



(RESEARCH ARTICLE)



## BEHIND THE MASK: EXPLORING WORKPLACE HAZARDS FACING ANESTHESIOLOGISTS AT BENGHAZI MEDICAL CENTER AND AL-JALAA HOSPITAL FOR SURGERY AND ACCIDENTS

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### ABSTRACT

**Background:** Anesthesiologists are exposed to a variety of occupational hazards chemical, ergonomic, and psychological result from nature of their work, and extended exposure to these hazards can be extremely harmful to the health. This study aimed to evaluate the effects of chemical, ergonomic, and psychosocial hazards on the anesthesiologists' health at Benghazi medical center (BMC) and Al-Jalaa Hospital for Surgery and Accidents.

**Material and methods:** This descriptive and analytical cross-sectional study was conducted at BMC and Al-Jalaa Hospital. The samples collected by two ways; blood samples were collected from 66 participants to test CBC, RFT, LFT, and cardiac enzymes. Also, questionnaires were filled by 112 technicians and doctors to evaluate the ergonomic and psychological; hazards, these data were analyzed using SPSS.

**Results:** The study found that among the symptoms experienced by participants, drowsiness, nausea, fatigue, and headaches, and majority of individuals in both hospitals had high urea levels, and large number of participants at the Al-Jalaa hospital had high troponin levels. Furthermore, it revealed that the most common complaints were of lower back pain, as a result of the nature of the work and standing for the long time while working. Additionally, many workers experiencing memory problems, concentration issues, and burnout.

**Conclusion:** The safety of anesthetic practice is essential and fundamental for the health of the anesthesiologist, and the anesthesiologist's occupational health is critical to ensuring patient safety.

**Keywords:** Anesthesiologists, Anesthetic gases, CBC, Cardia enzymes, Ergonomic, Hazard, LFT, RFT, Psychological.

## 1 INTRODUCTION

Anesthesiology is a high-risk and demanding medical specialty. The responsibilities of anesthesiologists continue to expand due to advances in anesthesia techniques and treatments. They work primarily in operating rooms and intensive care units, environments often regarded as “healthy,” yet they face multiple occupational hazards, including chemical, ergonomic, and psychosocial risks, which may adversely affect their physical and mental health (1). Limited recent data exists on anesthesiologists' morbidity and mortality. Historical U.S. data from 1979–1995 indicated anesthesiologists had a standardized mortality ratio of 0.48, with higher risks of suicide, drug-related fatalities, HIV, and cerebrovascular disease compared to other professions. The relative risk of suicide ranged from 2.5–5.7 in women and 1.1–3.4 in men (2). In China, high workloads exceeding 50 hours per week have contributed to cardiac arrests and rising rates of hypertension, gastrointestinal disorders, exhaustion, and mental health issues, including depression and substance abuse (3,4).

Exposure to halogenated anesthetic gases and nitrous oxide poses occupational risks. Chronic exposure can result in toxic hepatitis, neurological symptoms, peripheral neuropathy, and impaired immunity (5–9). Nitrous oxide interferes with vitamin B12 metabolism, potentially affecting the nervous system and liver function, while prolonged exposure may increase cardiovascular strain (10–12). Studies on occupational exposure show alterations in liver enzymes, hematological parameters, and genomic instability among anesthesiologists exposed to waste anesthetic gases (13–16).

Anesthesiologists also face significant physical strain due to patient positioning, heavy equipment, and repetitive movements. Common issues include lower back pain, neck and shoulder discomfort, and musculoskeletal disorders, which are major contributors to absenteeism and reduced productivity (17–21). Poor ergonomic setups, including prolonged bending, lifting patients without assistance, and improper workstation heights, exacerbate these risks (22–24).

Occupational stress, fatigue, and burnout are prevalent among anesthesiologists. Fatigue and insomnia impair cognitive function, alertness, and clinical decision-making, posing risks to both anesthesiologists and patients (25). Chronic stress contributes to cardiovascular, gastrointestinal, musculoskeletal, and neurological disorders and may lead to substance use, emotional disturbances, and suicide (26,27). Burnout is associated with excessive workloads, lack of recognition, interpersonal conflicts, and bureaucratic pressures, affecting over 50% of academic anesthesiologists and exacerbated during the COVID-19 pandemic (28–31).

Preventive strategies have been recommended to reduce occupational hazards. Substitution of inhaled anesthetics with intravenous or regional anesthesia can eliminate exposure risks, while engineering controls such as effective anesthetic gas scavenging systems and ventilation reduce chemical exposure. Administrative measures, including routine equipment maintenance, medical monitoring, and adherence to regulations, further enhance safety. Personal protective equipment such as gloves, goggles, and chemical protective clothing is advised during spill management (32,33). Ergonomic risks can be minimized by proper positioning, video laryngoscopy, adjustable beds, mechanical patient handling, and training on safe posture and lifting techniques (34–37). Psychosocial hazards can be mitigated through stress management strategies, including disciplined routines, hobbies, exercise, adequate sleep, workplace empowerment, team communication, and access to mental health services. Flexible therapy options, natural lighting, and scheduled breaks also contribute to reducing burnout (38–41).

Anesthesiologists are simultaneously exposed to chemical, ergonomic, and psychosocial hazards that may compromise their health and professional performance. Long-term effects include musculoskeletal disorders, liver and kidney dysfunction, mental health issues, depression, and burnout. Despite the clear risks, limited research exists on the combined impact of these occupational hazards and the effectiveness of preventive strategies. Therefore, evaluating these hazards and implementing comprehensive mitigation measures is critical for the well-being of anesthesiology professionals.

Anesthesiology is a very dangerous and demanding area of medicine. The duties and responsibilities of anesthesiologists are growing everyday due to new methods, treatments, and Advances in Anesthesia. Anesthesiologists operate in operating rooms (ORs) and intensive care units (ICUs). which are regarded as healthy work environments. Anesthesiologists may face a variety of physical, chemical, biological, ergonomic, and psychological risks and hazards in their workplaces. The hazards anesthesiologists face at work endanger their health and might impair their ability to execute their jobs effectively (42). This study will focus on three types of hazards chemical, psychosocial, and ergonomic hazards that impact on health of anesthesiologist. Several occupational risks are faced by anesthesiologists, including chemical exposure to anesthesia gases, ergonomic strain from extended work hours and difficult postures, and psychological stress from demanding work settings. These elements could have a detrimental effect on their emotional and physical well-being, resulting in long-term ailments like depression, burnout, respiratory problems, and musculoskeletal illnesses. Research on the combined effects of these dangers is scarce, despite their importance. The

purpose of this study is to examine their effects and provide practical preventative strategies. Therefore, this study aimed to evaluate the effects of chemical, ergonomic, and psychosocial hazards on the health and well-being of anesthesiologists at Benghazi medical center (BMC) and Al-Jalaa Hospital for Surgery and Accidents.

## 2 RESEARCH METHODOLOGY

**Study site:** This study was conducted at BMC and Al-Jalaa Hospital for Surgery and Accidents in Benghazi, Libya.

**Study design:** The design of this study is a descriptive and analytical cross-sectional design.

### 2.1 Methods of data collection

The data was collected in two ways: the first method is using a multiple-choice questionnaire, and the second method is taking blood samples from technicians and doctors.

### 2.2 Questionnaire design

The questionnaire used to evaluate the impact of exposure to an anesthetic agent on anesthesiologists in two hospitals involved three sections.

- Section one involves questions regarding sociodemographic information of anesthesiologists, which are age, gender, marital status, type of job, years of working, and smoking behavior. Also, it involves questions regarding the work practices.
- Section two involves questions regarding the impacts of ergonomic hazards.
- Section three involves questions regarding the impacts of psychosocial hazards.

### 2.3 Blood sample tests

The blood samples were taken and transferred to the laboratory within an hour to test complete blood counts (CBC). Also, to test the functions of the liver and kidney (LFT and RFT) as well as test cardiac enzyme levels.

**Sample size:** The questionnaire was filled out by 112 participants: 37 out of 60 physicians and technicians at Al-Jalaa Hospital for Surgery and Accidents and 75 out of 110 doctors and technicians at BMC. On the other hand, the blood samples were taken from 65 participants; 20 samples were taken from anesthesiologists at Al-Jalaa Hospital for Surgery and Accidents and 45 samples from BMC.

### 2.4 Statistical analysis

SPSS software version 22 was used to code and analyze all of the data, and it was used to determine the frequency and percentage of various variables. Also, the relationships between some variables were tested by using appropriate statistical tests.

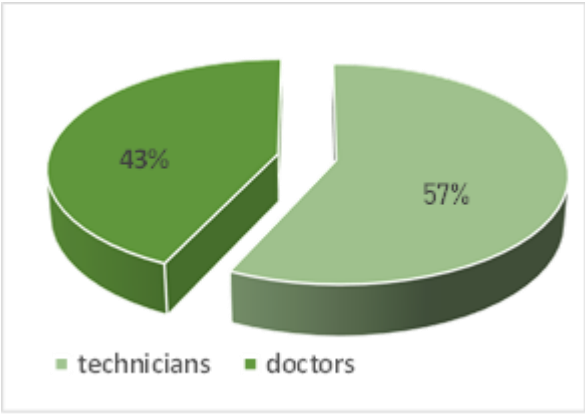
### 2.5 Ethical Considerations

The study was conducted after obtaining a letter of approval from the heads of Benghazi Medical Center and Al-Jalaa Hospital for Surgery and Accidents and oral permission from doctors and technicians to take blood samples from them.

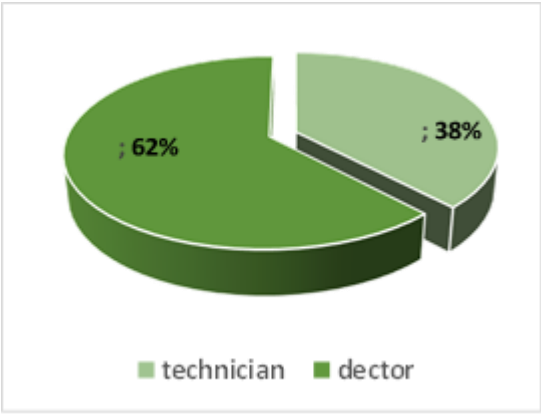
## 3 RESULTS

### 3.1 Part 1: Demographic information of the participants

This study included 112 participants: 57 doctors and 55 technicians from BMC and Al-Jalaa Hospital. Figure 1 shows that the large percentage of participants (N=34, 43%) were doctors and 41 (57%) were technicians at BMC, while figure 2 shows that the large percentage (N=23, 62%) were doctors and (38%) were technicians at Al-Jalaa Hospital.

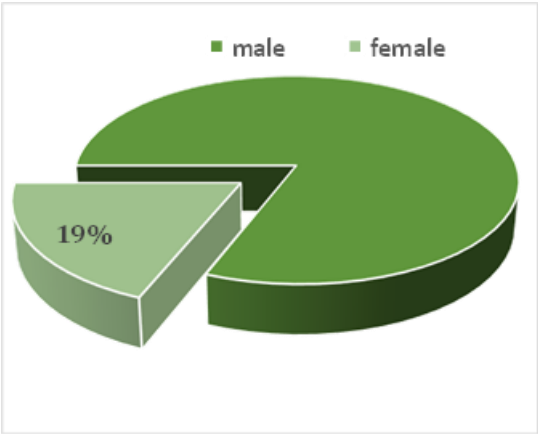


**Figure 1: Distribution of Doctors and Technicians at BMC**

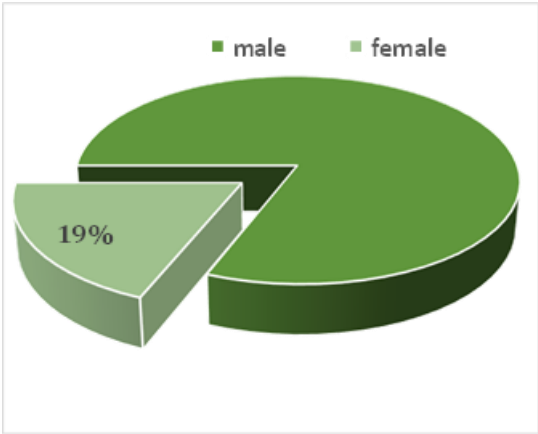


**Figure 2: Distribution of Doctors and Technicians at Al-Jalaa Hospital.**

Figure 3 and figure 4 show that the proportion of males was more than females at BMC and Al-Jalaa Hospital for Surgery and Accidents.

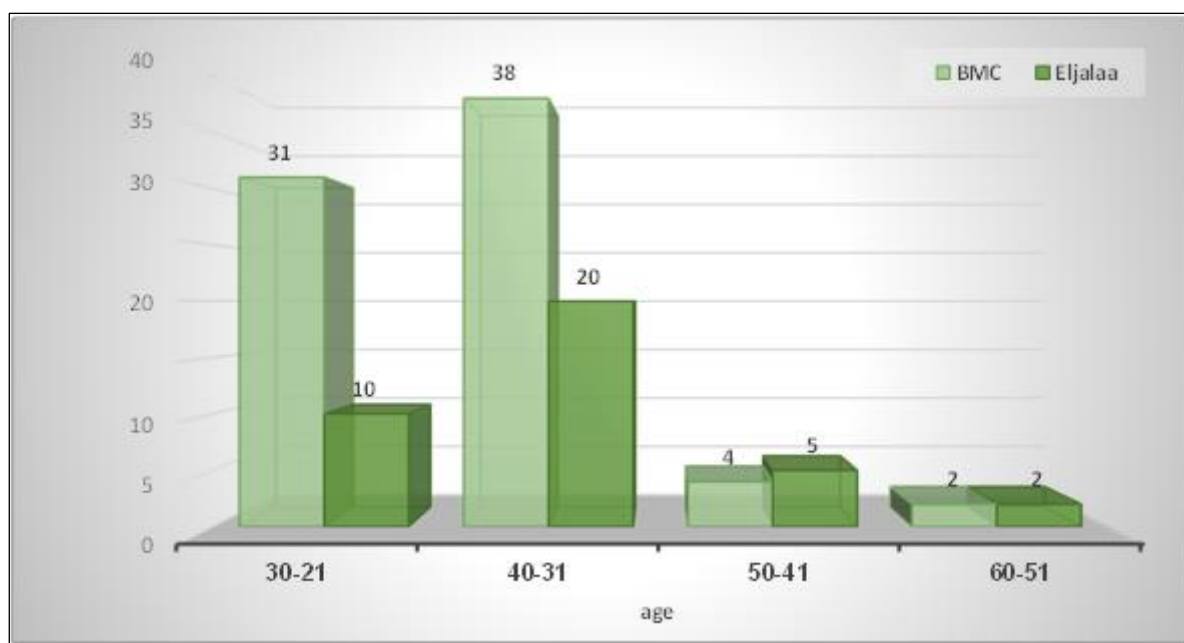


**Figure 3: Gender Distribution of Participants at BMC**



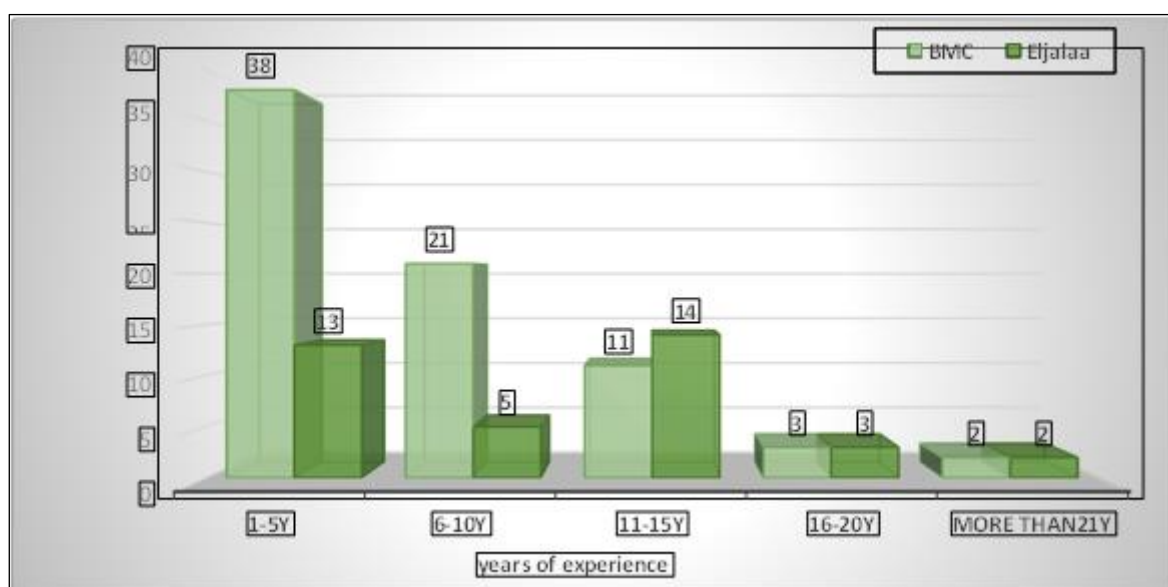
**Figure 4: Gender Distribution of Participants at Al-Jalaa Hospital**

The figure 5 shows the ages of the participants, the large number of anesthesiologists are at age group (31 to 40) in both hospitals.



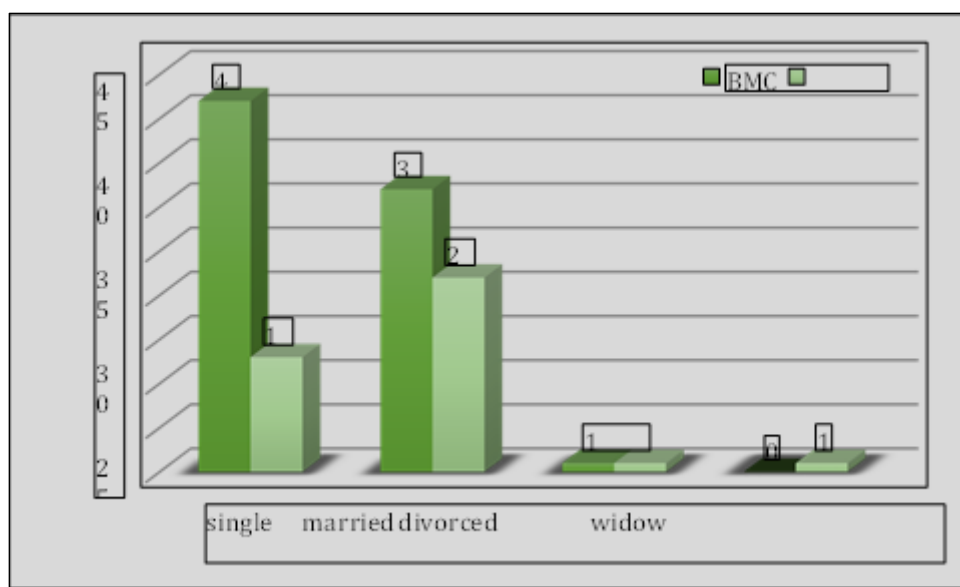
**Figure 5: Distribution of participants according to the number of age.**

The figure 6 shows the distribution of participants according to the number of years of work. The large number of them had years of experience from (1 to 5 years) in BMC (N=38), while the large number of anesthesiologists at Al-jalaa Hospital had experience years from (11 to 15 years ).



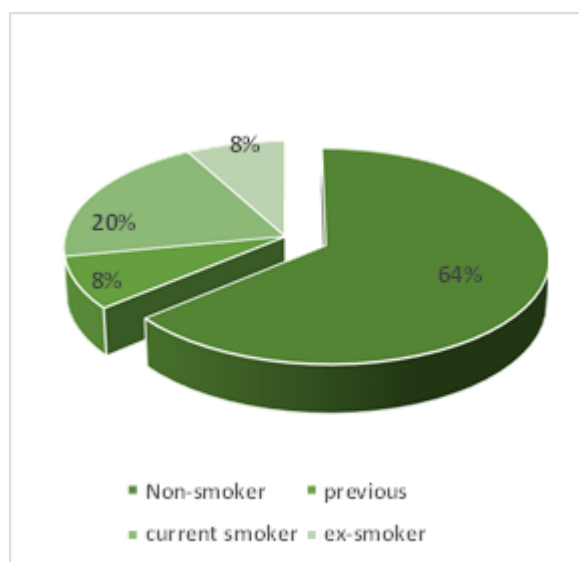
**Figure 6: Distribution of participants according to the number of years work.**

Figure 7 shows that the large number of anesthesiologists in BMC were single, while the large number of participants in Al-Jalaa Hospital were married.

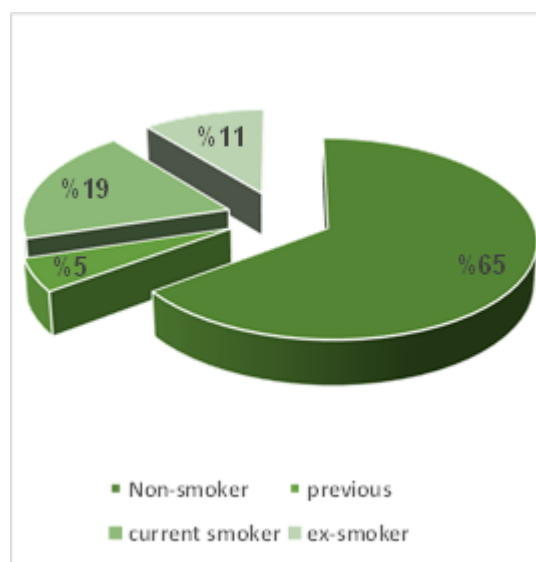


**Figure 7: Marital Status of Anesthesiologists in BMC and Al-Jalaa Hospital.**

Figure 8 and Figure 9 represent that the proportion of participants in BMC and Al-Jalaa hospitals who are nonsmokers is 64% and 65%, respectively.

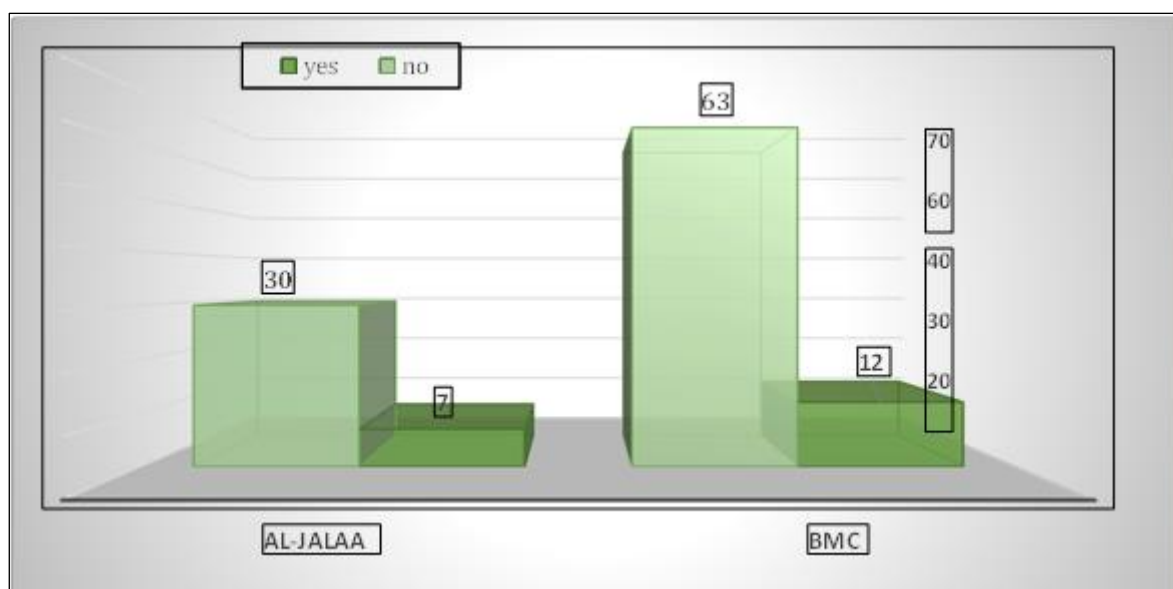


**Figure 8: Smoking Status of Participants at BMC**



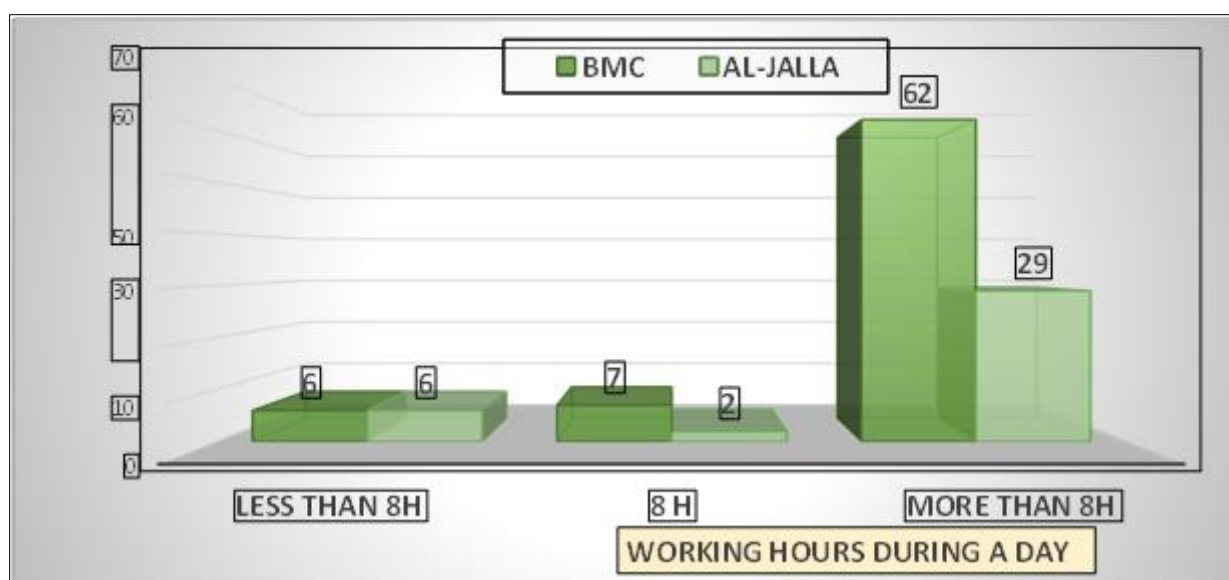
**Figure 9: Smoking Status of Participants at Al-Jalaa Hospital.**

Figure 10 shows that a small number of participants have a chronic illness in both hospitals, which were 12 participants in BMC and only 7 in Al-Jalaa Hospital.



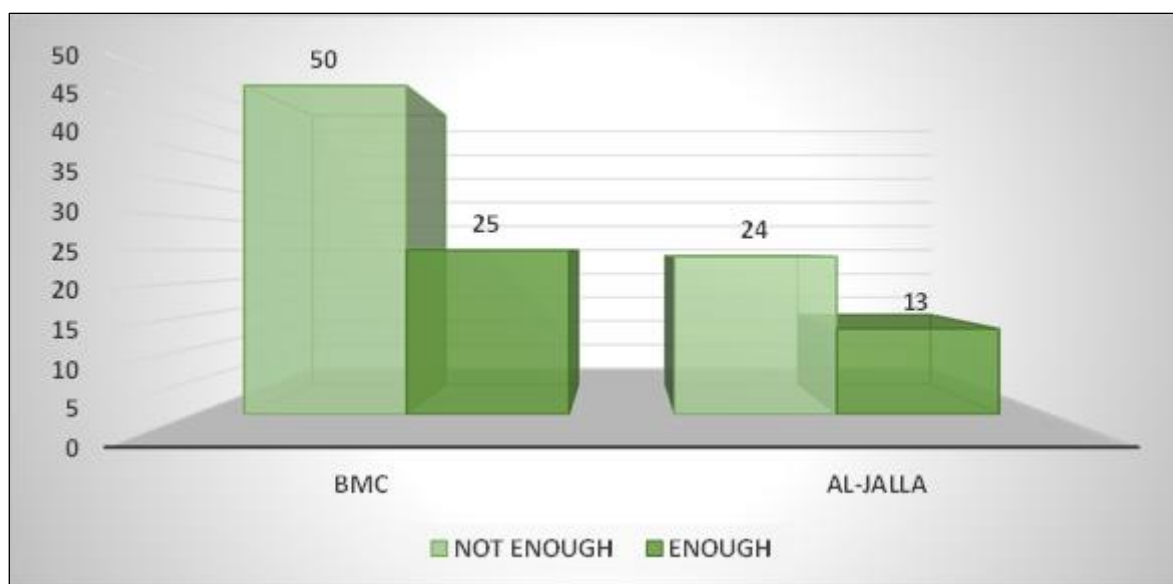
**Figure 10: Prevalence of Chronic Illness Among Participants in Both Hospitals.**

The figure 11 shows the hospitals percentages of participants in both hospitals who are working for more than 8 hours during a day.



**Figure 11: Daily Working Hours of Participants in Both Hospitals.**

Figure 12 shows that a large number of participants agree that rest time between procedures is not enough in BMC And Al-Jalaa Hospital for Surgery and Accidents



**Figure 12: Participants Opinions About Rest Time Between Procedures.**

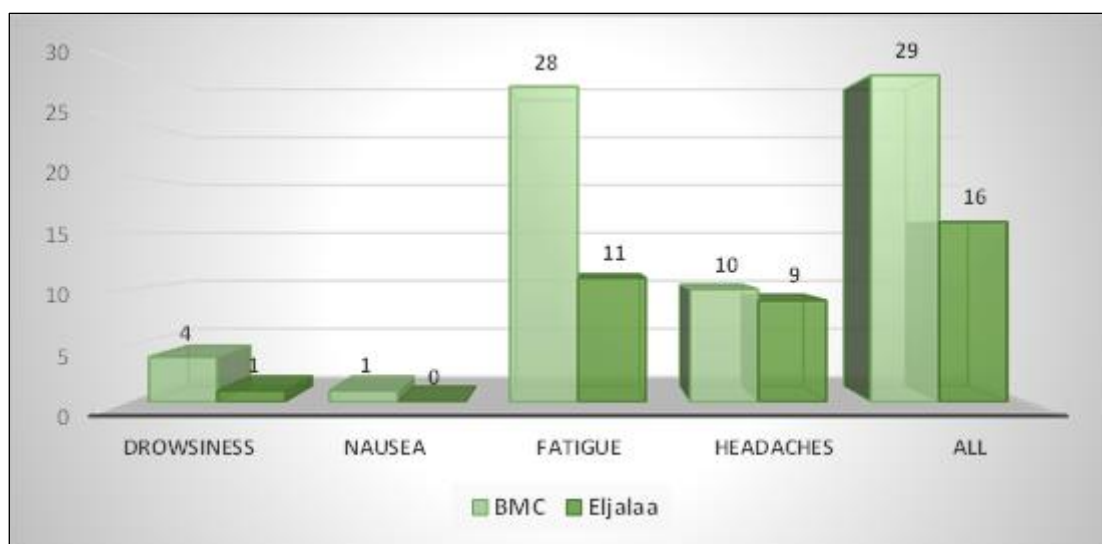
Figure 13 indicates that a large number of anesthesiologists in both hospitals are working in private and public institutions at the same time.



**Figure 13: Anesthesiologists Working in Both Public and Private Sectors.**

### 3.2 Part 2: The impacts of Chemical hazards

Figure 14 reports that the majority of anesthesiologists suffer from drowsiness, nausea, fatigue, and headache while working at both hospitals.



**Figure 14: Health Symptoms Reported by Anesthesiologists During Work.**

According to the liver function test analysis, table 1 shows that levels of AST, ALT, ALP and bilirubin were almost normal in the anesthesiologists of both hospitals.

**Table 1: Liver Function Test Results**

| Liver functions | Levels       | BMC | Al-Jalaa |
|-----------------|--------------|-----|----------|
| AST             | Low level    | 0   | 0        |
|                 | Normal level | 45  | 19       |
|                 | High level   | 0   | 1        |
| ALT             | Low level    | 5   | 0        |
|                 | Normal level | 39  | 19       |
|                 | High level   | 1   | 1        |
| ALP             | Low level    | 0   | 0        |
|                 | Normal level | 44  | 19       |
|                 | High level   | 1   | 1        |
| Bilirubin       | Low level    | 0   | 0        |
|                 | Normal level | 44  | 19       |
|                 | High level   | 1   | 1        |

Furthermore, the analysis tests of renal functions show an increase in the level of urea in BMC participants was high among a large number of participants; also, the results show that a small number of participants had an increase in the levels of potassium and chloride.

**Table 2: Renal Function Test Results**

| Renal functions    | levels       | BMC | Al-Jalaa |
|--------------------|--------------|-----|----------|
| Urea               | Low level    | 0   | 0        |
|                    | Normal level | 11  | 1        |
|                    | High level   | 34  | 19       |
| Creatinine (serum) | Low level    | 1   | 0        |
|                    | Normal level | 44  | 22       |

|                  |              |    |    |
|------------------|--------------|----|----|
|                  | High level   | 0  | 0  |
| <b>Potassium</b> | Low level    | 0  | 0  |
|                  | Normal level | 42 | 16 |
|                  | High level   | 3  | 4  |
| <b>Chloride</b>  | Low level    | 0  | 0  |
|                  | Normal level | 40 | 16 |
|                  | High level   | 5  | 4  |

Regarding the analysis of complete blood counts, **Table 3** represents the CBC profile of participants. Anesthesiologists at BMC typically have a larger percentage of low levels for a number of markers, especially HG, HCT, MCV, MCHC, and MCH. However, blood parameters like platelets, monocytes, and red blood cells, in particular, in Aljalla often exhibit more normal levels overall with fewer low or high values.

**Table 3: Complete Blood Count (CBC)**

| <b>CBC</b>        | Levels       | BMC | Al-Jalaa |
|-------------------|--------------|-----|----------|
| <b>WBC</b>        | Low level    | 3   | 1        |
|                   | Normal level | 39  | 18       |
|                   | High level   | 3   | 1        |
| <b>HG</b>         | Low level    | 10  | 0        |
|                   | Normal level | 32  | 20       |
|                   | High level   | 1   | 0        |
| <b>HCT</b>        | Low level    | 6   | 0        |
|                   | Normal level | 37  | 20       |
|                   | High level   | 2   | 0        |
| <b>MCV</b>        | Low level    | 14  | 4        |
|                   | Normal level | 31  | 16       |
|                   | High level   | 0   | 0        |
| <b>MCHC</b>       | Low level    | 14  | 4        |
|                   | Normal level | 31  | 16       |
|                   | High level   | 0   | 0        |
| <b>MCH</b>        | Low level    | 24  | 11       |
|                   | Normal level | 21  | 8        |
|                   | High level   | 0   | 1        |
| <b>PLATELETS</b>  | Low level    | 0   | 0        |
|                   | Normal level | 42  | 19       |
|                   | High level   | 3   | 1        |
| <b>LYMPHOCYTE</b> | Low level    | 0   | 0        |
|                   | Normal level | 31  | 13       |
|                   | High level   | 14  | 7        |
| <b>MONOCYTE</b>   | Low level    | 2   | 0        |
|                   | Normal level | 43  | 20       |

|                    |              |    |    |
|--------------------|--------------|----|----|
|                    | High level   | 0  | 0  |
| <b>NEUTROPHILS</b> | Low level    | 7  | 4  |
|                    | Normal level | 31 | 13 |
|                    | High level   | 7  | 3  |
| <b>RDW-CV</b>      | Low level    | 37 | 12 |
|                    | Normal level | 7  | 8  |
|                    | High level   | 1  | 0  |
| <b>RBC</b>         | Low level    | 0  | 0  |
|                    | Normal level | 41 | 18 |
|                    | High level   | 4  | 2  |

Moreover, table 4 represents the cardiac enzyme profile of the participants working at BMC and Al-Jalaa Hospital. Although a large number of anesthesiologists have normal levels of CK-MB, there are a small number who have high levels, which were 9 participants in BMC and 7 in Al-Jalaa Hospital. On the other hand, levels of troponin are normal in the majority of them.

**Table 4: Cardiac Enzyme Levels**

| Cardia enzymes    | Levels       | BMC | Al-Jalaa |
|-------------------|--------------|-----|----------|
| <b>Ck -mb</b>     | Low level    | 1   | 0        |
|                   | Normal level | 35  | 13       |
|                   | High level   | 9   | 7        |
| <b>Troponin I</b> | Low level    | 0   | 0        |
|                   | Normal level | 44  | 20       |
|                   | High level   | 1   | 0        |

### 3.3 Part 3: The Impacts of Ergonomic hazard

Table 5 shows that a large number of participants at BMC and Al-Jalaa suffered from work-related musculoskeletal disorders (WMSDs) in the past seven days and in the past 12 months.

Moreover, it observes that a high percentage of them have visited a doctor, taken, medication, had physical therapy, or had sick leave for WMSDs in the past 12 months. Also, the large majority of all participants said that their posture during work is standing almost all the time.

**Table 5: Work-Related Musculoskeletal Disorders (WMSDs) and Work Postures Among Participants in the Past 7 Days and 12 Months**

| Options                                                           | Options     | BMC | Al-Jalaa | Total |
|-------------------------------------------------------------------|-------------|-----|----------|-------|
| Work-related Musculoskeletal Disorders (WMSDs) in the past 7 days | Low Back    | 37  | 14       | 51    |
|                                                                   | Knees       | 1   | 3        | 4     |
|                                                                   | Neck        | 1   | 2        | 3     |
|                                                                   | Shoulder    | 4   | 1        | 5     |
|                                                                   | Wrist/ Hand | 2   | 1        | 3     |
|                                                                   | None        | 9   | 1        | 10    |
|                                                                   | ALL         | 21  | 15       | 36    |
|                                                                   | Total       | 75  | 37       | 112   |

|                                                                                                          |                                             |    |    |     |
|----------------------------------------------------------------------------------------------------------|---------------------------------------------|----|----|-----|
| WMSDs in the past 12 months                                                                              | Low Back                                    | 21 | 12 | 33  |
|                                                                                                          | Knees                                       | 5  | 6  | 11  |
|                                                                                                          | Neck                                        | 5  | 4  | 9   |
|                                                                                                          | Shoulder                                    | 6  | 1  | 7   |
|                                                                                                          | Wrist/ Hand                                 | 1  | 1  | 2   |
|                                                                                                          | Elbows                                      | 1  | 0  | 1   |
|                                                                                                          | None                                        | 9  | 1  | 10  |
|                                                                                                          | ALL                                         | 27 | 12 | 39  |
|                                                                                                          | Total                                       | 75 | 37 | 112 |
| Visited a Physician, took medications or physiotherapy or got sick leave for WMSDs in the past 12 months | Yes                                         | 33 | 6  | 39  |
|                                                                                                          | No                                          | 42 | 31 | 73  |
|                                                                                                          | Total                                       | 75 | 37 | 112 |
| Postures during work                                                                                     | Standing                                    | 39 | 15 | 54  |
|                                                                                                          | Sitting                                     | 5  | 2  | 7   |
|                                                                                                          | Turn round frequently                       | 10 | 7  | 17  |
|                                                                                                          | Keep the same posture for long time         | 3  | 1  | 4   |
|                                                                                                          | Keep bending for long time                  | 0  | 1  | 1   |
|                                                                                                          | Bend and turn at the same time frequently   | 0  | 1  | 1   |
|                                                                                                          | Heavy lifting of instruments ( $\geq 2$ kg) | 2  | 1  | 3   |
|                                                                                                          | ALL                                         | 16 | 9  | 25  |
|                                                                                                          | Total                                       | 75 | 37 | 112 |

Moreover, table 6 reports that there is no relationship between WMSDs and age, marital status, and years of experience of anesthesiologists at two hospitals since p-value is more than 0.05.

**Table 6: Relationship between WMSDs and age, marital status, and years of experience using Kruskal Wallis Test**

| Variables           | Hospitals | WMSDs in the past 7 days | WMSDs in the past 12 months |
|---------------------|-----------|--------------------------|-----------------------------|
| Age                 | BMC       | 0.114                    | 0.852                       |
|                     | Al-Jalaa  | 0.114                    | 0.288                       |
| Marital status      | BMC       | 0.637                    | 0.364                       |
|                     | Al-Jalaa  | 0.356                    | 0.664                       |
| years of experience | BMC       | 0.683                    | 0.808                       |
|                     | Al-Jalaa  | 0.199                    | 0.815                       |

Table 7 shows a positive correlation between age and visiting a physician, taking medications or physiotherapy, or getting sick leave in the past 12 months at Al-Jalaa Ho spital, while there is no relationship between age, years of experience, and postures during work.

**Table 7: Table relationship between visiting a physician, taking medication, postures during work, and age, marital status, and years of experience using the Kruskal-Wallis test**

| Variables           | Hospitals | Visited a Physician, took medications or physiotherapy or got sick leave in the past 12 months | Postures during work |
|---------------------|-----------|------------------------------------------------------------------------------------------------|----------------------|
| Age                 | BMC       | 0.895                                                                                          | 0.263                |
|                     | Al-Jalaa  | 0.027                                                                                          | 0.442                |
| Marital status      | BMC       | 0.565                                                                                          | 0.149                |
|                     | Al-Jalaa  | 0.092                                                                                          | 0.233                |
| years of experience | BMC       | 0.736                                                                                          | 0.929                |
|                     | Al-Jalaa  | 0.180                                                                                          | 0.627                |

Besides, table 8 reports no statistical difference between ergonomic impacts and gender and job type between two hospitals.

**Table 8: Relationship between ergonomic impact and gender and job type using the Mann-Whitney U test**

| Variables | Hospitals | WMSDs in the past 7 days | WMSDs in the past 12 months | Visited a Physician, took medications or physiotherapy or got sick leave in the past 12 months | Postures during work |
|-----------|-----------|--------------------------|-----------------------------|------------------------------------------------------------------------------------------------|----------------------|
| Gender    | BMC       | 0.809                    | 0.724                       | 0.158                                                                                          | 0.452                |
|           | Al-Jalaa  | 0.852                    | 0.658                       | 0.879                                                                                          | 0.208                |
| job type  | BMC       | 0.575                    | 0.072                       | 0.446                                                                                          | 0.497                |
|           | Al-Jalaa  | 0.217                    | 0.495                       | 0.806                                                                                          | 0.123                |

### 3.4 Part 4: The impacts of psychosocial hazards

Table 9 shows that a large number of workers at two hospitals suffer from memory and concentration problems, recalling dates and names or appointments. Besides, a large number of participants of BMC suffer from difficulty concentrating on tasks at work or at home and forget where they placed items (keys, documents).

**Table 9: Frequency of memory and concentration problems among participants at BMC and Al-Jall Hospital**

| Memory and Concentration                                | Options   | Hospital |          |
|---------------------------------------------------------|-----------|----------|----------|
|                                                         |           | BMC      | Al-Jalaa |
| difficulty remembering recent events or conversations   | Yes       | 38       | 13       |
|                                                         | No        | 22       | 8        |
|                                                         | Sometimes | 15       | 16       |
|                                                         | Total     | 75       | 37       |
| hard to concentrate on tasks at work or at home         | Yes       | 29       | 8        |
|                                                         | No        | 22       | 13       |
|                                                         | Sometimes | 24       | 16       |
|                                                         | Total     | 75       | 37       |
| any issues with recalling names, dates, or appointments | Yes       | 31       | 13       |
|                                                         | No        | 20       | 10       |
|                                                         | Sometimes | 24       | 14       |

|                                                       |           |    |    |
|-------------------------------------------------------|-----------|----|----|
|                                                       | Total     | 75 | 37 |
| forget where you placed items (keys, documents, etc.) | Yes       | 32 | 13 |
|                                                       | No        | 20 | 8  |
|                                                       | Sometimes | 23 | 16 |
|                                                       | Total     | 75 | 37 |

Furthermore, table 10 shows that attention in workers is clear in that a large number of workers (40) in BMC are easily distracted during work or daily activities and re-read or re- watch something to understand or remember. On the other hand, a large number of anaesthesiologists at Al-Jalaa reread or rewatch something to understand or remember.

**Table 10: Frequency of Attention Problems among Participants at BMC and Al-Jall Hospital**

| Attention problems                                      | Options   | Hospital |          |
|---------------------------------------------------------|-----------|----------|----------|
|                                                         |           | BMC      | Al-Jalaa |
| Easily distracted during work or daily activities       | Yes       | 33       | 9        |
|                                                         | No        | 22       | 15       |
|                                                         | Sometimes | 20       | 13       |
|                                                         | Total     | 75       | 37       |
| Re-read or re-watch something to understand or remember | Yes       | 40       | 15       |
|                                                         | No        | 13       | 9        |
|                                                         | Sometimes | 22       | 13       |
|                                                         | Total     | 75       | 37       |

Moreover, table 11 represents those 22 participants who reported difficulty organizing tasks or planning their day, 38 participants who did not face these problems, and 15 participants who experienced this problem sometimes at BMC.

On the other hand, 12 participants reported trouble organizing or planning their day, 15 participants did not have these issues, and 10 participants said they experienced this issue sometimes at Al-Jalaa Hospital.

**Table 11: Frequency of problem solving and executive function among participants at BMC and Al-Jall Hospital**

| Problem solving and executive function                                                         | Options   | Hospital |          |
|------------------------------------------------------------------------------------------------|-----------|----------|----------|
|                                                                                                |           | BMC      | Al-Jalaa |
| Difficulty in making decisions or solving problems that you would have normally handled easily | Yes       | 26       | 6        |
|                                                                                                | No        | 32       | 21       |
|                                                                                                | Sometimes | 17       | 10       |
|                                                                                                | Total     | 75       | 37       |
| Trouble organizing tasks or planning your day                                                  | Yes       | 22       | 12       |
|                                                                                                | No        | 38       | 15       |
|                                                                                                | Sometimes | 15       | 10       |
|                                                                                                | Total     | 75       | 37       |

Besides, table 12 shows BMC participants report more frequent mood and psychological health issues across the board compared to Al-Jalaa participants. The key areas of concern include feelings of sadness, anxiety, and depression; significant changes in mood or behavior; irritability, and loss of interest in activities. On the other hand, Al-Jalaa participants generally report lower levels of psychological distress, though the issues are still present, indicating that mood and psychological health concerns are not exclusive to BMC but may be less pervasive in Al-Jalaa.

**Table 12: Frequency of mood and psychological health among participants at BMC and Al-Jall hospital**

| Mood and Psychological Health                                              | Options | Hospital |          |
|----------------------------------------------------------------------------|---------|----------|----------|
|                                                                            |         | BMC      | Al-Jalaa |
| Frequently feel sad, anxious, or depressed                                 | Yes     | 43       | 23       |
|                                                                            | No      | 32       | 14       |
|                                                                            | Total   | 75       | 37       |
| Any significant changes in your mood or behaviour over the past few months | Yes     | 56       | 25       |
|                                                                            | No      | 19       | 12       |
|                                                                            | Total   | 75       | 37       |
| Increased irritability or frustration without a clear cause                | Yes     | 49       | 21       |
|                                                                            | No      | 26       | 16       |
|                                                                            | Total   | 75       | 37       |
| Lost interest in activities you once enjoyed                               | Yes     | 48       | 20       |
|                                                                            | No      | 27       | 17       |
|                                                                            | Total   | 75       | 37       |

Furthermore, table 13 shows BMC participants report higher levels of fatigue, sleep disturbances, and daytime drowsiness than Al-Jalaa participants. This could point to more severe or more common cognitive exhaustion and fatigue issues among BMC patients.

Additionally, the large number of participants experiencing trouble with sleep (55 at BMC vs. 22% at Al-Jalaa) may contribute significantly to the overall higher levels of fatigue and daytime sleepiness observed at BMC.

**Table 13: Frequency of Fatigue and Cognitive Exhaustion Problems Among Participants at BMC and Al-Jall hospital**

| Fatigue and cognitive exhaustion                                                              | Options | Hospital |          |
|-----------------------------------------------------------------------------------------------|---------|----------|----------|
|                                                                                               |         | BMC      | Al-Jalaa |
| feel fatigued or tired during work hours, even after a full night's sleep                     | Yes     | 53       | 29       |
|                                                                                               | No      | 22       | 8        |
|                                                                                               | Total   | 75       | 37       |
| having trouble falling asleep, staying asleep, or waking up too early                         | Yes     | 55       | 22       |
|                                                                                               | No      | 20       | 15       |
|                                                                                               | Total   | 75       | 37       |
| often feel sleepy or drowsy during the day, even when you haven't been working for long hours | Yes     | 47       | 18       |
|                                                                                               | No      | 28       | 19       |
|                                                                                               | Total   | 75       | 37       |

This table (14) reports that BMC participants are more likely to experience sensory and perceptual changes (vision, numbness/tingling, and hearing problems) compared to Al-Jalaa participants.

**Table 14: Frequency of Sensory and Perceptual Changes Problems Among Participants at BMC and Al-Jall Hospital**

| Sensory and Perceptual Changes                                                | Options | Hospital |          |
|-------------------------------------------------------------------------------|---------|----------|----------|
|                                                                               |         | BMC      | Al-Jalaa |
| any changes in your vision (e.g., blurriness, double vision)                  | Yes     | 34       | 8        |
|                                                                               | No      | 41       | 29       |
|                                                                               | Total   | 75       | 37       |
| any numbness or tingling sensations in your arms, legs, hands, or feet        | Yes     | 31       | 12       |
|                                                                               | No      | 44       | 25       |
|                                                                               | Total   | 75       | 37       |
| any difficulty with your hearing or feel that sounds are distorted or muffled | Yes     | 30       | 8        |
|                                                                               | No      | 45       | 29       |
|                                                                               | Total   | 75       | 37       |

Table 15 shows the percentages of participants at BMC who feel mentally exhausted or tired at the end of the workday and feel exhausted in the tasks and responsibilities at work, which are 38 and 42, respectively. Similarly, a large number of anesthesia staff at Al-Jall Hospital feel mentally exhausted or "burnt out" at the end of their workday.

**Table 15: Frequency of fatigue and cognitive overload problems among participants at BMC and Al-Jall Hospital**

| Fatigue and Cognitive Overload problems                           | Options   | Hospital |          |
|-------------------------------------------------------------------|-----------|----------|----------|
|                                                                   |           | BMC      | Al-Jalaa |
| feel mentally exhausted or "burnt out" at the end of your workday | Yes       | 38       | 15       |
|                                                                   | No        | 18       | 9        |
|                                                                   | Sometimes | 19       | 13       |
|                                                                   | Total     | 75       | 37       |
| feel overwhelmed by the tasks and responsibilities at work        | Yes       | 42       | 12       |
|                                                                   | No        | 17       | 10       |
|                                                                   | Sometimes | 16       | 15       |
|                                                                   | Total     | 75       | 37       |

## 4 DISCUSSION

### 4.1 Chemical Hazards

Anesthesiologists and anesthesia technicians are regularly exposed to occupational chemicals, particularly anesthetic gases, which can significantly affect their health. Many report experiencing symptoms such as sleepiness, nausea, fatigue, and headaches during or after work shifts, reflecting exposure to nitrous oxide and other anesthetics (43). Long-term exposure to nitrous oxide has been associated with dizziness, vomiting, euphoria, and tachycardia, with statistically significant differences compared to unexposed personnel (43).

Hematological studies reveal reductions in white blood cells, hemoglobin, hematocrit, MCV, MCH, and MCHC, indicating possible anemia or hepatotoxicity (44,45). Casale et al. also observed altered neutrophil and lymphocyte counts and elevated liver enzymes (GPT, GGT) and bilirubin among exposed personnel, highlighting the systemic impact of chronic chemical exposure (45).

Regarding renal function, this study found elevated urea levels among anesthesiologists, particularly at Al-Jalaa Hospital, potentially reflecting physical or psychological stress, dehydration, or disrupted diet and sleep. Creatinine levels, however, were unaffected, consistent with prior findings (46). Liver function tests were largely stable,

contrasting with other studies that reported elevated ALT and AST levels among personnel exposed to anesthetic gases, suggesting subclinical hepatic stress or damage (47,48). These findings highlight the importance of monitoring chemical exposure and implementing effective mitigation strategies, such as engineering controls and administrative safety measures, to minimize occupational risk.

## 4.2 Ergonomic Hazards

Ergonomic risks are highly prevalent among anesthesia professionals. A significant proportion of participants reported low back pain within the previous seven days and combined knee and back pain over the past 12 months. Prolonged standing, extended work hours exceeding 30 hours per week, awkward postures, and obstructive operating room environments were identified as major contributing factors (49,50).

These results are consistent with previous studies reporting that 98.4% of anesthesiologists experience work-related musculoskeletal disorders (WRMDs), particularly affecting the lower back, with knee issues more common among cardiothoracic anesthesiologists (49). Environmental risk factors such as obstructive electrical cables and extended bending further exacerbate musculoskeletal strain (51). Prolonged standing, bending, and lifting were also identified as primary contributors to high prevalence of lower back pain among anesthesia care providers in South-South Nigeria (52).

Other studies found that factors such as awkward trunk postures, lack of physical activity, advanced age, and insufficient rest periods increase the risk of musculoskeletal disorders (53). Younger anesthesiologists (21–40 years) and newly hired personnel were more likely to seek medical attention, which may reflect lower pain thresholds or higher health awareness, emphasizing the importance of individual health behaviors in occupational risk assessment (53).

## 4.3 Psychological Hazards

Psychological hazards significantly affect anesthesiologists, with many experiencing attention difficulties, mood changes, and emotional exhaustion. Subjective assessments indicate that anesthesiologists' psychological health is negatively impacted by high weekly workloads and dissatisfaction with personal health, with female professionals disproportionately affected (54).

A substantial number of participants reported mood changes over the past months. Zheng et al. found that 37.9% of anesthesiologists reported poor mental health, with 46.3% of female anesthesiologists experiencing emotional distress compared to 32.4% of males (55). Younger anesthesiologists (<30 years) reported higher rates of depression and stress, often using emotion-focused coping strategies, whereas older individuals combined problem- and emotion-focused strategies (56).

Sleep disturbances and fatigue were common, with participants feeling tired despite adequate sleep. Burnout prevalence among anesthesiology residents ranged from 2.7% to 67%, influenced by prolonged work hours, adverse workplace relationships, professional exams, and clinical stressors (57). Each additional hour worked per week increased the risk of depression and distress by 3% (57). Afonso et al. reported that 59.2% of anesthesiologists were at high risk of burnout, linked to insufficient support at work and home, working over 40 hours per week, staffing shortages, and other occupational stressors (58). These findings underscore the critical need for stress management, adequate rest periods, workplace support, and mental health interventions to safeguard anesthesiologists' well-being.

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## 5 CONCLUSION

This study found that anesthesiologists commonly experience fatigue and headache, followed by drowsiness, during or after work shifts. Blood analyses showed that many participants from Benghazi Medical Center had lower levels of hemoglobin, hematocrit, MCV, MCH, platelets, lymphocytes, and monocytes compared to those from Al-Jalaa Hospital. Elevated CK-MB levels were observed in over a quarter of Al-Jalaa participants, while troponin levels remained normal across both hospitals. Urea levels were higher, particularly at Al-Jalaa, whereas most liver function markers were stable.

Ergonomically, a significant proportion of anesthesiologists reported low back pain in the past week, with many also experiencing knee and back pain over the previous year. Prolonged standing during procedures was identified as a primary contributing factor.

Psychologically, high rates of symptoms were reported at both hospitals, including attention difficulties and mood changes. Many participants experienced sleep disturbances, fatigue during work hours despite adequate rest, and feelings of mental exhaustion or burnout. However, most did not report sensory or cognitive impairments such as vision or hearing changes. Overall, anesthesiologists were affected by chemical, ergonomic, and psychological stressors, leading to fatigue, pain, and emotional strain.

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## STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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I would like to thank all participants in the study.

### *Disclosure of conflict of interest*

The authors declare no conflicts of interest regarding this manuscript.

### *Statement of ethical approval*

The ethical approve was obtained from university of Benghazi, Benghazi, Libya.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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