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Effectiveness of educational intervention on reducing oxidative stress caused by occupational stress in nurses: A health promotion approach

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Abstract:

BACKGROUND: Nursing is one of the most stressful occupations. Educational intervention regarding stress management can play an important role in reducing occupational stress among nurses. The present study aimed to determine the effectiveness of educational intervention on reducing oxidative stress caused by occupational stress in nurses: A health promotion approach in a hospital in western Iran.

MATERIALS AND METHODS: The present interventional study was performed in 2019 among 92 nurses working at the Kosar Hospital located in the city of Sanandaj in the country of Iran. Occupational stress was evaluated using the Osipow Occupational Stress Questionnaire. Oxidative stress was measured by taking blood samples and measuring the enzymatic activity of superoxide dismutase (SOD), malondialdehyde, and catalase (CAT) using SOD, malondialdehyde (MDA), and CAT kits. Educational intervention was carried out in the second stage. Three months after the intervention, data were taken again.

RESULTS: The results of the present study indicated that there was a significant difference in occupational stress between before and after the educational intervention ($P < 0.05$). A significant reduction in MDA ($P = 0.038$) and SOD ($P = 0.048$) was observed after educational intervention, but this was not the case for CAT ($P = 0.592$). There was no significant correlation between occupational stress with oxidative stress parameters before and after the educational intervention ($P < 0.05$). No significant difference in occupational stress was observed between men and women. Among the oxidative stress parameters under evaluation, MDA was higher among men compared to women and this was statistically significant.

CONCLUSIONS: Educational intervention regarding occupational stress is effective in reducing oxidative stress among nurses. The group meetings teach stress management to the participants and enable them to better manage their stress by utilizing their own capabilities. Thus, attention to this issue is vital in maintaining the mental and physical health of nurses and, in turn, improves the quality of care rendered.

Keywords:

Educational intervention, health promotion, hospital, nurses, occupational stress, oxidative stress

Introduction

Stress is a nonspecific reaction caused by stressful factors and conditions in an individual and endangers one's physical

and mental health.^[1] An important source of occupational stress is the particular characteristics of an occupation. Occupational stress has become a common and costly issue in occupational environments.^[2] Occupational stress occurs whenever the

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conflict between job requirements and the individual's personal characteristics is irreconcilable, and the pressure of the job exceeds the capabilities of the individual. Researchers state that occupational stress is a problem of the 21st century and is widespread.^[3] Edwards and Burnard consider stress in the work environment to be the same as occupational stress.^[3] Occupational stress is the second common problem related to work (after musculoskeletal disorders) and leads to millions of pounds of losses due to absentee workers.^[4]

Hospitals and health centers are like an industrial unit consisting of capital, workforce, technology, and management that nurses are among the workforce of these centers and do 80% of the work of medical centers and hospitals.^[2] A nurse can be defined as a person who controls and monitors patients all the working hours and is exposed to the stress of performing these tasks.^[3,4] Studies have shown that nurses are considered the largest human resource and medical staff.^[5] The National Institute of Safety and Health ranked nursing among the top 40 professions with high stress and stress-related disorders among staff. It is believed that in the case of occupational stress, nursing may be included in the list of health care.^[2] After mining, nursing is known as the hardest occupation in the world and the nursing profession is defined as a job with high stress.^[6-9]

Occupational stress leads to excessive formation of free radicals, reactive oxygen species (ROS).^[9] ROS can cause diseases such as diabetes, atherosclerosis, cancer, and Parkinson's disease.^[10] Free radicals in the human body are formed in the cytosol, mitochondria, lysosomes, peroxisomes, and plasma membranes under both physiological and pathological conditions. They begin as a cascade and cause peroxidation of fat cells that directly damage the biological membrane, producing a number of by-products such as aldehydes and malondialdehyde (MDA), of which aldehydes are the most abundant due to the fat oxidation.^[10] The human body has an integrated antioxidant system which includes enzymatic and nonenzymatic antioxidants that are usually effective in preventing the harmful effects of free radicals. Normally, antioxidants convert ROS to H₂O, which prevents the increase of ROS. Enzymatic antioxidants, including superoxide dismutase (SOD), glutathione peroxide, and catalase (CAT), are responsible for intracellular protection. Occupational stress in the nursing profession increases absenteeism, decreases performance, and increases early resignation from work.^[11] On the other hand, when the balance between free radical production and antioxidants is disturbed, oxidative stress occurs, which leads to cell damage or death, subsequent damage, and eventually chronic disease.^[12] Tsuboi *et al.* indicated that the association between high levels of MDA and burnout symptoms in

participants was low, and there was a significant positive difference between the levels of MDA/TC ratio in low stress.^[13]

Stress cannot be eliminated completely, but it is possible to learn how to manage it. Stress management is necessary in reducing anxiety and depression and increasing courage. Stress control has been described as the ability, capacity, and skill in comprehending, assessing, and controlling excitations in others and in oneself.^[14] Using preventative methods including methods of education regarding the identification of stress and proper amelioration is important. Teaching stress management as a life skill can enable better adaptability as well as improved mental and social capabilities of individuals when dealing with the difficulties of life and the reduction of stress.^[1] This also enables the individual to convert his knowledge, values, and attitudes into actualized capabilities and can affect the feelings of the individual regarding himself and others. This compound intervention includes elements such as stress awareness, problem solving, self-expression, anger management, self-management, and planning activities.^[15]

The first Ottawa International Conference (1986) defines health promotion as enabling people to identify factors affecting personal and societal health as well as adopting healthy behaviors which result in healthy living.^[16] A look at the changing trends reveals that in recent years, a gradual shift has occurred from solely focusing on health education toward changing attitudes and behaviors within the individual. The present study aimed to determine the influential factors in health promotion among nurses by evaluating the efficacy of educational interventions regarding occupational stress.

Occupational stress is a major factor in reduced efficiency for organizations and causes adverse physical and mental side-effects among personnel. Occupational stress among nurses is known as an important part of the health-care system and has a significant effect on palliative care. Thus, educational interventions regarding occupational stress are an important pillar in health-care environments. Literature review in Iran reveals no interventional study regarding the effects of occupational stress on oxidative stress parameters among nurses. Considering that nurses are not in abundant supply and they perform more than 80% of the workload in hospitals also raises the importance of this issue. Thus, the present study was devised with a health promotion approach and aimed to determine the efficacy of educational intervention in reducing oxidative stress caused by occupational stress in a selected hospital in the city of Sanandaj.

Materials and Methods

Study design and setting

The present quasi-experimental and interventional study was carried out in 2019 among nurses of a select hospital with education as the intended intervention. The present study was executed in three stages including preintervention, intervention, and postintervention. In the first stage (before educational intervention), demographic information was collected using a questionnaire devised by the researcher. Then, information was collected regarding occupational stress using the Osipow Occupational Stress Questionnaire, taking blood samples and measuring the enzymatic activity of SOD, MDA, and CAT using SOD, MDA, and CAT kits. The intervention was carried out in the second stage of the study. Then, 3 months after the second stage, the third stage was carried out. In this stage (after educational intervention), the data were collected once more using the Occupational Safety Questionnaire, blood sample collection, and blood analysis similar to the first stage.

Study participants and sampling

Coordination with the selected hospital was initially carried out in order to have a briefing session. Then, all nurses in the Kosar Hospital in the city of Sanandaj were enrolled in the first stage of the study which was around 200 participants. In the second stage, 92 nurses were selected based on the entry criteria. A minimum of 1-year employment duration as well as informed consent was required for entry. Those with the following conditions were not enrolled: pregnant nurses, smokers, those suffering from chronic disorders (in the kidney or liver), those with diabetes, acute infectious diseases, malignant diseases or psychological disorders, and those using antioxidant medication (Vitamin E, A and minerals). Nurses who had any previous educational workshops regarding risk management and risk reduction were not enrolled. Any participant not willing to continue with the study was removed.

Data collection tool and technique

The demographic information of the participants was collected using a questionnaire devised by the researchers for this particular study. This questionnaire was used to collect population data including age, sex, employment history, level of education, marital status, smoking habits, level of physical activity, and dietary habits.

Occupational stress was evaluated using the Osipow Occupational Stress Questionnaire. This questionnaire was devised by Osipow *et al.* (1998) and is used to measure and evaluate an individual's stress levels caused by their occupational role. The aim of this questionnaire

is to determine the intensity and the differences in intensity pertaining to a particular occupational role among various organizational workers.^[17] The Osipow Questionnaire has six components which include role workload, incompetent of role, role ambiguity, boundary role, responsibility, and physical environment. Scoring and interpreting the questionnaire results are based on a 5-point Likert scale. The score can be anywhere between 60 and 300, with higher scores indicating high levels of stress. Overall stress levels can be classified into four states. A score of 50–99 indicates low levels of stress, a score of 100–149 indicates low to medium levels of stress, a score of 150–199 indicates medium to high levels of stress, and a score of 200–250 indicates extreme stress levels.

Sharigian *et al.* (2005) report the content validity of the Farsi version of this questionnaire to be satisfactory. The reliability of this questionnaire has been assessed using the test-retest method and reported to be satisfactory with a Cronbach's alpha of 0.89.^[18] The nurses were informed about the aim of the study before collecting the questionnaire and were assured that their personal information would be kept anonymous. Informed consent form was obtained from the participants after ensuring them that their answers would not affect their employment in any way.

In order to measure oxidative parameters, 5 cc of blood was taken from participants from 8 am to 10 am. The participants were in a fasting state (no food consumption) and the samples were taken at the laboratory of the Kosar Hospital facility in the city of Sanandaj.

The blood samples were placed inside a centrifuge at 2000 rpm and 4°C for a duration of 20 min in order to separate the serum which was then transferred into a microtube using a sampler. An MDA measurement kit made by Teb Pazhouhan Razi (92 tests) was used to measure the direct oxidative damage within the serum. A SOD enzymatic activity measurement kit made by Teb Pazhouhan Razi (92 tests) was used to measure the enzymatic activity of superoxide dismutase within the serum as an antioxidant. These kits are used to measure MDA and SOD in biological samples such as sperm, plasma, urine, and homogenized tissue. As for CAT, a kit made by Kiazist (92 tests) was used to measure CAT activity within the sample as an antioxidant. All three kits were analyzed via fluorimetry for better sensitivity. These kits last for more than 6 months from the time of receipt. Their components also remain stable for up to 2 months after preparation. It should be noted that the preparation and analysis of blood samples were performed immediately after the preparation of blood samples.

Data were collected before intervention and again after 3 months. The intervention involved four educational sessions (both theory and practice) each between 30 and 40 min, with one session per week being done according to the wishes and capabilities of the nurses. An expert panel comprised one PhD in clinical psychology and one in industrial and organizational psychology as well as an occupational health expert was used.

The first session of the educational workshop involved brainstorming, in which the nurses were given the opportunity to express their views on the problems and factors that contribute to their experience of occupational stress. The various views and opinions of the participants were collected and analyzed in terms of their psychological influence on occupational stress. The second session teaches stress management skills such as problem solving, reducing stress (relaxation, deep breaths, mindfulness), and caring for the feeling of job satisfaction with additional practices performed in small groups. The third session focused on managing stress associated with nursing including self-sufficiency, job skills, and acceptance of limitations in care. The final session involved discussions on stress-inducing occupational agents and ways to combat and control them.

After data collection, distribution normality was determined using the Kolmogorov–Smirnov test. SPSS v. 25, Armonk; NY, USA: IBM Corp, was used along with descriptive statistic methods such as mean, standard deviation as well as analytic statistic methods such as independent *t*-test and correlation test to analyze the data. A significance level of 0.05 was considered for all tests.

Ethical consideration

The present study has been approved by the ethics committee of the Shahid Beheshti University of Medical Sciences with the code: IR.SBMU.PHNS.REC.1397.102. The ethical considerations for the present study include voluntary participation, explanation of the aims and process of the study to the participants, use of written and informed consent forms as well as guaranteed anonymity of data.

Results

The results of measuring demographic variables are presented in Table 1. The participants had a mean age of 29.87 ± 4.52 years and a mean employment duration of 5.543 ± 3.53 years. The participants were comprised 51 males (55.43%) and 41 females (44.57%) nurses.

A comparison of occupational stress and oxidative stress parameters before and after intervention is presented in Table 2. A statistically significant

difference was found between occupational stress before and after intervention. Educational intervention caused a reduction in occupational stress among the individuals. According to the classifications of the Osipow Occupational Stress Questionnaire, the nurses were predominantly experiencing medium to extreme levels of stress. Educational intervention caused a significant reduction in the levels of MDA ($P = 0.038$) and SOD ($P = 0.048$) but did not manage to cause a significant reduction in CAT ($P = 0.592$).

Considering Table 3, a significant correlation was not observed between levels of occupational stress and oxidative stress parameters before and after educational intervention.

The difference between occupational stress levels and oxidative stress parameters (MDA, CAT, and SOD)

Table 1: Demographic variables of subjects

Variable	Mean±SD/percentage (n)
Age (years)	29.87±4.52
Work experience (years)	5.543±3.53
Consumption of fruits and Vegetables (gr/day)	331.96±249.17
BMI	25.35±3.8
Sex	
Female	44.57 (41)
Male	55.43 (51)
Marital status	
Single	40.21 (37)
Married	59.79 (55)
Activity level	
Always	28.2 (26)
Sometimes	57.6 (53)
Never	14.2 (13)
Educational level	
Diploma	8.7 (8)
Bachelor	71.7 (66)
Masters and PhD	19.6 (18)

SD=Standard deviation, BMI=Body mass index

Table 2: Comparison of occupational stress and oxidative stress parameter between before and after the educational intervention

Variables	Educational intervention	Mean±SD	P	
Occupational stress	Before	186.34±26.26	0.041*	
	After	166.12±21.11		
Oxidative stress parameter	SOD (U/mL)	Before	371.18±32.52	0.048*
		After		
	MDA (mm)	Before	12.24±4.27	0.038*
		After		
	CAT (nmol/mL)	Before	3.94±1.59	0.592
		After		

* $P < 0.05$, *Statistically significant values are shown. SD=Standard deviation, SOD=Superoxide dismutase, MDA=Malondialdehyde, CAT=Catalase

between male and female participants was analyzed and is presented in Table 4. According to these findings, stress levels were higher among men, but this was not statistically significant. MDA and CAT levels were higher in men, but this was only significant for MDA. However, SOD was higher among women, but this was not statistically significant.

Table 5 shows the differences in occupational stress levels and oxidative stress parameters (MDA, CAT, and SOD) among male and female participants. According to the findings, occupational stress levels were higher among those who were married, but this difference was not significant. CAT and SOD were higher among those

who were single, but this was only significant for CAT. However, MDA was higher among women, but this was not statistically significant.

Table 6 looks at the correlations between both age and employment duration with occupational stress and oxidative stress parameters (MDA, CAT, and SOD) among the participants. No significant correlation was found between age and employment duration with occupational stress and oxidative stress parameters.

Discussion

Stress management is a major skill for nurses. The present study evaluated the effectiveness of educational intervention in reducing oxidative stress caused by occupational stress among nurses using a health promotion approach. Based on the results, a significant difference was observed between occupational stress levels before and after educational intervention, indicating that the intervention caused a reduction in occupational stress ($P < 0.05$). Khazar and Jalili state that stress is among the prominent issues facing nurses. Their study agrees with our findings and shows reduced mean occupational stress scores in the intervention group after educational intervention.^[19] Arjmand *et al.* conducted a study on nurses aimed at evaluating the effectiveness of stress management educational intervention on occupational stress and the work-life opposition which showed a significant reduction in occupational stress in the intervention group compared to the control.^[20]

Hazavehei *et al.* conducted a systematic review among nurses and found most studies showing that educational intervention has a significant effect on reducing occupational stress and that using health education models in interventions has a greater effect on reducing occupational stress.^[21] Banisi *et al.* showed that educational intervention among workers caused reductions in stress and occupational burnout^[22] which agrees with our findings. Hosseini *et al.* conducted a study on health-care providers and found that teaching stress management skills can be influential on components such as support, feedback, role clarity, motivation, and job performance. They also suggest that workshops be held consistently in order to teach stress management skills for workers of health-care facilities.^[23]

Hazavehei *et al.* conducted another study that showed teaching nurses practical skills to use when dealing with stress-inducing situations can be very effective in reducing occupational stress.^[21] Reducing occupational stress based on health education theories is important. Studies on educational intervention using health education models are far more effective in occupational stress reduction compared to those that do not use this

Table 3: Correlation between occupational stress with oxidative stress parameter before and after the educational intervention

Variable	Educational intervention	Oxidative stress parameter		
		MDA	SOD	CAT
Occupational stress				
Before				
Correlation coefficient		-0.050	-0.145	0.042
<i>P</i> **		0.742	0.337	0.781
After				
Correlation coefficient		-0.096	-0.180	-0.161
<i>P</i> **		0.527	0.231	0.286

**Correlation is significant at the 0.01 level (*P*). SOD=Superoxide dismutase, MDA=Malondialdehyde, CAT=Catalase

Table 4: Effect of gender on occupational stress and oxidative stress parameters

Variables	Gender	Mean±SD	SEM	<i>P</i> *
Occupational stress	Male	181.56±22.32	3.12	0.286
	Female	178.46±24.65	3.85	
MDA	Male	13.41±4.89	0.68	0.015
	Female	10.23±2.05	0.32	
SOD	Male	360.27±30.38	4.25	0.502
	Female	368.70±26.88	4.19	
CAT	Male	4.03±1.635	0.22	0.466
	Female	3.62±1.749	0.27	

* $P < 0.05$, *Statistically significant values are shown. SD=Standard deviation, SE=Standard error mean, SOD=Superoxide dismutase, MDA=Malondialdehyde, CAT=Catalase

Table 5: Effect of marital status on occupational stress and oxidative stress parameters

Variables	Marital status	Mean±SD	SEM	<i>P</i> *
Occupational stress	Single	177.13±26.40	4.40	0.063
	Married	182.2±21.29	2.87	
MDA	Single	11.52±2.72	0.45	0.151
	Married	12.30±4.95	0.66	
SOD	Single	367.06±19.53	3.25	0.175
	Married	361.77±34.02	4.58	
CAT	Single	4.22±1.912	0.31	0.025
	Married	3.62±1.512	0.20	

* $P < 0.05$, *Statistically significant values are shown. SD=Standard deviation, SE=Standard error mean, SOD=Superoxide dismutase, MDA=Malondialdehyde, CAT=Catalase

Table 6: Correlation between age and work experience with occupational stress and oxidative stress parameters

Variables	Occupational stress	MDA	SOD	CAT
Age				
Correlation coefficient	-0.092	0.040	0.073	0.021
P*	0.381	0.705	0.486	0.843
Work experience				
Correlation coefficient	0.041	0.104	0.040	0.021
P*	0.696	0.322	0.708	0.844

*Correlation is significant at the 0.01 level (P). SOD=Superoxide dismutase, MDA=Malondialdehyde, CAT=Catalase

theory. This may be due to having a compound design theory for planning effective education programs.

Educational intervention caused a significant reduction in MDA ($P = 0.038$) and SOD ($P = 0.048$) after intervention, but no significant reduction in CAT was observed ($P = 0.592$). Mohamed *et al.* conducted a cross-sectional study aimed at determining the link between occupational stress and oxidative stress biomarkers among nurses and office employees of a hospital. Their results showed that 65% of nurses were experiencing extreme stress, while this was only true in 7.5% of office workers. MDA and SOD levels among nurses were significantly higher than the office employee group (control).^[24] The study by Yau *et al.* also agreed with our findings and was aimed at determining the amount of occupational stress as well as stress-inducing factors in the Zhuhai hospital in China.^[25] Biganeh *et al.* showed in their study that occupational stress among nurses causes a significant increase in MDA levels.^[26]

Having nurses participate in educational programs dealing with stress management can help reduce occupational stress. It is suggested that administrators attempt to put in place stress management programs in order to improve the health of their workers and their quality of care. Taft *et al.* looked at the effect of educational intervention on stress management among nurses working in a cardiology ward. Their results showed a significant reduction in mean stress scores obtained by the nurses in the intervention group compared to the control. In other words, those nurses who participated in educational programs regarding stress management reported lower levels of occupational stress later on.^[15]

Considering the results obtained, no significant correlation was observed between occupational stress levels and oxidative stress parameters before and after intervention. These results are in agreement with studies by Moradi *et al.*, Silveira *et al.*, and Bardhan *et al.* However, these findings are not in agreement with Moragón *et al.* and Casado *et al.* (2008).^[27-32] These similar and dissimilar results may be due to the differences in the

particular sections under consideration, the volume and workload of the subjects, nature of the hospital ward, and the participant's perception of stress. The acclimatization and adaptation of the subjects to stress must also be taken into account, as the effect of exhaustion on enzymes has been considered in the aforementioned studies but not in the present study. It is possible that the level of stress experienced by the subjects of the study is not enough to trigger exhaustion, in which case oxidative stress parameters are not affected.

According to the findings, occupational stress was higher among male subjects compared to female subjects, but this difference was not statistically significant. Casado *et al.* also found no significant difference in levels of occupational stress among male and female subjects in their study which agrees with our findings.^[33] Based on the results obtained, among the target oxidative stress parameters being considered, only MDA was significantly higher in men compared to women. This issue has also been confirmed in the study by Takaki,^[34] in which the link between occupational stress indices and oxidative biomarkers among Japanese men and women was investigated. In that study, oxidative biomarkers were significantly higher in men while no significant correlation was found between two occupational stress indices and oxidative biomarkers in women. The results of Casado *et al.*^[33] were also in agreement with our findings and show that SOD and CAT levels have a significant correlation with the participants' sex among palliative care workers.

Occupational stress levels were higher among married subjects compared to those who were single, but this was not statistically significant. Fang and Hung^[35] looked at health among married female nurses and showed that the level of occupational stress and familial stress was not in a desirable state. They add that the number of working hours per week, job-related stress, and the excessive commitment to their job have put the health of these workers at risk. According to their results, supervisors must refrain from scheduling workloads in excess of 48 h per week for their nurses. Other studies have shown that educational intervention focused on stress management has managed to reduce occupational stress among nurses and has been effective in mediating stress both at individual and organizational levels.^[36]

Based on our findings, among the oxidative stress parameters under consideration, CAT levels were significantly higher among unmarried subjects. Age and employment duration had no significant correlation with occupational stress and oxidative stress parameters. The study by Casado *et al.*^[27] conducted on nurses and doctors showed that MDA levels rise with age, but no significant changes were detected in regards to sex. However, they

did find significant differences in the levels of oxidative stress parameters among married and unmarried subjects. Their findings regarding higher levels of oxidative stress parameters among unmarried subjects are in agreement with our findings. Ortega-Galán *et al.* found that age, sex, and employment duration have a significant relationship with occupational stress among health-care professionals but found no significant link between marital status and occupational stress.^[37]

It can be concluded that educational intervention, as a solution for stress management, can reduce occupational stress and improve the health of nurses with the aid of a comprehensive and expansive program.^[38] Stress management methods are based on the idea that cognitive assessment of stress-inducing incidents and taking measures regarding these assessments play an important role in determining the response to stress. By teaching stress management in group sessions (educational interventions), participants can learn to use their own abilities to resist stress as well as how to remedy and alleviate it. The value of health education programs lies in their effectiveness which is itself dependent on the proper use of educational models.^[39] Stress management educational programs can reduce occupational stress among workers by increasing the awareness of workers regarding occupational stress management, teaching how to manage time as well as improving work relationships in order to reduce stress. This can, in turn, increase job satisfaction and improve the health of the.^[40-42]

Limitation and recommendation

The present study had certain limitations which include the relatively small sample size, small number of educational sessions, and the lack of cooperation and attention of certain nurses due to heavy work shifts, personal problems, and other disruptive elements in the work environment. It is suggested that in future studies, the influential factors affecting work performance be investigated in a multivariable setting which also take into account occupational excitations, spirituality, organizational commitments, general health, and financial rewards as well as corporate and occupational aspects.

Conclusions

Based on the findings of the present study, it can be concluded that educational intervention resulted in a significant reduction in occupational stress among nurses. However, the level of occupational stress before and after intervention had no significant correlation with oxidative stress parameters. By teaching stress management via educational intervention, the participants learned that with the help of this method,

they can better utilize their own abilities and strengthen their resolve against the stresses of living and ultimately reduce their occupational stress levels. Thus, stress management can increase the ability of individuals to reduce stress and better adapt to stress-inducing situations. Therefore, it is feasible to make the findings of the present study available to managers and nursing authorities so that they may take measures in organizing educational courses to teach stress management in occupational environments and thus increase the quality of nursing care. Further research is needed to determine changes in blood parameters in response to occupational stress while also accounting for disruptive factors so that the hypotheses presented in the present study can be further confirmed.

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Conflicts of interest

There are no conflicts of interest.

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