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Burnout syndrome, anxiety, and depression symptoms among workers in radiation field

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Abstract

Background Job burnout is defined as physical, emotional, and mental exhaustion due to persistent work stress, and it includes emotional exhaustion (EE), cynicism (CY), and reduced personal accomplishment (PA) and usually leads to symptoms of depression, lack of motivation, and decreased enthusiasm. Previous studies from different countries have suggested that job burnout, depression, and anxiety are a common work-related problems. This study aims to assess for job burnout, depression, and anxiety among radiation workers in order to investigate the effects of radiation exposure during work on the mental health. This comparative cross-sectional study was performed on 208 workers in the Egyptian Atomic Energy Authority (EAEA) and the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA) at Cairo Governorate, Egypt. Study participants were divided into 2 groups: 1st group which included 104 workers among radiation field and 2nd group which included 104 workers and employees who do not often work among radiation field. Maslach Burnout Inventory Scale (MBI), Hamilton Rating Scale for Depression (HAM-D), and Hamilton Rating Scale for Anxiety (HAM-A) were used to assess for burnout, depression, and anxiety among study participants.

Results The prevalence and severity of depression, anxiety, burnout, and among workers inside radiation field group were statistically significantly higher than those working outside radiation field group. Work type (WIRF) and number of working hours per week (> 40 h) were the significant risk factors for all the burnout, depression, and anxiety, while age (> 40–60 years old) was a significant predictor for depression, female gender was a significant predictor for anxiety, and both age (20–40 years old) and years of experience (≤ 10 years) were significant predictors for burnout among workers inside radiation field.

Conclusions Burnout, depression, and anxiety are common among workers inside radiation field with higher prevalence and severity than those working outside radiation field. Younger age, fewer years of experience, and more working hours per week are significantly associated risk factors for burnout among workers inside radiation field.

Keywords Burnout, Depression, Anxiety, Radiation workers, Egypt

Background

Stress at work is common, and stress-related conditions may lead to mental illness and occupational dysfunction [1]. Work stress may lead to anxiety, depression and job burnout among working populations which in turn have down growing in the effect of negative working problems [2, 3], and many studies have confirmed the occurrence of burnout in different jobs [4, 5, 6]. Bianchi et al. [7] reported a great overlap between burnout and depression in a major review.

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Burnout is a three-dimensional syndrome, which includes emotional exhaustion (EE) depersonalization (DP), and reduced personal accomplishment (PA) caused by sustained job stress [8, 9]. It has serious effects on the physical and mental health, work efficiency [10] and serious socio-economic impact in terms of decreased level of productivity, high resignation rate, and premature retirement [11], so researchers all over the world become concerned about it as an occupational health problem.

Radiation is considered as a risk factor for negative consequences on physical health as it may cause high risk of cancer, cardiovascular diseases, and cataract [12, 13]. The recent improvement of health services leads to increase in the use of radioisotopes and ionizing radiation in diagnosis and treatment [14].

The World Health Organization (WHO) and the International Labour Organization (ILO) have concerned about the physiological and psychological risks of prolonged exposure of radiation with low dose [15, 16].

Psychosocial problems usually occur before physical diseases, and there is often a lack of attention and intervention to assess those problems [17].

Among radiation workers, studies have found that job stress, anxiety, and depression were prevalent and much higher than in the general population [1, 18–22]. Long-term radiation exposure in this occupational group also aggravates the psychological burden, job stress, and job burnout [23].

Few studies have investigated job stress and burnout of radiation staff in different work roles using validated scales [24]. This study aims to estimate the prevalence and identify associated risk factors of burnout, depression, and anxiety among workers inside radiation field compared to those workers outside radiation field.

Methods

Study design and sampling

This comparative cross-sectional study was performed on 208 workers in the Egyptian Atomic Energy Authority (EAEA) and the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA) at Cairo Governorate, Egypt. The study was done during a period from February 2019 until January 2021. Workers in EAEA and ENRRA of both sexes, who aged from 25 to 60 years old and accepted to participate, were included in the study. Those who had a past history of medical and psychiatric disorders, had a cognitive disorder, age above 60 years, or refused to participate were excluded from the study. Participants in the study were divided into 2 groups: 1st group which included 104 workers inside radiation field (WIRF) and 2nd group which included 104 workers and employees who do not often work in radiation field, workers outside radiation field (WORF). Ethical approval for this study

was obtained from the Institutional Review Board (IRB) in the Faculty of Medicine, Zagazig University, and from publishing committee in Egyptian Nuclear and Radiological Regulatory Authority. All participants freely agreed to participate in this study, and consent was taken from them after discussing the aim of the study with them.

All participants were subjected to a semi-structured questionnaire which was designed to collect the following: sociodemographic data (which included age, sex, and marital status) and occupational data (work type, number of working hours per week, and years of experience).

Data collection and assessment tools

Psychometric assessment was done to assess burnout, depression, and anxiety using the following:

- 1) Maslach Burnout Inventory scale (MBI): Used to assess dimensions of burnout syndrome, emotional exhaustion (EE), depersonalization (DP), and reduced personal accomplishment (PA). The scale contains 22 items divided into the 3 subscales. The items are written in the form of statements about personal feelings or attitudes. The answers range in frequency from 0 (never) to 6 (everyday). Fifty-four, 48, and 30 are total scores for EE, for PA, and for DP. $EE \geq 27$, $PA \leq 21$, and $DP \geq 13$ indicated high burnout; EE 17–26, PA 38–22, and DP 7–12 indicated moderate burnout; and EE was ≤ 16 , PA was ≥ 39 , and DP was ≤ 6 indicated low burnout [25, 26]. The Arabic version of this inventory used in this study was previously validated and recorded with a Cronbach's alpha for the three subscales being the following: 0.88 for EE, 0.78 for DP, and 0.89 for PA.
- 2) Hamilton Rating Scale for Depression: Used to assess the severity of depression. The original version contains 17 items (HDRS17) pertaining to symptoms of depression experienced over the past week. Each element in the questionnaire is scored on a scale of 3 points (0, 1, 2) or 5 points (0, 1, 2, 3, 4), and the severity of depression is scored as follows: (0–7) means no obvious depression, (8–13) mild depression, (14–18) moderate depression, (19–22) severe depression, and (above 23) extremely severe depression, which needs hospitalization [27, 28]. We used Arabic version of this scale in the study.
- 3) Hamilton Rating Scale for Anxiety (HAM-A): Is used to rate the severity of anxiety. The scale consists of 14 items containing a number of anxiety symptoms, and each item is rated on a scale of 0 to 4 (0=no symptoms to 4=severe symptoms). The total score indicates anxiety severity (0–17=mild anxiety, 18–24=moderate anxiety, 25–30=severe anxiety, and above 30=extremely severe) [29–31]. Arabic version was used at this study.

Statistical analysis

SPSS program (Statistical Package for Social Science) version 16.0 was used for statistical analysis of data at this study. Comparison of qualitative data was done using chi-square test (χ^2) and Fisher’s exact, while Student’s *t*-test was used for comparison of quantitative data. Binary logistic regression analysis was done to detect the predictors of each scale. *p*-value < 0.05 is considered statistically significant.

Results

Two-hundred eight workers were included at this study, 104 were working inside radiation field (WIRF group), and 104 were working outside radiation field (WORF group). The mean age of WIRF group was 37.4 ± 8.7 which was nonsignificantly lower than 39.2 ± 9.2 for WORF group. Most of subjects in both groups (67.3%, 54.8%; in WIRF and WORF respectively) were males. A total of 65.4% of WIRF group were married compared to 56.7% in WORF group, but this difference was non-statistically significant. WORF group tended to have higher work experience (11.44 ± 3.85) years compared to WIRF group (9.31 ± 2.56 years) which was non-statistically significant. WIRF group has statistically significant longer work hours (82.7%) than WORF group (30.8%) (Table 1).

Table 2 illustrates that the prevalence and severity of depression, anxiety, and burnout among WIRF Group were statistically significantly higher than WORF group. There is a statistically significant difference between the studied groups in components of Maslach Burnout Inventory as workers among radiation field had higher emotional exhaustion (32.3 ± 12.9 VS 24.8 ± 13.5), depersonalization (7.8 ± 4.1 VS 6.7 ± 3.2), and lack of accomplishment (26.2 ± 9.3 VS 20.3 ± 11.8) than employees outside radiation field (Table 3).

Statistically significant association was found between burnout syndrome and both depression and anxiety (*P* = 0.000). Moderate and severe depression were associated with severe and very severe burnout syndrome. Very severe burnout syndrome was associated with the absence of anxiety, while severe burnout syndrome was associated with moderate anxiety as shown in Table 4.

Regarding the relationship between sociodemographic and work-related data of both groups and scores of all psychometric scales used, there was statistically significant association between working hours per week and high scores of all scales (Table 5). Binary logistic regression analysis revealed that work type (WIRF) and working hours per week (> 40 h) were significant risk factors for all the burnout, depression, and anxiety, while age (> 40–60 years old) was a significant predictor for depression. Female gender was a significant predictor for anxiety, and both age (20–40 years old) and years of experience (≤ 10 years) were significant predictors for burnout (Table 6).

Table 1 Sociodemographic characteristics and occupational history among both studied groups

Items	WIRF (n = 104) No. (%)	WORF (n = 104) No. (%)	p-value
Age (years)			
20–40	50 (48.1)	44 (42.3)	0.403
> 40–60	54 (51.9)	60 (57.7)	
Mean ± SD	37.4 ± 8.7	39.2 ± 9.2	
Range	26.0–60.0	24.0–57.0	
Gender			
Male	70 (67.3)	57 (54.8)	0.065
Female	34 (32.7)	47 (45.2)	
Marital status			
Married	68 (65.4)	59 (56.7)	0.201
Unmarried#	36 (34.6)	45 (43.3)	
Years of experience			
≤ 10 years	43 (41.3)	54 (51.9)	0.126
> 10 years	61 (58.7)	50 (48.1)	
Mean ± SD	9.31 ± 2.56	11.44 ± 3.85	
Range	1.0–26.0	1.0–27.0	
Work hours/week			
40 h	18 (17.3)	72 (69.2)	0.000*
> 40 h	86 (82.7)	32 (30.8)	

Unmarried including single, divorced, and widower. Significance at **p* < 0.01

Table 2 Prevalence and severity of depression, anxiety, and burnout among both studied groups

Variables	Severity	WIRF (n = 104) No. (%)	WORF (n = 104) No. (%)	P
Depression	No	30 (28.9)	49 (47.1)	0.000*
	Mild	20 (19.2)	28 (26.9)	
	Moderate	26 (25.0)	20 (19.2)	
	Severe	28 (26.9)	7 (6.7)	
Anxiety	No	44 (42.3)	75 (72.2)	0.000*
	Mild	24 (23.1)	17 (16.3)	
	Moderate	22 (21.2)	10 (9.6)	
	Severe	14 (13.4)	2 (1.9)	
Burnout	No	10 (9.6)	27 (25.9)	0.000*
	Mild	8 (7.7)	30 (28.8)	
	Moderate	24 (23.1)	26 (25.0)	
	Severe	62 (59.6)	21 (20.2)	

Significance at **p* < 0.01

Discussion

Many previous studies have reported that work stress is a risk factor for negative physiological and psychological reactions [23, 32, 33]. Burnout refers to a constellation of symptoms, including a loss of enthusiasm for work, a high degree of emotional exhaustion, high degree of

Table 3 Components of Maslach Burnout Inventory among both studied groups

Items	WIRF (n = 104) Mean ± SD	WORF (n = 104) Mean ± SD	p-value
Exhaustion	32.3 ± 12.9	24.8 ± 13.5	0.000**
Depersonalization	7.8 ± 4.1	6.7 ± 3.2	0.04*
Lack of accomplishment	26.2 ± 9.3	20.3 ± 11.8	0.000**

Significance at *p < 0.05, **p < 0.01

depersonalization, and a low sense of personal accomplishment [34, 35]. Radiologists are experiencing high rates of burnout, and this trend has only become worse over the years [36]. This study aimed to assess for burnout, depression and anxiety, and their predictors among

workers inside radiation field compared to those working outside radiation field in the Egyptian Atomic Energy Authority (EAEA) and the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA) at Cairo Governorate, Egypt.

At the current study, the prevalence and severity of depression, anxiety, and burnout among WIRF group were statistically significantly higher than WORF group. A total of 7.7%, 23.1%, 36.5%, and 23.1% of workers among radiation field had mild burnout syndrome, moderate burnout Syndrome, severe burnout syndrome, and very severe burnout syndrome, respectively. There was a statistically significant difference between group 1 and group 2 in components of Maslach Burnout Inventory as workers inside radiation field (WIRF) had higher levels of exhaustion, depersonalization, and

Table 4 Association between burnout syndrome and depression and anxiety among WIRF

Variables	Severity	Burnout syndrome				P
		No & mild	Moderate	Severe	Very severe	
		No. (%)	No. (%)	No. (%)	No. (%)	
Depression	No	17 (56.7)	10 (33.3)	3 (10.0)	0 (0.0)	0.000*
	Mild	1 (5.0)	14 (70.0)	5 (25.0)	0 (0.0)	
	Moderate	0 (0.0)	0 (0.0)	18 (69.2)	8 (30.8)	
	Severe	0 (0.0)	0 (0.0)	12 (42.9)	16 (57.1)	
Anxiety	No	7 (15.9)	8 (18.2)	8 (18.2)	21 (47.7)	0.000*
	Mild	4 (16.7)	11 (45.8)	9 (37.5)	0 (0.0)	
	Moderate	3 (13.6)	2 (9.1)	14 (63.7)	3 (13.6)	
	Severe	4 (28.6)	3 (21.4)	7 (50.0)	0 (0.0)	

Significance at *p < 0.01

Table 5 Relationship between sociodemographic and work-related data of groups and depression, anxiety, and burnout

Factors	Depression		P	Anxiety		P	Burnout		P
	WIRF (n = 74)	WORF (n = 55)		WIRF (n = 60)	WORF (n = 29)		WIRF (n = 94)	WORF (n = 77)	
Age (years)									
20–40	26 (40.5)	33 (60.0)	0.005**	41 (59.7)	18 (36.9)	0.558	44 (46.8)	22 (28.6)	0.015*
> 40–60	48 (59.5)	22 (40.0)		19 (40.3)	11 (63.1)		50 (53.2)	55 (71.4)	
Gender									
Male	45 (60.8)	21 (38.2)	0.011*	35 (58.3)	10 (34.5)	0.035*	64 (11.9)	42 (18.8)	0.069
Female	29 (39.2)	34 (61.8)		25 (41.7)	19 (65.5)		30 (88.1)	35 (81.2)	
Marital status									
Married	42 (56.7)	35 (63.6)	0.431	42 (70.0)	17 (58.6)	0.287	60 (71.4)	37 (68.8)	0.038*
Unmarried#	32 (43.2)	20 (36.4)		18 (30.0)	12 (41.2)		34 (28.6)	40 (31.2)	
Years of experience									
≤ 10 years	28 (37.8)	31 (56.4)	0.037*	40 (66.7)	16 (55.2)	0.293	40 (78.6)	47 (68.8)	0.016*
> 10 years	46 (62.2)	24 (43.6)		20 (33.3)	13 (44.8)		54 (21.4)	30 (31.2)	
Work hours/week									
40 h	3 (4.1)	40 (72.7)	0.000**	2 (3.3)	20 (69.0)	0.000**	10 (10.6)	47 (61.0)	0.000**
> 40 h	71 (95.9)	15 (27.3)		58 (96.7)	9 (31.0)		84 (89.4)	30 (39.0)	

Unmarried including single, divorced, and widower. Significance at *p < 0.05, **p < 0.01

Table 6 Binary logistic regression analysis showing the most significant risk factors of depression, anxiety, and burnout

Variables	SE	Wald	Sig	Odds ratio (95% CI)
Depression				
Age (> 40–60 years old)	1.21	3.83	0.032*	1.59 (1.12–4.23)
Gender (female)	0.77	0.58	0.770	0.49 (0.12–3.09)
Years of experience (\leq 10 years)	1.83	1.07	0.831	0.44 (0.07–2.92)
Work hours/week (> 40 h)	0.43	3.09	0.040*	2.37 (1.23–4.65)
Type of work (WIRF)	0.06	5.43	0.007**	5.31 (1.83–8.09)
Anxiety				
Gender (female)	0.23	3.22	0.002**	0.66 (1.09–2.23)
Work hours/week (> 40 h)	0.83	1.09	0.023*	1.52 (1.02–4.32)
Type of work (WIRF)	1.14	2.53	0.045*	2.53 (1.98–5.09)
Burnout				
Age (20–40 years old)	1.09	3.43	0.042*	1.82 (1.12–4.09)
Marital status (married)	0.84	4.22	0.087	3.87 (0.76–6.12)
Years of experience (\leq 10 years)	0.22	1.48	0.006**	1.89 (1.27–3.56)
Work hours/week (> 40 h)	1.37	4.09	0.021*	2.14 (1.05–4.13)
Type of work (WIRF)	0.76	4.86	0.031*	1.74 (1.20–3.98)

Significance at * $p < 0.05$, ** $p < 0.01$

lack of accomplishment than employees outside radiation field. Those high levels may be due to identified high workload and staff shortages, interpersonal conflict, and technology as key sources of stress in the radiation work environment.

In line with our study, burnout among radiologists was well documented internationally. High emotional exhaustion (EE) and high depersonalization (DP) and low personal accomplishment (PA) have been reported among radiation workers at different countries [23, 37–43] reported that 32.88%, 24.43%, and 6.02% of medical radiation workers at China had mild, moderate, and severe burnout.

In support with our study, a study by Singh et al. (2017) revealed that the majority of workers inside radiation field (87.4 to 100%) had higher burnout scores than workers outside radiation field.

The current study showed statistically significant differences between the studied groups in depression and anxiety, as workers inside radiation field had higher prevalence of depression and anxiety (25% had moderate depression, 26.9% had severe depression, 21.2% had moderate anxiety, 13.4% had severe anxiety) than employees outside radiation field (19.2% had moderate depression, 6.7% had severe depression, 9.6% had moderate anxiety, 1.9% had severe anxiety). Older age and female sex were significant predictors for depression and anxiety respectively, while more working hours per week were significant predictors for both depression and anxiety among workers inside radiation field.

Our results were supported by previous studies of [19, 44, 45] that reported that workers with radiation had high prevalence of depression and anxiety.

Radiologists and radiotherapists are exposed to significant risk factors at their work as high workloads or organizational difficulties [19], seeing patients suffering [46], financial problems [47], or fear of occurrence of malpractice or errors [48]. Radiologists are considered to have the higher levels of work-related stress than other medical specialties [19, 20]. Research has indicated that radiographers feel they have little autonomy in the radiology clinic, and other health professionals concur with the radiographers' perception [49, 38].

This study found statically significant association between burnout and depression and anxiety among workers at radiation field. Many researchers have reported high association between burnout and depression, so this suggests an overlap, and that burnout may not be a separate psychological disorder but a continuum of depression [50, 51] suggested that there is an overlap between burnout and depression, or burnout may lead to developing of depression. Bakusic et al. (2017) reported that there is a common biological basis between burnout and depression. Also, researchers suggested that work-related stress may be a risk factor for anxiety symptoms [52]. Similarly, [53] found a positive correlation between emotional exhaustion and cynicism and anxiety symptoms and negative correlation between professional efficacy and anxiety symptoms.

In addition, the current study showed statistically significant association between burnout syndrome and age, sex,

job satisfaction, years of experience, and working hours per week. After binary logistic regression, younger age (20–40 years old), less years of experience (≤ 10 years), and more working hours/week (> 40 h) were the most significant predictors for burnout among working in radiology field.

Regarding the association between sociodemographic factors and burnout, our results were consistent with previous studies that showed that younger physicians (e.g., younger than 50 years old) had experienced higher burnout [54–56]. These are somewhat expected results indicating that the initial years of the career may be the most challenging years [57].

Also, consistent with our results, several studies found that fewer years of experience correlated with higher burnout risk [9, 33, 39, 57, 58] reported that increased residency years were associated with higher burnout among radiology residents.

Numerous studies have reported that increasing workload is one of the leading sources of job-related stress, psychological distress, and fatigue [58–62].

Similar to our findings, more working hours were the key contributor to burnout among radiologists at previous studies [4, 34, 57, 63]. Studies also reported that radiologists working a higher number of night shifts might be at a higher risk of burnout [57, 64].

In contrast to our results, [4, 34] reported that there were no statistically significant associations between radiologists' burnout scores and any of the demographic variables investigated. The results of [35] showed that being a female, had senior professional title, more radiation working years, and working at nuclear medicine and radiotherapy are related to burnout among radiation staff.

Social and occupational medicine should offer good prevention and intervention of occupational health management for workers with radiation. Promoting physical examination, estimating personal dose of radiation, concern with working environment safety, suitable management of workload and working hours, and frequent education about occupational health are recommended for improving workers' coping ability and awareness about self-protection in prolonged radiation exposure and thereby reducing the job stress [23].

Limitations

This study had several limitations. First, this study, as all survey studies, is prone to response bias. In addition, data were collected from only two places, so our results cannot be generalized. Also, this study is a cross-sectional study, so we are unable to prove causation. Also, some risk factors that may significantly predict burnout were not included in the study. Although these limitations, our study provides valuable data about burnout, depression

and anxiety rates and risk factors that can predict them among radiation workers. The understanding of the interaction between burnout, depression and anxiety, and their predictors can help to determine the source causes of them in radiologists and manage them effectively.

Conclusions

Burnout syndrome, depression, and anxiety are common among workers inside radiation field with higher prevalence and severity compared to workers outside radiation field. Younger age, fewer years of experience, and more working hours per week were significant predictors of burnout. Older age and increased working hours per week were significant predictors of depression, while female sex and increased working hours were significant predictors of anxiety among workers inside radiation field. Burnout was significantly associated with depression and anxiety.

Abbreviations

EE	Emotional exhaustion
CY	Cynicism
PA	Personal accomplishment
EAEA	Egyptian Atomic Energy Authority
ENRRA	Egyptian Nuclear and Radiological Regulatory Authority
MBI	Maslach Burnout Inventory Scale
HAM-D	Hamilton Rating Scale for Depression
HAM-A	Hamilton Rating Scale for Anxiety
WIRF	Workers inside radiation field
WORF	Workers outside radiation field

Acknowledgements

The authors would like to thank all participants of the study.

Authors' contributions

RS, NA, and DE were responsible for the conceptualization and work design and original draft; RA was responsible for collection of data and writing; EF contributed in writing, revising the manuscript, and editing and helped in the interpretation of data, formal analysis, and editing; and lastly, SA was responsible for the process of general editing and final revision. All authors have approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

After explaining the study's objectives, all participants provided their informed consent. Our research was created to follow the guidelines developed by the Zagazig University's Research Ethical Committee, and their approval for the study was granted.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 15 June 2024 Accepted: 22 July 2024
Published online: 06 September 2024

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