

# Awareness with Recall During General Anesthesia: A Cross-Sectional Study

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## ABSTRACT

**Background:** Accidental awareness and recall a well-known complication of anesthesia and sedation despite advancements in monitoring, drugs, and techniques. This study aimed to determine the prevalence and factors of awareness with recall (AWR) during general anesthesia in a tertiary care hospital.

**Methods:** A cross-sectional study was conducted at Maqsood Medical Center Peshawar from April to October 2022, with a total of 383 patients  $\geq 18$  years, in good neurological health, and having ASA Physical Status I, II, III, IV undergoing elective general anesthesia-based procedures were included through a convenience sampling technique. Data was collected by administering the Brice questionnaire for structured interviews one hour after admission in PACU after assessing responsiveness. Data was analyzed using SPSS 26 with  $p < 0.05$  considered significant.

**Results:** The mean age of the study participants was 40.93 $\pm$ 05.2 years. The Incidence of awareness was found 7(1.8%) out of which 8(2.1%) experienced pain, 7(1.8%), being touched, 7(1.8%), hearing sounds, 8(2.1%), unable to speak 8(2.1%), feeling of paralysis, 6(1.6%) experienced tube being inside the throat, 17(4.4%) experienced an abrupt increase in blood pressure, 7(1.8%) experienced sweating, and tear production and 5(1.3%) observed movement and grimacing. No specific association was found between awareness of gender and surgery type. There was a significant association between awareness and ASA classification( $p=0.000$ ) and with intraoperative pain( $p=0.00$ ), and hemodynamic changes ( $p=0.04$ ).

**Conclusion:** In conclusion, there was an unexpectedly high prevalence of anesthetic awareness with recall. During surgery, patients typically experience pain, difficulty in communication, and paralysis.

**Keywords:** Analgesia, Anesthesia, Operative Surgical Procedure, Metacognition.

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## INTRODUCTION

Patient recollection of intraoperative events while under general anesthesia constitutes the definition of "awareness under anesthesia." It's not common but is a well-known complication of anesthesia. Intraoperative awareness under anesthesia is one of the most distressing side effects of anesthesia for patients, right behind postoperative nausea and vomiting<sup>1</sup>. It can cause problems during surgery, but it can also cause problems later on, such as post-traumatic stress disorder. In addition, intraoperative awareness has emerged as a significant factor in anesthetic-related malpractice lawsuits<sup>2,3</sup>. Anesthesiologists rank intraoperative consciousness as the second most serious issue (just behind death) that might arise during surgery<sup>4</sup>. There have been several attempts at measuring consciousness in unconscious patients. Checking vitals such as Blood Pressure BP, Heart rate HR, ET concentration, and bispectral index are all on the list (BIS)<sup>5</sup>. None of these methods, however, is foolproof when it comes to identifying consciousness while a patient is under general anesthesia.

Out of every thousand individuals who undergo a general anesthetic, one or two may experience awareness while under anesthesia (0.1% to 0.2 %) <sup>6,7</sup>. Overall, the incidence rates for obstetric patients are 0.4%, and for cardiac patients, they range from 1.1% to 1.5%<sup>8</sup>. From soreness at the incision site to irritation in the throat, over 36% of patients reported experiencing pain<sup>9</sup>. Some people experience long-lasting, negative impacts such as post-traumatic stress disorder and depression, even though the majority of awareness incidents are moderate. Up to 33% of people who have had awareness have reported experiencing late effects such as anxiety, nightmares, and flashbacks<sup>10</sup>.

There can be a variety of causes for the obstetric population to have a higher risk of awareness than the overall surgical population<sup>11,12</sup>. An example of a physiological shift is the increased cardiac output that occurs during pregnancy; this increases the rate of intravenous anesthetic agent redistribution but decreases the time it takes to establish an appropriate partial pressure of the volatile anesthetic agent<sup>13-15</sup>. More issues arise when considering the use of volatile anesthetics, their effects on uterine tone, and the hemodynamic effects of anesthetic agents in emergency settings, as well as the potential exposure of neonates to drugs immediately before birth<sup>7</sup>.

Awareness occurs between 0.1% and 0.2% of the time in wealthy nations<sup>16,17</sup>. Few studies have been conducted outside of the developed world, although anecdotal evidence suggests that the prevalence of intraoperative consciousness may be higher there than in the West<sup>18</sup>. Possible reasons include a large patient volume, the use of older, less effective drugs, and an inadequate system for administering and monitoring anesthesia. We conducted a comprehensive literature search but were unable to locate any estimates of the consciousness under anesthesia problem in Peshawar settings. Therefore, this study was designed to investigate the prevalence and factors of awareness with recall (AWR) during general anesthesia in a tertiary care hospital.

## METHODS

This single-center, cross-sectional study was performed in a tertiary care hospital Maqsood Medical Center Peshawar. The ethical approval was obtained from the Institute of Paramedical Sciences research committee (F-222/Student Affairs/IPMS/2023/2051). The duration of the study was April 22, to October 22, 2022, patients who opted for elective surgery in a variety of surgical specialties (including general surgery, orthopedics, ear, nose, and throat surgery, urology surgery, and plastic surgery) under general anesthesia were considered for inclusion through convenience sampling technique in this study. Patients had to be 18 years of age or older, in good neurological health, and have an ASA Physical Status I, II, III, IV considered. Patients who were either too young (18 and under), too sick to be extubated following surgery, or too unstable mentally to be moved to the intensive care unit were not included in this study. All patients provided written informed permission in their native language before participation. This study strictly followed the highest level of ethical standards proposed by the Helsinki Declaration (Revised 2013), and the International Ethical Guidelines for Human Research in Health (2016). A sample size of 383 patients was calculated keeping the anticipated frequency at 50% with a significance level of 5% and a confidence interval of 95% by availing open Epi sample size calculator.

General anesthesia with endotracheal intubation and positive pressure ventilation was administered to all patients in this study. However, the exact method and

medications used for anesthesia differed depending on the patient's preoperative condition, the surgical procedure being planned, and the anesthesiologist's preference (PPV). The patient was given propofol intravenously to induce sleep, and then either Cis-atracurium or atracurium to relax their muscles. For analgesia synthetic opioids were used. After intubation, anesthesia was maintained with 100% oxygen and a volatile anesthetic with standard MAC (isoflurane or sevoflurane). Nitrous oxide (N<sub>2</sub>O) was not used during general anesthesia; instead, we used opioids for analgesia. Patients' vital signs (such as heart rate, oxygen saturation, electrocardiography, and non-invasive blood pressure) were monitored at 5-minute intervals during the procedure and for the duration of the postoperative period.

Analgesia was achieved using opioids (e.g., morphine, fentanyl), and non-opioid analgesics (e.g., acetaminophen, NSAIDs). Maintenance of neuromuscular blockade (NMB) is ensured using non-depolarizing agents (e.g., Atracurium, Cisatracurium) or depolarizing agents like succinylcholine for rapid sequence induction. Agents used for inducing and maintaining loss of consciousness (LOC) include intravenous anesthetics such as propofol. Monitored Anesthesia Care (MAC) involves administering sedation and/or analgesia to patients undergoing procedures without general anesthesia. Patients are not paralyzed or intubated during MAC. The technique aims to maintain consciousness and comfort, often using agents like benzodiazepines, opioids, and sometimes hypnotics for deeper sedation. This approach allows patients to maintain spontaneous breathing while being monitored closely for safety. MAC is commonly used for procedures such as endoscopies and minor surgeries, where avoiding general anesthesia can reduce risks and promote faster recovery. A few patients received TIVA, which is advantageous for procedures where rapid recovery, stable hemodynamics, and reduced postoperative nausea are crucial, making it ideal for outpatient surgeries, neurological procedures, and ENT surgeries.

Clinical characteristics like pupillary reaction, perspiration, and tears were used to fine-tune the volatile anesthetic concentration. Because the necessary equipment was not accessible at our institution, we did not do instrumental monitoring of electrical activity in the brain or volatile anesthetic concentration. Neither a laryngeal mask airway nor the use of a mask to breathe during surgery was used for any patient in this study. A single experienced consultant anesthesiologist who was aware of which patients were in the study administered general anesthesia to all patients. Extubation in the OR requires specific criteria to ensure patient safety, including adequate oxygenation and ventilation (SpO<sub>2</sub> > 92% on FiO<sub>2</sub> ≤ 40%, PaO<sub>2</sub> > 60 mmHg, PaCO<sub>2</sub> < 50 mmHg), hemodynamic stability, protective airway reflexes, neuromuscular recovery

(TOF ratio > 0.9), and the ability to follow commands. The patient must be awake or easily arousable, maintaining a stable airway without significant respiratory support, with supplemental oxygen, suction, and resuscitation equipment ready.

Upon shifting to the PACU, a thorough handover covers the patient's airway and breathing, hemodynamic status, level of consciousness, pain, and comfort, surgical site condition, and drains. The handover includes a summary of the surgical and anesthetic procedures, intraoperative events, medications, fluid balance, and postoperative orders. In the PACU, the patient should remain easily arousable, able to follow simple commands and maintain a patent airway independently, with continuous monitoring to ensure stability and responsiveness. Surgery was finished, the patient regained consciousness, and they were transferred to the post-anesthesia care unit (PACU).

After about an hour in the postoperative care unit (PACU), a separate anesthesiologist evaluated the patient's level of consciousness throughout the operation. The anesthesiologist visited the patient and interviewed them in the patient's native language. First, demographic data state was collected, including demographics like age, gender, ASA status, anesthetic method, chronic drug use, and past awareness. The second section of the survey was based on an updated version of the Brice questionnaire<sup>19</sup>. It has been used by similar studies designed to assess intraoperative awareness in the past.<sup>16-18,20</sup>

Patients were classified as having either definite consciousness, potential awareness, or no awareness after the questionnaire was examined. Patients were classified as having definite consciousness if their recollection of events after surgery was corroborated by staff members present at the time or if the investigator was sure the memory was genuine. A patient was considered to have "possible awareness" if they were unable to recall any specific event that would indicate awareness, but their recollections could have been connected to events that occurred during the operation. If a patient stated they were unconscious during surgery or if any recollections they did have were likely from either before or just after the procedure, we assumed they were not conscious. Similar categories have been used in previous research on intraoperative consciousness.<sup>17-23</sup> Patients having intraoperative dreaming were categorized separately<sup>16,22,23</sup>.

All the data was entered and analyzed in SPSS version 26.0. Mean + SD was calculated for quantitative variables like age. Frequency and percentages were calculated for categorical variables. The frequency and percentage approaches were used to represent the qualitative variables. A chi-square test was used to

compare categorical variables, and a p-value less than 0.05 was considered significant. Tables and graphs were used to display all of the results.

**RESULTS**

The mean age of the study participants is 40.93 +5.0 years. Among the total participants, 219 (57.2%) are male, and 164 (42.8%) are female. The reported P-value is 0.63, indicating that gender is not statistically significant in this context. Among all, the distribution of participants across different ASA classes. Class I has 101(26.4%), Class II has 172(44.9%), Class III has 95(24.8%), and Class IV has 15(3.9%). The reported p-value is 0.04, indicating that ASA class has a statistically significant association with awareness. In total, the data indicates that 330 participants (86.2%) under-

went low-risk surgeries, while 53 participants (13.8%) underwent high-risk surgeries. High-risk surgeries include trauma surgery (e.g., laparotomy), obstetric surgery (e.g., emergency cesarean sections under general anesthesia), neurosurgery (e.g., craniotomy) gynecological surgeries (e.g., hysterectomy). Which has no statistical significance is reported (P > 0.05). Among the total participants, 234 (61.1%) underwent minor surgeries, while 149 (38.9%) underwent major surgeries. No statistical significance is reported (P > 0.05). The table provides information about the mean age, gender distribution, ASA classification, nature of the surgery (low risk or high risk), and surgery type (minor or major). It also indicates whether any statistical significance was observed for certain parameters (based on the reported P-values) as shown in Table 1.

**Table 1: Demographic characteristics of the patients.**

Parameters		Mean ± SD	n (%)	p-value
Age		40.93 ± 5.0		
BMI		24.5 ± 0.8		
Gender		Male	219(57.2)	0.63
		Female	164(42.8)	
ASA Classification		Class I	101(26.4)	0.04
		Class II	172(44.9)	
		Class III	95(24.8)	
		Class IV	15(3.9)	
Anesthetic procedure duration (mins)				
Minor procedures		90.5 ± 10.2		
Major procedures		150.5 ± 20.2		
Nature of the Surgery		Low risk	330(86.2)	0.65
		High risk	53(13.8)	
Surgery Type		Minor	234(61.1)	0.55
		Major	149(38.9)	
Surgery/Procedure	Gastrointestinal Surgery	Low risk	48 (82.8%)	0.73
		High risk	10 (17.2%)	
	Orthopedic Surgery	Low risk	77 (83.7%)	
		High risk	15 (16.3%)	
	Ophthalmic Surgery	Low risk	30 (100%)	
		High risk	0 (0%)	
	Maxillofacial Surgery	Low risk	40 (88.9%)	
		High risk	5 (11.1%)	
	Other Surgery	Low risk	135 (84.9%)	
		High risk	24 (15.1%)	

Results from this study of 7(1.8%) patients show that various anesthetic methods produce diverse patterns of awareness during surgery (AWR) and intraoperative dreaming. The rather high incidence of consciousness in this small sample is shown by the TIVA (Total Intravenous Anesthesia) AWR rate of 28.5%. Even more so, intraoperative dreaming is reported by 61.9% of patients undergoing TIVA. The

incidence of intraoperative dreaming is fairly minor, and BA (Balanced Anesthesia) had a lower AWR rate of 14.2%. (0.09%). Patients undergoing MAC (Monitored Anesthesia Care) are more likely to experience AWR (57.1%), suggesting a higher chance of awareness, and 28.5% report experiencing intraoperative dreaming.

**Table 2: Prevalence of intraoperative awareness with recall (AWR) in elective surgery patients, and prevalence of intraoperative dreaming.**

Anesthetic technique	Number of AWR patients (n=07)	Intraoperative dreaming (n=21)
TIVA	2 (28.5%)	13(61.9%)
Late psychological symptoms after awareness among consecutively included surgical patients. Anesthesiology	1(14.2%)	02(0.09%)
MA	4(57.1%)	06(28.5%)
Awareness Status	Unaware	377(98.2)
	Aware	7(1.8)
	Total	384(100)

*TIVA: total i.v. anaesthesia with propofol; BA: balanced anaesthesia; MA: mixed anaesthesia*

After the evaluation of 384 patients, the magnitude of awareness was found to be 1.8% (7 cases), out of these 7 patients 4 were male and 3 were female as shown in table 3. Among all, whether the patient experienced pain during the surgery. The majority of patients (375 out of 383) reported no intra-operative pain, which accounts for 98% of the total. There was a statistically significant association between pain during the surgery and intraoperative awareness. To assess whether the patient felt any touch from someone or something during awareness and recall the surgery. The majority of patients (376 out of 383) reported no such sensations, accounting for 98.2% of the total. The p-value is 0.00, indicating a statistically significant association. To examine whether the patient heard any sounds during the surgery. Most patients (n=375 out of 383) reported not hearing any sounds, which represents 97.9% of the total. To investigate whether the patient felt the presence of a

tube in their throat during the surgery. The majority of patients (n=377 out of 383) reported not sensing the tube, which accounts for 98.4% of the total. The p-value is 0.00, indicating statistical significance. To assess whether there were any hemodynamic changes (changes in blood pressure, heart rate, etc.) during the surgery. The majority of patients (366 out of 383) did not experience hemodynamic changes, representing 95.6% of the total. To find out whether the patient remembers when the anesthetist placed the mask on their face. The p-value is 0.45, indicating that there is no statistically significant association. The majority of patients (376 out of 383) did not show such signs, representing 98.2% of the total. Most patients (378 out of 383) did not exhibit such signs, accounting for 98.7% of the total. The p-value is 0.00, indicating a statistically significant association as shown in table 3.

**Table 3: Intra-operative factors.**

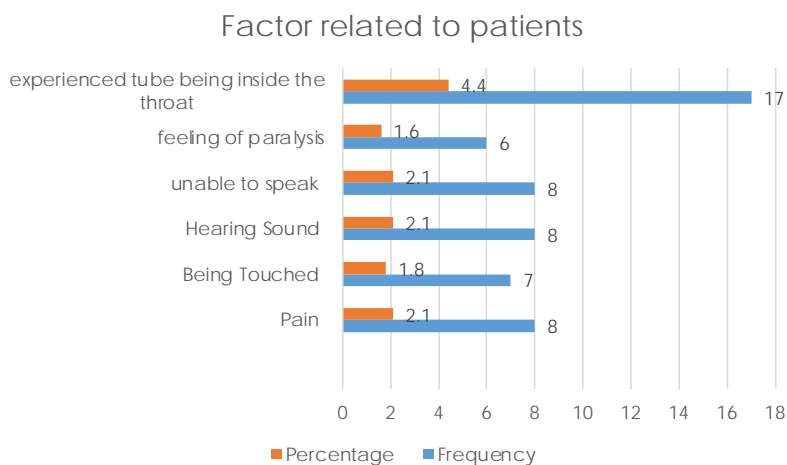
Parameters	Response	n (%)	p-value
Intra-operative pain	No	375(98)	0.00
	Yes	8(2)	
Being touched by someone or something during the surgery	No	376(98.2)	0.00
	Yes	7(1.8)	
hear any sound during the surgery	No	375(97.9)	0.00
	Yes	8(2.1)	
Tube being inside your throat during the surgery	No	377(98.4)	0.00
	Yes	6(1.6)	

Hemodynamic changes	No	366(95.6)	0.00
	Yes	17(4.4)	
Do you remember when the anesthetist put the mask on your face?	No	153(40.0)	0.45
	Yes	231(60.0%)	
Any signs of sweating and tear production	No	376(98.2)	0.00
	Yes	7(1.8)	
Signs of patient movement or grimacing	No	378(98.7)	0.00
	Yes	5(1.3)	

$p < 0.05$  was considered statistically significant.

The data indicates that among the patients surveyed, (8)2.1% reported experiencing pain, hearing sounds, or being unable to speak during anesthesia. Additionally, (7)1.8% felt they were being touched, and (8)1.6% experienced a feeling of paralysis. Notably, (17)4.4% of patients reported

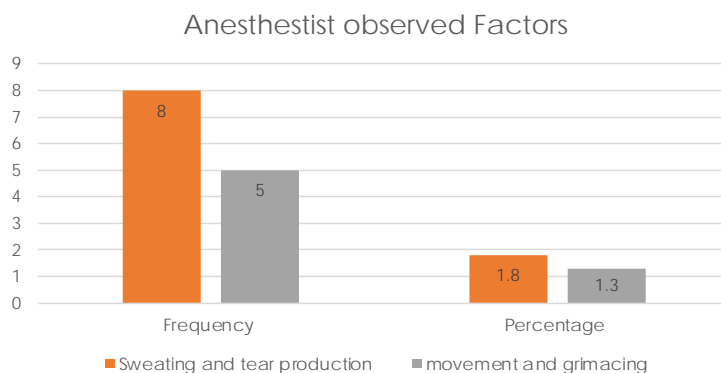
experiencing the sensation of a tube being inside their throat, making it the most frequently reported sensation. These findings highlight various degrees of awareness and sensory experiences during anesthesia, with the sensation of the endotracheal tube being the most common.



**Figure 1: Patient-Associated Factors with Recall During Anesthesia.**

The data shows that 8(1.8%) of patients experienced sweating and tear production during anesthesia, while 5(1.3%) exhibited movement and grimacing. These observations suggest that a small proportion

of patients exhibit physical signs of awareness or discomfort during anesthesia, indicating the importance of monitoring and managing such responses to ensure patient comfort and safety.



**Figure 2: Associated Factors observed by anesthetist with recall during anesthesia.**

## DISCUSSION

Our investigation found that 1.8% of patients experienced awareness under anesthesia with postoperative memory. Patients with possible consciousness would also be included in the analysis, increasing the rate of awareness under anesthesia to 0.78%. This figure is substantially greater than what most Western studies have shown, which is an incidence of 0.1% to 0.2%.<sup>16,17</sup> Research conducted by Errando et al. on over 4000 patients found that the incidence of awareness of the recall was 1% among all patients operated on under anesthesia and 8% after removing high-risk cases<sup>13</sup>.

Although the majority of these studies have been conducted in Western countries, Xu et al. discovered an unexpectedly high percentage of intraoperative awareness in a Chinese study that included individuals (0.41%)<sup>7,11,10</sup>. Additionally, 3.19% of patients reported dreaming during operation, according to the same study. In most cases, a total intravenous anesthetic was administered, as shown in a Japanese study that found a rate as low as 0.028%, which includes patients who showed signs of likely awareness (21 out of 24)<sup>14</sup>. A recent study conducted in a prominent hospital in India found that awareness rates were 1 in 300. (0.33%). Consequently, the level of awareness differs across hospitals, but it is present in almost all of them. Pharmacological and procedural differences in anesthesia delivery could be the reason for this variation<sup>15</sup>.

The 5th National Audit Project, led by the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland (UK), documented cases of accidental awareness during general anesthesia in the UK<sup>16</sup>. It predicted that 1 in 15,414 cases in the UK will experience awareness under anesthesia, which is lower than what had been previously reported. In addition, the period between induction and operation started to include more than 50% of the recorded awareness incidences in the UK. But that study only included cases that were brought to the notice of the anesthesiologists involved, not the patients themselves. In 2004, another study out of the UK validated earlier results showing that anesthesiologists frequently underestimate patients' levels of consciousness when they are under anesthesia<sup>17</sup>.

Future prevention efforts can benefit from a better understanding of the factors that lead to awareness of memory when under anesthesia<sup>18</sup>. One possible factor is the fact that people react differently to anesthetics. Dissimilarities in target receptor expression and activity across individuals may be a contributing factor. Cheng et al. found that the amnesic effects of the anesthetic medicine etomidate could not be triggered in mice that were genetically deficient in alpha-gamma-aminobutyric

acid (5 GABA). The pharmacology of synaptic and extra-synaptic GABAA receptors in response to agonists and allosteric modulators is altered by persistent alcohol consumption, according to another study by Liang et al.<sup>19</sup>. Thus, in addition to genetics, chronic exposure to certain chemicals or medications may contribute to the altered anesthetic response. Different target receptors are only one more reason why some patients, such as those with severe hypovolemia or impaired heart function, may not be able to tolerate a full dose of anesthesia<sup>24</sup>. Inadequate anesthetic depth can cause the patient to not feel changes in their heart rate and blood pressure, which beta-blockers can amplify<sup>25,26</sup>. Finally, anesthesia overdoses might occur as a result of an unusual procedure, poorly maintained anesthesia equipment, or an operator's unfamiliarity with the new method or equipment<sup>27</sup>.

Nevertheless, patients will remain unconscious during surgery as long as an adequate level of anesthesia is maintained. Anesthesiologists have long kept tabs on their patients by recording vital signs (blood pressure, pulse rate, etc.), lacrimation, and other hemodynamic variables. Being aware is helpful, but it can occur even in the absence of a change in vital signs. Additional techniques include determining the minimum alveolar concentration and estimating the concentration of volatile anesthetic gas. To make sure there's enough anesthetic depth, BIS monitoring has also been utilized. By placing electrodes on the patient's forehead, the device may assess their brain's electrical activity and provide a result ranging from zero to one hundred. According to the research, the chances of being conscious while unconscious are quite low when the BIS is between 40 and 60.

Our research contained several flaws despite our best efforts. We only questioned each patient once, around an hour after they arrived in the PACU. Some individuals who may have regained consciousness while under anesthetic may have been lost as a result. Second, no one was given any tranquilizers before their procedures. This may have contributed to a Will contribute to awareness with recall. Therefore, additional investigations with a larger number of patients may be needed to more precisely determine the prevalence of awareness under anesthesia in the Peshawar region.

## CONCLUSION

The study reveals that the prevalence of anesthetic awareness with recall is significantly higher than anticipated within the tertiary care hospital setting in Peshawar, highlighting a critical concern in surgical anesthesia that impacts patient safety and care quality. Patients reported distressing sensations during surgery, including significant pain, an overwhelming sense of paralysis, and difficulty in

communication, leading to immediate and potentially long-term psychological sequelae such as PTSD, anxiety, and chronic pain syndromes. This elevated prevalence underscores the urgent need for enhanced monitoring techniques and protocols to ensure adequate anesthetic depth, comprehensive training for anesthesia providers, and robust patient communication pre-and post-operatively to manage adverse psychological effects.

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#### CONFLICT OF INTEREST

No authors have declared a conflict of interest.

#### PATIENT CONSENT

Informed consent was taken from each participant.

#### ETHICAL APPROVAL

Ethical clearance and approval were obtained from the ethical and scientific committee of the Institute of Paramedical Sciences, Khyber Medical University, IPMS, KMU (F-222/Student Affairs/IPMS/2023/2051).

#### AUTHORS CONTRIBUTION

MN, T, S, MA, SM, MT: Conceptualized the study, designed the research methodology, and supervised the overall project. MT, MTA, and SA Assisted in data collection and analysis, and contributed to the interpretation of the results. T, S, MA, SM, MT Conducted a literature review and contributed to the drafting of the manuscript. MN, T, S, MA: Managed the data collection process and ensured the accuracy of the data. MT: Played a key role in data analysis and statistical evaluation, and significantly contributed to the writing of the manuscript.

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