Original Article

The Effect of Gender, Work Experience, Age, and Job Stress on the Errors' Number and Work Speed in Laboratory Employees

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Abstract

Aim: A high error rate among laboratory staff leads to accidents. This study aimed to investigate the effect of gender, work experience, age, and job stress on the number of errors and work speed in laboratory employees. **Materials and Methods:** This cross-sectional study was performed on 32 laboratory staff via census method. The instruments used in this study were the General Health Questionnaire Mental Health Questionnaire, demographic questionnaire capturing age, gender, work experience, and level of education, and Health and Safety Executive Job Stress Questionnaire in England. A precision targeting vibrometer was used to measure the speed and number of errors. Independent *t*-test and Mann–Whitney *U*-test as well as Pearson's and Spearman's correlation coefficients were used to evaluate the relationship between the parameters using SPSS software version 26. **Results:** The mean and standard deviation of age, work experience, and job stress were 43.56 ± 7.80 years, 205.68 ± 107.43 months, and 132.59 ± 12.55, respectively. Furthermore, the mean and standard deviation of the number of errors and work speed were 4.90 ± 4.09 and 14.27 ± 5.84, respectively. A significant positive correlation was found between age and the number of errors. **Conclusion:** The results indicated that gender, work experience, and job stress do not affect the number of errors and work speed in laboratory staff, but age affects the number of errors in employees, and the number of errors increases with age. Explaining the factors affecting the accuracy and speed of staff in the laboratory can lead to use of appropriate manpower and ultimately enhance productivity and reduce accidents in laboratories.

Keywords: Age, errors' number, laboratory, work speed

Introduction

Fires, explosions, and poisonings are among the main accidents in laboratories. Hazardous operator actions or unsafe conditions have been reported as effective factors in the occurrence of these accidents.[1] The U. S. Laboratory Safety Association reported 34 accidents between 2000 and 2015, 11 of which happened in university laboratories. The US government also reported 10,000 accidents in research laboratories in 2005.[2]

A thorough examination of many major accidents shows that more than 70% of occupational accidents are caused by unsafe actions and human error.[3] In a study, human error is reported to be the cause of 80% of accidents in industries.[4] Factors such as incompetence, poor equipment, poor working conditions, high workload, fatigue, low accuracy, poor management, lack of experience, insufficient training, lack of proper time to do work, poor work instructions, inadequate communication, and lack of motivation have been reported as factors affecting human error.[5] Several studies have reported individual factors such as age, gender, work experience, and job stress as effective factors in the occurrence of occupational accidents.[6-8] In a study by Biabani *et al*., individual factors such as gender, age group, marital status, level of education, and work experience of individuals were effective in the incidence of recurrence and severity of accidents.[9] Important perceptual-motor functions such as reaction time, accuracy in achieving the goal, and work speed are affected by age. A study by Guan and Wade showed that cognitive-motor adaptation diminishes with age.[10]

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Gender is one of the factors affecting human error.[11] A study conducted by Al-Balbissi to investigate role of gender in road accidents showed that there is a significant difference in the incidence of accidents between the genders and it is reported that the incidence of accidents is higher in men than in women.[12]

Work experience is mentioned as one of the criteria for people's qualifications. Many studies suggest that there is a positive relationship between work experience and job performance.[13] In a study by Mohammad Fam on the factors affecting occupational accidents, it was shown that most occupational accidents occurred in people under 30 years old and with a maximum of 2 years of work experience.[14]

Psychosocial factors to some extent reduce the accuracy of performance and increase the work speed. These variables include stress, personality traits, and cognitive factors.[15] One of the reasons for human error leading to occupational accidents is stress caused by work. Stress plays a significant role in work-related accidents. Stress symptoms reduce the worker's ability and increase the risk of occupational accidents.[16] Ghiami *et al*.'s study results revealed that there is a significant relationship between job stress and job accident, where eliminating job stress sources has a significant role in reducing accidents.[7]

Laboratory staff, including human resources, are prone to human error and accidents. In some studies, a high rate of human error has been reported in laboratory staff.[17] Although the rate of accidents in laboratories is lower than in industrial accidents, many accidents in laboratories have led to injuries, deaths, and financial losses.[1] According to the studies and the importance of preventing accidents as well as reducing human error, further studies are required to identify the factors affecting the incidence of accidents and human errors. As such, this study aims to investigate the relationship between age, gender, work experience, and job stress on the number of errors and work speed in The Effect of Gender, Work Experience, Age, and Job Stress on the Errors' Number and Work Speed in Laboratory Employees of the Isfahan University of Medical Sciences.

Materials and Methods

This cross-sectional study was performed on 32 laboratory staff of Isfahan University of Medical Sciences in 2021. The census method was used for sampling and all eligible individuals were invited to participate in the study. The inclusion criteria were as follows: no history of musculoskeletal disorders, no eye disease including myopia, hyperopia, and astigmatism, no medication before the test, general health, and the participant's consent for participating in the study. General Health Questionnaire (GHQ) was used to assess the general health of individuals, while other criteria were assessed by simply asking some questions from participants. A score of less than 22 was an acceptable score on the GHQ for inclusion in the study. The validity and reliability of this questionnaire were evaluated by Taghavi and its Cronbach's alpha was determined between 0.72 and 0.87.[18]

To prevent the environmental conditions effect on individuals, all tests were performed on all participants in a controlled laboratory environment. Initially, the consent form was provided to the participants, and then both the purpose of the research and the working method were explained to the individuals. The device was placed on a table with a height of 100 cm and the participants performed the test standing. The levels of brightness and sound were comfortable. In order not to affect fatigue during the work shift on the cognitive parameters of the participants, therefore, the test was performed in the morning and at the beginning of the person's work shift.

Two questionnaires of demographic and job stress of Health and Safety Executive (HSE) in England were used in this study. The demographic questionnaire included variables such as age, gender, work experience in the current job, and education level of the individual, which was completed by the participant. HSE Job Stress Questionnaire had 35 questions in seven sections of role, communication, support of officials, support of colleagues, control, demand, and changes. The validity and reliability of this questionnaire were evaluated by Marzabadi and Fesharaki and its Cronbach's alpha was found 0.78.[19] In this study, job stress was investigated to investigate the possible effect of this factor on cognitive performance parameters and to adjust its effect if there is a relationship between job stress and cognitive performance parameters. Each question on this questionnaire consisted of 5 options with a score of 1–5, and the score of each selected option was added together, then the total score of the questionnaire was obtained for each person. The interpretation of the results of the questionnaire was that every person who had obtained a higher score from the questionnaire had a lower job stress.

One of the battery tests (a set of job skills assessment tests) called the stability and uniformity test was employed to measure the variables of speed and accuracy. This set of tests was used to check eye-hand coordination, accuracy, work speed, motor skills, hand coordination, and agility. The stability and uniformity test consisted of a precision targeting vibrometer and a V Pieron vibrometer. This device consisted of 10 circles with different diameters, which were placed in the device from the largest diameter to the smallest one, respectively. The test was initiated from the larger circle and continued to the smallest circle using a needle-shaped pen connected to the time and error counter, so that there was no collision between the pen and the pore wall when the pen entered and exited. In this test, error was going to be recorded by the device in case of any impact of the pen on the pore wall. Then, the test time was considered as the individual work speed. The test results of individuals were compared with each other and spending less time to complete the test was considered as higher speed.[20]

Data analysis was performed using SPSS software version 26 (IBM corp, Armonk, New York). The normality of the data

was evaluated using the Kolmogorov–Smirnov test. The mean and standard deviation were used to describe qualitative data, number and percentage index, and quantitative data. The relationship between the data was examined using an independent *t*-test, Mann–Whitney *U*-test, as well as Pearson's and Spearman's correlation coefficients. The significant level accepted of statistical tests used in this study was $P < 0.05$.

Results

This study was conducted on 32 people with the mean and standard deviation age of 43.5 ± 7.8and an age range of 30–60 years. 53.1 (17 case) of the participants were female and the rest were male. People with a mental health score of <22 were included in the study. The mean and standard deviation of the GHQ of the participants in this study was 14.22 ± 7.80. More details about the demographic parameters of the participants are provided in Table 1.

The mean and standard deviation of the parameters of age, work experience, job stress, and work speed parameters as well as the number of errors obtained from the precision targeting vibrometer test are shown in Table 2.

Error number data had a nonnormal distribution, so the Spearman's correlation coefficient was used to examine its relationship with age, work experience, and job stress. Furthermore, the nonparametric Mann–Whitney *U*-test was used to examine its relationship with gender. In order to investigate the relationship between other demographic parameters and cognitive performance parameters, according to the normal distribution of data, Pearson's correlation coefficient and independent *t*-test were used.

The results showed that there was no significant relationship between the speed of work and age ($P > 0.05$, but the relationship between age and the number of errors was significant ($P < 0.05$). The results of examining the relationship between work experience and the number of errors showed that there is no significant relationship between these two parameters ($P > 0.05$). Furthermore, the correlation between work experience and speed of the work was insignificant ($P > 0.05$).

Pearson's and Spearman's correlation coefficients were used to investigate the relationship between job stress and the parameters of work speed and accuracy. The results of the correlation between these two parameters showed that there is no significant relationship between job stress and the parameters of work speed and accuracy ($P > 0.05$). As a result, this parameter was not a confounding factor in the cognitive performance parameters investigated in this study, so the effect of adjusting this parameter was excluded. More details can be seen in Table 3.

The results of the independent *t*-test in examining the relationship between gender and work speed indicated that the average work speed in the women's group (13.90 ± 7.16) compared to the men's group (14.70 ± 4.05) did not show statistically significant difference ($P > 0.05$, t (30) =0.384). Furthermore, the Mann–Whitney *U*-test results revealed that there was no significant relationship between the number of errors in the two groups of men and women ($P > 0.05$).

Table 1: Number and percentage of demographic parameters (education, gender, and age range) of participants (*n*=32)

Parameter	*n* (%)
Education	
Diploma and high school	3 (9.4)
Postdiploma	2 (6.3)
Bachelor	8 (25)
Master	11 (34.4)
Ph.D	7 (21.9)
Postdoctoral	1 (3.1)
Gender	
Female	17 (53.1)
Male	15 (46.9)
Age range	
30-40	13 (40.6)
41-50	12 (37.5)
51-60	7 (21.9)

Table 2: Mean and standard deviation of parameters such as age, work experience, job stress, and parameters obtained from the precision targeting vibrometer test (*n*=32)

Parameter	Mean±SD
Job stress	132.5±12.55
Age (years)	43.5±7.80
Work experience (month)	205±107.43
Work speed (s)	14.2±5.84
Number of errors	4.9±4.09

SD: Standard deviation

Table 3: Investigating the relationship between age, work experience, as well as job stress and the number of errors plus work speed

Parameter	Correlation coefficient	*P*
Age		
Number of errors	0.387	0.029
Work speed	0.236	0.193
Work experience		
Number of errors	0.311	0.083
Work speed	0.239	0.187
Job stress		
Number of errors	0.207	0.256
Work speed	0.13	0.943

Discussion

This study aimed to investigate the effect of age, gender, work experience, and job stress on the number of errors and

work speed in laboratory employees. In the present study, no relationship was found between gender and the number of errors as well as work speed. Furthermore, gender did not affect the error rates in individuals and the number of errors in both genders was the same and there was no statistically significant difference between them. Furthermore, both genders spent the same amount of time to perform the tests, which was considered as the work speed. The results indicated that gender did not affect the work speed and both genders work at almost the same speed. The present study is consistent with the review study conducted by Jancke on gender differences in cognitive function, which states that there is no significant difference between cognitive function between men and women, where cognitive function is more influenced by other factors such as the environment, culture, etc.[21] Another study conducted by Haciomeroglu *et al*. showed that there was no considerable difference between the cognitive ability of the two groups of men and women.[22] From the results of the present study and the conducted studies, it can be concluded that gender is not an effective factor in people's cognitive performance, including the speed of doing work and the number of errors, and that the cognitive performance of people of both genders is the same.

In the present study, a weak positive correlation was found between age and the number of errors. The study results indicated that the incidence of errors increased with age, with older people showing more errors than younger counterparts. The results of this study were in contrast to the study of Omidvari and Rasouli Ghamaroudi, in which age was one of the effective factors in the incidence of accidents, with younger individuals committing more human errors,[23] while being in line with Murman's study. The difference in the results of the present study and the mentioned study can be due to the difference in the work history of the people, so that younger people in the industry make mistakes due to lack of experience in their jobs. In this study, the participants were performing such an experiment for the first time. Murman stated that cognitive function, including the speed of information processing, diminishes with age due to changes in brain function and structure.[24] In a review study conducted by Di Pasquale *et al*., it was stated that with increasing age of the productive force in the industry, due to reduced capacity and human capabilities, human error grows in work systems.[25] As the results of the present study and previous studies showed, age affects the number of errors in individuals and increasing age raises the number of errors by individuals.

In the study, there was no relationship between work speed and age of individuals and there was no statistically significant difference between the work speed of people of different ages either. The results revealed that age does not affect the work speed and people of different ages perform the task at the same time or in other words with almost the same speed. This study contrasts with a study by Starns and Ratcliff on the speed and accuracy of both the elderly and the young. They found that the speed and accuracy of young people are in balance while older people try to have fewer errors even though it reduces their work speed.[26] The difference between this study and the mentioned study can be due to the age range of the people present in both studies. So that, the age range of the people in the study was between 30 and 60 years and the people in the said study were in three age groups: college people, people in the age range of 60–74 years, and people in the age range of 78–85 years. Thus, it was recommended to conduct this study with a larger age group. From the results of this study, it can be concluded that age is not effective in the age range of 30–60 years.

In the present study, no relationship was found between work experience, work speed, and the number of errors. The also results indicated that work experience had no effect on the number of errors and work speed, and that people with different work experiences have the same error probability. On the other hand, the study of Omidvari and Rasouli Ghamaroudi showed that people with less experience are more likely to make mistakes and are more prone to occupational accidents.[23] The reasons for the difference in the results include the laboratory nature of the present study and the same experience of individuals in performing the test. It is recommended that in future studies, the relationship between the work experience of people in the laboratory and the number of errors recorded by people in the laboratory work will be investigated.

In the present study, no relationship was found between job stress, work speed, and the number of errors. Considering the average job stress of the people in the study and obtaining approximately 88% of the maximum job stress score, and since the higher the score of the questionnaire, the lower the job stress level of the people, so the results revealed that people had suitable levels of job stress and this amount of job stress did not affect the work speed and the number of errors people made. A study conducted by Sadeghi-Yarandi *et al*. showed that job stress is related to functional memory; low job stress improves functional memory.[27] Furthermore, a study conducted by Vosoghi Niri *et al*. suggested that job stress has a negative effect on job performance and the general health of people in the study.[28] The difference in the results can be due to the differences in the amount of job stress between the two groups in the present and previous studies; the amount of job stress in the present study was in a better level than the mentioned studies.

One of the limitations of this study was the lack of control of all the parameters affecting people's cognitive performance and the possibility of people being dishonest in responding to occupational stress questionnaires and GHQ. As the limitations of the study, it is suggested that in future studies, larger sample size and wider age range should be considered and more mental performance parameters should be included in the study.

Conclusion

The results of this study indicated that gender and work experience have no effect on the number of errors and work speed in laboratory staff also, the results of this study showed

that age is effective on the number of errors in the laboratory, and older people have more errors, and the speed of doing work in the age range of 30–60 years, which is usually in the preretirement range of people, is not affected by age. Good conditions in factors affecting job stress cause low job stress and this factor causes no effect of low job stress on cognitive performance factors. The results of this study can be used to employ a suitable workforce in laboratories and work environments and to improve working conditions for personnel by employers and to control the statistics of accidents caused by human errors. It is necessary to do more research on this issue in future studies, so that by explaining the factors affecting the work speed and accuracy of people and other parameters of mental performance, more suitable people can be selected to be employed in job positions, which ultimately reduces accidents and increases productivity.

Ethics code: IR.MUI.RESEARCH.REC.1399.655.

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Conflicts of interest

There are no conflicts of interest.

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