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Comparison on Awareness of Radiation Hazards among Females of Different Age Group

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Authors' contributions

This work was carried out in collaboration among all authors. Author AAJ has done literature search, data collection, analysis, manuscript drafting. Author RP has aided in conception of the topic, participated in the study design, statistical analysis and has supervised in preparation and final corrections of the manuscript. Author PS has done data verification, manuscript drafting, and preparation of manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Radiation is a source of energy which travels through materials. The ionising radiation produce free radicals from an atom with the electron removal. X-ray is the most common ionizing radiation helping in diagnosis. There is an increase in the use of radiation in diagnosis, procedural along with surgical treatment where radiologists and the patients should be aware of the radiation hazards and its ill effects. The aim of our study is to analyse the radiation hazards awareness among females of various age groups.
Materials and Methods: The study was done as an online setting; the responses were obtained from 103 female participants from the Chennai sub population. A self-structured questionnaire comprising about 18 yes or no types of questions were prepared in google forms and circulated as a link to the participants. The responses were exported to google sheets and data was retrieved

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and analysed in SPSS software version 26. The results were obtained from SPSS software.
Results: From the results analysed, 74.76% have undergone X ray or any procedures but only few (25.24%) did not undergo any diagnostic procedures. 71.84% of them were aware that all radiation is hazardous whereas the rest (28.16%) were not aware. 88.35% of them accepted that bone marrow and child's thyroid tissue are more sensitive to radiation but few (11.65%) did not accept it. 71.84% of the participants of females of age group 20-40 years were more aware than females of 40-60 years age group (16.50%) that bone marrow, the child's thyroid is the sensitive tissue affected by radiation. Chi square test was done and the association was found to be not statistically significant with *P*-value .236 (*P* = .05). Chi square test was done to check awareness of thyroid cancer caused mainly through radiations between the two age groups of females and the association was found to be not statistically significant with p-value is .703 (*P* = .05).
Conclusion: Within the limits of the study, the females of age group 20-40 years have higher levels of awareness than females of age group 40-60 years.

Keywords: Radiation; X-rays; cancer; birth defects; females; awareness.

1. INTRODUCTION

Radiation is the energy that comes from a source and travels through various materials and space. The ionising radiation is the radiation with sufficient energy to remove an electron from an atom or molecule and produces free radicals. The most common ionising radiation is X rays which is used extensively in diagnostic procedures [1]. Ionising radiation has biological damaging effects either affecting cells directly or indirectly through production of free radicals and they lead to DNA (Deoxyribo Nucleic Acid) damage of single or double stranded breaks, DNA protein cross links. Both dentists and patients are at high risk of stochastic effects as it has no dose threshold [2]. There is an increase in the use of radiation in diagnosis, procedural along with surgical treatment where radiologists and the patients should be aware of the radiation hazards and its ill effects [3]. Exposure to medical radiation increases risk of bone marrow suppression, cataract, infertility, birth deformities and several types of cancer, especially thyroid carcinoma. It also causes foetus anomalies like microcephaly, cleft palate. The awareness and knowledge about radiation hazards may differ based on occupational roles and levels of training[4]. The awareness created among low economic status people may be low whereas it is different for higher economic individuals. The general principle of radiation protection, pro post by ICRP (International Commission on Radiological Protection), is based on justification, optimisation and dose limitation and also follows RSO (Radiation Safety Officer), RSC (Radiation Safety Committee), 10-day rule concept [5,6].

There is much research work done on creating and knowing the awareness of radiation hazards, like the previous work by Hamarsheh A, 2012 [7] where a questionnaire was prepared and circulated to 163 physicians in 2 hospitals. The study concluded that only one third of physicians had received radiation protection courses during their undergraduate study, only 6.1% of them were able to identify ALARA (As Low as Reasonably Achievable) principle but 98.2% were not over the safe dose limit according to international recommendations. The participants lacked proper awareness and knowledge. There was a need to increase their knowledge and awareness among physicians. Similarly, the work by Bhavana Agarwal, etal,2015 [8,9] was done on awareness on radiation safety measures in dental clinics were assessed on 163 dental practitioners of CDE (Continuing Dental Education) and the results showed only 2.45% of them had thorough knowledge, 49.07% had moderate knowledge and 48.46% had poor knowledge. More emphasis should be placed on radiation hazards and its protection techniques from the UG (Under Graduate) curriculum.

The study by Aysegul Yurt, et al., 2014 [10,11] was done through a questionnaire which was given to physicians, nurses, technicians, about 92 participants took part in the study where their level of knowledge about ionising radiation was found to be weaker. In statistical comparison between the groups, the level of knowledge of physicians was found to be significantly higher than the other groups. The study demonstrates that general knowledge of radiation, its protection, health risks and doses are insufficient among health workers (professionals). Another study by BS Aravind, et al.,2016 [12–14] was done by questionnaire-based study among 300 dental practitioners. Among them, 80.3% of them were found to have separate sections for

radiographic examination in their clinics, but only 9.7% of them followed the protocol and 6.7% of them were not using safety measures. The awareness level on radiation hazards and safety was acceptable but their knowledge with patient and personal safety was highly lacking [15].

The awareness of radiation and its hazardous effects were very low among the public over recent years [16–20]. The lacunae found on the past research works were the items of the questionnaire were different and it did not involve the awareness created among particular gender, especially females. There is an urgent need to create and impose awareness among the public, especially women who have a high incidence of getting cancers. So, the aim of the study is to compare the awareness level of radiation hazards between females of age 20-40 years and 40-60 years.

2. MATERIALS AND METHODS

The study was done as an online setting which is a prospective observational study. The study includes large amounts of data that can be stored and is cost effective and easy to handle and the options may not be available to the participant and the participant's truthfulness cannot be tested. The questionnaire was circulated to 272 females between 20-60 years of age from the Chennai sub-population, of which 147 responded and only 103 respondents gave non-biased responses, the rest 44 respondents gave biased responses. The responses were obtained from 103 female participants with inclusion criteria of females within 20-60 years of age and exclusion criteria of females less than 20 years and above 60 years of age, male participants were excluded was used.

A self-structured questionnaire comprising about 18 yes or no type of questions were prepared in google forms. The questionnaire was validated by the senior lecture guide and circulated as a link to the participants. The responses were exported to google sheets and data was retrieved and analysed in SPSS (Statistical Package for the Social Sciences) software version 26. The statistics test that was used is descriptive statistics from SPSS software. The method of representation of output variables was a bar graph. The independent variables of the study were height, weight, skin tone and dependent variables are radiation hazards, awareness, females, age. The results were obtained from SPSS software.

3. RESULTS

From 103 female respondents from 20-60 years of age, 74.76% of them have undergone X ray or any procedures but only few (25.24%) did not undergo any diagnostic procedures. 71.84% of them were aware that all radiation is hazardous whereas the rest (28.16%) were not aware. 88.35% of them accepted that bone marrow and child's thyroid tissue are more sensitive to radiation but few (11.65%) did not accept it. 80.58% of them were aware of exposure to radiation received per year from natural background and few (19.42%) are not aware of this actual fact. 78.64% of the participants were aware that they receive 10-20 mSV from diagnostic radiology but few (21.36%) are not aware of it. About 84.47% of them are aware of the symptoms of radiation sickness but only a few of about 15.53% are not aware of these symptoms. About 78.64% of them knew that one CT scan can emit as much as 200 chest X-rays but 21.36% of them did not know it. 72.82% of them about were aware of the risk of damage from X-rays but 27.18% are not aware of it. 90.29% of them were aware that beta and gamma radiation can penetrate skin and damage the cells inside but only about 9.71% are not aware of the fact.

About 91.26% of them are aware that gamma radiation from radioactive decay elements could be hazardous to living beings but few about 8.74% are not aware of it. About 56.31% would not undergo diagnostic imaging in absence of medical indication for personal doubts, but nearly 43.69% of them would undergo them. The participants were asked about whether mammograms are recommended for women above 40 years, about 67.96% have this thought but 32.04% don't have it. 62.14% of them are aware of the safety dose limit for fetuses but 37.86% were not aware of it. About 86.41% of the participants are aware of the pregnancy birth defects caused by radiation but 13.59% were not aware, during the first trimester the radiation causes microcephaly, cleft palate was accepted by 80.58% of them. The cause of thyroid cancer is mainly due to radiations was agreed by 67.96% of the females, leukaemia was caused due to hazardous effects of radiation was accepted by 68.93% and the skin cancer was caused by mainly UV radiations accepted by 83.50% of the females of both age group (Table 1).

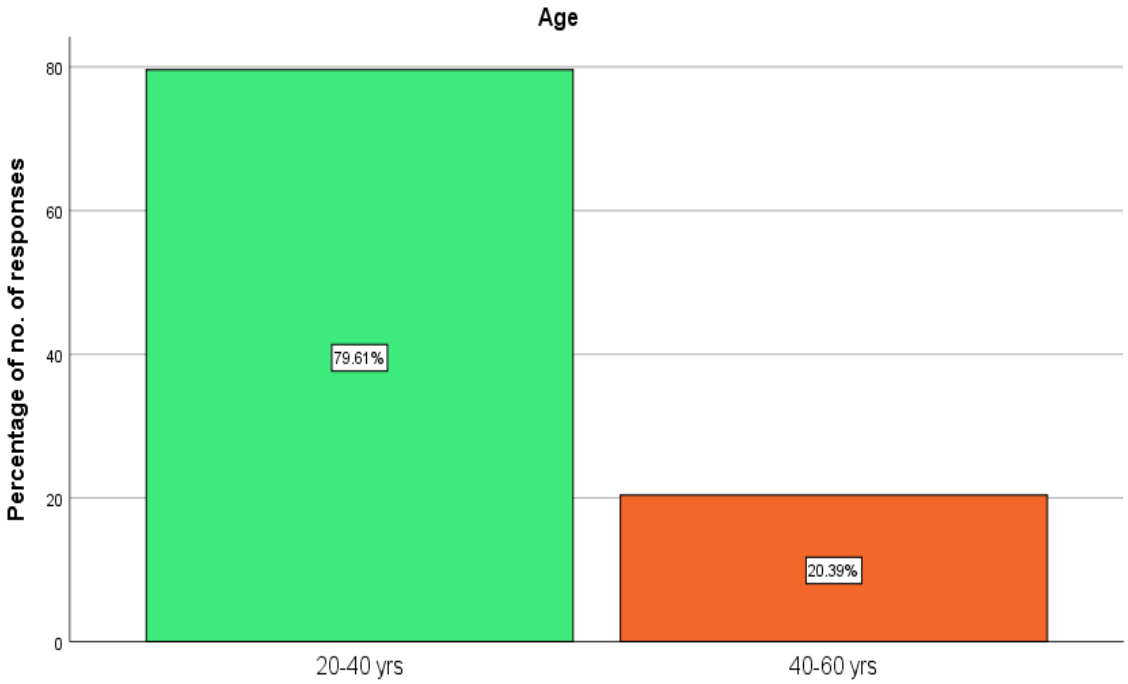

Fig. 1. The graph shows the age group of the participants. X axis gives age group and Y axis gives percentage of the responses. Green colour bar indicates 20-40 years age group participants and the orange colour bar depicts the 40-60 years age group participants. Females of the age group 20-40 years (79.61%) is the dominant group among the participants

Table 1. The table shows the analysed parameters with its awareness level among females

Analysed Parameters	Agree	Disagree
Undergone X-ray	74.56%	25.24%
Radiations are hazardous	71.84%	28.16%
Bone marrow sensitive to radiations	88.35%	11.65%
Radiation receiving from natural background	80.58%	19.42%
Receive diagnostic radiology	78.64%	21.36%
Radiation sickness symptoms	84.47%	15.53%
CT scan equals to 200 chest X-rays	78.64%	21.36%
Risk of damage to tissues	72.82%	27.18%
Beta, Gamma radiation penetrating effect	90.29%	9.71%
Gamma radiation hazardous	91.26%	8.74%
Personal doubt indication	43.69%	56.31%
Mammograms women recommend	67.96%	32.04%
Foetus radiation dose	62.14%	37.86%
Pregnancy birth defects	86.41%	13.59%
Microcephaly, cleft palate	80.58%	19.42%
Thyroid cancer radiations	67.96%	32.04%
Leukaemia hazardous effect radiation	68.93%	31.07%
Skin cancer UV radiations	83.50%	16.50%

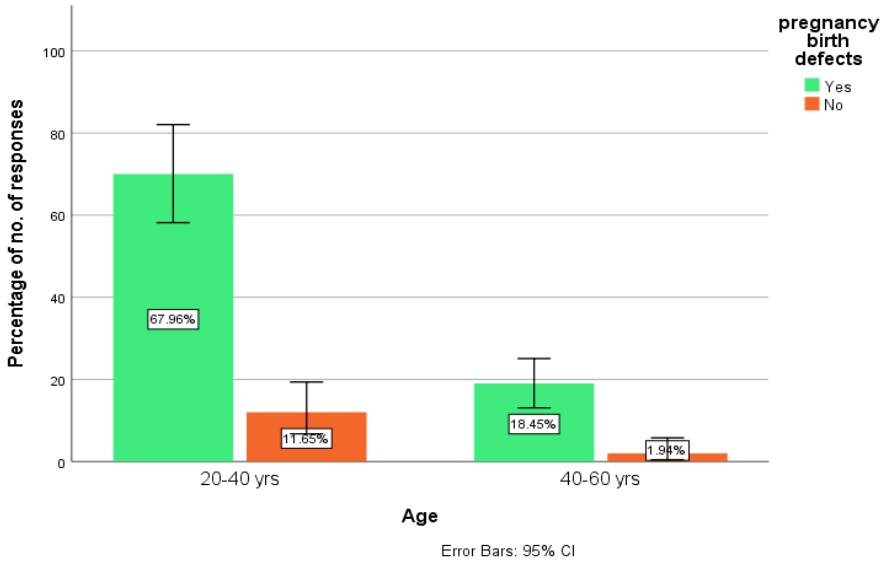

Fig. 2. The graph shows the correlation of awareness of birth effects caused by radiation during the first trimester of pregnancy between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (67.96%) of females of age group 20-40 years were more aware than females of 40-60 years age group (18.45%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .542 and it is not statistically significant

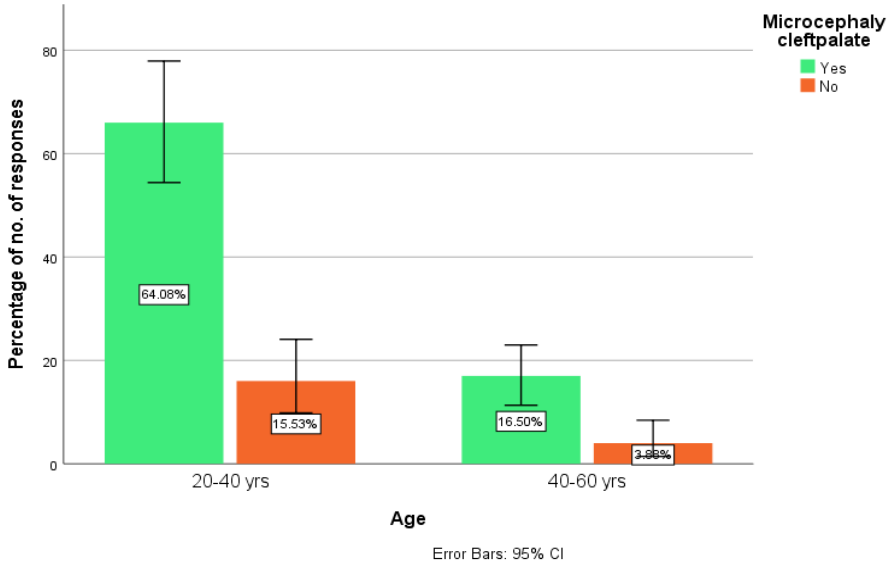

Fig. 3. The graph shows the correlation of awareness of microcephaly, cleft palate caused by radiation during the first trimester of pregnancy between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (64.08%) of females of age group 20-40 years were more aware than females of 40-60 years age group (16.50%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .962 and it is not statistically significant

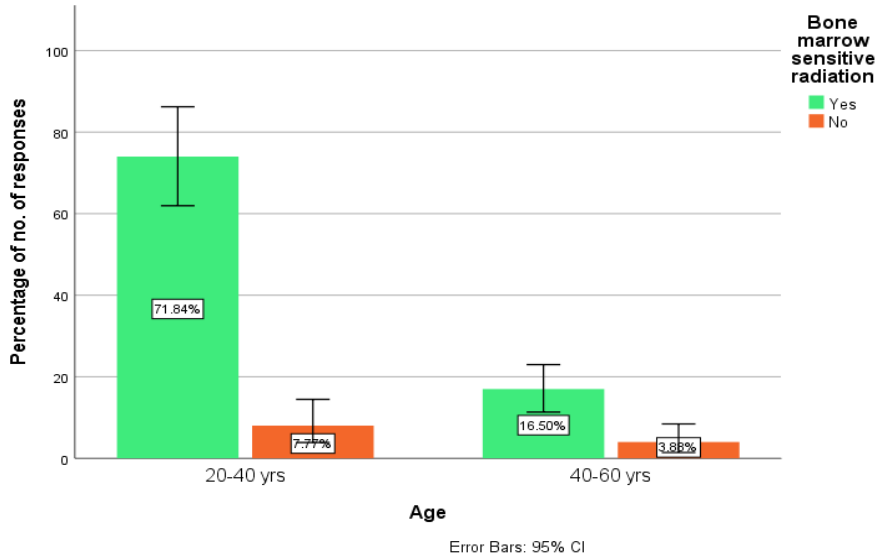

Fig. 4. The graph shows the correlation of awareness that bone marrow, the child's thyroid, is the sensitive tissue affected by radiation between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (71.84%) of females of age group 20-40 years were more aware than females of 40-60 years age group (16.50%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .236 and it is not statistically significant

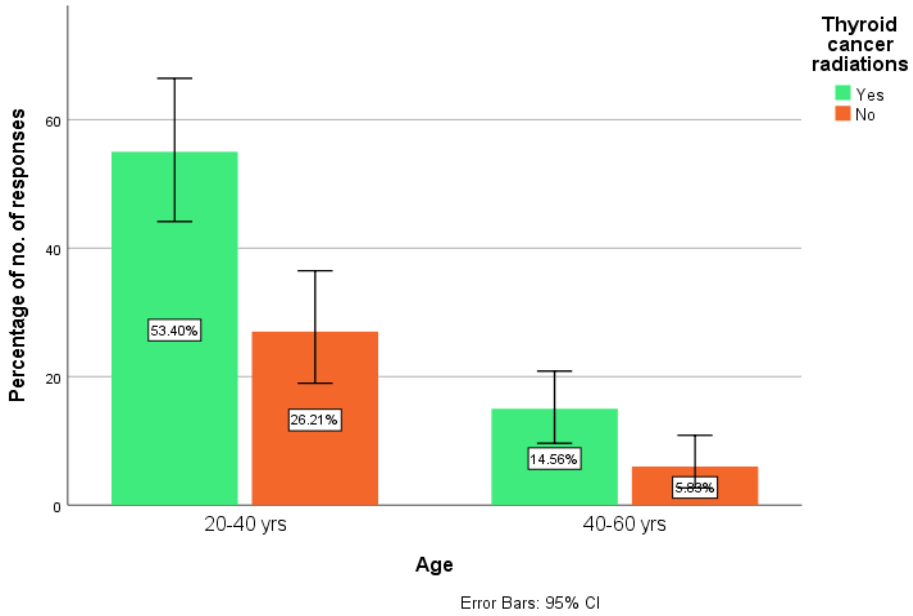

Fig. 5. The graph shows the correlation of awareness of thyroid cancer caused mainly through radiations between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (53.40%) of females of age group 20-40 years were more aware than females of 40-60 years age group (14.56%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .703 and it is not statistically significan

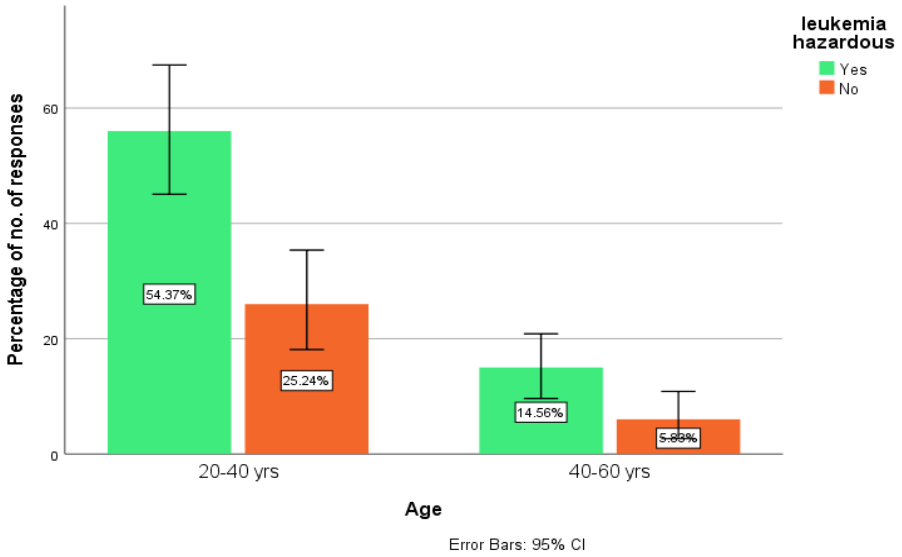

Fig. 6. The graph shows the correlation of awareness of leukaemia being caused by hazardous effects of radiation between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (54.37%) of females of age group 20-40 years were more aware than females of 40-60 years age group (14.56%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .782 and it is not statistically significant

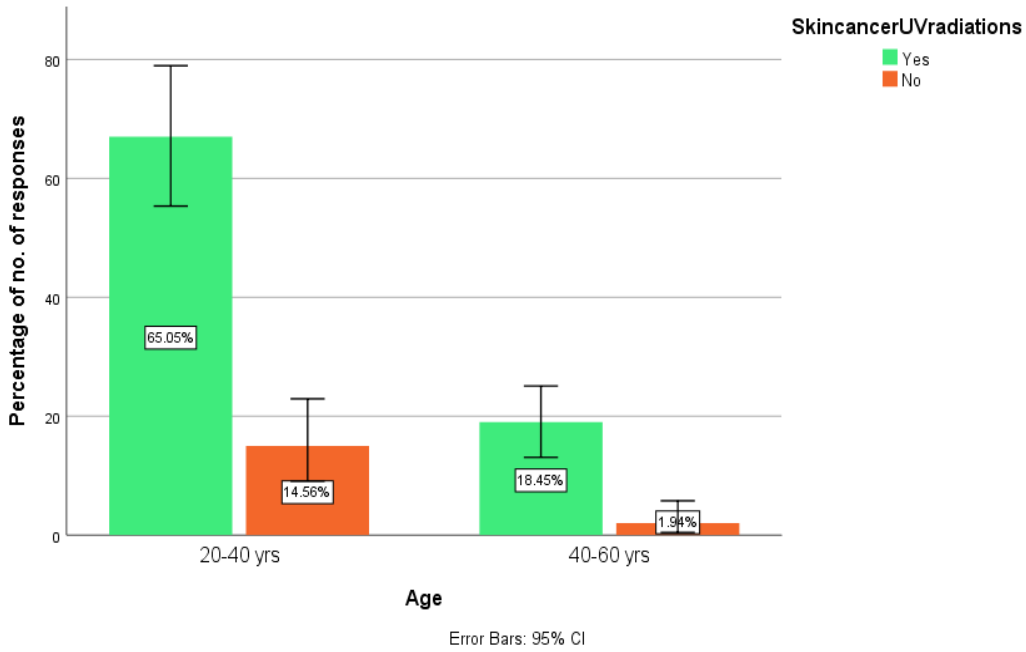

Fig. 7. The graph shows the correlation of awareness of skin cancer being caused mainly by UV radiations between the two age groups of females. X axis gives the age group and Y axis gives the percentage of the responses. Green colour bar indicates the yes type answer and the orange colour bar depicts the no type answer from the participants. Majority of the participants (65.05%) of females of age group 20-40 years were more aware than females of 40-60 years age group (18.45%). Chi square test was done and the association was found to be not statistically significant. *P*-value is .334 and it is not statistically significant

Table 2. The table illustrates hazardous effects parameters analysed with its awareness level by previous researchers

Authors (by reference)	Sampling	Hazardous parameters analysed	Awareness level
NA Yunus, et al.,2014	27	Radioactive elements being hazardous	Mean score= 7.59
Syed Mohammed Mubeen, et al.,2008	112	Gamma radiation hazardous	25.8%
KJ Awosan, et al.,2016	110	Acute radiation sickness and its symptoms	56.4%
MA Alzubaidi, et al.,2017	300	Radiation sickness	<53%
Akingboye M Dauda, et al., 2019	217	Diagnosing imaging for first trimester	21.51%
BN Praveen, et al.,2013	-	Radiation from natural background	>82%
Ryan KL Lee, et al.,2012	158	Radiation dose from diagnostic imaging	0%

Generally, from the results analysed it is well understood that females of the younger age group (20-40 years) are more aware than the older age group (40-60 years). About 59.22% of the females of age group 20-40 years have undergone diagnostic imaging procedures particularly X ray than 15.53% of 40-60 years age group which in correlation shows no significant difference. The younger age group are well aware that all radiations are hazardous from 58.25% of them than the older age group 13.59% of them. The awareness of receiving radiation from natural background was higher for females of the younger age group about 65.05% than the other age group. The symptoms of radiation sickness were asked for awareness, females of younger age groups (66.02%) were aware, but these results don't have statistical significance between females of different age groups. Majority of the younger age group (41.75%) would not undergo diagnostic imaging for personal doubt where they are more aware than females of the older age group (14.56%). The awareness of radiation dose during the first trimester, recommendation of mammograms for females above 40 years, the penetrating effect of beta, gamma radiation and effect of CT scan proves that females of 20-40 years age group have higher levels of awareness than females of 40-60 years age groups.

4. DISCUSSION

The study by NA Yunus, etal, 2014 [21,22] gave the results like the awareness of radiation safety and radioactive elements being hazardous is at a higher level among participants. The mean score for awareness was obtained as 7.59 which indicates that the participants have more awareness which is similar to the present study where the awareness of gamma radiation from radioactive elements causes hazardous effects where 91.26% accepted the fact but 8.74% have no acceptance (Table 1). The results are contraindicated to the work done by Syed Mohammed Mubeen, etal,2008 [23,24] where the participants about 25.8% accepted the fact but majority of them have no acceptance due to lack of awareness that was created among them. The awareness of gamma radiation to be hazardous created among the public is higher which is satisfactory. There is a need to impose safety measures on them and educate them for disposal of radioactive elements in a proper way.

The work by KJ Awosan, etal,2016 [25,26] was done on the awareness of acute radiation sickness and its symptoms like nausea, vomiting. The participants surprisingly are aware of radiation sickness symptoms from 56.4% of them but the rest are not aware of it. This work is more or less similar to the present study where the awareness of weakness, fatigue, fainting, confusion are symptoms of radiation sickness where 84.47% are aware of the symptoms but 15.53% of them are not aware of these symptoms (Table 1). These results are contraindicated to the work by MA Alzubaidi, etal,2017 [27,28] . The study was conducted among nurses where the awareness of symptoms of radiation sickness was less than 53% which was very contraindicated to present study. The awareness of radiation hazards created was lesser than present study. The public should be educated of ill effects of radiation sickness for better awareness in future.

The study by KJ Awosan, etal, 2016 [25,29,30] concluded that awareness of congenital malformations for fetuses exposed by ionising radiations were higher about 68.2% and awareness of radiation causing infertility was 67.3% of them were aware. This study supports the present study where awareness of pregnancy birth defects was asked, about 86.41% were aware but only 13.59% were not aware. Awareness of microcephaly, cleft palate in children was asked, where 80.58% of them were aware (Table 1). The study results contraindicated the study of Akingboye M Dauda, etal, 2019 [31,32] where a question was asked about taking action against MRI scans to be taken for pregnant women causing CNS anomalies of foetus. About 21.51% of them wanted to take action but the rest had lack of concern. Pregnancy birth defects and its awareness needs to be created among the public. They should be acknowledged for the hazardous effects of radiation.

The study by BN Praveen, etal,2013 [1,33] concluded that there is high knowledge and awareness of radiation dose of 20mSV per year caused by diagnostic imaging. The dental practitioners are well aware of radiation dose and safety dose limits. Similarly, the present study also found that there is a high level of awareness for radiation dose where 78.64% were aware (Table 1). Even though the present study stated higher awareness, contradicted by the study of Ryan KL Lee, etal,2012 [34,35] where the non-radiologists of about 77% underestimated the radiation dose and no non-radiologist correctly stated the radiation dose. So, the common public are not aware of the radiation dose. Only radiologists, dental practitioners have awareness when compared to the public. It is not like that, so there is a need to create awareness and impose general knowledge about radiation hazards among females particularly.

Nearly half of the control group believed a chest radiograph would expose them to more radiation than a week of natural background radiation, while 40% said they didn't know. The quantity of radiation in a chest radiograph was overestimated by 57 percent of the research participants, with 17.5% choosing the option that the radiation exposure would be similar to a dosage greater than 1 year of background radiation. The students in the research group had a fair understanding of the risks regarding CT radiation exposure. Only 39% of the research participants and 67% of the controls were aware that CT entailed the use of X-rays [36]. In the present study, the females of age 20-40 years were well aware of the radiation exposure and its associated health risks.

There is an increased awareness among the health care professionals [37–39] but not in females of different age groups when compared. The younger female age group (20-40 years) have better knowledge due to knowledge imposition by the learning institutes, media and others. From previous research done, it is well understood that only awareness is created among the medical professionals [40,41] and not in the common public, especially females.

As of now, the awareness among the females of the 20-40 age group is higher than the 40-60 years age group. There is a need to create general awareness irrespective of the age group in future [42–45]. There should be spread of awareness through social media, health camps, polls, etc., to prevent the increase of cancer rate per year worldwide. The limitations of the study were small scale population, multi-centered trials were not conducted, the participants truthfulness not tested.

5. CONCLUSION

Within the limits of the study, the females of age group 20-40 years have higher levels of awareness than females of age group 40-60 years. In the future, awareness should be advanced for them particularly females of all age groups including 40-60 years of age which lacked awareness in the present study.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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