ORIGINAL ARTICLE

Survey on Radiation Awareness and Knowledge Among Malaysians in Johor, Malaysia

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ABSTRACT

Background: Members of public in Malaysia need to have knowledge and awareness regarding radiation and its associated risks to prevent misconception and misunderstanding about the information. Despite the safety of low-level radiation in medical contexts, many Malaysians perceive all radiation as harmful, influenced by historical events like the Hiroshima and Nagasaki bombings and limited public awareness. This study aims to determine the existing level of radiation knowledge and awareness among Malaysians in Johor and to assess the public's source of knowledge and information regarding radiation. By addressing these gaps, the research seeks to guide educational and healthcare practices, encouraging the development of curricula and communication strategies that promote accurate understanding of radiation, ultimately fostering a more informed and confident public. **Methods:** A total of 384 respondents took part in this study. A set of questionnaires with a total of 21 questions and consists of two parts which are demographic data and radiation knowledge, and awareness was distributed online by using Google forms. It was distributed through all online platforms including social media to reach out the respondents that lives in Johor. **Results:** The survey data was collected and analysed by using non-parametric tests which are Pearson chi-square and Kruskal-Wallis to see the relationship between demographic characteristics with the level of radiation knowledge and awareness. Based on the results, it demonstrates significant gaps in radiation awareness among Johor residents and identified demographics (e.g., health-related fields, workplace environment) associated with higher knowledge levels. The results underscore the importance of targeted educational outreach, especially through credible sources, to improve public understanding of radiation. **Conclusion:** The public needs more disclosure towards the correct facts about radiation and its associated information. It is recommended that the general public obtain the correct information from reliable source to avoid misconception regarding radiation.

INTRODUCTION

This study addresses misconceptions about radiation among the general public in Malaysia, particularly in Johor. Many people mistakenly view all radiation as dangerous due to misinformation, often from sources with inadequate understanding. Such misconceptions contribute to public fear and anxiety. Knowledge and awareness are critical for countering these fears, enabling individuals to distinguish between harmful and non-harmful radiation. Awareness, coupled with accurate knowledge, can help the public understand both the risks and benefits of radiation.

In Malaysia, radiation misconceptions are prevalent. According to the Maulana et al. (2018), many Malaysians believe there is no safe radiation dose, despite low-level exposures in medical settings being non-hazardous when managed by trained professionals. Historic events, like the Hiroshima and Nagasaki bombings, have also influenced public perception, associating radiation with catastrophic harm, which fuels these misconceptions. Studies from 1994 to 2014 examined natural radioactivity in Malaysia but found limited awareness and understanding among the public about radiation.

The study's objectives include assessing the level of radiation awareness and knowledge among Johor residents and understanding the factors and sources influencing public knowledge. It seeks to determine whether misinformation is linked to specific sociodemographic factors and whether sources of information significantly affect public perception. Key research questions focus on evaluating current knowledge levels, identifying factors that cause varied awareness, and

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analysing the impact of information sources on public perception.

The significance of this research lies in its potential to inform educational and healthcare practices. Findings could aid educational providers across Malaysia in crafting curricula that enhance radiation awareness. For healthcare providers, particularly in medical imaging, the study highlights the importance of providing clear, factual information about radiation exposure to patients. This can help alleviate unfounded fears and enable informed decision-making among the public, ultimately contributing to a more informed and less fearful society regarding radiation.

MATERIALS AND METHODS

This methodology ensures a robust approach to gathering, validating, and analysing data on public radiation knowledge and awareness. The study design allows for generalizable results within Johor, while the questionnaire's structured format and careful validation enhance data accuracy and reliability.

Research Design

A quantitative approach was used, employing a questionnaire to measure correlations between demographic factors (e.g., age, education) and radiation knowledge and awareness. The conceptual framework in this study highlights the relationships between demographic factors (age, gender, education level, study field, and workplace) and radiation awareness. This study has obtained approval from the Kulliyyah Postgraduate and Research Committee (KPGRC) KAHS 55-18 and IIUM Research Ethics Committee (IREC) IREC 2018-235.

Population and Sampling Design

The study targets Malaysian residents of Johor aged 20 years and above. Probability sampling was used, allowing each person an equal chance of selection and ensuring the results could be generalized to the broader population of Johor. The sample size calculation was performed using Cochran's formula based on a confidence level of 95% and a 5% margin of error (Eq. 1). The calculation assumes maximum variability (p = 0.5) and results in a required sample size of 384 respondents, which is appropriate for Johor's population.

$$n_0 = z^2pq / e^2 \qquad (1)$$

where,

n_0 = sample size
z = selected critical value of desired confidence level
p = the estimated proportion of an attribute that is present in the population
q = 1- p
e = desired level of precision

The inclusion criteria for this study were residents of Johor, aged 20 and above, and literate. While the exclusion criteria were residents outside Johor and those who are illiterate.

Questionnaire Development

A self-administered, bilingual questionnaire (in English and Bahasa Malaysia) was created to gather data on demographics and knowledge and awareness of radiation. The questionnaire was designed to include multiple-choice, dichotomous (yes/no), and open-ended questions, allowing for a comprehensive assessment of participants' knowledge and perceptions. An informed consent section was included at the beginning of the questionnaire, ensuring ethical compliance and participants' consent.

Questionnaire structure in this study comprises two parts; Part I: Socio-Demographic Data which captures respondents' gender, age, education level, field of study, and workplace environment, and Part II: Radiation Awareness and Knowledge comprises 14 questions on topics such as sources of radiation, benefits, risks, radiation symbols, and permissible exposure limits.

To ensure content validity, the questionnaire was reviewed by eight content experts from the Kulliyyah of Allied Health Sciences at the International Islamic University Malaysia (IIUM). Validation was based on criteria for relevance, clarity, simplicity, and ambiguity using Lawshe's Content Validity Ratio (CVR) with a minimum threshold of 0.75, and Content Validity Index (CVI) developed by Waltz and Bausell's (Yaghmaie, 2003). The pilot study involved 40 respondents to test reliability, yielding a Cronbach's alpha of 0.887, indicating high internal consistency.

Via this questionnaire, knowledge and awareness scores were based on modified Bloom's taxonomy. Correct answers scored 1 point; incorrect answers scored 0. Scores were categorized as Low (<58%), Moderate (59-78%), or High (>79%) to reflect varying levels of knowledge and awareness.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 21.0. Given the non-normal

distribution of demographic variables (p-value > 0.05 in Kolmogorov-Smirnov tests), non-parametric tests were selected; Pearson Chi-Square Test and Kruskal-Wallis Test. Each demographic factor was examined for significant correlations with radiation awareness. The threshold for statistical significance was set at p<0.05.

RESULTS

Radiation Knowledge and Awareness based on Socio-Demographic Data

Demographic information, including gender, age, education level, field of study, and workplace environment, was analysed to assess how these factors influence radiation knowledge and awareness.

Out of 384 respondents, 27% were male and 73% female. Statistical analysis (Pearson chi-square) in Table 1 revealed no significant relationship between gender and radiation awareness, indicating that awareness levels do not differ by gender.

Table 1: Association of level of knowledge and awareness based on gender

Level of knowledge and awareness	Gender		Chi-square statistics (df)	*p*-value
	Male, n (%)	Female, n (%)		
Low	77 (20.1)	227 (59.1)	3.158 (2)	0.206
Moderate	21 (5.5)	41 (10.7)		
High	7 (1.8)	11 (2.9)		

Most respondents were aged 20-29 (73%), with smaller numbers in older age groups. Analysis (Kruskal-Wallis test) in Table 2, found no significant differences in awareness across age groups, suggesting age is not a major factor influencing radiation knowledge.

Table 2: Significant difference between age and level of knowledge and awareness

Age group	n	Mean rank	F stat, (df)	*p*-value
20-29	282	194.58	5.127 (4)	0.275
30-39	29	179.12		
40-49	39	181.68		
50-59	30	190.43		
60-69	4	264.00		

Based on education level, most of respondents held a bachelor's degree (58%), followed by diploma/equivalent qualifications (20%). Statistical analysis showed in Table 3, no significant association between education level and radiation awareness, indicating that higher education does not necessarily correlate with better understanding of radiation.

Table 3: Differences between education level and level of knowledge and awareness

Highest education level	n	Mean rank	F stat, (df)	*p*-value
Primary school/PMR	5	262.30	7.780 (5)	0.169
SPM/SPMV/equivalent	38	173.87		
STPM	11	169.14		
Diploma or equivalent	76	192.61		
Bachelors degree/equivalent	228	193.76		
Master or higher or equivalent	26	204.85		

Participants were categorized as having field of study either a health-related background (17%) or non-health background (83%). Analysis found a significant relationship between field of study and awareness levels, with those in health-related fields demonstrating higher knowledge of radiation, likely due to more direct exposure to radiation topics (Table 4).

Table 4: Relationship between major field of study and level of knowledge and awareness

Level of knowledge and awareness	Major field of study		Chi-square statistics (df)	*p*-value
	Non-health, n (%)	Health, n (%)		
Low	268 (69.8)	36 (9.4)	32.36 (2)	<0.001
Moderate	39 (10.2)	23 (6.0)		
High	10 (2.6)	8 (2.1)		

Around 38% of respondents worked in radiation-related environments and others were not related to radiation-related field. Statistical analysis revealed a significant association between workplace environment and radiation awareness, with those in radiation-exposed workplaces showing higher awareness, likely due to greater exposure to radiation safety practices and information (Table 5).

Table 5: Association between workplace environment and level of knowledge and awareness

Level of knowledge and awareness	Workplace surrounded by radiation		Chi-square statistics (df)	*p*-value
	No, n (%)	Yes, n (%)		
Low	203 (52.9)	101 (79.2)	17.91 (2)	<0.001
Moderate	32 (8.3)	30 (7.8)		
High	4 (1.0)	14 (3.6)		

Level of Radiation Knowledge and Awareness

Knowledge and awareness levels were categorized into three groups; low, moderate, and high, using a scoring system aligned with Bloom's taxonomy. The results reveal a significant gap (Table 6) in understanding among the public, echoing findings in similar studies on radiation awareness (Maulana et al., 2018; Jin et al., 2016).

Table 6: Distribution of level of knowledge and awareness

	Characteristic	n (%)	Mean (SD)
Level of knowledge and awareness	Low	304 (78.8)	0.26 (0.53)
	Moderate	62 (16.1)	
	High	18 (4.7)	

A large majority of respondents, comprising 304 out of 384 participants (78.8%), scored in the low category, indicating limited knowledge about radiation. These participants struggled to accurately identify basic information, such as sources of radiation, appropriate safety protocols, and permissible exposure limits. Many respondents, for example, mistakenly categorized non-ionizing sources like mobile phones and microwaves as ionizing radiation sources—a misconception noted in studies by Iqbal et al. (2014) and Yurt et al. (2014), who found that the public often confuses everyday electronic devices with sources of harmful radiation. Furthermore, misunderstandings about radiation risks were common in this group, with many unaware of the low-risk nature of controlled medical exposures, as reported by Kada (2017). The prevalence of low scores highlights the urgent need for accessible, accurate information on radiation basics.

Approximately 62 respondents (16.1%) fell within the moderate category, demonstrating partial understanding of radiation-related topics. While this group was somewhat familiar with radiation sources and applications, gaps remained in more specific areas, such as distinguishing between ionizing and non-ionizing types and understanding permissible exposure levels. Studies by Evans et al. (2015) suggest that such partial knowledge often results from limited exposure to structured education on radiation or reliance on general media sources, which may lack technical accuracy. Respondents in this category generally recognized some risks associated with radiation but lacked a nuanced understanding of its benefits, especially in medical imaging and cancer treatment, as found by Dauer et al. (2011). This level of awareness indicates that, although some foundational knowledge exists, more comprehensive education could greatly enhance understanding.

Only a small fraction of respondents, 18 in total (4.7%), achieved a high level of awareness, indicating a strong understanding of radiation concepts. These individuals were able to accurately identify various radiation sources, distinguish ionizing from non-ionizing types, and understand both risks and benefits of radiation use. Their familiarity with permissible exposure limits and safety measures suggested practical knowledge, likely due to backgrounds in healthcare, radiation safety, or related fields (Zhou et al., 2010). Studies such as those by Ricketts et al. (2013) have shown that individuals with professional or educational exposure to radiation topics exhibit significantly higher levels of understanding and awareness, consistent with findings in this study.

The findings indicate that nearly 80% of respondents possess low radiation knowledge levels, while fewer than 5% achieved high scores. This significant gap in public awareness is consistent with other research highlighting a lack of reliable information and prevalent misconceptions in the general population (Hauri et al., 2013; Maulana et al., 2018). The results suggest that the low knowledge levels could stem from limited access to accurate sources and reliance on informal information, as supported by Acar and Ince (2010), who found that misconceptions are often fuelled by unreliable online content. Given the findings, there is a clear need for educational interventions to provide foundational information on radiation safety, benefits, and risks.

The data underscore the importance of improving public education on radiation to address the pervasive misconceptions and alleviate unnecessary fears, particularly concerning medical applications (Allison, 2009; Lumbreras et al., 2017). Enhancing awareness through government-supported campaigns or healthcare provider resources could significantly improve public understanding and confidence regarding radiation exposure in controlled settings. This study's results reinforce previous recommendations for outreach efforts to counter misinformation and promote informed decision-making regarding radiation exposure (Evans et al., 2015; Jin et al., 2016).

CONCLUSION

In summary, the results indicate that the public in Johor lacks adequate knowledge and awareness of radiation, with a strong need for reliable educational resources and targeted awareness efforts. The results suggest that enhancing public understanding could help mitigate fears and misconceptions, potentially reducing anxiety related to radiation exposure in medical and environmental contexts.

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