A *icQoL2024KotaKinabalu*

https://www.amerabra.org

12th AMER International Conference on Quality of Life
The Magellan Sutera Resort, Kota Kinabalu, Malaysia, 26-28 Jan 2024

Knowledge, Attitude, and Practice of Radiation Safety among Radiographers in the Government Hospital in Tai'an City

Sitong Liu[1], Akehsan Dahlan[1], Qiong Wu[2], Ahmad Taufek Abdul Rahman[3*]

* Corresponding Author

[1] Faculty of Health Sciences, Universiti Teknologi MARA, Campus of Selangor, 42300 Puncak Alam, Selangor, Malaysia,
[2] Shandong Province Central Hospital, Taishan District, Shandong Province, Shan Dong Province, China
[3] School of Physics and Material Studies, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia,

654723980@qq.com, akehsan@uitm.edu.my, qiongqiong3704@sina.com, ahmadtaufek@uitm.edu.my
Tel: +60355211767

Abstract
Radiographers are professionals tasked with operating equipment emitting radiation, such as X-rays and Computer Tomography (CT). The focus on their Knowledge, Attitude, and Practice (KAP) concerning Radiation Protection (RP) establishes a significant and imperative study area. This study endeavours to comprehensively investigate the KAP of RP among Radiographers in the Government Hospital in Tai'an City, aiming to explore correlations with various demographic and professional factors. In conclusion, the study asserts that myriad factors distinctly influence the KAP of RP among radiographers in the government hospital in Tai'an City.

Keywords: Radiation Safety; Knowledge, Attitude and Practice

1.0 Introduction
Medical imaging technology, an integration of information technology and medicine, has emerged as one of the most fascinating study areas in medical diagnostics (Gou Liang et al., 2002). Medical imaging is a technology that studies the interaction between the human body and irradiations of X-ray, ultrasound, magnetic field, etc., and represents anatomical structures of human organs/tissues with the implication of irradiation attenuation in the form of grayscales (Wu et al., 2023). Similar to X-ray technology, the identification of the internal structure of the human body is achieved by confirming the degree of X-ray absorption by organs of varying densities (Li & Zhang., 2013). Currently, especially in malignant tumors (Deng J, Xu S et al., 2018), the use of radiological equipment in clinical applications is growing. Nevertheless, radiation technology, being a double-edged sword, also poses implications for the health of the practitioners involved. Therefore, the purpose of this study is to find the factors affecting the KAP of radiographers.

2.0 Literature Review

X-ray radiation is harmful to human health. Patients undergoing X-rays inevitably expose themselves to direct X-rays, while medical radiographers operating inspection machines are susceptible to scattered and leaking rays (Žauhar & Dresto-AlaB, 2021). The different hospitals and regions of radiographers have different levels of knowledge about radiation protection (Zhou, 2016). The education and training system for radiation workers in China is well implemented, and the pre-job training rate is high, but some problems still exist. (Yang et al.,2020). The KAP (Knowledge, Attitude, and Practice) model is a theoretical tool proposed by British researcher Koster in the 1960s. It is used to explain how personal knowledge, attitudes, and beliefs are related, affect health behavior changes, and evaluate group differences through customized questionnaires to propose intervention measures.

A study in Dongcheng District, Beijing, found that the awareness rate among radiological diagnostic workers was uneven. Factors such as employment age and level of medical institutions will affect the mastery of radiation protection knowledge (Shi et al., 2020). However, a survey study in Tianjin showed that radiographers' basic knowledge of RP needs to be revised and has no significant correlation with their education level (Huo et al., 2019). Therefore, the KAP survey allows us to understand the current status of radiographers' knowledge, attitudes, and practices of RP and to develop targeted training and education programs accordingly to enhance the implementation of RP.

To date, there is a lack of research on radiation safety action plans for radiographers at Tai'an Municipal Government Hospital in China. Therefore, conducting regional studies can provide valuable data and insights that can help improve awareness of radiation safety among local medical professionals.

3.0 Methodology

3.1 Research Design

A cross-sectional study design was conducted in which the researcher administered a KAP questionnaire to radiographers in the Radiographers Department across 18 governmental public hospitals in Tai'an. The radiographers were provided with explanations about the KAP questionnaire and requested to complete it before returning it. Securing ethical approval for a research study is a cornerstone in upholding the principles of responsible research conduct. In the case of this study, such approval was diligently obtained from the Universiti Teknologi MARA (UiTM) Ethical Committee, identified by the reference number [REC/154/29, 600-IRMI (5/1/6)]. This approval signifies a commitment to adhering to the institution's ethical guidelines and regulatory standards.

3.2 Research Instrument

Knowledge, Attitude, and Practice (KAP) on Radiation safety, which was developed by Alvin was used in this study (Alvin et al., 2017). These KAP questionnaires gather in-depth information on individual characteristics such as educational background, professional competence, frequency of exposure to radiation, and various aspects of radiation safety, including the knowledge of radiographers of RP principles, their attitudes towards radiation safety guidelines, and their adherence to best practices in their daily work. In addition, this questionnaire asked a wide range of questions about radiation safety knowledge, attitudes, and practices, thereby providing a holistic understanding of the perspectives of radiographers on radiation safety. This questionnaire was translated into Chinese through a back-to-back translation process and validated by the researcher. The mean KAP score was 35.22 (SD=6.2). Cronbach's alpha of the translated KAP was 0.81; item-scale correlation ranged from 0.33–0.71.

3.3 Inclusion and Exclusion Criteria

The inclusion criteria for this study are:
- Senior radiographers or academicians who have at least a degree in medical imaging or medical techniques.
- Senior Radiographers who can understand Chinese.
- Radiographers who work for at least five years.

The exclusion criteria is:
- Other healthcare professionals who work in the department, such as nurses and medical assistants,

3.4 Sampling and sample size

A cluster random sampling strategy was used to determine the participants. The sample size for this study was determined using the Raosoft Sample Size Calculator Online Software (2004). It was decided that the margin error of the study was set at 5%, with a confidence level of 95% and a response distribution of 50%. Currently, there are 373 Radiographers in the Government Hospital in Tai'an City. Hence, using the Raosoft sample size calculator, with a statistical significance (alpha) of 0.05 (95% confidence interval [95% CI]), 190 radiography participants are sufficient to provide 80% power of the study. Given the possibility of an alteration rate of 10%, the total sample that should be obtained is 210 radiographers.

3.5 Data collection

The data was collected at the 18 governmental public hospitals in Tai'an City from March 31, 2023, to May 31, 2023. Using the Wechat Group.

3.6 Limitation
Given that this study utilized self-reporting by radiologists, it could be subject to subjective biases and false positives. More precise methods should be employed to rectify the current shortcomings.

4.0 Findings

4.1 Descriptive analysis of the participants in the study.
A total of 245 questionnaires were distributed to the radiographers, and 230 questionnaires were returned, yielding a 93.9% response rate. The study respondents comprised 120 male radiographers (52.17%) and 110 female radiographers (47.83%). The age of respondents varied from 25 to 55 years, with an average age of 32.85 (4.84) years. Most respondents fell into the 35 to 45-year-old age group, accounting for 50.87% of the total respondents. In terms of their professional backgrounds, the average length of service among these respondents was 10.85 ± 6.84 years, with the range extending from 1 to 27 years. Intriguingly, a substantial portion of the respondents, amounting to 56.09%, reported not receiving specific training on radiation safety. Moreover, 45.65% of the respondents indicated they had not experienced radiation exposure in their work, as shown in Table 1 below.

Table 1. Distribution of Participants According to Exposure and Practice

	Variable	Respondents (N)	Frequency (%)
Gender	Male	120	52.17
	Female	110	47.83
Age (Years old)	≤34	117	50.87
	35-45	113	49.13
Education level	Technical secondary school and below	8	3.48
	Junior college	39	16.96
	Undergraduate	125	54.35
	Postgraduate and below	58	25.22
Length of service (Years)	≤10	91	39.57
	>10	139	60.43
Hospital grade	The secondary III	111	48.26
	The grade III A	119	51.74
Receiving radiation safety training	No	129	56.09
	Yes	101	43.91
Radiation exposure while working	No	105	45.65
	Yes	125	54.35

4.2 Specific analysis
Table 2 summarizes participant distribution based on exposure to ionizing radiation and adherence to RP practices. Out of 161 participants (70.0%), exposure occurred at least once per week, while the remaining 30.0% had less frequent exposure. Only 132 participants (57.39%) consistently followed RP policies, procedures, and personal protective equipment (PPE) usage. This indicates that, although most are regularly exposed to ionizing radiation, a significant number do not adhere to recommended RP practices. Possible reasons for this lack of adherence include inadequate training, insufficient awareness of risks, or practical challenges in implementing RP measures.

Table 2. Distribution of Participants According to Exposure and Practice

Variable	Participants (No)	Frequency (%)
Exposure frequency (/week)		
Less than once/week	69	30.00
1 - 3 times/week	75	32.61
More than three times/week	86	37.39
Adherence to RP policies, procedures & PPE		
Adherent	132	57.39
Not adherent	98	42.61
Applicability & convenience of RP policies, procedures & PPE (yes)		
Lead aprons	144	62.61
Thyroid shields	121	52.61
Leaded gloves	150	65.22
Eyeglasses	138	60.00
Distance from the radiological device without protection during the procedure (meter)		
Less than 1 meter	8	3.48
1 - 2 meters	72	31.3
More than 2 meters	150	65.22

Table 3 provides an overview of participants' knowledge regarding radiation doses in various clinical scenarios. This information is critical for understanding participants' awareness levels when making informed decisions about radiological investigations and minimizing the potential risks associated with ionizing radiation. The results reveal that 60.00% of participants correctly identified the background radiation equivalent dose, and 63.91% accurately recognized the radiation equivalent dose in chest X-rays. However, participants' understanding of the equivalent number of chest X-rays in different radiological investigations varied considerably.

Table 3. Distribution of Physician-knowledge Regarding Radiation Dose

Variable	Correct answers (No)	Frequency (%)
Radiation dose		
Background radiation dose (mSv)	138	60.00
Chest X-ray radiation dose (mSv)	147	63.91
Equivalent number of chest X-rays in radiological investigations		
Ray-ray	69	30.00
CT	40	17.39
MRI	81	35.22
Ultrasound	167	72.61

Table 4 provides a detailed overview of participants' attitudes and perceptions regarding RP policies and procedures in their hospitals. The data highlights strengths and areas for improvement, particularly in physician understanding, confidence, and adherence to radiation safety measures.

Table 4. Distribution of Physician-knowledge Regarding Radiation Dose

Variable	Correct answers (No)	Frequency (%)
Policies and procedures on radiation precautions are clear and easy to understand	150	65.22
I feel confident about the steps I need to take when caring for patients needing radiation precautions	92	40.00
I know whom to contact if I have questions about what radiation precautions are needed for a particular patient	135	58.70
I can clearly explain the radiation precautions needed to patients and their visitors.	115	50.00
I feel safe when caring for patients needing radiation precautions	63	27.39
I feel the institutional policies and procedures are based on current regulations.	81	35.22
I feel confident the institution is carefully monitoring my radiation exposure.	35	15.22

As shown in Table 4, 65.22% of the participants believed that the hospital's RP policies and procedures were clear and easy to understand. In addition, 40.00% of people are confident that they can correctly implement radiation prevention procedures. 58.70% knew who to contact if they had questions about radiation prevention for a specific patient, and 50.00% could clearly explain these measures to patients and visitors. However, the data also shows some areas of concern. Only 27.39% of participants felt safe when caring for patients undergoing radiological examinations, which was significantly lower. Additionally, 35.22% believed hospital policies complied with regulations, and only 15.22% expressed confidence in the institution's careful monitoring of radiation exposure.

4.3 Result of analysis of factors affecting workers

Table 5 presents the associations between sociodemographic characteristics and the level of knowledge, attitude, and practice regarding X-ray protection. The table includes odds ratios (OR) with 95% confidence intervals (CI) and corresponding p-values to assess the significance of these associations. The odds ratios indicate:

1. There are no significant associations between KAP with gender, age, and hospital grade.
2. There are as significant associations for knowledge with undergraduate, junior college, and technical secondary school and below compared to postgraduate education level. However, there are no significant associations with attitude or practice for any education level.
3. There is a significant association for KAP with a length of service greater than ten years compared to less than or equal to 10 years.
4. There is a significant association for knowledge KAP among participants who received radiation safety training compared to those who did not.
5. There are no significant associations between radiation exposure and knowledge or attitude. However, there is a significant association with practice for participants who experience radiation exposure while working compared to those who do not.

In summary, Table 5 presents the associations between various sociodemographic characteristics and the level of knowledge, attitude, and practice regarding X-ray protection. It highlights significant associations with education level, length of service, receiving radiation safety training, and radiation exposure while working. Unfortunately, it is disappointing to note that there are no significant associations with gender, age, or hospital grade in this study.

Table 5. Association between sociodemographic characteristics and level of knowledge, attitude, and practice of X-ray protection

Variable	Knowledge		Attitude		Practices	
	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
①Gender						

Male	1		1		1	
Female	1.04(0.41-2.61)	0.940	1.93(0.77-4.87)	0.163	0.56(0.20-1.53)	0.255
②Age						
≤34	1		1		1	
35-45	0.98(0.43 - 2.20)	0.958	1.49(0.69 - 3.24)	0.312	1.03(0.46 - 2.29)	0.943
③Education level						
Postgraduate	1		1		1	
Undergraduate	0.31(0.14-0.66)	0.002	0.890.44-1.80)	0.744	0.39(0.19 - 0.81)	0.012
Junior college	0.17(0.06-0.50)	0.001	0.710.28-1.79)	0.467	0.12(0.05-0.32)	<0.001
Technical secondary school and below	0.23(0.03-1.56)	0.133	3.570.73-17.39)	0.116	0.19(0.04-1.02)	0.053
④Length of service						
≤10	1		1		1	
>10	2.66(1.20-5.90)	0.016	2.36(1.12 - 4.97)	0.023	2.85(1.31-6.18)	0.008
⑤Hospital-grade						
The secondary III			1		1	
The grade III A	1.43(0.77-2.69)	0.257	1.42(0.79-2.54)	0.239	1.18(0.66-2.10)	0.576
⑥Receiving radiation safety training						
No	1		1		1	
Yes	5.42 (2.39-12.30)	<0.001	2.63(1.21-5.72)	0.015	2.48 (1.17-5.27)	0.018
⑦Radiation exposure while working						
No	1		1		1	
Yes	2.26(0.84-6.08)	0.107	0.80(0.31-2.08)	0.652	3.60(1.29-10.05)	0.015

The variables represented by bars ① to ⑦, as shown in Figure 1 correspond to gender, age, education level, length of service, hospital grade, receiving radiation safety training, and radiation exposure while working, respectively. This graph comprehensively illustrates the influence of various factors, including gender, age, education level, length of service, hospital grade, receipt of radiation safety training, and radiation exposure at work, on radiographers' knowledge, attitudes, and practices.

In conclusion, the results presented in Table 5 suggest that factors such as length of service, training, and educational level significantly influence participants' KAP regarding radiation safety training precautions. To improve radiation safety, it is crucial to provide continuous education and training to participants, especially those with limited experience or lower educational levels. A targeted approach will help improve compliance with radiation safety precautions, ultimately promoting a safer healthcare environment for participants and patients.
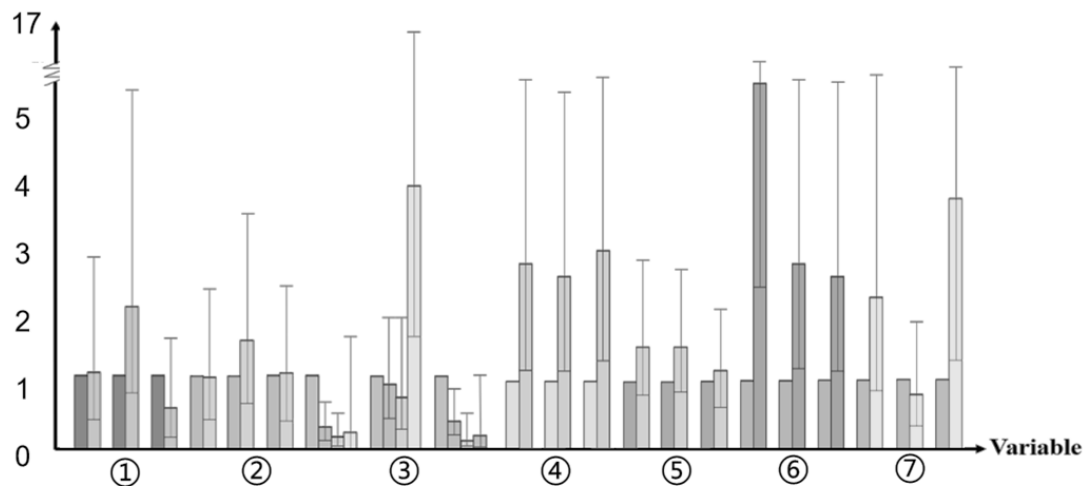

Fig. 1: Association Between Sociodemographic Characteristics and Level of Knowledge, Attitude, and Practice of X-ray Protection

5.0 Discussion

In this study, we assessed the KAP of radiographers in the field of RP in Tai'an City, China. Through an online questionnaire, we collected and analyzed the relevant data. The survey results showed that Tai'an City radiographers need more RP knowledge. Only 35.22% have a good understanding of radiation prevention and control, and only 53.91% can strictly follow RP regulations. However, only 35.22% of respondents possessed a good knowledge of radiology control and prevention (scores above 80), indicating that the radiation safety knowledge level of X-ray workers in Tai'an City needed to be improved compared to other areas in China (Fang et al., 2020). This indicates that radiographers in Tai'an City need an effective pre-service and on-the-job training program in radiation prevention and control.

In terms of attitude, the survey also reflected several problems. Only 35.22% of the technologists believed that the policies and procedures of their hospitals were based on the latest regulations, and 15.22% of the technologists believed that the hospitals conducted strict monitoring of radiation exposure. The results highlight deficiencies in the RP system in some hospitals and also show a need for

more clarity on the responsibilities of RP in these hospitals. Concerning hands-on practice, we found significant differences in the performance of radiographers from different regions and backgrounds. These differences may stem from variations in educational backgrounds, healthcare systems, policies, and the implementation of monitoring in these regions. However, attitudes toward RP are crucial drivers for positive changes in behaviour and practice (Kong et al., 2011).

Although China's Ministry of Health has made clear regulations on training related to radiation prevention and control, such as RP training for new radiation workers conducted at least four days before installation, radiological diagnostic and therapeutic workers must be trained and pass relative examinations, and the training of on-duty personnel shall not be less than two years, with each session lasting no less than two days (Zhang et al., 2018), there are still difficulties and challenges in practice. Our study found that many radiographers have yet to receive any RP training.

6.0 Conclusion& Recommendations

In summary, radiographers in Tai'an City need to improve their RP knowledge, attitudes, and practices, with years of experience and training being the main factors affecting their performance. To improve the RP level of radiographers, attention should be paid to updating and enforcing relevant regulations on RP, increasing training efforts, improving the quality of training, advocating a culture of prioritizing safety, and investing sufficient resources and equipment. The combined implementation of these measures is expected to improve the RP level of radiographers to safeguard their own health and that of their patients. Future research regarding the effect of education and training on knowledge and practice on RP should be conducted in the future.

Acknowledgement

Paper Contribution to Related Field of Study

This paper will contribute to the field of radiography, radiation protection, and health among radiographers.

References

Alavi, S. S., Dabbagh, S. T., Abbasi, M., & Mehrdad, R. (2017). Medical technologists' knowledge, attitude, and practice protect themselves against ionizing radiation in Tehran Province, Iran. *Journal of Education and Health Promotion, 6(5), 58–58.*

Deng, J., Xu, S., Hu, W., Xun, X., Zheng, L., & Su, M. (2018). Tumor targeted, stealthy and degradable bismuth nanoparticles for enhanced X-ray radiation therapy of breast cancer. *Biomaterials*, 154, 24–33.

Fang JY, Yang CJ, Wei HJ, Lu JJ, Li LL, & Cai H. (2020). Study on radiation protection status and control strategy of nuclear medicine staff and patients in Guangxi. *Occupation and Health. 36(17):2425-2428.*

Feng chunyan, & Wang Liying. (2020). Effects of long-term low-dose ionizing radiation on thyroid gland in medical staff. *Occupational Health and Emergency Rescue (1), 3.*
Gou, L., Wang, X., & Cao, H. (2002). Current status and trends of X-ray imaging. *Journal of Chengdu University of Technology, 29(2), 5.*

Huo, M., Su, K., Jiao, L., Yin, C., Wang, F., & Zhang, W. (2019). Investigation and analysis of occupational health management of radiological workers. *Chinese Journal of Radiological Health, 29(5), 582-585.*

Kong Y, Zhuo WH, Chen B. (2011). Research progress of personal dose monitoring methods for interventional radiology workers. *Chinese Journal of Radiological Medicine and Protection. 31(5),614–616.*

Li ZM,& Zhang SZ. (2013). Follow the radiation examination principles of comprehensive assessment of radiation risk, medical safety and benefit to patients. *Chinese Journal of Radiology. 47(004), 379–381.*

RaoSoft Inc. (2004). RaoSoft® sample size calculator. Retrieved May 5, 2023, from *http://www.raosoft.com/samplesize.html*

Shi HM, Zhao SJ, Wei X, Liu JL. (2020). Investigation on knowledge, attitude and practice of RP and analysis on influencing factors among radiodiagnosis workers in hospitals of Dongcheng District in Beijing. *Occupation and Health. 36(17),2365-2368.*

Wu J, Qiao H. Medical Imaging Technology and Imaging Agents[M]//Visualized Medicine: Emerging Techniques and Develo** Frontiers. Singapore: *Springer Nature Singapore, 2023: 15-38*

Yang Jiangmao, Zhu Xiaoyan, Huang Ying, Wang Dan, & Luo Hengyan. (2020). Discussion on the protection of bedside DR radiography. *Journal of Imaging Research and Medical Applications, 4(3), 255-256.*

Žauhar, G., & Dresto-Alač, B. (2021). Trends in Professional Radiation Exposures of Medical Staff Covered by Personal Dose Monitoring at a Rijeka Clinical Hospital Centre (2000 to 2015). *Health Physics, 120(3), 308–315.*

Zhang L,Zhang Y,Hu CY,Gao B,Li FL,Jiang W,Hua XG,& Zhang XJ. (2018). The investigation and analysis of radiation protection of ionization contact personnel in the medical institutions of Hefei City. *Chinese Journal of General Practice. 16(11),1916-1919.*

Zhou GX. (2016). Sampling survey on the understanding and implementation of radiation safety in medical units in Shanghai. *Hebei Medical Journal. 38(8), 1256–1258.*