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The effect of occupational burnout on cognitive failure and general health in industrial workers (case study: Iran Tire Factory)

BACKGROUND

Human resources are the most important organizational resources and play the most important role in the production and productivity cycle. Considering the importance of people's health and the study of their burnout as a possible cause of occupational cognitive failures, this study aimed to investigate the relationship between burnout, cognitive failure, and general health.

PARTICIPANTS AND PROCEDURE

A cross-sectional-analytical study was conducted in Iran Tire Factory. The statistical population of this study was 302 personnel who were randomly selected. Data were collected by four valid questionnaires (demographic information, Maslach burnout, cognitive failure, and general health questionnaire). Then data were analyzed using SPSS software.

RESULTS

The results of the analysis revealed a significant and direct relationship between burnout and cognitive failure

($p < .001$), and a significant inverse relationship was found between cognitive failure and physical health ($p = .022$). The other results showed that emotional exhaustion and depersonalization dimensions are significantly associated with cognitive failure ($p < .001$, $p = .016$).

CONCLUSIONS

According to the results of this study, burnout causes cognitive failures among factory personnel and on the other hand, cognitive failures affect the physical health of individuals and lead to deterioration of physical health, which in turn can reduce a person's performance and reduce work efficiency.

KEY WORDS

emotional exhaustion; cognitive failure; general health; job burnout

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BACKGROUND

In the workplace, five categories of physical, chemical, biological, ergonomic, and psychological factors as occupational hazards threaten employees (Nankongnab et al., 2020). Stress is considered the most important psychological factor affecting health. Stress is the sum of the body's physical, mental and behavioral reactions against factors that disrupt natural stability and balance. Any stimulus that causes stress is known to be a stressor. If a person cannot cope with stressors, he will suffer from many physical, psychological, and behavioral complications. One of the most critical outcomes of continued stress is burnout (Moalemi et al., 2018).

Occupational burnout could be the result of long-term exposure to high job demands, e.g. time pressure (Hulsegge et al., 2020), and refers to physical or mental exhaustion (Lu et al., 2020). As defined by Maslach and Jackson (1986), burnout consists of three dimensions: emotional exhaustion, such as diminished emotional resources, depersonalization, and decreased personal accomplishment or the peak of feelings of inadequacy (Dinibutun, 2020; Jia et al., 2021; Pellerone et al., 2020). Emotional exhaustion is the sense in the operators of being worn out and exhausted emotionally. Also, it is the sense of being burdened by the situation. Depersonalization can be defined as an indifferent, cold, inflexible, or even ruthless attitude toward co-workers. The person engages in degrading and rude behavior and ignores the calls and requests of colleagues. Personal accomplishment is the eligibility and psychological senses of success. Individual inadequacy means that one recognizes oneself as incompetent and ineffective in one's career. In this period, the person is personally full of feelings of failure (Dinibutun, 2020). According to Maslach, burnout is caused by anxiety and fear of losing a job, overwork, an unsafe work environment and inflexible planning (Ahola et al., 2010).

Burnout is affected by many agents such as the nature of the job, unfavorable working conditions, conflict and confusion in the role, injustice against experienced people, job uniformity, extreme workload, type of supervision, lack of communicative support, organizational settings, and working times (Ahola et al., 2010; Maslach & Leiter, 2008). People with burnout have reported specific attention-related problems (for example, not focusing while reading instructions or focusing on a complex problem or task). They show that burnout is specifically connected with voluntary control or execution problems during the attention process. Given the fact that burnout is caused by chronic job stress, the cognitive deficits observed among staff with burnout are not unexpected. Chronic stress can have negative effects on the brain (Koutsimani et al., 2021). Burnout and

its effects are not yet fully understood. It is assumed that long-term exposure to stress negatively affects the regulation of stress hormones and specific areas of the brain, especially the prefrontal cortex (Qin et al., 2009). This area is involved in working memory processing (Kiefer et al., 1998). People with burnout also often complain about attention problems (Van Der Linden et al., 2005), and they often have difficulties with concentration and memory (Horvat & Tement, 2020).

In a study on teachers, researchers reported that the symptoms of burnout are reflected in the face of work stress, and it can be expected that this syndrome not only affects work motivation and work-related activities but it can also affect the processing of information (Van Der Linden et al., 2005).

According to the theory of mind speed, information processing and information processing speed are among the most important bases of cognitive abilities that affect cognitive high-level abilities and cognitive function in the real world such as school, university and job performance. Processing speed may directly or indirectly affect cognitive performance in the real world through intelligence and creativity (Rindermann & Neubauer, 2004).

We cannot process all the information that reaches our sensory organs all the time. It is important to be able to select the information that is most important for our current purposes and to exclude other information from the analysis cycle (James, 1890).

Selective attention increases with the entry of relevant information and the suppression of irrelevant information. This process is not always successful and leads to cognitive errors or cognitive failures. The frequency of cognitive failure varies from person to person (Sandberg et al., 2014). People with experience of various cognitive failures in their regular lives may be more vulnerable to health impairment in stressful situations. Cognitive factors are linked to adverse psychological responses in stressful conditions, but the causality has not been precisely explained (Bridger et al., 2013). At present, the factors that increase the likelihood of cognitive failures are not well understood; these failures are the same errors that occur in everyday tasks that we often do without error (Elfering et al., 2011). An investigation of accidents showed that more than 90% of industrial accidents are related to human error. Human errors are cognitive errors that occur during a task that a person can usually perform without error. These errors occur in various cognitive domains such as memory, attention, and action (Van Der Linden et al., 2005). Cognitive failures are termed a slip in performance, a slip in attention (failure in comprehension), a slip in memory (slips in information retrieval), and a slip in action (Farshad et al., 2013). Cognitive deficits are perceived as an enduring feature such as construction and experimental work. In

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particular, a cognitive failure is described as a failure in cognitive functions that results in a cognitive error or mistake in performing a person's task that he or she can naturally perform, and some people are more prone to failure (Wallace & Vodanovich, 2003). Everyday cognitive functions include daily slipping and attention and memory errors such as forgetting assignments, forgetting names, not paying attention to traffic signs or work instructions and marked movement paths; these errors often involve daily cognitive failures (Boals & Banks, 2012). Understanding the factors related to cognitive failure of employed people is very important. Van Der Linden et al. (2005) found in a study that the symptoms of severe burnout were associated with many of their reported cognitive failures (Elfering et al., 2011). This finding supports previous clinical observations, which have shown that people with burnout face difficulties in paying attention to their daily tasks (Keijsers, 2001; Schaufeli & Enzmann, 1998). Past studies on patients with stress and burnout have shown that burnout can negatively affect cognitive function (Jonsson et al., 2013, 2017; Sandström et al., 2005). In this study we focus on burnout in industrial workers and its relationship to cognitive job failures and general health. Despite safety equipment and engineering measures, accidents and near misses still occur and psychological factors play a significant role in the occurrence of these accidents and quasi-accidents. This research project was carried out in a tire factory to assess psychosocial factors could affect worker safety and general health. Considering the importance of investigating the effective causes of cognitive errors as an important factor in personnel safety and health, we decided to conduct this study. The main objective was to investigate the relationship between burnout, cognitive failure and general health in Iran Tire Factory. In this study, the main question was, Is there a link between workers' burnout and cognitive failure and their general health?

PARTICIPANTS AND PROCEDURE

SAMPLE SIZE AND SAMPLING METHOD

This research was a cross-sectional-analytical study conducted in 2020. In this study, considering the specific size of the target population, which was 1400 people, Cochran's sample size formula was used to determine the sample size. According to Morgan's formula, the sample size was 302 people (Formula 1). After designing this research, it was reviewed and approved by the ethics committee of the Iran University of Medical Sciences (ethics code: 32671-193-01-97). After receiving the approval of the ethics committee, determining the sample size and

obtaining the informed consent of the workers, we reviewed the workers' medical records and workers who did not meet the inclusion criteria were excluded. Then, based on the random sampling method, the subjects were selected. The inclusion criteria were no history of specific illness (mental illness and other neurological disorders), lack of experience of tragedy in the last 2 years (divorce or death of loved ones), being interested in participating in the study and spending time completing the questionnaires.

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N} (\frac{z^2 pq}{d^2} - 1)} = 302 \quad (\text{Formula 1})$$

N = size of the target population = 1400

d = permissible error level = 0.05

z = value of normal variable with 95% confidence level = 1.96

p is the (estimated) proportion of the population which has the attribute in question = 0.5

q is 1 - p = 0.5

ASSESSMENT TOOLS

Four questionnaires were used to conduct this research.

Demographic characteristics questionnaire. This questionnaire included the items gender, marital status, age, level of education and work experience.

Maslach Burnout Inventory - General Survey (MBI-GS). This questionnaire consists of 22 items that measure emotional exhaustion, depersonalization phenomena and personal accomplishment in the context of professional activity (Schaufeli et al., 1996). The validity and reliability of the tool in Iran were examined and approved by Moalemi et al. (2018). Cronbach's α was .75.

General Health Questionnaire (GHQ). The 28-item General Health Questionnaire was presented by Goldberg and Hillier (1979), has 4 subscales, and each scale has 7 questions. These scales are: the Physical Health Scale, the Anxiety Scale, the Social Functioning Scale and the Depression Scale (Jalilian et al., 2020). Taghavi (2002) assessed the validity of the questionnaire through retesting and Cronbach's α , which obtained validity coefficients of .70 and .90, respectively, and the results showed that this questionnaire has sufficient validity.

Cognitive Failure Questionnaire. This questionnaire contains 30 questions whose validity and reliability were confirmed by Hassanzadeh-Rangi et al. (2014). The results of the validity and reliability of this questionnaire showed that the content validity index of the final questionnaire is 0.7 which is acceptable. Hassanzadeh-Rangi et al. (2014) propose 4 dimen-

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sions for this questionnaire. Job Cognitive Failure Questionnaire is a self-report tool. In this questionnaire, information is provided about the nature and components of cognitive failures in the workplace. This questionnaire includes questions appropriate to the three dimensions of cognitive failure (attention, memory and action). In this tool, there are questions such as: How many times have you not remembered the steps or time sequence of a job? How often do you find that when you start a task, you find that you are not wearing the protective gear you need? How often have you ignored warning signs such as traffic lights, voicemails, etc.? How often are you distracted while reading an instruction? How many times have you accidentally hit an object or person while traveling in the workplace? How many times have you accidentally turned a device on or off? (Farshad et al., 2013). In this study, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed to test the theoretical structure of the cognitive failure questionnaire, examine its internal reliability, and test the hypothesis that a relationship between the observed variables and their underlying latent constructs exists.

STATISTICAL ANALYSES

After determining the study tool, the data were collected using a query method and a report with their own approach and their information was analyzed using SPSS.22 software. In this study, descriptive statistics and analytical methods (Pearson correlation test, independent *t*-test and analysis of variance) were used at the 95% confidence level and a *p*-value of $< .05$ was considered statistically significant. In this study, EFA with varimax rotation and enforcing four-factor solution using the principal component analysis extraction method was first performed to test the theoretical structure of the cognitive failure questionnaire and examine its internal validity reliability. CFA was then conducted to test whether a relationship between observed variables and their underlying latent constructs exists. In order to investigate the four-factor models' goodness of fit, several statistics were used: relative chi-square (chi-square goodness of fit statistic/degrees of freedom), root mean square error of approximation (RMSEA), comparative fit index (CFI), and incremental fit index (IFI).

Table 1

Comparison of cognitive failure scores at different levels of demographic variables

Variables	Frequency (%)	<i>M</i>	<i>SD</i>	<i>p</i>
Age (years)				
< 30	14.3	101.98	22.11	.926
30-40	39.2	100.55	21.58	
≥ 40	46.5	101.00	18.83	
Work experience (years)				
< 5	13.3	104.93	21.55	.010
5-10	19.3	106.02	17.94	
10-15	38.9	96.37	21.12	
≥ 15	28.6	101.95	19.28	
Marital status				
Single	11.6	96.17	22.88	.139
Married	88.4	101.59	19.97	
Level of education				
High school	9.0	95.29	25.41	.115
Diploma	56.8	100.16	20.69	
Academic studies	34.2	103.77	17.99	

RESULTS

After completing the initial review, a total of 302 people completed the questionnaires. The results of the EFA suggested that four factors explained over 70% of the variance. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.89, indicating that the sample was adequate. Bartlett's test of sphericity gave a *p*-value $< .001$, indicating that the data's four-factor structure is appropriate. Also, goodness-of-fit statistics showed a very good fit, with RMSEA = 0.048 (below 0.05), relative $\chi^2 = 1.8$ (below 3), CFI and IFI = 0.96, which are above 0.95. Demographic analysis of the statistical sample showed that most of the participants in the study (56.8%) had education at the diploma level, and about 34.2% had a higher level of education. The mean and standard deviation of the age of the subjects were 38.48 ± 7.52 years. Also, in this study, 46.5% of the subjects were over 40 years old. The mean and standard deviation of work experience were 11.71 ± 5.77 years; most subjects had 10 to 15 years of work experience. 88.4% of the participants in this study were married, and 11.6% were single. After examining the normality of data and assumptions of one-way analysis of variance (ANOVA), analysis of variance showed that there was no significant relationship between job cognition failure score and demographic variables such as age and different educational levels, while we found a significant relationship between cognition failure and work experience. Also, the independent *t*-test showed no significant relationship

Table 2

Comparison of burnout scores at different levels of demographic variables

Variables	Frequency (%)	M	SD	p
Age (years)				
< 30	14.3	82.00	12.15	.264
30-40	39.2	84.18	13.76	
≥ 40	46.5	85.48	11.34	
Work experience (years)				
< 5	13.3	80.90	12.42	.010
5-10	19.3	87.26	12.15	
10-15	38.9	84.42	12.98	
≥ 15	28.6	84.33	11.73	
Marital status				
Single	11.6	82.86	15.68	.102
Married	88.4	84.68	11.99	
Level of education				
High school	9.0	75.71	13.84	< .001
Diploma	56.8	86.12	12.22	
Academic studies	34.2	84.04	11.59	

Table 3

Comparison of general health scores at different levels of demographic variables

Variables	Frequency (%)	M	SD	p
Age (years)				
< 30	14.3	21.54	9.58	.018
30-40	39.2	24.69	11.55	
≥ 40	46.5	26.78	10.69	
Work experience (years)				
< 5	13.3	22.65	9.98	.271
5-10	19.3	27.11	9.02	
10-15	38.9	25.06	11.05	
≥ 15	28.6	25.35	12.45	
Marital status				
Single	11.6	20.94	8.99	.014
Married	88.4	25.78	11.13	
Level of education				
High school	9.0	27.04	15.71	.662
Diploma	56.8	25.11	10.38	
Academic studies	34.2	24.93	10.61	

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between marital status and cognitive failure score (Table 1). The relationship between burnout and demographic variables revealed that burnout has a significant association only with the education level (Table 2). Also, the study of the relationship between public health and demographic variables in the present study revealed a significant association between public health and age and marital status (Table 3). The Pearson correlation test results showed a significant relationship between burnout and cognitive failure ($p < .001$). The study results of the relationship between the dimensions of burnout and cognitive failure showed that the dimensions of emotional exhaustion and depersonalization are significantly associated with cognitive failure. However, no significant relationship was found between personal accomplishment and cognitive failure (Table 4). In the present study, the correlation between cognitive failure and general health dimensions revealed an inverse and significant association between physical health and cognitive failure (Table 5). Also, the correlation between the components of general health and burnout revealed a significant and direct rela-

Table 4

Correlation between study variables and cognitive failure

Variables	Cognitive failure	
	Type of correlation coefficient	r (p)
Emotional fatigue	Pearson	.26 (< .001)
Depersonalization	Pearson	.14 (.016)
Personal accomplishment	Pearson	.04 (.510)
Overall burnout score	Pearson	.26 (< .001)
Physical health	Pearson	-.13 (.022)
Anxiety	Pearson	-.10 (.090)
Social function	Pearson	-.08 (.144)
Depression	Pearson	.01 (.920)
General health score	Pearson	-.11 (.056)

Table 5*Multiple correlations of general health components with burnout of Iran Tire Factory personnel*

Variables	1	2	3	4	5	6	7	8
1. Emotional fatigue	1							
2. Depersonalization	$r = .48^*$ $p < .001$	1						
3. Personal accomplishment	$r = .10$ $p = .077$	$r = -.01$ $p = .846$	1					
4. Physical health	$r = -.11$ $p = .065$	$r = -.13^{**}$ $p = .030$	$r = .25^*$ $p < .001$	1				
5. Anxiety	$r = -.16^*$ $p = .006$	$r = -.12^{**}$ $p = .033$	$r = .18^*$ $p = .002$	$r = .55^*$ $p < .001$	1			
6. Social function	$r = -.19^*$ $p = .001$	$r = -.20^*$ $p < .001$	$r = .26^*$ $p < .001$	$r = .38^*$ $p < .001$	$r = .35^*$ $p < .001$	1		
7. Depression	$r = -.05$ $p = .377$	$r = -.15^*$ $p = .008$	$r = .33^*$ $p < .001$	$r = .34^*$ $p < .001$	$r = .35^*$ $p < .001$	$r = .54^*$ $p < .001$	1	
8. General health	$r = -.17^*$ $p = .003$	$r = .20^*$ $p = .001$	$r = .33^*$ $p < .001$	$r = .80^*$ $p < .001$	$r = .77^*$ $p < .001$	$r = .72^*$ $p < .001$	$r = .70^*$ $p < .001$	1

Note. *Significance level at .01, **significance level at .05.

relationship between general health and personal accomplishment. On the other hand, general health was significantly and inversely related to emotional exhaustion and depersonalization.

DISCUSSION

BURNOUT AND COGNITIVE FAILURE

In the present study, the results revealed a significant relationship between burnout and cognitive failure. Boals and Banks (2012) showed that the level of burnout of employees is associated with more cognitive failure. In one of the earliest studies in this area, Van Der Linden et al. (2005) compared three groups of people with varying degrees of burnout symptoms. Their results showed that cognitive deficits increase with the severity of burnout symptoms.

Another study showed that the cognitive effects of burnout do not develop in separate stages, but gradually increase according to the severity of the main symptoms of burnout (such as fatigue) (Van Der Linden et al., 2005). Similar findings were found by Oosterholt et al. (2012). These results are consistent with the present study. A recent study performed by Koutsimani et al. (2021) did not find any evidence that burnout is associated with cognitive performance. Contrary to the results of this study, no significant correlation was found between emotional exhaustion and cognitive errors in 140 samples from the public and private general working population

(Koutsimani et al., 2021). These differences may be due to the differences between the study groups.

EMOTIONAL EXHAUSTION, DEPERSONALIZATION AND COGNITIVE FAILURE

The study results of the association between the dimensions of burnout and cognitive failure showed that emotional exhaustion as the main element of burnout and depersonalization are significantly associated with cognitive failure. The results of Athar et al.'s (2020) study revealed that there is a significant relationship between burnout and cognitive failure in nurses and increased emotional exhaustion and depersonalization lead to more cognitive failure, and increased personal accomplishment reduces burnout and cognitive failure. Feuerhahn et al. (2013) discovered a negative relationship between emotional exhaustion and performance in learning and memory tasks in a sample of 100 teachers. Their conclusions support the adverse consequences of emotional exhaustion for cognitive performance and health (Feuerhahn et al., 2013). The results of Diestel et al. (2013) show that people with unusual exhaustion performed worse on working memory tasks. In contrast, other studies have reported no association between cognitive performance and emotional exhaustion. In their study, Gajewski et al. (2017) studied a community including nurses, police, teachers, physicians, and firefighters, but in the study of

McInerney et al. (2012) and Sokka et al. (2016) there were nurses and volunteers, respectively.

COGNITIVE FAILURE AND GENERAL HEALTH

This study examined the correlation between cognitive failure and general health dimensions. The results revealed an inverse and significant relationship between physical health and cognitive failure. The results of Österberg et al.'s (2009) study showed that people with a history of burnout caused by stress sometimes performed worse than healthy employees in performing cognitive tasks that required attention. These results are consistent with the results of the present study. The study results by Day et al. (2012) also showed that people whose general health is more at risk are those who experience more cognitive failures and are more likely to have accidents at work. According to Simpson et al. (2005) and Park and Kim (2013), one of the factors influencing the occurrence of accidents is the rate of cognitive failure. Burnout is one of the results of various stresses that appear in the form of physical symptoms (headache, stomach ulcers), psychological symptoms (depression, anger) and behavioral symptoms (decreased staff performance and absenteeism) (Russell et al., 1987).

GENERAL HEALTH, EMOTIONAL EXHAUSTION, DEPERSONALIZATION AND PERSONAL ACCOMPLISHMENT

The present study's findings show a significant inverse relationship between general health and dimensions of burnout. An inverse relationship was found between emotional exhaustion and depersonalization. Hence with increasing emotional exhaustion and depersonalization, burnout increased among factory personnel. As a result, general health is more at risk, which is in agreement with the study findings of Abdi Masouleh et al. (2007) and Saberi et al. (2009).

The results also showed a significant direct relationship between general health and the dimension of personal accomplishment. With the increasing personal accomplishment, burnout decreases and general health improves. Reducing personal accomplishment is a negative self-assessment when doing work, reducing one's sense of worthiness and doing one's job properly. The meaning of this component is to create a feeling of reduced personal success. Sense of personal accomplishment arises when a person influences the policies of the organization and finds a positive attitude towards clients and colleagues. The high rate of burnout in the dimension of personal accomplishment leads to the formation of a negative attitude towards the self and profession (Barkway, 2006).

The results of the study by Öhman et al. (2007) showed that people who complain of memory problems might lack some cognitive domains. These cognitive deficits can involve a failure to concentrate on tasks, more confusion, and the necessity for more energy to perform a duty (Capuron et al., 2006).

LIMITATIONS OF THE STUDY

Because the data collected in this study are self-reported there is a possibility of bias. The state of cognitive functions of employees at the beginning of their work was not investigated and defined. The data are also cross-sectional, causal inference is weak and there may not be a causal relationship between burnout and cognitive decline, but the hypotheses generated and the variables examined can be tested in other industrial populations for more definitive answers. The present study results showed that burnout can affect general health and cognitive failure, but it is possible other factors affect cognitive processes and result in cognitive failure (e.g. position at work (managerial, non-managerial), motivation systems at work (payroll and non-payroll), personality traits (e.g. level of neuroticism) or coping styles, frequent risk taking outside work, symptoms, income, sleep problems), so more research is needed in this area and effective factors in a larger community need to be extracted to make interventions more effective.

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CONCLUSIONS

According to the results of this study, burnout has relationships with cognitive failures among factory personnel. On the other hand, cognitive failures affect the physical health of individuals and lead to deterioration of physical health, which can reduce a person's performance and reduce work efficiency. On the other hand, more cognitive failures threaten the safety of personnel. Cognitive failures are the same cognitive errors that can cause irreversible events. Therefore, in general, burnout affects the general health of the individual by affecting cognitive failures.

The present study results showed a significant relationship between burnout, cognitive failure, and general health. Therefore, factory managers must reduce the amount of pressure on people by recognizing the sources of stress and pressure. Using retraining programs, thanking and appreciating staff performance, and positive employee attention to create a positive attitude can increase individual and organizational productivity. Finally, improving the work environment and reducing environmental stressors can reduce burnout, improve general health, and reduce workers' cognitive failures. In this

way, its possible consequences such as industrial accidents, work-related absences, job changes, reduced personal performance and reduced productivity can be reduced.

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