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Effect of Perceived Stress Factors on Cortisol Level Among Industrial Workers

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Abstract

This cross-sectional study to evaluate the effect of perceived stress and hormone change will help the workers to better understand the way to manage and reduce stress. The aim of this study was to explore the relationship between occupational stress symptoms, perceived stress level, and cortisol level in industrial workers. The study was conducted with 137 workers from the automotive parts manufacturing industry. The levels of perceived stress were assessed by a stress assessment instrument, and the stress symptoms were assessed by questionnaires; samples of urine were collected for the determination of urinary cortisol levels through an enzymatic immunoassay. The study results found that a sleep problem was a risk factor for increased stress symptoms (11.48; 95% CI, 1.37–26.24). The cortisol level of workers with elevated perceived stress was higher than that of office workers (control group). The office workers and operation workers groups had cortisol levels of 126.4 ng/mL and 187.8 ng/mL, respectively. Increased perceived stress could lead to an increase in hypertension incidence. High cortisol could increase the risk of many stress symptoms. Our findings indicate that stress substantially contributes to symptom occurrence, with increased cortisol levels appearing to be a more influential factor than changes in health-related behaviors.

INTRODUCTION

Social and occupational stressors can adversely affect both physical and psychological health. Evidence emerging from the COVID-19 pandemic indicates that sudden lifestyle changes, quarantine measures, and adjustments to new routines substantially increased levels of anxiety, uncertainty, and psychological stress (Brooks et al., 2020). Previous studies conducted during the pandemic have also documented that individuals exposed to these conditions experienced various mental health problems, including emotional distress, depressive symptoms, mood instability, irritability, sleep disturbances, attention-related problems, post-traumatic stress symptoms, and anger (Brooks et al., 2020; Rubin & Wessely, 2020). Chronic stress responses in the body can be harmful to health. Numerous scientific studies have demonstrated that chronic stress is a risk factor for both physical and mental health. Research has shown that stress significantly affects cardiovascular disease (Vaccarino, V., & Bremner, 2024), obesity, and high blood pressure (Yaribeygi et al., 2017). Stressors that affect people, in general, are a combination of environmental, socioeconomic, and personal factors (Hill et al.,

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2015). Stress factors were not specific to psychological symptoms. Instead, it was caused by an unpleasant external environment that stresses the body, affects feelings, and induces biological changes, such as noise, heat, and muscular workload (Ardiyansyah et al., 2023).

Stress reactions were used to evaluate a person's response to stress. It was caused by perceived past and present stress. Perceived stress was used to measure a person's responsiveness to stress and how stressful situations affected them. The physiological response to stress involves coordinated activity among multiple regions of the brain. Key neural structures responsible for initiating stress reactions include the locus coeruleus, components of the limbic system, and hypothalamic pathways that activate downstream responses. The hippocampus, which plays an essential role in memory processes, contributes to stress regulation by providing inhibitory feedback to the hypothalamus, thereby influencing cortisol secretion. In addition, the prefrontal cortex, responsible for higher-order cognitive functions such as decision-making and impulse regulation, modulates stress responses by inhibiting the amygdala and hypothalamus (Meier and Schwabe, 2024).

The long-term stress reaction manifests in abnormal bodily functions. Symptoms of stress that occur include fatigue, poor sleep quality, diarrhoea or constipation, forgetfulness, frequent aches and headaches, lack of energy or focus, sexual problems, stiff jaw or neck, tiredness, insomnia or excessive sleep, stomach pain, use of alcohol or medications to relax, and weight loss or symptoms of a gastrointestinal disorder (de Souza et al., 2020). It also causes biological changes in the body when it is stressed or exposed to stressors, such as an increase in cortisol levels. Therefore, Cortisol may be used to confirm biological changes in the body's stress response. Several studies have found that cortisol levels are linked to physical stress (James et al., 2023). Prolonged exposure to cortisol or chronic stress can also contribute to cardiovascular disease, obesity, and high blood pressure in the future. Many elements that affect the working environment in an industrial setting include physical factors, chemical factors, shift work, and psychosocial factors. As a result, industrial workers will be exposed to factors that cause stress in the industry, in addition to stress from socioeconomic conditions or mental and emotional factors, and psychosocial factors, as normal people.

Work stress affects employee health and reduces productivity. Approximately 15% of working-age adults have mental disorders (WHO, 2024). The prevalence of stress in industrial workers was reported to be 59.3% (Kefelew et al., 2023). A significant relationship between work stress and quality of work life was found ($p < 0.001$) (Eisapareh et al., 2022). Therefore, stress is a complex issue to assess. In people, normal external expressions may mask subconscious problems. This time, we saw the gaps in knowledge in assessment with psychological and scientific tools. Therefore, the objectives are to evaluate the correlation between personal and occupational factors affecting stress levels for both stress symptoms and perceived stress, and to examine the factors that influence variation in cortisol levels among industrial workers. The benefits gained led to the selection of appropriate stress assessment tools and to the reduction of stress risk factors among employees, resulting in improved quality of life and higher levels of work productivity.

METHOD

Study design and participants

In this cross-sectional study, 148 employees from the automotive parts manufacturing industry participated. There are 69 office workers and 79 production workers. Questionnaires were collected from 148 participants. This research has parts that can be studied in humans. Ethical approval for this study involving human participants was obtained in accordance with internationally accepted standards for the protection of research subjects. All procedures were conducted with full consideration of participant rights and welfare, as approved by the Research Ethics Review Committee for Research Involving Human Subjects, Thammasat University (COA No. 045/2564). Prior to data collection, the study objectives were clearly explained to all participants, and informed consent was obtained from those who agreed to participate.

Research tool and quality

The questionnaire was created using methods derived from other researcher tools (Vallejo et al., 2018; Ioannou et al., 2019; García-León et al., 2019) and questionnaire standards (Maroufizadeh et al., 2019; Bastianon et al., 2020). The questionnaire was divided into two parts: general information and stress evaluation. General information includes a subject's age, gender, congenital disease, body mass index (BMI), waist circumference, alcohol consumption, smoking habits, physical activity, and health examination results. Stress evaluation consists of two parts of the question: stress symptoms and stress percep-

tion.

The stress symptoms scale was developed from the book on stress management. The questionnaire asks about the frequency of experiencing stress-related symptoms such as headaches, problems with sleep or staying asleep, unexplained muscle pain, jaw pain, uncontrolled anger, and frustration. For each chooses from the rating scale: 0 - Never, 1 - Sometimes, 2 - Often, 3 - Very often **(**Musana et al., 2020**)**. The rating score can be interpreted as lower than average, Average, moderately higher than average, or much higher than average (Kongcharoen et al., 2020).

The Perceived Stress Scale (PSS) was a stress assessment instrument. The tool was developed from the employee assistance program of New Hampshire State and the American Sociological Association. The purpose was to comprehend how various situations affect feelings and perceived stress. The questions asked about feelings and thoughts in the previous month and how frequently they were felt or thought. Choose an alternative scale for each question: 0 means never, 1 means almost never, 2 means occasionally, 3 means fairly frequently, and 4 means very frequently. The PSS scores range from 0 to 40, with higher scores indicating greater perceived stress (Maroufizadeh et al., 2019; Bastianon et al., 2020). The process of developing a questionnaire includes reviewing the literature to determine the content and testing for validity and reliability.

The questionnaire was validity tested. The face and content validity of the questionnaire were assessed by 3 experts, all of whom are professionals with research experience or work in epidemiology, industrial hygiene, or stress evaluation. The experts will be requested to provide comments on the position of items, correct scaling, and the wording structure, and on the necessity of adding or removing each item. There are 4 criteria for reviewing the questionnaire and assessing each item on relevance, clarity, simplicity, and necessity. This study calculated content validity indices (CVIs) and reported values greater than 0.8 for all items that met the passing and evaluation criteria (Gosak et al., 2021).

The reliability testing was conducted with try-out subjects: 30 workers from the same factory who met the inclusion and exclusion criteria but were not study subjects. The correlation coefficient will be calculated using the Cronbach's Alpha method's alpha coefficient formula (coefficient) at a significance level of 0.05.

Cortisol collections

A spot urine specimen (30 mL) was collected from each participant between 7:00 and 9:00 AM to assess diurnal hormonal variation associated with circadian rhythms. The collected samples were placed in sterile plastic containers and maintained at 4°C until laboratory analysis. Urinary cortisol concentrations were determined using an expanded-range high-sensitivity enzyme immunoassay kit (R&D Systems Inc., USA) according to the manufacturer's recommended protocol. Concentration values were calculated from absorbance readings using a standard calibration curve based on a four-parameter logistic (4PL) model.

Data analysis

The cortisol levels, for normally distributed data, are shown with the mean and standard deviation. The inferential statistics for objective testing: i) distribution of general profile variables by office and operation workers using chi-square test, ii) comparison of stress symptoms between gender by independent t-test, iii) comparison of perceived stress between gender by independent t-test, iv) Factors affecting symptoms stress and perceived stress by univariate logistic regression, v) comparison of stress symptoms between occupation groups by independent t-test, vi) comparison of perceived stress between occupation groups by independent t-test, set P value <0.05.

RESULT AND DISCUSSION

Distribution of general variables

One hundred forty-eight workers participated in this study. The average age of the study population was 35.76 years (SD = 7.8 years), with most (72.2%) participants aged below 42 years. General worker information, such as personal data, health information, and health behaviors, was grouped to facilitate comparisons between the two groups. Using chi-squares to find the relationship between the factors and the study groups.

There are 69 employees in the office and 79 in manufacturing. Most employees in the production process are male (42.56%), while most office workers are female (22.29%). The most common qualification was a bachelor's degree (33.3%), but 41.13% of the production staff had graduated from secondary school. According to Table 1, most employees in both groups drank coffee, did not exercise, did not have sleep or mental health problems, and had only one occupation.

The distribution of general profile variables by office and operation workers using chi-square test, the results found differences between the office and operation workers group, including: gen-

der (χ^2=16.656, P value <0.001) education level (χ^2=33.502, P value <0.001), congenital disease (χ^2=2.632, P value = 0.042) and work duration (years) (χ^2=8.281, P value = 0.004). Just under half of the participants had a normal weight (52.7%), and the other half were overweight or obese (42.6%). In addition, 73.7% of the participants reported taking caffeine, and more than half (72.3%) considered themselves to have no sleep problem (Table 1).

Moreover, the study showed an association between personal factors, behaviors, and health, and found that the smoking factor was associated with gender; men smoked significantly more than women (P value 0.05). BMI was found to be associated with shift work (2= 6.970, P value = 0.008) and with the presence of underlying disease (χ^2= 11.328, P value = 0.003). Smoking was associated with waist circumference (χ^2= 3.900, P value = 0.048). Waist circumference was associated with alcohol consumption. (χ^2= 3.395, P value = 0.050) (Not displayed in the table).

The correlation between personal factors and stress

The study examining the relationship between individual characteristics and stress levels revealed that both alcohol use and gender have an impact on the manifestation of stress symptoms. The findings of differences between people who consumed various amounts of alcohol showed that the quantity of alcohol consumed affected the perceived stress score. Those who consumed more than 14 drinks per week showed a considerably different perceived stress score than those who consumed no alcohol or less. Nevertheless, there was no differentiation between stress symptoms and alcohol consumption. This is consistent with Matei-Mitacu et al. (2024) found that psychological distress and emotional dysregulation predict problematic alcohol consumption ($p<0.05$). It is possible that alcohol causes a feeling of intoxication that people who are stressed may use as a temporary coping mechanism. However, it is not a solution to the root cause and is not sustainable. Solving the problem by drinking alcoholic beverages can lead to addiction and negative health and social impacts (Clay & Parker, 2018). Considering the stress symptoms caused by each factor and the amount of alcohol consumed, it was found to be associated with bouts of anger/hostility, which were found to be correlated with stress symptoms. Negatively low correlation was observed. It has been shown that people with alcohol-drinking behaviors may be able to lessen anger/hostility bouts.

There was an association observed between gender and symptoms of stress. In a statistical comparison of stress levels between males and females, both stress symptoms and perceived stress were found to differ significantly (P value < 0.05), with females having higher stress scores. Comparison of stress-related symptoms between males and females indicated that female participants reported significantly higher frequencies of several symptoms, including headaches, muscle tension, neck and back discomfort, anxiety-related conditions, mood disturbances, anger or hostility, and irregular eating behaviors compared with males (P < 0.05). These findings are consistent with earlier studies (Graves et al., 2021; Redondo-Flórez et al., 2020). For instance, research conducted in Spain demonstrated that females showed significantly higher levels of perceived stress, emotional exhaustion, and neuroticism than males ($p \leq 0.05$). This may be due to individual biological and sociopsychological factors, such as the altered estrogen response associated with social stress (Albert & Newhouse, 2019), or to women often having multiple roles, including work, home care, and childcare, which can lead to more to think about (Shankland, 2025).

Distribution of perceived stress

Males and females experienced perceived stress factors differently, as indicated by comparisons of each factor. The differentiating factors were groups of negative perceived stress, such as feeling irritable or upset or uncomfortable, cannot control the important things in life, feeling stressed or anxious, feeling unable to cope or deal, angry because of things beyond to control, problems accumulate more and more until they cannot all editable, with females having more negative stress perceptions than males. Regarding positive perceived stress factors, there were no significant gender differences (Table 2).

Factors affecting symptoms, stress, and perceived stress

In a logistic regression of individual factors affecting stress symptoms and perceived stress, it was shown that sleep problems increased stress symptoms by 11.48 times (95% CI = 1.37 to 26.24). Other factors were not associated with stress symptoms and perceived stress. (Table 3).

Stress symptoms factors between office workers and operational workers

When the stress symptom scores of the study groups were compared, there was no statistically significant difference between office

Table 1. Distribution of general profile variables by group

Variables	Category	Office workers group	Operational workers group	χ^2	P value
Sex	Male	29 (19.59%)	63 (42.56%)	16.656	< 0.001*
	Female	33 (22.29%)	16 (10.81%)		
Education	Primary/secondary school	16 (11.35%)	58 (40.84)	33.502	< 0.001*
	Vocational Certificate / Undergraduate	47 (33.33%)	20 (14.18 %)		
Congenital disease	No underlying disease	53 (43.80%)	61 (50.41 %)	2.632	0.042*
	Congenital disease	5 (4.13%)	2 (1.65%)		
Drinking behaviour	No drinking	31 (22.63%)	34 (24.82%)	0.145	0.703
	Drinking	32 (23.36%)	40 (29.20%)		
Work duration	3 years and over	29 (20.42%)	54 (38.03%)	8.281	0.004*
	Less than 3 years	35 (24.65%)	24 (16.90%)		
Smoking behaviour	No smoking and ex-smoker	50 (35.46%)	46 (32.62%)	5.771	0.020*
	Smoking	14 (9.93%)	31 (21.99%)		
Exercise	No/ sometime	51 (41.13%)	57 (45.97%)	0.154	0.694
	Regularly	8 (6.45%)	8 (6.45%)		
Waistline	Normal	42 (33.60%)	53 (42.40%)	0.308	0.579
	Higher than normal	15 (12.00%)	15 (12.00%)		
BMI	Normal or healthy weight	38(26.95%)	40 (28.37%)	0.573	0.751
	Overweight	19 (13.48%)	32 (22.70%)		
	Obese	6 (4.26%)	6 (4.26%)		
Other job	One job	54 (38.03%)	69 (48.59%)	0.507	0.477
	More than one job	10 (7.04%)	9 (6.34%)		
Caffeine intake	Have caffeine intake	55 (39.01%)	69 (48.94%)	0.445	0.505
	No caffeine intake	9 (6.38%)	8 (5.67%)		
Sleep problem	No sleep problem	47 (33.10%)	60 (42.25%)	0.230	0.632
	Have sleep problem	17(11.97%)	18 (12.68%)		
Psychology problem	No psychology problem	56 (39.44%)	71 (50.00%)	0.463	0.496
	Have psychology problem	8 (5.63%)	7 (4.93%)		

Note: using chi-square test, *P value <0.05

workers (21.90 ± 7.59) and production workers (19.73 ± 8.29). The mean perceived stress score for office workers was 14.46 ± 5.64, and for operational workers, 14.07 ± 5.03, which did not differ significantly. However, when analyzing the symptoms, it was found that operation workers had significantly different symptoms of anxiety/worry/phobias and bouts of anger/hostility from office workers (Table 4).

There was no statistically significant difference between the two groups in most stress symptoms, except for anxiety, worry, phobias, and anger/hostility outbursts (P value < 0.05)

Perceived stress factors between office workers and operational workers

The comparison of the perceived stress scores of the study groups revealed statistically significant differences. When each factor was compared, almost all of them were statistically different (P value < 0.05), except for "feel capable of dealing with whatever comes" (Table 5).

The expression of cortisol on personal factors, work factors, and stress

Participants' urinary cortisol levels ranged from 49.8–240 ng/mL, with a mean of 126.4 ng/mL (SD = 18.34 ng/mL) in the office wor-

Table 2. Distribution of perceived stress by gender

Variables	Gender	Mean	SD	t-test	P value
1. feel irritable, upset, or uncomfortable	Male	2.11	0.90	-3.376	< 0.001*
	Female	2.66	0.94		
2. cannot control the important things in life	Male	1.57	0.75	-3.441	< 0.001*
	Female	2.09	0.97		
3. feel stressed or anxious	Male	1.86	0.92	-2.663	0.001*
	Female	2.30	0.93		
4. Feel confident in your ability to cope.	Male	2.90	1.53	-0.823	0.410
	Female	3.11	1.05		
5. feel that things are going in the direction you have set your goals.	Male	2.78	1.31	-0.719	0.478
	Female	2.93	0.90		
6. feel unable to cope or deal	Male	1.59	0.76	-4.242	< 0.001*
	Female	2.22	0.94		
7. Feeling capable of dealing with whatever comes can be distracting	Male	2.83	1.46	-1.002	0.326
	Female	3.06	1.01		
8. can control the situation.	Male	3.01	1.42	-0.423	0.677
	Female	3.11	0.87		
9. angry because of things beyond your control.	Male	1.95	0.90	-2.412	0.002*
	Female	2.34	0.94		
10. problems accumulate more and more until you cannot edit them all	Male	1.81	0.92	-2.656	0.011*
	Female	2.26	0.94		

Note: using an independent t-test, *P value <0.05

Table 3. Factors affecting symptoms stress and perceived stress

Factors	Stress symptoms		OR	95%CI	Perceived stress		OR	95%CI
	1 or more symptom (s)	No symptom			1 or more ever (s)	never		
Congenital disease	23(67.6)	11(32.4)	0.41	0.11 to 1.53	33(97.1)	1(2.9)	0.28	0.02 to 3.27
Smoking behaviour	35(67.3)	17(32.7)	0.91	0.30 to 2.71	49(94.2)	3(5.8)	0.27	0.04 to 1.67
Drinking behaviour	56(67.5)	27(32.5)	1.11	0.37 to 3.34	75(90.4)	8(9.6)	1.03	0.18 to 5.77
Exercise	84(77.8)	24(22.2)	0.70	0.16 to 2.91	98(90.7)	10(9.3)	2.12	0.19 to 23.04
Sleep problem	73(68.2)	34(31.8)	11.48*	1.37 to 26.24	95(88.8)	12(11.2)	1.09	0.02 to 1.85
Caffeine intake	92(74.2)	32(25.8)	0.79	0.17 to 3.73	111(89.5)	13(10.5)	1.11	1.00 to 1.86

Notes: Constant= 1.577, Cox & Snell R^2=1.39, Nagelkerke R^2=0.208; References group: Congenital disease= Congenital disease, smoking behaviour= Yes, Drinking behaviour= Yes, exercise= No, Sleep problem= Yes, Caffeine intake= Yes. using univariate logistic regression, *P value <0.05.

Table 4. Distribution of stress symptoms factors by group

Variables	Groups	Mean	SD	t	P value
Headaches	Office workers	2.44	1.09	0.787	0.433
	Operation workers	2.28	1.28		
Tense muscles, sore neck, and back	Office workers	3.17	1.27	1.462	0.146
	Operation workers	2.84	1.43		
Fatigue	Office workers	2.98	1.30	0.590	0.556
	Operation workers	2.85	1.44		
Anxiety, worry, phobias	Office workers	2.06	1.23	2.742	0.007*
	Operation workers	1.55	0.98		
Difficulty falling asleep	Office workers	2.00	1.19	-0.469	0.640
	Operation workers	2.10	1.37		
Bouts of anger/hostility	Office workers	2.42	1.23	2.887	0.005*
	Operation workers	1.86	1.09		
Boredom, depression	Office workers	1.81	1.11	1.335	0.184
	Operation workers	1.57	1.05		
Eating too much or too little	Office workers	2.06	1.23	1.577	0.117
	Operation workers	1.74	1.20		
Diarrhea, cramps, gas, constipation	Office workers	1.69	0.90	0.271	0.787
	Operation workers	1.64	0.94		
Restlessness, itching, tics	Office workers	1.34	0.73	-1.292	0.198
	Office workers	1.54	1.04		

Note: using an independent t-test, *P value <0.05

Table 5. Distribution of perceived stress factors by group

Variables	Groups	Mean	SD	t-test	P value
1. feel irritable, upset, or uncomfortable	Office workers	1.49	0.99	2.365	0.019*
	Operation workers	1.11	0.89		
2. cannot control the important things in life.	Office workers	0.93	0.85	2.377	0.019*
	Operation workers	0.59	0.84		
3. feel stressed or anxious	Office workers	1.18	0.92	2.353	0.020*
	Operation workers	0.80	0.97		
4. Feel confident in your ability to cope.	Office workers	1.74	1.30	-2.322	0.022*
	Operation workers	2.28	1.41		
5. feel that things are going in the direction you have set your goals.	Office workers	1.82	1.01	-3.337	0.001*
	Operation workers	2.47	1.24		
6. feel unable to cope or deal	Office workers	1.11	0.89	4.105	< 0.05*
	Operation workers	0.53	0.78		
7. feel capable of dealing with whatever comes	Office workers	1.87	1.13	-1.696	0.092
	Operation workers	2.25	1.46		
8. can be distracting, but can control the situation.	Office workers	1.62	0.98	-2.889	0.004*
	Operation workers	2.23	1.38		
9. angry because of things beyond your control.	Office workers	1.25	0.94	2.052	0.042*
	Operation workers	0.92	0.90		
10. problems accumulate more and more until you cannot edit them all	Office workers	1.21	1.01	2.969	0.004*
	Operation workers	0.75	0.83		

Note: using an independent t-test, *P value <0.05

kers group and 187.8 ng/mL (SD = 39.34 ng/mL) in the operation workers group. The majority (90.3%) of office workers had cortisol levels in the normal range, and 50.6% had high levels. There were statistically significant correlations among people with mental health issues or taking psychotic symptom-treating drugs, as shown by the chi-square correlation test (χ^2 = 4.842, P value = 0.028). However, other personal factors were not associated with cortisol levels. Compared to a group of people with normal and high cortisol levels using factors related to stress symptoms and perceived stress, the results showed that there were statistically significant differences in cortisol levels among those with "anxiety, worry, phobias, and problems that accumulate more and more until you cannot all be editable" (P value < 0.05). Those with normal cortisol levels had a negative correlation with the positive question, feel capable of dealing with whatever comes, can be distracting (χ^2= -0.217, P value = 0.013). The lower the score on the positive question, the higher the cortisol level.

According to the findings of the study, two personal factors were associated with stress: sexual factors and alcohol consumption behavior. It was discovered that females experience higher stress symptoms and perceived stress than males. Various factors, including physical factors, social status issues, and work-related factors, contribute to the presence of female stress. The mechanism of hormone production and the body's response to stress, the sympathetic-adrenal-medullary (SAM) axis, secretes adrenaline for a few minutes. Then the hypothalamic-pituitary-adrenal (HPA) axis secretes cortisol. Stress hormones are accumulated through the catabolic process to break down fat and the anabolic process to create a homeostasis and response to the stressful state of the body. The body reacts differently to cortisol in males and females. Males were shown to be twice as likely as females to react to cortisol (Thau, et al., 2023). However, according to Shankland (2025), men and women live different lives in modern society due to differing societal expectations and biological processes for women (menstruation, pregnancy, and menopause). These extra feelings of stress may be tied to traditional gender roles. As a result, males have a fight-or-flight pattern, whereas females prefer to engage in social contact, find people to talk with, and make them feel comfortable and lower their stress levels through a tend-and-befriend pattern. Social contact is calming and reduces stress levels (Chu et al., 2024). Mood disorders, post-traumatic stress disorder, bipolar disorder, and physically linked symptoms such as sleep problems, personality disorders, and the capacity to function in various professions were more prevalent in women than in men. In psychology, it was discovered that females suffer more from a physical disorder than males (Joel and McCarthy, 2017). Sex Perspectives in Occupational Stress Research has shown that work-related gender role allocations and male-female responsibilities differ from social inequity. Women continue to have more responsible roles than men in both household and work roles. Del Boca et al. (2020) mentioned that women do more housework than men, especially during the COVID-19 pandemic. Housework and childcare activities have significantly increased in women, which can contribute to stress.

This research clearly showed that alcohol consumption was associated with hostile or angry behavior. And because of their sexuality, Males were more likely to consume alcohol than females, and males were more likely than females to behave angrily or in a hostile manner. Based on the relevant literature, it was evident that alcohol consumption was positively associated with work-related stress and depression (García-León et al., 2019). Various factors, including gender (Albert & Newhouse, 2019), age, marital status, social status (Probst et al., 2020), and work factors, influenced alcohol consumption factors (García-Arroyo and Cárdenas-Moncayo, 2022). Even an individual's personality can affect alcohol consumption (Airages et al., 2017). Alcohol-related behaviors were associated with anger or hostility. Alcohol consumption has been widely recognized to reduce behavioral inhibition and increase the tendency toward aggressive actions, particularly among males (Jones et al., 2022). In addition, occupational conditions were associated with the occurrence of comorbid diseases. Among office-based employees, chronic conditions such as obesity, diabetes, and cardiovascular disorders were observed more frequently than among operational workers. This difference may be related to sedentary work patterns, as prolonged sitting has been linked to the development of metabolic syndrome, type 2 diabetes, hypertension, and several mental health disorders, including depression, anxiety, bipolar disorder, and schizophrenia (Suhaima et al., 2022).

Stress affects biological responses and causes stress-related physical and health disorders, from mental illnesses such as depression and anxiety disorders to physical problems such as high blood pressure and heart disease. It was also found that people with high expectations for coping with stressful situations activate adaptive

mechanisms to deal with stressful events, which influence their thinking, control, and behavioral manifestations (Pulopulos et al., 2020). A high cortisol awakening response was observed in people with high stress (Sherman, G. D., & Mehta, 2020; James et al., 2023). However, cortisol acts as an output (stress index) and input (to behavioral inhibition) (Sherman, G. D., & Mehta, 2020). Cortisol levels were associated with perceived stress, with lower perceived stress associated with lower cortisol levels (Shorout et al., 2020). In people with low resilience, perceived stress and cortisol levels were increased. And it was associated with depression, nervousness symptoms, and mental hostility (García-León et al., 2019). Fluctuations in daily cortisol levels can have serious consequences for physical and mental health. Cortisol levels can thus be used to explain the relationship between psychosocial stress and the subsequent physical and mental health effects (Adam et al., 2017).

Work-related factors were correlated with the incidence of comorbidities. In office workers, obesity, diabetes, and cardiovascular disease were more likely to appear as comorbidities than in operation workers. Office workers who spend a lot of time sitting are more likely to develop metabolic syndrome, type 2 diabetes, and hypertension. Prolonged sitting has also been associated with depression, anxiety, bipolar disorder, and schizophrenia (Suhaimi et al., 2022). The prevalence of psychotic disorders increased in industrialized countries (Pezeshki et al., 2021) where mental disorders were directly and indirectly linked to physical health (Ohrnberger et al., 2017). It was also considered that physical and mental stress contributed to the development of mental disorders. Therefore, to assess employees' holistic health, it was necessary to consider measures to address factors that cause stress, both physical and mental.

CONCLUSION

The results of this study highlight the important role of physiological mechanisms in the relationship between cortisol levels and stress responses. Measurement of urinary cortisol may help identify individuals with altered responses to stress. The combined influence of personal, social, and workplace factors suggests potential long-term health consequences of occupational stress, underscoring the need for continued investigation. Furthermore, elevated cortisol levels observed among workers with adaptive coping responses underscore the importance of effective stress management strategies in industrial settings.

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