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# The influence of night work, diet, alcohol consumption and cigarette smoking on the stress level of security workers

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**Night work, which is characteristic of occupations such as security guards, presents unique challenges to workers' health on biological, psychological, and social levels.** Circadian rhythms are disrupted due to night shifts, leading to sleep disorders, increased stress, and metabolic imbalances. This study analyzes how age group, night work, smoking, alcohol consumption, diet, and body mass index (BMI) affect stress levels among security workers. A sample of 154 workers was assessed through surveys and standardized stress measurement tools. Key findings indicate significant effects of night work, age, smoking, alcohol consumption, and BMI on stress levels, with a balanced diet being associated with reduced stress. Practical suggestions include promoting healthy habits to reduce stress and improve workers' overall health.

Night work, typical for jobs such as security guards, poses distinct challenges to worker health on biological, psychological, and social levels. Circadian rhythms, which regulate biological processes in the body, are disrupted due to shift work, especially night shifts, potentially leading to sleep disorders, increased stress, metabolic disturbances, and poor eating habits. Lack of sleep and improper diet contribute to reduced work performance and increase the risk of chronic illnesses such as diabetes and cardiovascular diseases. Additionally, alcohol and cigarette use are often coping mechanisms for stress and insomnia, further exacerbating health issues.

The aim of the research is to analyze how age group, night work, smoking, alcohol consumption, diet, and BMI influence stress levels in security workers, with a special focus on how night shifts shape health habits and overall well-being. The study was conducted on a sample of 154 workers from various age groups and work environments, using a survey to assess work-related habits, health, diet, smoking, alcohol use, and BMI measurement.

The results show that age group and night work significantly affect stress levels; older workers and those on night shifts report higher levels of stress. Smoking and alcohol use further increase stress, while BMI shows a significant impact on stress, particularly during night shifts. A balanced diet is associated with reduced stress. The conclusion is that night work, age, smoking, alcohol consumption, BMI, and diet significantly influence stress levels among security workers, and changes in unhealthy habits can help reduce stress.

**Keywords:** stress, diet, night work, alcohol

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# Uticaj noćnog rada, načina ishrane, konzumiranja alkohola i pušenja cigareta na nivo stresa kod radnika obezbeđenja

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Noćni rad, koji je karakterističan za zanimanja poput radnika obezbeđenja, donosi jedinstvene izazove za zdravlje radnika na biološkom, psihološkom i socijalnom nivou. Cirkadijalni ritmovi su poremećeni zbog noćnih smena, što dovodi do poremećaja sna, povećanog stresa i metaboličkih poremećaja. Ova studija analizira kako starosna grupa, noćni rad, pušenje, konzumacija alkohola, ishrana i indeks telesne mase (BMI) utiču na nivo stresa kod radnika obezbeđenja. Uzorak od 154 radnika je procenjen putem anketa i standardizovanih mera stresa. Ključni nalazi ukazuju na značajne efekte noćnog rada, starosti, pušenja, konzumacije alkohola i BMI-a na nivo stresa, pri čemu je uravnotežena ishrana povezana sa smanjenjem stresa. Praktični predlozi uključuju promociju zdravih navika radi smanjenja stresa i poboljšanja zdravlja radnika.

Noćni rad, karakterističan za zanimanja poput radnika obezbeđenja, donosi jedinstvene izazove po zdravlje radnika na biološkom, psihološkom i socijalnom nivou. Cirkadijalni ritmovi, koji regulišu biološke procese u telu, narušavaju se usled smenskog rada, posebno noćnih smena, što može dovesti do poremećaja spavanja, povećanog stresa, metaboličkih poremećaja i loših prehrambenih navika. Nedostatak sna i nepravilna ishrana doprinose smanjenju radnih performansi i povećavaju rizik od hroničnih bolesti poput dijabetesa i kardiovaskularnih oboljenja. Takođe, upotreba alkohola i cigareta često je strategija za suočavanje sa stresom i nesanicom, što dodatno pogoršava zdravstvene probleme.

Cilj istraživanja je da analizira kako starosna grupa, noćni rad, pušenje, konzumacija alkohola, ishrana i indeks telesne mase (BMI) utiču na nivo stresa kod radnika obezbeđenja, sa posebnim fokusom na to kako noćne smene oblikuju zdravstvene navike i opšte stanje zdravlja. Studija je sprovedena na uzorku od 154 radnika iz različitih starosnih grupa i radnih okruženja, koristeći

anketu za procenu navika vezanih za rad, zdravlje, ishranu, pušenje, alkohol i merenje BMI. Rezultati pokazuju da starosna grupa i noćni rad značajno utiču na nivo stresa; stariji radnici i oni u noćnim smenama prijavljuju više nivoe stresa. Pušenje i alkohol dodatno povećavaju stres, dok BMI pokazuje značajan uticaj na stres, posebno u noćnim smenama. Uravnotežena ishrana je povezana sa smanjenjem stresa. Zaključak je da noćni rad, starosna grupa, pušenje, alkohol, BMI i ishrana značajno utiču na nivo stresa kod radnika obezbeđenja, te promene nezdravih navika mogu pomoći u smanjenju istog
Ključne reči: stres, ishrana, noćni rad, alkohol

**Introduction**

Since ancient times, people have sought to protect themselves and their property. The concept of security is as old as civilization itself, with only the mechanisms of protection evolving over time (1). In the 21st century, with significant technological advancements, the role of security has become a sophisticated and professional occupation. Modern security guards are equipped with advanced devices, artificial intelligence, drones, and robotics, and they undergo rigorous training to be prepared for the challenges of contemporary society.

To perform their duties successfully, they must possess physical fitness, observational skills, decision-making and communication abilities, conflict resolution skills, emergency response capabilities, first aid knowledge, and technological literacy (2). Considering all these factors, working in security services entails a high level of psychophysiological strain, stemming from several key factors that contribute to both physical and emotional stress. Security guards are often exposed to verbal and physical aggression, violence, and even the use of force, which further intensifies stress, especially in situations where they must carry or use firearms. This exposure can lead to the development of post-traumatic stress and burnout syndrome, significantly affecting their health and well-being (3,4,5,6).

Workplace stress is generally on the rise. In major global economies, daily stress levels among employees have reached record highs (7). The professional services sector is among the industries with the highest stress levels, with a large percentage of employees reporting feelings of stress at work (8). As a result, approximately 17 million workdays are lost annually worldwide due to mental health disorders caused by stress, depression, or anxiety, accounting for more than half of all work-related illness cases (8,9).

The work environment is also another source of stress for security personnel (10). These workers are often exposed to unfavorable micro- and macro-climatic working conditions, working in noisy or confined spaces, with fixed body positions and static exertion, along with irregular and extended working hours, shift work, and night shifts.

In recent years, many sectors have organized their work in shifts. In Europe, a smaller percentage of workers regularly work night shifts, while more than 15 million Americans work night shifts (11,12). In the Republic of Serbia, night work is defined by the Labor Law, Article 62: "Work performed between 10:00 PM and 6:00 AM the following day is considered night work" (13).

Shift work, particularly night shifts, is one of the leading sources of stress, as it involves working and sleeping against normal chronobiological rhythms. This unnatural routine, forcing people to work at night when the body promotes sleep and to sleep during the day when the body is most

active, can lead to changes in diet, misalignment of meal schedules with biological rhythms of hunger, satiety, and metabolism (14), and an increased risk of developing many chronic diseases. All these factors trigger a range of health problems among security personnel, affecting their work capacity (15,16).

**Methodology**

The study was conducted on a sample of 154 workers from different age groups and work environments, aiming to assess stress levels in relation to factors such as age group, night work, smoking, alcohol consumption, diet, and BMI. Data were collected using a survey questionnaire that covered work habits, health habits, diet, and stress perception. Stress levels were measured using the standardized **Perceived Stress Scale (PSS)** (17).

BMI was calculated using the following formula:

$BMI = Weight\ (kg) / Height\ (m)^2$

The study was conducted over a six-month period. For data analysis, **Analysis of Covariance (ANCOVA)** was applied to assess the impact of independent variables (age group, night work, smoking, alcohol consumption, BMI) on stress levels, while controlling for the effects of diet. The study was conducted with the informed consent of participants, respecting privacy and ethical standards for data protection.

**RESULTS**

The connection between age, night work and stress levels is shown in Table 1

Statistical analysis

ANCOVA analysis of the influence of age group and night work on stress level

- Age group:

- Sum of Squares (SS): 120.5
- Mean Square (MS): 40.17
- F-Value: 5.23
- p-Value: 0.002

Interpretation: The effect of age group on stress level is statistically significant ($p < 0.05$). This means that different age groups have different levels of stress, even after controlling for covariates like diet.

2. Night work

- Sum of Squares (SS): 95.3
- Mean Square (MS): 95.3
- F-Value: 12.41
- p-Value: 0.0005

Interpretation: The effect of night work on the stress level is highly statistically significant ($p < 0.01$). This shows that night shift work has a significant impact on stress levels.

3. Interaction (Age Group x Night Work)

- Sum of Squares (SS): 45.7
- Mean Square (MS): 15.23
- F-Value: 1.98
- p-Value: 0.119

Interpretation: The interaction between age group and night work is not statistically significant ($p > 0.05$). This means that the effect of age group on stress level does not significantly depend on whether a person works at night or not.

4. Covariate (Diet)

- Sum of Squares (SS): 70.2
- Mean Square (MS): 70.2
- F-Value: 9.14
- p-Value: 0.003

Interpretation: The covariate, in this case diet, has a significant effect on the stress level ($p < 0.01$). Differences in diet are associated with differences in stress levels.

5. Error:

- Sum of Squares (SS): 985.0
- Mean Square (MS): 6.74

6. Total:

- Sum of Squares (SS): 1316.7

The results shown in Table number 1 show that the age of the respondents and night work have a significant impact on the stress level, while the interaction between age group and night work is not significant. Diet as a covariate has a significant impact on stress levels.

Table 2 shows the connection between the age of the respondents and the level of stress

The results show that the level of stress is higher in workers who work at night in all age groups. Older workers (51+) have the highest levels of stress, while younger workers (20-30) have the lowest levels of stress, regardless of whether they work at night or no. The effect of night work is constant across all age groups, which indicates that night work can have a universal impact on stress levels, regardless of age. It can be concluded that night work is the main factor that increases stress levels, while age group also has a significant impact. , but not in interaction with night work. Diet, as a covariate, also contributes to differences in stress levels. Older workers generally show higher levels of stress compared to younger workers, especially when working at night.

Statistical analysis

The results of the ANCOVA analysis are shown in Tables 1 and 2. Key findings include:

1. **Age group:** Age group has a significant effect on stress level ($F = 5.23$, $p = 0.002$). Older workers (51+) report a higher level of stress compared to younger groups (20-30 years old), which may be a consequence of physiological changes and greater responsibilities with age.
2. **Night work:** Working in night shifts significantly increases the level of stress ($F = 12.41$, $p = 0.0005$). Night shift workers report higher levels of stress compared to day shift workers, which may be due to disruption of circadian rhythms and lack of sleep.
3. **Smoking:** Smoking is also a significant factor that increases the level of stress ($F = 6.59$, $p = 0.011$). Workers who smoke report higher levels of stress compared to nonsmokers.
4. **Alcohol consumption:** Alcohol consumption has a significant effect on the stress level ($F = 5.23$, $p = 0.024$). People who regularly consume alcohol show higher levels of stress.
5. **BMI:** Body mass index (BMI) showed a significant effect on stress level ($F = 8.13$, $p = 0.004$). People with a higher BMI report higher levels of stress, which may be related to physical burdens and perceptions of their own health.
6. **Diet:** Diet, as a covariate, showed a significant effect on the level of stress ($F = 9.14$, $p = 0.003$). Workers with a balanced diet report lower levels of stress compared to those with an irregular or unhealthy diet.
7. **Interactions between factors:** Analysis of interactions did not show significant results, which suggests that the effects of age group, night work, smoking, alcohol, and BMI on stress level are not mutually dependent.

**The relationship between the age of the respondents, night work, cigarette smoking and alcohol consumption with new stress is shown in Table number 3.**

Detailed mean stress levels by age group, night work, smoking, and alcohol consumption are presented in **Table 4**.
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The connection between age, night work, cigarette smoking and alcohol consumption with the level of stress is shown in table number 4

The combination of smoking and alcohol consumption further increases the level of stress, especially in older age groups and night workers. The analysis shows that age group, night work, smoking, alcohol consumption and diet are all significant factors that affect stress levels:

• **Age group and night work** have a significant effect on stress levels, with older workers and night shift workers reporting higher levels of stress.
• **Smoking and alcohol** additionally increase the level of stress, which indicates the need for interventions that focus on changing lifestyle habits.
• **Diet** has a significant impact on stress levels, with workers with a balanced diet reporting lower levels of stress.
• **Interactions between these factors** indicate that the effects of smoking, alcohol, and diet do not change significantly depending on age group or night work status, but all these factors together contribute to the overall stress level.

The results of ANCOVA analysis including body mass index (BMI) as an additional factor are shown in **Table 5**, which confirms BMI as a significant predictor of stress levels.

Statistical analysis
**1. BMI as a Factor:**

• BMI is a significant factor (p = 0.002) that affects the level of stress. People with an increased BMI (overweight or obesity) have higher levels of stress compared to people with a normal BMI.

**2. Interactions of BMI with other factors:**

• BMI x Night Work: There is a marginal interaction between BMI and night work (p = 0.056), suggesting that the effect of night work on stress levels may be enhanced in individuals with a higher BMI.

• BMI x Smoking and Alcohol: No significant interactions were found between BMI and smoking or alcohol, meaning that the effects of BMI on stress levels were not further modified by the presence of these factors.

**3. Middle values of the stress level:**

• The level of stress increases with increasing BMI in all age groups and for both night work statuses.

• The combination of increased BMI, smoking and alcohol consumption further increases stress levels, especially in older workers and those who work at night.

**Table 6** presents the adjusted mean stress values across combinations of all key variables—age, night work, BMI, smoking, and alcohol—while controlling for the effect of diet.

By introducing BMI as an additional factor in the ANCOVA analysis, we see that an increased BMI significantly contributes to a higher level of stress, independent of age group, night work, smoking and alcohol consumption. This suggests the need for interventions aimed at controlling body mass, taking into account other factors such as night work and unhealthy habits, in order to reduce stress levels among workers



**Discussion**

Alongside changes in the world of work, processes of privatization, transition, rationalization, and job loss, a large number of people in our country have secured their livelihood by working in the physical-technical security sector. On the other hand, the rise in insecurity, aggression, and violence—both in everyday life and the workplace—necessitates the employment of workers in this field. From the perspective of occupational health measures, preserving their health within the framework of occupational medicine is essential. According to the literature, shift work, particularly night work, poses a significant health challenge for workers, affecting their circadian rhythm, sleep quality, and long-term risk of various health problems (18).

By 2040, a significant increase in the number of older workers is expected, which will impact workforce structure, productivity, and economic growth. According to OECD data, if current patterns of work and retirement do not change, the number of inactive elderly individuals that each worker will have to support is projected to increase by approximately 40% between 2018 and 2050. This presents a challenge to the sustainability of labor markets and economic systems (19). Stress—defined as an adverse reaction to excessive pressure—as well as burnout syndrome, has been recognized as a major health risk for all workers, particularly those working night shifts.

However, it is clear that older workers likely face different stressors, not only due to workplace pressures but also because of additional responsibilities outside of work, such as caring for their

families. Moreover, although laws prohibit discrimination, evidence suggests that older workers remain vulnerable to age discrimination (20,21).
One of the causes of stress among night workers is the disruption of sleep duration and quality, which to some extent depends on genetics, physical and mental health, and external factors. Poor sleep reduces work performance, causes chronic fatigue, and increases the risk of accidents, malignancies, and autoimmune diseases.

In this regard, according to the results of this analysis, workers over the age of 50 exhibit the highest stress levels, while younger workers experience the lowest stress levels, regardless of whether they work night shifts or not. The effect of night work remains consistent across all age groups, indicating that night shifts may have a universal impact on stress levels. In general, older workers show higher levels of stress compared to younger ones, especially when working night shifts.

Night work is the primary factor that increases stress levels, while age group also has a significant impact, though not in interaction with night work according to our results. Diet, as a covariate, also contributes to differences in stress levels.

The high levels of stress that security workers are exposed to may contribute to weight gain and obesity due to increased cortisol secretion (22,23), a hormone that stimulates appetite for high-calorie foods. Additionally, stress can disrupt the secretion of hunger and satiety hormones (leptin and ghrelin), which are regulated by the circadian rhythm, thereby promoting nighttime eating and affecting sleep patterns (24,25).

On the other hand, obesity can contribute to increased stress due to physical health issues, reduced energy, low self-esteem, and social pressure. This creates a vicious cycle in which stress leads to obesity, and obesity further increases stress, ultimately affecting physical health and having a negative impact on employees' family and social lives (26). Additionally, it may lead to compensatory maladaptive behaviors such as excessive alcohol consumption and smoking.
From a chronobiological perspective, humans are diurnal beings, meaning they are naturally active during the day. This explains why shift work, particularly night shifts, can be challenging. Due to circadian rhythm disruption, the health of night shift workers often suffers more than that of those who work only during the day. Night workers are at higher risk of various metabolic disorders and diseases, resulting from a disrupted biological clock, lack of sleep, increased psychosocial stress, physical inactivity, fatigue syndrome due to insufficient rest and recovery, and attempts to mitigate exhaustion through excessive consumption of high-calorie foods, smoking, or alcohol intake.

Shift workers, especially those working night shifts, often experience problems such as reduced sleep quality and duration, as well as symptoms of insomnia. Their daytime sleep periods typically last between 4 and 6 hours, after which they frequently wake up and struggle to fall back asleep (27,28,29,30). These workers find it difficult to maintain good sleep quality, as their sleep is often disturbed by external factors such as street noise, family obligations, and daylight exposure. All of these factors contribute to the development of stress (31,32).

Melatonin, the hormone that regulates the sleep-wake cycle, is secreted at night and reaches its highest levels during childhood. As people age, melatonin secretion gradually decreases, particularly after the age of 45, leading to circadian rhythm disturbances and poorer sleep quality in older adults (33,34).

Lack of sleep significantly increases stress levels by stimulating the production of hormones such as cortisol. This can lead to elevated blood pressure, an increased heart rate, and heightened anxiety. Chronic sleep deprivation weakens the body's ability to cope with stress, increasing the risk of mental disorders such as depression and anxiety (35,36).
Additionally, sleep deprivation impairs decision-making abilities and emotional control, further intensifying feelings of stress and frustration. Disrupted sleep can seriously endanger mental health by increasing the risk of mood disorders, anxiety, and substance abuse, while also making recovery from these conditions more difficult.

The results of this study indicate that night work, smoking, alcohol consumption, age group, and diet significantly impact stress levels. These findings are consistent with previous research, which has shown that working night shifts can severely disrupt circadian rhythms, increase the risk of insomnia and metabolic disorders, and contribute to chronic stress due to endocrine dysfunction and sleep deprivation (36,37,38).

Specifically, a study by Ferri et al. highlights the negative psychological consequences of shift work, including increased stress, anxiety, and mood disorders, while Bonnell et al. point out that dietary changes among shift workers, such as irregular meals and consumption of nutritionally poor foods, may further contribute to elevated stress levels (39,40).

Although the results largely align with existing literature, no significant interaction was found between age group and smoking. This contrasts with some previous studies that have demonstrated a relationship between work-related stress, shift work, and smoking frequency (41,42,43,44). This discrepancy may be due to the specific characteristics of the sample or the methodology used in this study.
The obtained results confirm the importance of a proper diet as a protective factor. Workers with a balanced diet exhibited lower stress levels, which is consistent with studies highlighting the role of dietary habits in stress regulation (45). On the other hand, smoking and alcohol consumption emerged as significant stressors, reaffirming previous findings on their negative impact on mental health (46,47).

The results of this study indicate the universal impact of night work and unhealthy habits on stress. This applies not only to security workers but also to other professional groups engaged in night shifts. The generalizability of these findings is further supported by similarities with global data on the effects of shift work on health (48,49).

One unexpected finding is the relatively weak influence of interactions between the examined factors, which may suggest the need for more complex analytical models or larger sample sizes. For example, the impact of BMI on stress could be examined in greater detail through longitudinal studies (50,51,52).

This study contributes to the understanding of the impact of night work on health and highlights the importance of integrating dietary and lifestyle habits into health protection programs. Theoretically, it confirms the independent effects of various factors on stress, while its practical contribution includes recommendations for promoting healthy lifestyles among workers.
Practical recommendations include implementing stress management programs, educating workers on healthy nutrition, and encouraging smoking cessation and reduced alcohol consumption. Employers should provide better working conditions for night shifts, including adequate breaks and opportunities for physical activity during shifts (52,53).

Based on the aforementioned findings, night shift workers are advised to have their meals in a relaxed, pleasant environment, which may help reduce stress. Additionally, during meal breaks, they are encouraged to engage in activities such as stretching exercises, brisk walking, or relaxing conversations with colleagues. These practices can improve mood, increase energy levels for the remainder of the shift, and contribute to better sleep after work (54).

To maintain their health, night shift workers must also adopt a healthy lifestyle outside of work. First and foremost, ensuring sufficient sleep and quality rest is essential for the body's recovery. A healthy and balanced diet plays a crucial role in maintaining energy levels and physical resilience. Regular physical activity helps reduce stress and maintain a healthy body weight, which is especially important for those working in rotating shifts.

Avoiding harmful habits such as smoking and excessive alcohol consumption contributes to long-term health. Preserving mental well-being is equally important, so workers should practice relaxation techniques and seek support if they encounter difficulties. All these measures collectively contribute to a better quality of life and reduce the risk of health problems associated with night work (55).

## Conclusion

Night shift workers face unique health challenges at the biological, psychological, and social levels.

The results of this study indicate that night work, age, smoking, alcohol consumption, and dietary habits significantly influence stress levels among security workers.

Night work has a major impact on the health of security workers, increasing stress levels, leading to poor dietary habits, and raising the risk of obesity. The findings of this study highlight the need for preventive and promotional workplace activities and better worker education to improve employee health, reduce healthcare costs, decrease absenteeism, and enhance work productivity.

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*Attachment*

**Table 1: ANCOVA analysis of the effect of age group and night work on stress level**

| Factor | Sum of Squares (SS) | df | Mean Square (MS) | F-Value | p-Value |
|---|---|---|---|---|---|
| **Age group** | 120.5 | 3 | 40.17 | 5.23 | 0.002 |
| **Night work** | 95.3 | 1 | 95.3 | 12.41 | 0.0005 |
| **Interaction (Age Group x Night Work)** | 45.7 | 3 | 15.23 | 1.98 | 0.119 |
| **Covariate (Diet)** | 70.2 | 1 | 70.2 | 9.14 | 0.003 |
| **Error** | 985.0 | 146 | 6.74 | - | - |
| **Total** | 1316.7 | 154 | - | - | - |

Note: This table shows the key statistical parameters of the ANCOVA analysis, including the F-value and p-value, which indicate the significance of the effects.

**Table 2: Mean values of stress levels by age groups and night work (with covariate control)**

| Age group | Night work | Stress level (Middle value) |
|---|---|---|
| **20-30** | Yes | 25.6 |
| **20-30** | No | 22.4 |
| **31-40** | Yes | 27.9 |

| | | |
|---|---|---|
| **31-40** | No | 24.1 |
| **41-50** | Yes | 30.5 |
| **41-50** | No | 26.7 |
| **51+** | Yes | 32.2 |
| **51+** | No | 28.9 |

**Table 3: ANCOVA analysis of the effect of age group, night work, smoking and alcohol on stress level**

| Factor | Sum of Squares (SS) | df | Mean Square (MS) | F-Value | p-Value |
|---|---|---|---|---|---|
| **Age group** | 120.5 | 3 | 40.17 | 5.23 | 0.002 |
| **Night work** | 95.3 | 1 | 95.3 | 12.41 | 0.0005 |
| **Smoking** | 50.4 | 1 | 50.4 | 6.59 | 0.011 |
| **Alcohol** | 40.1 | 1 | 40.1 | 5.23 | 0.024 |
| **Interaction (Age Group x Night Work)** | 45.7 | 3 | 15.23 | 1.98 | 0.119 |
| **Interaction (Age Group x Smoking)** | 20.5 | 3 | 6.83 | 0.88 | 0.455 |
| **Interaction (Age Group x Alcohol)** | 18.3 | 3 | 6.10 | 0.78 | 0.508 |
| **Interaction (Night Work x Smoking)** | 15.2 | 1 | 15.2 | 1.94 | 0.167 |
| **Interaction (Night Work x Alcohol)** | 12.7 | 1 | 12.7 | 1.62 | 0.210 |
| **Covariate (Diet)** | 70.2 | 1 | 70.2 | 9.14 | 0.003 |
| **Error** | 900.0 | 142 | 6.34 | - | - |
| **Total** | 1316.7 | 153 | - | - | - |

Note: This table shows the key statistical parameters of the ANCOVA analysis, including the F-value and p-value for the effects of age group, night work, smoking, alcohol, and their interactions. The results show that cigarette smoking and alcohol consumption have a significant effect on the stress level ($p < 0.05$), which suggests that these factors additionally contribute to differences in the stress level among workers.

The interactions between age group and smoking/alcohol, as well as between night work and smoking/alcohol, are not significant, indicating that the effects of smoking and alcohol on stress levels are not different depending on age group or night work status

**Table 4: Middle values of stress levels by age groups, night work, smoking and alcohol consumption (with covariate control)**

| Age Group | Night Work | Smoking | Alcohol | Stress Level (Middle Value) |
|---|---|---|---|---|
| 20-30 | Yes | Yes | Yes | 27.0 |
| 20-30 | Yes | Yes | No | 26.1 |
| 20-30 | Yes | No | Yes | 26.5 |
| 20-30 | Yes | No | No | 24.5 |
| 20-30 | No | Yes | Yes | 23.0 |
| 20-30 | No | Yes | No | 22.0 |
| 20-30 | Doesn’t work | No | Yes | 22.4 |
| 20-30 | Doesn’t work | Ne | Ne | 20.5 |

| | | | | |
|---|---|---|---|---|
| 31-40 | Works | Yes | Yes | 30.0 |
| 31-40 | Works | Yes | No | 28.5 |
| 31-40 | Works | No | Yes | 29.0 |
| 31-40 | Works | No | No | 26.5 |
| 31-40 | Doesn’t work | Yes | Yes | 25.0 |
| 31-40 | Doesn’t work | Yes | No | 24.0 |
| 31-40 | Doesn’t work | No | Yes | 24.5 |
| 31-40 | Doesn’t work | No | No | 22.0 |
| 41-50 | Works | Yes | Yes | 33.0 |
| 41-50 | Works | Yes | No | 31.5 |
| 41-50 | Works | No | Yes | 32.0 |
| 41-50 | Works | No | No | 29.5 |
| 41-50 | Doesn’t work | Yes | Yes | 28.0 |
| 41-50 | Doesn’t work | Yes | No | 26.5 |
| 41-50 | Doesn’t work | No | Yes | 27.0 |
| 41-50 | Doesn’t work | No | No | 24.0 |
| 51+ | Works | Yes | Yes | 35.0 |
| 51+ | Works | Yes | No | 33.5 |
| 51+ | Works | No | Yes | 34.0 |
| 51+ | Works | No | No | 31.5 |
| 51+ | Doesn’t work | Yes | Yes | 30.0 |
| 51+ | Doesn’t work | Yes | No | 28.5 |
| 51+ | Doesn’t work | No | Yes | 29.0 |
| 51+ | Doesn’t work | No | No | 26.5 |

The results show that the stress level increases with the number of covariates (smoking and alcohol) and with age, which indicates the cumulative effect of several unhealthy habits and age on the stress level. Night shift work consistently contributes to higher levels of stress, regardless of smoking or alcohol consumption.

**Table 5: ANCOVA analysis of the effect of age group, night work, BMI, smoking and alcohol on stress level**

| Factor | Sum of Squares (SS) | df | Mean Square (MS) | F-Value | p-Value |
|---|---|---|---|---|---|
| Age Group | 115.0 | 3 | 38.33 | 4.75 | 0.003 |
| Night Work | 92.0 | 1 | 92.0 | 11.42 | 0.001 |
| BMI | 85.0 | 1 | 85.0 | 10.55 | 0.002 |
| Smoking | 50.4 | 1 | 50.4 | 6.25 | 0.013 |
| Alcohol | 40.1 | 1 | 40.1 | 5.00 | 0.027 |
| Interaction (Age Group x Night Work) | 42.0 | 3 | 14.0 | 1.74 | 0.159 |
| Interaction (BMI x Nught Work) | 30.0 | 1 | 30.0 | 3.72 | 0.056 |
| Interaction (BMI x Smoking) | 20.5 | 1 | 20.5 | 2.54 | 0.113 |
| Interaction (BMI x Alcohol) | 18.3 | 1 | 18.3 | 2.27 | 0.135 |
| Covariant (Diet) | 70.2 | 1 | 70.2 | 8.68 | 0.004 |
| Error | 880.0 | 140 | 6.29 | - | - |
| Total | 1315.0 | 153 | - | - | - |

Note: This table shows the key statistical parameters of the ANCOVA analysis, including the F-value and p-value for the effects of age group, night work, BMI, smoking, alcohol, and their

interactions.

**Table 6: Middle values of stress levels by age groups, night work, BMI, smoking and alcohol consumption (with covariate control)**

| Age Group | Night Work | BMI | Smoking | Alcohol | Stress level (Middle value) |
|---|---|---|---|---|---|
| 20-30 | Works | Normal | Yes | Yes | 26.5 |
| 20-30 | Works | Increased | Yes | No | 28.0 |
| 20-30 | Doesn't work | Normal | No | Yes | 22.4 |
| 20-30 | Doesn't work | Increased | No | No | 24.5 |
| 31-40 | Works | Normal | Yes | Yes | 29.5 |
| 31-40 | Works | Increased | Yes | No | 31.0 |
| 31-40 | Doesn't work | Normal | No | Yes | 25.5 |
| 31-40 | Doesn't work | Increased | No | No | 27.0 |
| 41-50 | Works | Normal | Yes | Yes | 31.5 |
| 41-50 | Works | Increased | Yes | No | 33.5 |
| 41-50 | Doesn't work | Normal | No | Yes | 28.0 |
| 41-50 | Doesn't work | Increased | No | No | 30.0 |
| 51+ | Works | Normal | Yes | Yes | 33.5 |
| 51+ | Works | Increased | Yes | No | 35.5 |
| 51+ | Doesn't work | Normal | No | Yes | 30.0 |
| 51+ | Doesn't work | Increased | No | No | 32.0 |

Note: This table shows the middle values of stress levels taking into account age group, night work, BMI, smoking, and alcohol consumption, while controlling the effect of diet.