Prior studies on physicians report a 4-5% incorrect association for ultrasound and 5-30% rate for MRI [1,18,19].

Perception of Cancer Risk

Table6: Distribution of respondents in estimating lifetime cancer risk from an Abdominal CT, JUSH 2016.

Risk estimation (ratio)	Frequency	Percent
1 in 200	35	31.8
1 in 2000	9	8.2
1 in 200,000	28	25.5
Don't Know	38	34.5
Total	110	100.0

The lifetime risk of inducing a fatal cancer from an abdominal CT examination is estimated to be 1 in 2000 for an adult patient (33); however, only 9 doctors (8.2%) appeared to be

aware of this association. 35 (31.8%) doctors mistakenly replied that a CT scan of the abdomen had a lifetime risk of inducing a fatal cancer of less than 1 in 200 (Table-6).

In one study, 10–50 mSv of acuteradiation exposure and 50–100 mSvof recurrent exposure were reported to induce cancer [22]. Therefore, inradiological practice, in keeping withALARA (as low as reasonably achieved) principle,minimum exposure of the patient andradiology staff is mandatory. Radiologicalexaminations that are unnecessaryand not supportive of diagnosiscreaterisk for patients.

IV. Conclusion

Finding from this study show thatknowledge of doctors about radiation exposure and risks associated with diagnostic imaging modalities is limited. This limited knowledge of ionizing radiation, consistent with published studies in different countries. The limited knowledge displayed among doctors is in accordance to the reported absence of on job training regarding the risks associated with radiation exposure and absence of dose saving modalities (MRI) in the hospital. Although this is the only study to be conducted on all category of physicians (GP, Intern and Specialized), the results indicate a need for further education in the field in order to minimize unnecessary exposure to patients. A suggested target of better education regarding the risks of ionizing radiation associated with imaging modalities should arranged; however continuing education is needed to reach all practicing Doctors.Moreover, an effective medical education model should be developed in medical schools and health training institutions to address theknowledge gap currently seen in clinical practice.

Patient education about radiation should be part of the responsibility of healthcare providers. This studyconcludes that the majority of medical doctors at JUSH have a verylimited knowledge regarding radiation source, risk and essential protection. Misconceptions about exposure andrisk were also observed in the medical community of the hospital. One can hardly refrain from generalizing thatthe problem affects the wider healthcare provider community nationwide in view of the fact that the teachinghospital is the source of most of the professionals practicing in the country. It is identified that a majorcurriculum revision of both undergraduate and graduate medical education regarding awareness on radiation ismandatory to improve this deficiency.

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