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Radiation Protection Knowledge, Attitude and Practice (RP-KAP) as Predictors of Job Stress Among Radiation Workers in Tehran Province, Iran

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Abstract

Background: In recent years, much attention has been paid to occupational stress, but relatively little or no research has been conducted on the influence of knowledge, attitude, and practice of radiation protection (RP-KAP) on job stress among radiation workers

Objectives: This study aims to assess job stress among health care workers in Iran who are occupationally exposed to radiation in order to determine the effects of KAP on self-protection against radiation on their job stress.

Materials and Methods: The population in this descriptive cross-sectional study comprised 670 healthcare workers, including 428 staff with a degree in radiology and 242 other medical personnel who were working in 16 hospitals affiliated with Tehran University of Medical Sciences (TUMS) in Tehran, Iran. The census method was used to sample the workers. In total, 264 staff with a degree in radiology and 149 other medical personnel completed the job content questionnaire (JCQ) and the RP-KAP questionnaire from May to November 2014.

Results: The prevalence rate of job stress was 22.5% based on calculation formulas and possible scores on the JCQ. Sex, RP-knowledge, attitude, practice, and in-service training predicted 41.8% of the variance in job stress. According to the results of the binary logistic regression, workers with higher scores on knowledge (OR = 0.82, 95% CI: 0.75 - 0.90), attitude (OR = 0.71, 95% CI: 0.63 - 0.82), and practice (OR = 0.78, 95% CI: 0.72 - 0.86) and those who had participated in training programs had significantly lower rates of job stress (OR = 0.51, 95% CI: 0.28 - 0.93).

Conclusions: The effects of RP knowledge, attitude, and practice on job stress were significant. In order to reduce job stress in radiation environments, ongoing training programs related to self-care and protection principles are recommended.

Keywords: Ionizing Radiation, Health Personnel, Occupational Stress, Radiation Protection

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1. Background

Healthcare workers have long been recognized as a high-stress group. They have been associated with higher levels of psychological stress compared to many other occupational groups. In a study conducted in 2011, healthcare workers were classified into two groups, professionals, and support staff. The results showed that within the support group, radiation workers experienced job stress more than others did (1). Despite numerous studies on job stress among healthcare workers, few have focused on the importance and causes of stress among radiation workers (2, 3), particularly in Iran (4).

Reducing employees' stress is a main benefit of any program that addresses workplace health and safety promotion (5). Accordingly, efforts that lead to low levels of job stress should be given top priority in organizational changes. It is widely accepted that the most effective way to reduce stress is to identify and remove related stressors (6). Work related stressors adversely affect the productivity, creativity, and the economic and health status of both patients and healthcare workers. Previous studies found that higher levels of job stress reduced mental (7) and physical (8) health and could cause healthcare workers to neglect their own health (1). Several factors are involved in job stress of healthcare workers. Exposure to hazardous substances, such as ionizing radiation, is an environmental stressor (6, 9) that can place the healthcare workers at risk by affecting them both genetically and somatically (10, 11).

Radiation is a main issue that has not been consid-

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ered in the occupational safety of health personnel (12). Moreover, the general fear of radiation is a consequence of inadequate knowledge about the subject (13). In other words, insufficient and mismatched knowledge and abilities in the workplace is a general source of job stress (14). However, if workers feel confident about their practice, their certainly is enhanced, and their occupational stress decreases (15). A previous study showed that people with greater practical experience suffered lower levels of job stress (7). Previous studies also revealed that positive attitudes toward safety issues significantly decreased job stress (16, 17).

2. Objectives

Although the psychosocial stress of health personnel who work in radiation settings is an important concern, few studies have investigated their radiation protection KAP (RP-KAP). The present study was conducted to determine whether radiation protection KAP (RP-KAP) as a means of self-protection could predict the occupational stress of radiation workers.

3. Materials and Methods

This descriptive cross-sectional survey was conducted at the Tehran University of Medical Sciences (TUMS) in Tehran, Iran from May to November 2014. The research setting consisted of 16 governmental referral hospitals that treat patients with complicated health problems from across the country and neighboring countries.

Based on the pilot study, the final sample size consisted of 640 patients, which was calculated by the Query Advisor 3 software: $\alpha = 0.05$, $\beta = 0.2$ (power 80%), stress prevalence = 20.5%, and error = 20%. We used the census sampling method and sent the questionnaires to the 670 healthcare workers, who were working in radiation environments in the research setting.

The medical ethics committee of TUMS approved the study protocol (ethical code No. 121843; date of issue, 26 August 2014). The objectives, methodology, and protocol of the research were described to the participants who held a degree in radiology and to other healthcare personnel who worked in environments that were exposed to radiation. Informed and written consent was obtained for their voluntary participation in the research. All participants were assured that they were free to leave and withdraw from the study without consequences "at any time for any reason" if they wished to do so. The participants were assured of the confidentiality and anonymity of the collected information. Furthermore, no conflict or potential conflict was encountered during the study.

It is noteworthy that people with different educational backgrounds were invited to participate in the study. Radiation environments require appropriate RP knowledge, attitudes, and practice in order to protect themselves, regardless of the workers' educational background.

The data were collected through a comprehensive self-administered questionnaire, which included items on participants' characteristics, their KAP on self-protection against radiation, and job stress.

The participants' characteristics included sex, marital status, years of work in a radiation environment, participation in RP in-service training over the past year, field of study at the university (radiology or other fields in medical education), and academic degree.

The content of the RP-KAP-related questions was based on the most common experiences and issues faced by the authors and the approved protocols and guidelines for RP. Accordingly, this part of the questionnaire was divided into three sections: 13 questions were on RP-knowledge' 13 questions were on RP-attitude; and 6 questions were on participants' practice regarding their protection against radiation. The face validity and the content validity of the questionnaire were approved. The content validity ratio (CVR) and the content validity index (CVI) were used to evaluate the content validity of the questionnaire. Ten experts with different educational backgrounds (e.g., educational planning, epidemiology, radiology, and occupational health) assessed the questionnaire's content, specifically to ensure that it asked appropriate questions and avoided ambiguity. The CVRs of the questionnaire constructs were 0.61 to 0.76, and the CVI structure was 0.77 to 0.93. In order to measure the face validity of the questionnaire, 30 radiation workers and the 10 experts rated each question for clarity, understandability, and length. Face validity was ensured by the revision of seven items. The internal consistency reliability was calculated using Cronbach's alpha ($\alpha = 0.92$). In order to assess the levels of the participants' KAP, the scores were calculated according to a maximum of 20.

Job stress was assessed by the Persian version of the self-report job content questionnaire (JCQ) (18, 19). In this questionnaire, which is based on Karasek-demand-control model, the subscales consist of skill discretion (6 items), decision-making authority (3 items), job demand (5 items), decision latitude (9 items), co-worker support (4 items), supervisor support (4 items), and job insecurity (3 items). The items were scored using a four-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Skill discretion refers to the possibility of performing tasks using a variety of skills. Decision-making authority is the freedom to decide the tasks performed. Job demand includes the psychological stressors on the worker that influence the pace

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and volume of the work, such as having to perform multiple tasks at the same time, not enough time to do the work, and the degree of task difficulty. Decision latitude is the combination of skill discretion and decision-making authority. Co-worker and supervisor support were defined as the positive interactions of colleagues and direct supervisors with the staff in the workplace.

Choobineh et al. (19) approved the validity of the Persian version of the questionnaire. All subscales had an internal consistency reliability (Cronbach's alpha) between 0.54 and 0.85. Cronbach's alpha between 0.8 and 0.9 indicates high internal consistency, and alpha values of 0.7 and higher indicate good internal stability (20).

The scores were calculated in accordance with the JCQ users' guidelines (18, 19). According to this questionnaire, occupational stress occurred when the scores for decision latitude (i.e., skill discretion and decision-making authority) and co-worker and supervisor support were low, and the scores for job demand and job insecurity were high.

According to the JCQ users' guidelines, the scores for job stress and its subscales were calculated by the following formulas (Table 1) (18, 19):

Table 1. Formulas Used to Calculate the Scores on the JCQ Scale

Formula	Possible Range
Skill discretion = [Q1 + Q3 + Q5 + Q7 + Q9 + 5-Q2] × 2	12 - 48
Job decision-making authority = [2 × (Q4 + Q6 + Q8)] × 2	12 - 48
Job decision latitude = **Skill discretion** + **Job decision-making authority**	24 - 96
Job demands =3 × (Q10 + Q11) + 2 × (15- Q13 – Q14 – Q15)	12 - 48
Coworker Support = Q17 + Q18 + Q19 + Q20	4 - 16
Supervisor Support = Q21 + Q22 + Q23 + Q24	4 - 16
Job Insecurity = Q 25 + Q27 + 5-Q16	3 - 13
Job stress ratio term: (Demands × 2)/Decision latitude, A score > 1 indicates job stress.	

In order to evaluate the degree of the participants' stress, the mean score for each subscale was compared to the mean values located at the approximate midpoint of the possible range of scores based on Karasek et al. (18). The means (SD) of all subscales were compared with the "national averages from 1969, 1972 and 1977 U.S. quality of employment surveys" among 4495 people.

3.1. Statistical Analysis

After calculating the job stress scores, the participants were divided into two groups: with stress and without stress. A statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 17.0. A descriptive data analysis then was conducted. The normality of the data was evaluated using the Kolmogorov Smirnov test. A Chi square test was conducted to compare the qualitative variables between the two groups. Multivariate analyses using a binary logistic regression were performed to find the effects of the independent variable of RP-KAP on job stress, which was the dependent variable. The P value was considered significant at 0.05.

4. Results

A total of 413 of 670 questionnaires were returned from 16 hospitals (the response rate was 61.6%). The majority of the health care workers were female (60.5%), married (70.2%), and held a bachelor's degree (69.2%) and a certificate in radiology (63.9%). The participants' academic fields of study and related academic degrees are presented in Table 2.

The mean (SD) years of experience in working with radiation was 10.1 (7.2). The results revealed that the mean scores of RP knowledge, attitude, and practice were 7.2 (3.4), 8.6 (2.7) and 13.1 (3.3), respectively.

The demographic characteristics of the health care workers who worked in radiation environments according to their complaints of job stress are shown in Table 3. Most participants who suffered from job stress were female (P = 0.041), married (P = 0.039), had a bachelor's degree (P = 0.029), and had not participated in any in-service training over the past year (P = 0.008). A degree in radiology (P = 0.326) and number of years of experience in a radiation environment (P = 0.186) were not related to job stress.

Ninety-three (22.5%) participants experienced job stress. The scores for job stress subscales, possible ranges (based on the JCQ questionnaire users' guide), and mean (SD) found in a national survey conducted in the US are shown in Table 4.

The bivariate analysis of the relationship between RP-KAP and occupational stress showed that the higher mean scores of RP knowledge (P < 0.001), attitude (P < 0.001), and practice (P < 0.001) were significantly associated with lower rates of job stress (Table 5).

According to the results of the binary logistic regression analysis shown in Table 6, RP-knowledge, attitude, and practice as well as in-service training were significant predictors of job stress. Radiation workers with higher scores for RP knowledge (OR = 0.82, 95% CI: 0.75 - 0.90), attitude (OR = 0.71, 95% CI: 0.63 - 0.82), and practice (OR = 0.78, 95% CI: 0.72 - 0.86) perceived lower occupational stress. Participants who had attended in-service training programs over the past year had lower rate of stress compared to those with no training (OR = 0.51, 95% CI: 0.28 - 0.93). Female radiation workers experienced higher levels of job

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Table 2. Participants' Academic Fields of Study and Related Academic Degrees

Field of Study	Educational Degree			
	Associate N = 72	Bachelor N = 286	Master N = 12	Medical Specialist N = 43
Radiologic areas				
Radiologic technologist	15 (21.0%)	174 (61.0%)	5 (41.7%)	10 (23.3%)
Nuclear medicine technologist	9 (12.5%)	0	0	8 (18.6%)
Medical radiation Technologists	0	9 (3.1%)	1 (8.3%)	0
Radiotherapists/ assistants	4 (5.6%)	18 (6.3%)	2 (16.7%)	6 (14.0%)
Medical physics Technologists	0	0	3 (25.0%)	0
Other medical fields				
Nurse	32 (44.4%)	77 (26.9%)	0	0
Anesthesiologist/ assistants	12 (16.5%)	8 (2.7%)	1 (8.3%)	4 (9.3%)
Cardiologist	0	0	0	3 (7.0%)
Orthopedic surgeon	0	0	0	5 (11.5%)
Neurologist	0	0	0	3 (7.0%)
Urologist	0	0	0	4 (9.3%)

Table 3. Characteristics of Participants Based on Occupational Stress[a]

Variable	With Stress N = 93	Without Stress N = 320	Total N = 413	P Value
Sex				0.041
Male	28 (30.1)	135 (42.2)	163 (39.5)	
Female	65 (69.9)	185 (57.8)	250 (60.5)	
Maritalstatus				0.039
Married	57 (61.3)	233 (72.8)	290 (70.2)	
Single	36 (38.7)	87 (27.2)	123 (29.8)	
Educational degree				0.029
Bachelor or lower	20 (21.5)	52 (16.3)	72 (17.4)	
Bachelor	68 (73.1)	218 (68.1)	286 (69.2)	
Higher than Bachelor	5 (5.4)	50 (15.9)	55 (13.3)	
Field of study				0.326
Radiology	55 (59.1)	209 (65.3)	264 (63.9)	
Other medical fields	38 (40.9)	111 (34.7)	149 (36.1)	
In-service training				0.008
Yes	27 (29.0)	143 (44.7)	170 (41.2)	
No	66 (71.0)	177 (55.3)	243 (58.8)	

[a]Values are expressed as No. (%).

stress than their male counterparts did although no significant relationship was found between job stress and sex (OR = 1.75, 95% CI: 0.96 - 3.20). According to the regression model developed in the present study, variables such as RP-knowledge, attitude, practice, and in-service training, accounted for 41.8% of the total variance in predicting job stress.

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Table 4. The Mean Scores on the Job Content Questionnaire Scale

Variable	Mean (SD)	Median	Min-Max	Possible Range[a]	National Averages for JCQ Scales from U.S. Quality of Employment Surveys (4495 People), Mean (SD)
Job skill discretion	34.1 (5.1)	34	18 - 48	12 - 48	33.5 (8.50)
Decision-making authority	30.7 (6.1)	30	12 - 48	12 - 48	36.8 (9.90)
Decision latitude	64.7 (9.5)	64	31 - 92	24 - 96	70.3 (15.60)
Job demand	35.2 (5.2)	34.5	20 - 48	12 - 48	30.9 (8.48)
Coworker support	12.1 (1.8)	12	6 - 16	4 - 16	12.73 (2.53)
Supervisor support	11.4 (2.5)	12	4 - 16	4 - 16	11.94 (4.85)
Job insecurity	5.5 (0.8)	6	4 - 7	3 - 12	4.91 (1.97)

[a]Based on the JCQ users' guidelines.

Table 5. RP-KAP Scores and Job Stress[a]

	Without Stress	With Stress	P Value
Knowledge	10.8 (3.3)	13.5 (3.4)	< 0.001
Attitude	10.9 (2.1)	13.5 (2.8)	< 0.001
Practice	12.0 (3.7)	15.1 (3.2)	< 0.001

[a]Values are expressed as Mean (SD)

5. Discussion

This study was conducted to investigate the prevalence rate of job stress among health care workers that were occupationally exposed to radiation. We also studied the relationship between RP-KAP and work-related stress. Based on the JCQ users' guidelines (18), the prevalence rate of occupational stress was 22.5%. The scores of job stress subscales were not satisfactory. Based on the results, the scores of decision latitude and co-worker and supervisor support were lower and the scores of job demand and job insecurity were higher than the scores found by the US national survey. Relatively low mean scores for job decision-making authority and high mean scores for job demand, compared to the possible ranges, were indicators of work-related stress among the studied radiation workers. Consequently, the results showed that the study population was exposed to considerable levels of occupational stress. In the present study, the estimated prevalence rate of job stress was consistent with the findings of previous research at about 30% (3, 21). In another study, anxiety, which is one of psychological components of occupational stress, was rated at 45.7% using a visual analogue of 0% to 100% (22). Another study found that 71% of cancer care workers working in a radiation oncology inpatient unit (OIU) and 52% of those working in an academic acute palliative care reported increased levels of work-related stress (23). A study in Sydney, Australia found that 92% of radiographers working in private radiography establishments and 88% of those working in public hospitals had occupational stress (24).

The results of the present study showed lower scores for RP knowledge, attitude, and practice predicted higher stress. In addition, the effect of in-service training on occupational stress was significant. In other words, improvement in the participants' KAP on self-protection against radiation was associated with lower rates of stress. Previous research indicated that health care workers who take part in training programs regarding healthy behavior experienced lower stress rates (25). In addition, Reisi et al. confirmed the link between healthcare workers' levels of self-care and sufficient knowledge, positive attitudes, and appropriate practice (KAP) in a study on healthy behaviors (26). However, in some cases, despite appropriate knowledge about healthy behavior, the knowledge was not well translated into self-care (27-29). Miller believed that accidents were predictable when people had adequate knowledge about the factors and conditions influencing their occurrence (30). This predictability is one of the most important factors affecting job stress. Therefore, job stress could be reduced or even prevented when workers have sufficient knowledge about preventive actions, are sufficiently motivated, believe in the relevant skills, and implement necessary skills. In this regard, RP training with an emphasis on the protection of radiation workers would prepare them to encounter radiation at work properly under safe conditions, which would help in managing and overcoming the effects of workplace stress. Kiani et al. examined the relationship between safety training and occupational stress and found that safety training had a significant effect on improved attitudes toward safety at work and decreased perceived job stress (17). Using mediation analysis, they found that the effects of safety training on attitudes toward safety issues reduced job stress.

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Table 6. Results of the Binary Logistic Regression Analysis of Independent Risk Factors Potentially Influencing Job Stress[a]

Variable	Beta	S.E	P Value	OR	95% CI for OR	
					Lower	Upper
Sex (female)	0.56	0.31	0.063	1.75	0.96	3.2
Knowledge	-0.20	0.05	< 0.001	0.82	0.75	0.90
Practice	-0.24	0.05	< 0.001	0.78	0.72	0.86
Attitude	-0.34	0.07	< 0.001	0.71	0.63	0.82
In-service training (yes)	-0.68	0.31	0.02	0.51	0.28	0.93

[a] Total $R^2 = 0.418$

Therefore, improving KAP on self-protection against radiation first depends on planning for the continuing education of a wide range of health professionals, from policymakers, authorities, and executives to radiation workers. Hence, safety protocols are implemented and standards are met. Consequently, the level of self-protection against radiation will improve. Radiation awareness among senior decision makers in the health sector is associated with increases in the quality and quantity of protective equipment, the application of updated techniques, and the setting of safety guidelines and regulations, all of which contribute to a culture of self-care. Second, periodic inspections, unannounced and impromptu supervision, and periodic performance reports would reinforce RP regulations and standards and encourage workers to pay attention to self-protection against radiation.

This study has the following limitations. The cross-sectional design of the study did not allow the examination of a directional relationship between RP-KAP and occupational stress. Therefore, the results should be considered with caution. In addition, before generalizing the results, individual, environmental, and demographic factors should be examined, and the effects of confounding factors should be limited. Furthermore, it is important to emphasize that in several studies, multiple factors were found related to job stress either directly or indirectly. However, this study focused on a limited number of variables. In addition, although radiation workers' job stress and their KAP were assessed separately in earlier surveys, the association between these variables has not been adequately investigated in Iran and in the world. Therefore, the results of the present study need to be replicated in further studies and supported by empirical research. Nonetheless, because of the limited number of studies in this field, this study contributed to the research in this area. The authors hope that the results of this study will encourage other researchers to conduct longitudinal studies to assess the link between increased RP-KAP and lower levels of job stress. It then would be possible to identify the most appropriate interventions to prevent and limit the adverse consequences of job stress among radiation workers. The close collaboration of occupational physicians and radiology professionals is needed to conduct a precise data analysis, which would guarantee an appropriate intervention, if it were required. Interventions aimed at psychological health promotion should be included in RP education and training and periodic monitoring should be conducted with the goal of improving the mental and physical health of radiation workers. Interventions would ensure that a safe environment and promote radiation workers' psychological health.

In conclusion, health care workers in radiation settings of hospitals affiliated with TUMS experience considerable occupational stress. In this study, RP-KAP on self-protection against ionizing radiation adversely influenced occupational stress. Planning for continued education based on the personnel's educational needs, assessment of their beliefs, and monitoring their performance could be effective in reducing or controlling job stress.

Footnotes

Authors' Contribution: S. Shohreh Alavi, was the main investigator and performed the literature review manuscript preparation; Sima Taghizadeh Dabbagh, managed the study and contributed to the study by designing the research strategy and the literature review; Mahya Abbasi, managed the acquisition of data and contributed to the study design and writing of the first draft. Ramin Mehrdad, contributed to the analysis and interpretation of the data. The correspondent author was Sima Taghizadeh Dabbagh.

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lection, management, analysis of the data, or the preparation, review, and approval of the study.

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