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The Extent and Awareness of Medical Staff about the Effects of Radiation on Human Health

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ABSTRACT

This study investigates the knowledge and perceptions of radiation among residents of Derna, Libya, through a global questionnaire distributed from August 15 to December 4, 2024. A total of 216 respondents participated, providing demographic data and responses to 11 knowledge-related questions. The findings reveal a slight majority of female respondents, with a significant concentration in the 36-45 age range and a predominance of higher educational attainment. While there is a reasonable understanding of radiation effects and health risks, notable gaps exist regarding awareness of radiation sources, types, and protective measures. For instance, only 39.8% of participants recognized the sources of radiation, and 42.6% were aware of how to protect themselves from harmful exposure. the strongest negative correlation ($R = -0.252$, $P = 0.000$) indicates that higher education levels are associated with a greater understanding of the concept of useful radiation. Statistical Significance: Several questions demonstrate statistically significant findings ($P < 0.05$), particularly concerning knowledge about radiation sources ($P = 0.049$), types of radiation ($P = 0.013$), awareness of risks associated with radiation ($P = 0.022$), and knowledge of protective measures ($P = 0.003$). Correlation analysis indicated a complex relationship between education level and knowledge of radiation, with significant negative correlations in several areas. These results highlight the necessity for targeted educational initiatives to enhance public understanding of radiation, particularly focusing on sources and safety measures, to better inform and protect the community from potential risks associated with radiation exposure.

1. INTRODUCTION

Medical staff exhibit a concerning lack of understanding regarding radiation hazards, despite advancements in protective measures. Awareness of acute health effects, such as radiation sickness and long-term risks like cancer, remains insufficient, highlighting the need for improved education and training. (Xu et al., 2024), Most healthcare workers in the study demonstrated poor knowledge about radiation exposure safety, with inadequate practice compliance concerning radiation protection procedures.

This lack of awareness exposes them to harmful effects, emphasizing the need for improved education on radiation safety. (Allam et al., 2024), healthcare workers regarding radiation protection and dose levels, with only 62% answering radiation protection questions correctly. Additionally, 18% felt they lacked sufficient knowledge about radiation's effects on human health. (Alyousef et al., 2023), 95% of radiology staff had weak awareness of radiation's adverse effects, while 96.7% demonstrated good safety practices. This highlights a significant knowledge gap, necessitating improved education on radiation safety among medical staff. (Tahmina sahoo, 2023), 70.5% of physicians had poor knowledge regarding radiation hazards, despite a positive attitude towards reducing routine X-ray and CT scans. This indicates a significant gap in awareness about the effects of radiation on human health. (Najjar et al., 2022), varying perceptions among medical radiologic technologists regarding radiation's health effects, with significant differences based on specialty and work routines. Awareness of radiation's impact, particularly on children and during pregnancy, was notably low among younger respondents. (Yashima & Chida, 2022), radiation protection efforts primarily focused on preventing obvious harm, like radiation burns, for practitioners. However, awareness of less obvious effects, such as radiation-induced cancer, has evolved, emphasizing the need for ongoing education among medical staff. (Chaturvedi & Jain, 2019), Most healthcare professionals exposed to ionizing radiation have low awareness of its harmful effects, with many not receiving prior education on radiation. This lack of knowledge contributes to insufficient use of personal protective equipment and increased health complaints. (Uçar et al., 2020), healthcare personnel's awareness of radiation hazards and knowledge of radiation protection is crucial due to the increasing use of medical radiation. Adequate understanding is necessary to mitigate potential health risks associated with radiation exposure. (Khamtuikrua & Suksompong, 2020). Awareness and risk knowledge about working with MRI equipment and protecting staff remain insufficient. Medical personnel experience radio anxiety related to health concerns from radiation exposure, which increases with work experience, highlighting the need for further education and monitoring. (Ibrayeva et al., 2021). nurses generally lack adequate awareness of radiation protection and its effects on human health. It emphasizes the need for integrating radiation protection education into nursing curricula and providing Continuing Professional Development for nurses. (Bwanga & Kayembe, 2020), 98.1% of medical doctors demonstrated poor awareness of radiation risks, with only 1.4% showing fair awareness. Most participants lacked formal training, highlighting significant gaps in understanding the effects of radiation on human health. (Dauda et al., 2019), a generalized lack of knowledge regarding radiation hazards among cath-lab medical staff, with inadequate implementation of radiation protection techniques. Approximately 10% reported health problems potentially induced by radiation exposure, highlighting significant awareness gaps among the personnel. (Mansour et al., 2024), 91.3% of radiology staff were aware of safety procedures, with 17.4% reporting symptoms from radiation exposure. This indicates a high level of training and awareness regarding the effects of radiation on human health among medical staff. (Alharbi et al., 2022), healthcare professionals, particularly house officers, exhibited inadequate awareness of medical radiation exposure effects on pediatric patients. Only 53.8% had satisfactory knowledge, highlighting a significant gap in understanding radiation risks and the need for(Ng et al., 2022), 68.7% of medical staff returned questionnaires, with only 58.87% correctly understanding occupational radiation limits. Additionally, 48.23% overestimated CT scan radiation exposure, highlighting significant gaps in awareness regarding radiation's effects on human health. (Sankhe et al., 2015).

2. METHOD

Study area and period

The questionnaire was compiled by Google Form questionnaire link https://docs.google.com/forms/d/e/1FAIpQLSdDm-7YRz0xx0rqH7hZod_s_oS1JrlZs5DKtHX31Dh-fxNRIw/closedform and distributed globally from 15/08/2024 to 04\12\2024 in the city of Derna, Libya

Study design

As the first step of production, our team of epidemiologists indicated the main areas of interest and phrased index questions accordingly.

The English-language version of the questionnaire is provided in the Appendix as an Additional file. The first set included 3 (sex, age, education,).

Followed by a set of 11 questions regarding knowledge including multiple-choice questions about information sources.

Statistical analysis:

The Statistical analysis by SPSS 27.0 statistical software we use Correlation, Frequency, Percentage, and P-Value

3. ETHIC APPROVAL

For research to be considered ethical, it must receive approval from a scientific research ethics committee located in the same region where the research is being conducted.

4. RESULT

The provided table presents demographic characteristics of a sample group, highlighting gender, age, and education level, alongside their respective frequencies and percentages. Here are some observations and discussions based on the data: Gender Distribution Male: 101 (46.8%), Female: 115 (53.2%) The sample has a slightly higher proportion of females compared to males, indicating a gender distribution that leans toward female respondents. This could reflect the demographics of the population being studied or the nature of the survey, which might attract more female participants.Age Distribution, the age groups are distributed as follows: The age distribution shows a concentration of respondents in the 36-40 years age group (17.6%) and the 41-45 years group (16.7%). Younger age groups (20-25 and 26-30) also have a notable presence, indicating engagement from both young adults and middle-aged individuals. However, there is a significant drop in participation from older age groups (56 years and above), which could suggest a lack of representation from seniors in this sample. The education levels are as follows: Primary Level: 11 (5.1%), Secondary Level: 35 (16.2%), Higher Institute: 110 (50.2%), Master: 30 (13.9%), PhD**: 17 (7.9%), Intermediate Institute**: 13 (6.0%), A dominant majority of respondents (50.2%) have attended a higher institute, indicating a highly educated sample. The secondary and master's levels also represent significant portions (16.2% and 13.9%, respectively).

Table (1) frequency and percentage of Demographic Characters

Demographic Characters	N(%)
Gender	
Male	101(46.8)
Female	115(53.2)
Age	
20 - 25 years	29(13.4)
26 - 30 years	33(15.3)
31 - 35 years	21(9.7)
35 - 40 years	38(17.6)
41 - 45 years	36(16.7)
46 - 50 years	23(10.6)
51 - 55 years	21(9.7)
56 - 60 years	13(6.0)
61 - 65 years	1(0.5)
66 - 70 years	1(0.5)
Education Level	
Primary Level	11(5.1)
Secondary Level	35(16.2)
Higher Institute	110(50.2)
Master	30(13.9)
PhD	17(7.9)
Intermediate Institute	13(6.0)
Total	**216(100.0)**

The data in Table 2 presents responses to a series of questions regarding knowledge and perceptions of radiation among respondents. Here's a detailed discussion of the findings: The table summarizes responses across various questions related to harmful and useful radiation, knowledge of radiation effects, sources, and health risks. The total number of respondents is 216. Understanding the Difference Between Radiation Types, yes: 12 (56.0%), No: 77 (35.6%) Maybe: 18 (8.3%), A majority of respondents (56.0%) indicate they know the difference between harmful and useful radiation. However, the significant proportion (35.6%) responding "No" suggests a gap in understanding that could be addressed through education. Perception of Sun Radiation, yes: 59 (27.3%), No: 114 (52.8%), Maybe: 43 (19.9%), More than half (52.8%) believe that sun radiation is not harmful, which may reflect a lack of awareness regarding the risks associated with UV exposure. This highlights a need for increased public education on sun safety.
Knowledge of Radiation Effects, Yes**: 135 (62.5%), No: 64 (29.6%), Maybe**: 17 (7.9%), A strong majority (62.5%). claim to have knowledge about the effects of radiation, indicating a generally informed population in this area. Knowledge of Radiation Sources, yes: 86 (39.8%), No: 114 (52.8%), Maybe: 16 (7.4%), Despite a reasonable level of knowledge about radiation effects, only 39.8% are aware of its sources. This discrepancy suggests the need for more comprehensive education on where radiation originates. Knowledge of Radiation Types, yes: 89 (41.2%), No: 111 (51.4%), Maybe16 (7.4%), Similar to the previous question, awareness of different types of radiation is moderate, with more than half (51.4%) unaware. Understanding Radiation Damage to Health, yes: 140 (64.8%), No: 60 (27.8%), Maybe**: 16 (7.4%), A high percentage (64.8%) recognize the potential health damage caused by radiation, indicating effective communication on this issue. Perception of Useful Radiation, Yes: 99 (45.8%), No: 92 (42.6%), Maybe: 25 (11.6%), Almost half (45.8%) believe in the existence of useful radiation, reflecting a balanced understanding of the dual nature of radiation. Knowledge of Man-Made Sources, yes: 68 (31.5%), No: 121 (56.0%), Maybe: 27 (12.5%), Awareness of man-made sources of radiation is notably low, with over half the respondents indicating they do not know about these sources. Awareness of Radiation Risks, yes: 133 (61.6%), No: 69 (31.9%), Maybe: 14 (6.5%), A significant majority (61.6%) are aware of the risks associated with radiation, suggesting good awareness of health implications. Knowledge of Protection Methods, yes: 92 (42.6%), No**: 100 (46.3%), Maybe: 24 (11.1%), Awareness of how to protect oneself from dangerous radiation is less than optimal, with almost half (46.3%) indicating they do not know how to protect themselves. Knowledge of Diseases Caused by Radiation, yes: 145 (67.1%), No: 49 (22.7%), Maybe: 22 (10.2%), A majority (67.1%) know about diseases caused by dangerous radiation, indicating effective education in this area.

(2) **frequency and percentage of Questions and Answer**

Answer / **Questions**	**Yes N(%)**	**No N(%)**	**Maybe N(%)**
Do you know the difference between harmful radiation and useful radiation?	12(56.0)	77(35.6)	18(8.3)
Do you think sun radiation is harmful radiation?	59(27.3)	114(52.8)	43(19.9)
Do you have any Knowledge about the Effects of Radiation?	135(62.5)	64(29.6)	17(7.9)
Do you have Knowledge about the Sources of Radiation?	86(39.8)	114(52.8)	16(7.4)
Do you have Knowledge about the Types of Radiation?	89(41.2)	111(51.4)	16(7.4)
Do you have Knowledge about the Effect of Radiation Damage to Human health?	140(64.8)	60(27.8)	16(7.4)
Is there any Useful Radiation?	99(45.8)	92(42.6)	25(11.6)
Do you know the man-made source of radiant?	68(31.5)	121(56.0)	121(56.0)
Do you know the risk of the radiation on the human?	133(61.6)	69(31.9)	14(6.5)
Do you know how to protect yourself from dangerous radiation?	92(42.6)	100(46.3)	24(11.1)
Do you know diseases caused by dangerous radiation?	145(67.1)	49(22.7)	22(10.2)
Total	216(100.0)		

The provided figure presents the frequency and percentage of responses to a set of questions (Q1 to Q11), categorized into three response types: "Yes," "No," and "Maybe." Here's a breakdown of the data and its implications:
Overview of Responses, High Agreement (Yes Responses): Questions Q3, Q9, Q10, and Q11 show a significant number of "Yes" responses, indicating strong agreement or positive sentiment towards these questions. Particularly, Q10 appears to have the highest frequency of "Yes" responses, suggesting it may address a particularly relevant or favorable topic. Neutral or Indecisive Responses (Maybe): The "Maybe" responses are notably high for questions Q1 and Q6, showing that respondents may feel uncertain or ambivalent about these topics. This could indicate areas where further clarification or information is needed. Disagreement (No Responses), Questions Q4 and Q5 have a relatively higher frequency of "No" responses, suggesting disagreement or dissatisfaction with the statements posed in these questions. Understanding the reasons behind these negative responses could be crucial for improvements. Implications, Areas of Strength: Questions with high "Yes" responses can be considered strong points, possibly reflecting positive attitudes towards specific aspects of the subject matter being addressed.
Need for Further Inquiry: The questions with high "Maybe" and "No" responses indicate potential areas for further research or intervention. Engaging with respondents to understand their concerns or uncertainties may provide valuable insights. Strategic Focus: The data can guide strategic decisions, with emphasis on reinforcing the positive aspects while addressing the concerns raised in the "No" and "Maybe" categories.

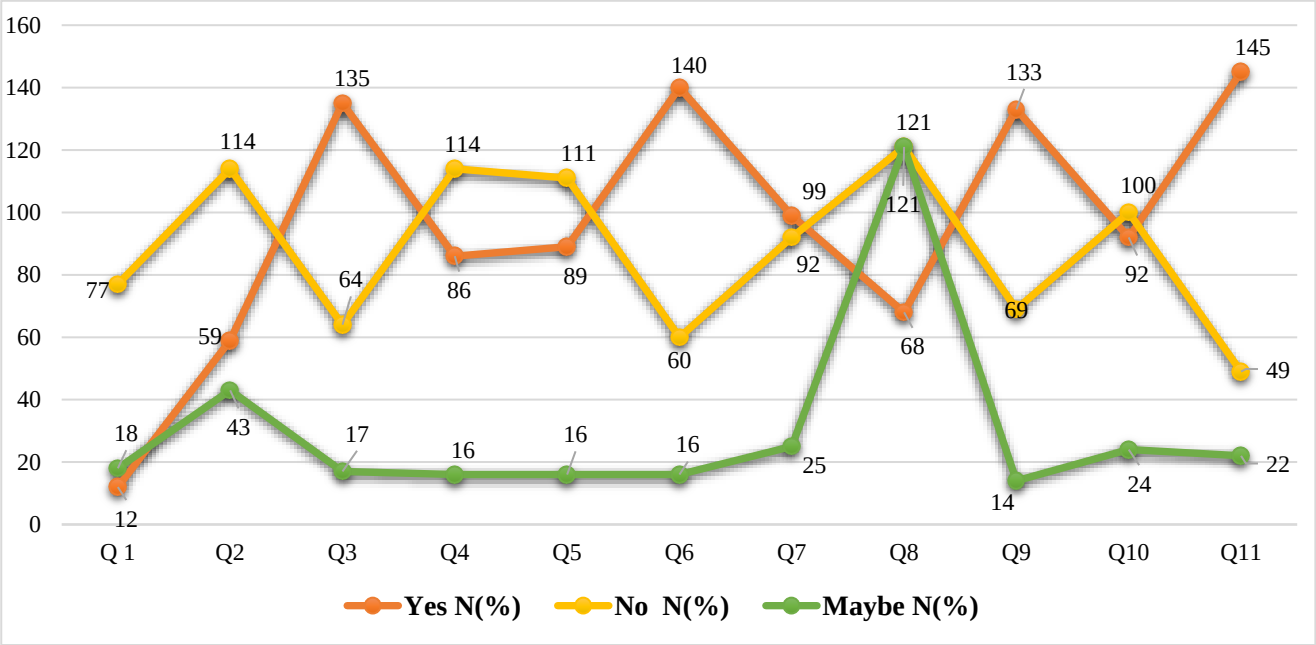

Figure (1) frequency and percentage of Questions and Answer

Table (3) notated that Relationship Between Education and Population Response The analysis of the relationship between education level and knowledge about radiation reveals several significant insights: Negative Correlation: There are notable negative correlations between education level and knowledge regarding various aspects of radiation, particularly in areas related to understanding useful radiation and protective measures. For instance, the strongest negative correlation ($R = -0.252$, $P = 0.000$) indicates that higher education levels are associated with a greater understanding of the concept of useful radiation. Statistical Significance: Several questions demonstrate statistically significant findings ($P < 0.05$), particularly concerning knowledge about radiation sources ($P = 0.049$), types of radiation ($P = 0.013$), awareness of risks associated with radiation ($P = 0.022$), and knowledge of protective measures ($P = 0.003$). This suggests that as education level increases, there may be a greater understanding of specific radiation-related concepts.

Mixed Findings: Other aspects, such as the knowledge of the difference between harmful and useful radiation and the effects of radiation damage to human health, show non-significant correlations, indicating that education may not directly influence these areas.
Implications for Education:

Table (3) relationship between education and papulation response

Questions	Education Level		Mean	St.D
Do you know the difference between harmful radiation and useful radiation?	R	-0.101-	1.52	0.647
	P- Value	0.141		
Do you think sun radiation is harmful radiation?	R	-0.021-	1.93	0.685
	P- Value	0.756		
Do you have any Knowledge about the Effects of Radiation?	R	-0.120-	1.45	0.638
	P- Value	0.079		
Do you have Knowledge about the Sources of Radiation?	R	-0.134-*	1.68	0.607
	P- Value	**0.049**		
Do you have Knowledge about the Types of Radiation?	R	-.168-*	1.66	0.611
	P- Value	**0.013**		
Do you have Knowledge about the Effect of Radiation Damage to Human health?	R	-0.068-	1.43	0.628
	P- Value	0.318		
Is there any Useful Radiation?	R	-0.252-**	1.66	0.677
	P- Value	**0.000**		
Do you know the man-made source of radiant?	R	-0.148-*	1.81	0.637
	P- Value	**0.030**		
Do you know the risk of the radiation on the human?	R	-0.156-*	1.45	0.615
	P- Value	**0.022**		
Do you know how to protect yourself from dangerous radiation?	R	-0.198-**	1.69	0.663
	P- Value	**0.003**		
Do you know diseases caused by dangerous radiation?	R	-0.065-	1.43	0.672
	P- Value	0.341		
	N	216		

5. DISCUSSION

The table presents a correlation analysis between education level and various knowledge-related questions regarding radiation. Here's a breakdown of the key findings: General Observations, Correlation Coefficients (R-values), from -0.252 to -0.068, indicating a generally negative correlation between education level and responses to the knowledge questions about radiation. This suggests that as education level increases, knowledge about certain aspects of radiation may decrease or is less straightforward. Statistical Significance (P-values) indicate the statistical significance of the correlations. A P-value below 0.05 typically suggests a significant relationship. Significant findings ($P < 0.05$) are observed for: Knowledge about the sources of radiation ($P = 0.049$), Knowledge about the types of radiation ($P = 0.013$), Awareness of useful radiation ($P = 0.000$), Knowledge of man-made sources of radiation ($P = 0.030$), Understanding the risks of radiation ($P = 0.022$), Knowledge on protecting oneself from dangerous radiation ($P = 0.003$) Non-significant Findings.
Questions regarding the difference between harmful and useful radiation, the harmfulness of sun radiation, and diseases caused by dangerous radiation resulted in non-significant P-values (greater than 0.05). This suggests these areas might not have a strong relationship with education levels. Specific Insights Useful Radiation: The strongest negative correlation ($R = -0.252$, $P = 0.000$) indicates that higher education levels correlate with a greater understanding of the concept of useful radiation. This could reflect an increased awareness of beneficial uses of radiation in fields like medicine or technology.

Protection from Radiation: The significant negative correlation (R = -0.198, P = 0.003) suggests that education level might influence knowledge about protective measures against harmful radiation. This could imply that educational programs might need to emphasize practical safety measures. Knowledge Gaps: The non-significant correlations in some areas, such as the understanding of diseases caused by dangerous radiation (R = -0.065, P = 0.341), indicate potential gaps in knowledge despite education. This could point to the need for more targeted educational efforts.

Overall, the table illustrates a sample characterized by a higher proportion of females, a concentration in middle age, and a significant level of educational attainment. These factors should be considered when interpreting the results of any analysis derived from this data, as they may influence the outcomes and applicability of the findings to the broader population. Further exploration into the reasons for these demographic trends could provide deeper insights into the context of the study. The data reveals mixed levels of knowledge and awareness regarding radiation. While there is a reasonable understanding of the effects and health risks of radiation, gaps exist in knowledge about its sources and types, particularly man-made sources and protection methods. These findings suggest that targeted educational initiatives could enhance public understanding of radiation, particularly focusing on the sources and protective measures, to better inform and protect the population from potential risks associated with radiation exposure.

The data suggests that while there is a decent level of awareness regarding the effects and health risks of radiation, there are significant gaps in knowledge about its sources, types, and protective measures. These gaps highlight the need for educational initiatives to improve public understanding, particularly focusing on man-made sources and practical safety measures. This will contribute to better informed and safer behaviors regarding radiation exposure in the community.

the figure highlights a mixed response landscape, with certain areas demonstrating clear approval while others reveal uncertainty or disagreement. This balanced view is essential for any subsequent actions or research initiatives, ensuring that both strengths and weaknesses are adequately addressed. Further qualitative exploration might be beneficial to deepen the understanding of the respondents' perspectives. The findings suggest a complex relationship between education and knowledge about radiation. While some aspects show significant negative correlations, indicating a need for improved education in specific areas, others do not, suggesting that education alone may not be sufficient to enhance understanding. Future research could explore the underlying reasons for these trends and identify effective educational strategies to address knowledge gaps in radiation safety and awareness.

6. CONCLUSION

Knowledge Gaps: While there is a reasonable level of awareness regarding the effects and health risks associated with radiation, substantial gaps exist in knowledge about its sources, types, and protection measures. Many respondents demonstrated a lack of understanding concerning man-made sources of radiation and how to protect themselves effectively.

Educational Needs: The mixed levels of knowledge suggest a need for targeted educational initiatives to improve public awareness and understanding of radiation. Emphasis should be placed on clarifying misconceptions about harmful and useful radiation, as well as enhancing knowledge regarding practical safety measures.

Correlation with Education: The study indicates a complex relationship between education level and knowledge of radiation. Some areas showed significant negative correlations, implying that higher education does not necessarily correlate with a better understanding of specific radiation knowledge aspects. This highlights the need for educational programs that are not only informative but also relevant to the community's concerns and knowledge gaps.

Strategic Focus for Future Research: Future research should explore the reasons behind the observed trends and develop effective educational strategies to address the identified knowledge gaps. Qualitative studies may provide deeper insights into the perceptions and attitudes of the population regarding radiation and its risks.

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