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Investigation of the relationship between occupational cognitive failures and work-related accidents in heavy equipment operators of Shahid Rajaei port complex

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Abstract:

INTRODUCTION: Occupational accidents have many undesirable and irreparable effects on labor forces, assets, environment, and credibility of organizations. Human errors are one of the most important causes of occupational accidents. Human errors have different causes, but in all cases, human cognitive abilities and limitations play important roles; in this research, the relationship between occupational cognitive failures and work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex has been investigated.

METHODS: This research was done through the field method. A sample of 332 people was selected by a stratified sampling method among all heavy equipment operators. The data gathering tool contained a 30-item occupational cognitive failure questionnaire. Furthermore, regression analysis method was used to test the hypotheses.

RESULTS: The results of this study showed that cognitive failures of occupational accidents on direct work-related accidents in heavy equipment operators of Shahid Rajaei Port complex have a direct effect ($P < 0.00$). Further more, variables that modify the research are age, work experience, working hours, educational level, type of occupation, and marital status of the operators.

CONCLUSION: Regarding the direct relation between cognitive occupational failures and occupational accidents, one can predictive this result that the occupational cognitive failure questionnaire can be used as a predictive tool in accidents of Shahid Rajaei Port Complex.

Keywords:

Cognitive failure, occupational accidents heavy equipment operators

Introduction

Accidents are one of the phenomena that have been spreading along with the industrialization and advancement of technology, which not only imposes many human and financial losses but also to human societies. Many of the work processes in industrial organizations have potentially catastrophic consequences for workers and

the environment.^[1] Occupational accidents and injuries are one of the causes of worries of workers and employers due to the costs of treatment and unemployment, as, each year, 25 million workers are subject to occupational accidents and illnesses. In general, the events result in the loss of physical and mental health, time and money, and, in some cases, irreparable damages.^[2] In other words, human costs are so expensive and far-reaching that they

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cannot be estimated. An incident is an unplanned event that may result in damage. Occupational injury causes physical injuries to the employees, in such a way that its range begins with cuts and superficial injuries resulting in organ failure and death.^[3]

Various researchers have looked at different types of occupational accidents. Some have tried to identify all incident predictions, and others have emphasized only a few of them. Most occupational safety-related researches emphasize the two elements of insecure conditions and the individual characteristics of workers in the event of accidents.^[4] Recent studies show that there are a number of personality traits that are associated with incidents, but many of these attributes are largely independent of each other. In all of these studies, human factors are considered as one of the most important causes of occupational accidents although the work environment conditions and the nature of occupational tasks also play a role in the incident. Among these factors are the cognitive factors that have recently attracted the attention of psychologists.^[5] Although the effect of knowing on events is less evident, it must be emphasized that cognitive factors play a significant role in causing events.^[6] Cognitive failures can be defined by errors with a cognitive basis in performing simple tasks that one can perform without mistakes. These mistakes may occur in one or all three stages of the process of processing information: memory, attention, and action.^[7] Cognitive impairments can lead to major problems due to interference with daily activities. When these errors occur in triggering actions, they may cause serious injury and even death.^[8] Research has discovered that there is a relationship between cognitive deficits, anxiety, psychological stress, fatigue, sleepiness, and emotional disturbances.^[9] Recently, safety-related studies have been designed to investigate the influence of cognitive processes in incidents.^[10] For example, a study by Petitta *et al.*, in 2019 on the effects of cognitive failures in incidents, showed a positive correlation between incidence rates and cognitive deficits.^[10] In another study, Wallace and Vodanovich examined the relationship between cognitive failures with three variables of occupational accidents, occupational evaluation, and car accident rates. The results showed that the total score of cognitive impairments had a positive and significant relationship with the rate of car accidents, occupational accidents, and performance evaluation scores of the individuals.^[11]

Considering the fact that few studies have been done in Iran regarding the association of occupational cognitive failures with work-related incidents in industrial environments so far, this is the first time that the investigation of the relationship between occupational cognitive failures and work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex is performed.

Methods

Considering the aims and objectives of this field research, the data were collected from 332 out of 2430 heavy equipment operators of Shahid Rajaei Port Complex using the Cochran sampling formula. Due to the nature of the heavy equipments, operators and their categorization in Gantry crane and Port Container Gantry Crane groups, forklift operators, crane operators and drivers from all groups, the samples of the population were selected by stratified sampling method. For the development of our research literature, library studies including books, journals, articles, and theses related to our research topic were used. A standardized questionnaire was used as our data gathering tool in our research. The questionnaire of this research consists of two parts. The first part relates to the measurement of demographic variables and the number of accidents occurred in the individuals, and the second part relates to the measurement of occupational cognitive failure variables that was presented by Broadbent *et al.*,^[12] and its reliability was verified by Dr. Allahyari *et al.* in 2012. The questionnaire contains 30 questions that the respondents answer to them in the form of a Likert spectrum. The mean of these questions is considered as the criterion of the extent of the cognitive decline of the respondent and its impact on the work-related accidents of the individuals being examined. In addition to formal validity, the content validity of the questionnaire was confirmed by experts, and its reliability was obtained through Cronbach's alpha coefficient equal to 0.875, indicating good tool reliability.^[13]

Results

Among 332 samples taken from heavy equipment operators of Shahid Rajaei Port Complex, 167 (50.3%) of them were between the ages of 30–39 years and 118 (35.5%) had a history of 10–14 years of work experience, and among the occupational categories, 89 employees (26.8%) were Gantry crane and Gonter and Trans Operator, 62 (18.7%) Forklifts operators, 15 (4.5%) crane operators, and 166 (50%) lorry drivers.

Table 1 shows the average of occupational cognitive failures and the number of accidents in different groups of demographic variables. The highest mean of cognitive impairment and the average number of incidents related to operators of <30 years age (1.09 and 2.31), the most cognitive failure relates to 5–9 years work experience operators (0.61 and 2.08), the highest mean of occupational failures and average number of incidents relate to lorry drivers (1.12 and 2.18).

Table 2 shows that occupational cognitive failures on work-related accidents in heavy equipment operators of the

Shahid Rajae Port Complex have a significant positive/negative effect. Considering that the confidence coefficient obtained in the regression analysis is <0.05 , there is a significant relationship between occupational cognitive impairment and work-related accidents. Therefore, it can be concluded that occupational cognitive impairments have an impact on work-related accidents in the heavy equipment operators of Shahid Rajae Port Complex. Regarding the sign and the amount of the independent variable coefficient (B), this effect is positive and its rate is 0.975.

Table 3 shows the relationship between the operators' ages and occupational cognitive failures of work-related occupational incidents in heavy equipments of Shahid Rajae Port Complex. It also shows the confident coefficient obtained from regression analysis in all age groups is less than 0.05 in all groups, which has a significant relationship with comparison independent variable coefficient with group B . The regression in all groups is significant. The comparing amounts of independent coefficient variable B in all groups shows that the operators' age and the role of occupational cognitive failures on work-related incidents in operators of heavy equipments. As it can be seen, the effect of occupational cognitive failures on work-related incidents in the age group of <30 years is more than other age groups with the amount of 1.986.

Table 4 shows the relationship between the work experience of the operator regarding occupational cognitive failures of work-related accidents in heavy equipment operators of Shahid Rajae Port Complex, considering that the confidence coefficient obtained in regression analysis in the age group of <5 years from 0.05 is more than regression and is not meaningful.

In the group over 20 years of age, a regression cannot be applied due to the fact that the values of the dependent variable are constant. However, the confidence coefficient obtained in regression analysis in all working groups is <0.05 . Regression has a meaningful relationship in all groups. Comparing the values of the independent variable coefficient (B) in the groups shows that the work experience of the operator has an impact on the role of occupational cognitive failures in accidents caused by the heavy equipment operators of the Shahid Rajae Port Complex. As can be seen, the effect of occupational cognitive failures on work-related accidents in a group with a work experience of 9–5 years with an effect of 1.378 is more than other age groups.

According to Table 5 the relationship between the operator's working hours and the effect of occupational cognitive failure on work-related incidents show that the amount of confident co-efficient obtained

Table 1: Occupational cognitive failure and number of accidents in different groups of demographic variables

Variable	Category	Average cognitive impairment	Average number of incidents
Age	<30 years	2/31	1/09
	30-39 years	1/90	0/34
	40-49 years	1/94	0/28
	50<	2/24	0/76
Work experience	<5 years	1/89	0/03
	5-9 years	2/08	0/61
	10-14 years	1/97	0/40
	15-19 years	1/85	0/32
Hours of work (h)	20<	2/07	0
	Up to 8	2/05	0/58
Operator education	>8	1/88	0/22
	Under the diploma	1/93	0/26
	Diploma	2/03	0/60
	More than diploma	1/94	0/16
Occupational	Bachelor's degree	1/77	0/17
	Gentry and trans operator	2/04	0/87
	Forklift operator	1/96	0/66
	The operator of the crane	1/85	0/25
Marital status	Lorry driver	2/18	1/12
	Married	1/96	0/40
	Single	2/01	0/32

Table 2: Relationship between occupational cognitive failures on work-related accidents in heavy equipment operators of Shahid Rajae Port Complex

Independent variable	The dependent variable	R	R ²	The statistics F	B	Significant
Occupational cognitive failure	Accidents caused by work	0.555	0.308	146.774	0.975	0.000

Table 3: The relationship between age of operators occupational cognitive failure with work-related accidents of heavy equipment in Shahid Rajaei Port Complex

Independent variable	Age of subjects															
	<30			30-39			40-49			50 <						
	Sample size	R	B	Significant	Sample size	R	B	Significant	Sample size	R	B	Significant				
Occupational cognitive failure caused by work	23	0.714	1.986	0.000	167	0.184	0.751	0.00	121	0.137	0.581	0.00	21	0.776	0.876	0.00

Table 4: Relationship between the work experience of the operator and the occupational cognitive failures of work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex

Independent variable	Work experience of subjects																	
	<5			5-9			10-14			15-19			20 <					
	Sample size	R	B	Significant	Sample size	R	B	Significant	Sample size	R	B	Significant	Sample size	R	B	Significant		
Occupational cognitive failure caused by work	34	0.054	0.109	0.188	97	0.372	1.378	0.000	118	0.175	0.760	0.000	21	0.776	0.876	0.00	4	Due to the fact that the values of the dependent variable are constant in the 4 views, this regression group cannot be implemented

from regression analysis is less than 0.05 in the two groups, therefore regression in two groups is significant. Comparison of the independent variable of coefficient values (*B*) in the two groups shows that the operator's work hours affect the role of occupational cognitive failures of work-related accidents in the heavy equipment operators of Shahid Rajaei Port Complex. As can be seen, the effect of occupational cognitive failures on work-related accidents in the working-time group is up to 8 h a day, with an impact level of 1.253 is more than the other groups.

Table 6 shows the relationship between the operator's education and work-related cognitive failures with work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex. Since the confidence level obtained in regression analysis is <0.05 for all educational levels except for the bachelor's degree, regression is significant in those groups. In the group of bachelor's degree, since the value of the coefficient of confidence is >0.05, the regression is not significant. Comparison of independent variable coefficient values (*B*) in groups shows that operator's education affects the role of occupational cognitive failures on work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex. As can be seen, the effect of occupational cognitive failures on work-related accidents in the diploma group with an impact level of 1.264 is more than other groups.

Table 7 shows the relationship between the operator type of job and occupational cognitive failures in work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex. As the amount of reliability obtained in regression analysis in all occupational groups is <0.05, regression is significant. The comparison of independent variable coefficient values (*B*) in groups shows that the type of job affects the role of occupational failures on work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex. As can be seen, the effect of occupational cognitive failures on work-related accidents in a group of lorry drivers with an impact level of 0.859 is more than other groups.

Discussion

The incidence of accidents in the various countries of the world, especially in the industrial sectors, is relatively high, and over time, it continues to increase, with 260 million incidents leading to injuries and 250,000 deaths

in jobs.^[14] The impact which has cognitive impairments on occupational accidents^[7,15] led to this study with the general aim of investigating the relationship between occupational cognitive failures and accidents. The results of this study showed that the impact of occupational cognitive failures on work-related accidents is positive. If one unit increases/decreases in occupational cognitive deficits, 0.975 will be decreased/increased to the number of incidents. The results of studies such as the study of Larson and Merritt on motorcycle accidents and cognitive deficits in 1991 showed a positive correlation between incidents and occupational defects.^[16] Furthermore, the study of Wallace and Vodanovich showed that the total score of cognitive failures with the rate of car accidents, occupational accidents, and the performance evaluation score of the individuals has a positive and significant relationship with the present study.^[11] Another study by Allahyari *et al.*, in 2014, with the occupational cognitive failure questionnaire on the personnel of a large industrial company, showed that there is a positive relationship between cognitive failures and personnel's accidents in a large industrial company in Iran.^[15] Furthermore, another study by Allahyari *et al.* in 2008 showed that cognitive failures have a high correlation with drivers' mistakes in the driving simulator.^[17] Wadsworth *et al.* investigated the effect of cognitive impairment (memory, attention, or practice problems) in the event of accidents and injuries, which indicates a direct association of cognitive dissonance with events.^[18] The results of the study by O'hare *et al.* showed that there is a significant relationship between cognitive errors and accidents.^[19] In a study, Park and Kim *et al.* reviewed 279 nurses in the same year to examine the impact of stress and cognitive error on the safety of patients. The factors that affect incidents are job change, cognitive failure, job insecurity, and job instability.^[20]

According to our study, the greatest impact of occupational cognitive failures on work-related accidents is on the age group of <30 years with work experience of 5–9 years. Regarding the effect of moderating variables on the relationship between occupational cognitive deficits, few studies have been conducted on accidents. The study of Abolghasemi and Kiamarsi, in 2009, showed that the aging of individuals has a significant impact on their cognitive performance; possibly, it increases cognitive function. Due to the fact that this study was done on the elderly, the results are not consistent with our study.^[21] However, the

Table 5: Relationship between operator's work hours and occupational cognitive failures of work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex

Independent variable	The dependent variable	Work hours of subjects							
		Up to 8 h a day				>8 h a day			
		Sample size	R	B	Significant	Sample size	R	B	Significant
Occupational cognitive failure	Accidents caused by work	161	0.368	1.253	0.000	171	0.191	0.572	0.000

Table 6: Relationship between operator educations on the occupational cognitive failures of work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex

Independent variable	The dependent variable	Education															
		Under the diploma			Diploma			Associate degree			Bachelor						
		Sample size	R	B	Significant	Sample size	R	B	Significant	Sample size	R	B	Significant				
Occupational cognitive failure	Accidents caused by work	80	0.221	0.546	0.000	161	0.415	1.164	0.000	68	0.07	0.345	0.029	23	0.000	-0.018	0.965

Table 7: Relationship between the types of operator's job on occupational cognitive failures in work-related accidents in heavy equipment operators of Shahid Rajaei Port Complex

Independent variable	The dependent variable	Subjects occupation															
		Gentry and trans operator			Forklift operator			Crane operator			Fatal driver						
		Sample size	R	B	Significant	Sample size	R	B	Significant	Sample size	R	B	Significant				
Occupational cognitive failure	Accidents caused by work	89	0.226	0.504	0.000	62	0.097	0.221	0.000	15	0.036	0.152	0.029	166	0.320	0.859	0.000

research done by Brati and Arizi in 2015 showed that the relationship between cognitive deficits and age is negative and the relationship between metacognition and age is positive. Furthermore, age, negative beliefs, cognitive trust, and carelessness explain cognitive deficits.^[22] These results are consistent with the results of Wallace and Vodanovich.^[11] This could be due to the fact that the age growth of using metacognition (the knowledge of the evaluation, monitoring, and control of knowledge) increases and these elements reduce cognitive impairment. Using metacognition can also explain the negative impact of work experience and shift work on the relationship between occupational cognitive failures and work-related accidents. Individuals with diploma education had also more cognitive failures because of less familiarity with the principles of safety in attention and practice, and the lorry drivers, due to the repetition and uniformity of their work, suffered more from cognitive decline in attention, memory, and practice than other operators and they had more incidents. Married operators are also less likely to experience cognitive impairment and occupational accidents due to their orientation and concentration.

Conclusion

Considering the results obtained in this study, it can be concluded that cognitive impairment has a direct relationship with work accidents and is the most significant mean of cognitive impairment in work-related accidents in lorry drivers. Hence, this occupational is very important. In the case of lorry drivers, the more accurate implementation of the periodic examination process can be beneficial. Physical, physiological, and psychological factors of operators that have an effective role in the occurrence of accidents must further be studied.

Considering that occupational cognitive failures and incidents in operators of <30 years and those who had less work experience was more than the others, thus, it can be foreseen that the training courses must be held to prevent such incidents. Furthermore, metacognitive teaching such as monitoring, evaluating and betterment of learning strategies and solving problems can be effective. It was also seen that occupational cognitive failures are more common in individuals who hold diplomas and upper educational status is more than the other groups. Therefore, training courses can be used to ensure safety and work principles. In addition, operators with a bachelor's degree who have less cognitive impairment should be put into the night shift to prevent accidents.

In the case of shift work, managers can come up with solutions that the individuals must be employed

according to their conditions to use their physical and intellectual capacities. They should also provide a mechanism for the job rotation system based on the approved scientific principles. Hence, according to the results of this study, we can use occupational cognition failures to predict the incidence of accidents.

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Conflicts of interest

There are no conflicts of interest.

References

1. Kim T, Chi S. Accident case retrieval and analyses: Using natural language processing in the construction industry. *J Construct Engin Manage* 2019, 145.3: 04019004
2. Niu S. Ergonomics and occupational safety and health: An ILO perspective. *Appl Ergon* 2010, 41.6: 744-753.
3. Tamers SL, Chosewood LC, Childress A, Hudson H, Nigam J, Chang CC. Total Worker Health® 2014-2018: The novel approach to worker safety, health, and well-being evolves. *Int J Environ Res Public Health* 2019;16: 321.
4. Earle AM, Napper LE, LaBrie JW, Brooks-Russell A, Smith DJ, de Rutte J. Examining interactions within the theory of planned behavior in the prediction of intentions to engage in cannabis-related driving behaviors. *J Am Coll Health* 2019:1-7.
5. Bergheim, K., Nielsen, M. B., Mearns, K., & Eid, J. The relationship between psychological capital, job satisfaction, and safety perceptions in the maritime industry. *Safety Sci* 2015;74:27-36.
6. Hussain, S., Batool, I., Bano, S., & Ali, H. Emotional climate, work stress and occupational cognitive failure in doctors. *Peshawar J Psychol Behav Sci* 2018, 4.2: 221-235.
7. Simpson SA, Wadsworth EJ, Moss SC, Smith AP. Minor injuries, cognitive failures and accidents at work: Incidence and associated features. *Occup Med (Lond)* 2005;55:99-108.
8. van Doorn RR, Lang JW, Weijters T. Self-reported cognitive failures: A core self-evaluation? *Pers Individ Diff* 2010, 49.7: 717-722.
9. Mecacci L, Righi S. Cognitive failures, metacognitive beliefs and aging. *Pers Individ Diff* 2006;40.7:1453-9.
10. Petitta L, Probst TM, Ghezzi V, Barbaranelli C. Cognitive failures in response to emotional contagion: Their effects on workplace accidents. *Accid Anal Prev*, 2019, 125: 165-173
11. Wallace JC, Vodanovich SJ. Workplace safety performance: Conscientiousness, cognitive failure, and their interaction. *J Occup Health Psychol* 2003;8:316.
12. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The Cognitive Failures Questionnaire (CFQ) and its correlates. *Br J Clin Psychol* 1982;21:1-6.
13. Hassanzadeh Rangi, N., Allahyari, T., Khosravi, Y., Zaeri, F., & Saremi, M. Development of an Occupational Cognitive Failure

- Questionnaire (OCFQ): Evaluation validity and reliability. *Iran Occup Health* 2012;9:29-40.
14. Hämmäläinen P, Takala J, Saarela KL. Global estimates of occupational accidents. *Safety Sci* 2006;44:137-156.
 15. Allahyari T, Rangi NH, Khalkhali H, Khosravi Y. Occupational cognitive failures and safety performance in the workplace. *Int J Occup Saf Ergon* 2014;20:175-180.
 16. Larson GE, Merritt CR. Can accidents be predicted? An empirical test of the Cognitive Failures Questionnaire. *Applied Psychol* 1991;40:37-45.
 17. Allahyari, T., Saraji, G. N., Adi, J., Hosseini, M., Irvani, M., Younesian, M., & Kass, S. J. Cognitive failures, driving errors and driving accidents. *Int J Occup Saf Ergon* 2008;14:149-158.
 18. Wadsworth EJ, Simpson SA, Moss SC, Smith AP. The Bristol Stress and Health Study: Accidents, minor injuries and cognitive failures at work. *Occup Med (Lond)* 2003;53:392-397.
 19. O'HARE DA, Wiggins M, Batt R, Morrison D. Cognitive failure analysis for aircraft accident investigation. *Ergonomics* 1994;37(11):1855-69.
 20. Park YM, Kim SY. Impacts of job stress and cognitive failure on patient safety incidents among hospital nurses. *Saf Health Work* 2013;4:210-215.
 21. ABOLGHASEMI, Abbas; KIAMARSI, Azar. The Relationship between metacognition and cognitive failures in the elderly. *Advances in Cognitive Science* 2009;11:8-15.
 22. Barati H, Oreyzi SS. Relation between Cognitive Failures and Cognitive Beliefs in Life Span Considering thought Control; 2015:235-251.