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Surgeon Stress and Its Impact on Outcomes : Coping Strategies in Complex and Emergency Surgeries

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L A P R E S S E M É D I C A L E

M. O., she, and M. M., he: Conducted the literature search, synthesized data, and drafted the Background and Context section, focusing on the interplay between surgeon stress and patient outcomes.

A. M., he, and M. H., he: Analyzed stress-inducing factors, including procedural complexities, time constraints, and unpredictable scenarios, for the Sources of Stress in Complex Surgeries section.

Z. M., she, and M. I., she: Evaluated coping strategies, including preoperative preparation, institutional-level interventions, and team-based support, for the Coping Strategies for Surgeon Stress section.

N. A., she, and M. K., he: Developed strategies for surgeon resilience and well-being, including stress management and burnout mitigation, for the Strategies for Enhancing Surgeon Resilience and Performance section.

Abstract

Introduction: Surgery is a high-stress profession, with complex and emergency procedures intensifying surgeon stress, leading to adverse effects on decision-making, performance, and overall well-being.

Purpose & Research Questions: This review explores the impact of surgeon stress on surgical outcomes, identifies key stress-inducing factors, and evaluates effective coping strategies to mitigate its effects.

Methods: A systematic review was conducted using PRISMA guidelines, analyzing studies on surgeon stress and its impacts. Data sources included PubMed, Scopus, and institutional reports. Results were synthesized thematically.

Results: Surgeon stress impairs decision-making, increases error rates, and contributes to burnout. Effective coping strategies include institutional interventions, team-based approaches, and individual practices such as mindfulness and resilience training.

Conclusion: Mitigating surgeon stress through multi-level interventions enhances surgical performance, improves patient outcomes, and promotes the sustainability of surgical practices and surgeon well-being.

Introduction

Surgical work is widely acknowledged as one of the most stressful professions, requiring the ability to remain calm under extreme pressure and make split-second decisions—both critical in determining surgical outcomes. While the inherent nature of the job is undoubtedly high-stress, additional factors such as time constraints, urgency, and procedural complexity further amplify the pressure. This can impair surgeons' cognitive and emotional functions, significantly affecting their performance.

During surgeries, healthcare professionals must make nearly instantaneous, life-altering decisions, navigate unexpected complications, and manage other unpredictable factors—all while ensuring seamless teamwork. Prolonged exposure to such immense stress contributes to burnout, emotional fatigue, deteriorated physical health, and reduced productivity.

Despite the severity of this issue, research on the correlation between stress levels and surgical outcomes remains limited and ambiguous. Emergency and complex surgeries, in particular, present unique stressors, including time-sensitive decision-making and rapidly evolving scenarios with new variables. Institutional challenges such as short staffing, long shifts with minimal breaks, and administrative burdens exacerbate stress levels. Additionally, communication breakdowns during high-risk procedures hinder coordination and decision-making, further compromising patient safety. Addressing these factors is crucial for implementing targeted interventions to reduce stress and improve outcomes for both surgeons and patients.

Stress management strategies in surgical settings must be multi-leveled, encompassing individual, team-based, and institutional approaches. At the personal level, mindfulness and cognitive behavioral techniques can help manage stress, though these methods are not yet widely implemented in healthcare systems. Further investigation is needed to assess their effectiveness in surgical contexts.

The primary objective of this review is to explore how surgeon stress influences surgical outcomes and surgeon well-being. Specifically, it aims to identify key stressors during emergency and complex surgeries, evaluate their impact on patient safety and clinical performance, and determine effective coping strategies. Additionally, the review seeks to identify actionable solutions for integrating stress management into surgical training and institutional policies while fostering a culture that prioritizes surgeon health and patient safety.

Research Questions

1. What are the primary sources of stress in complex and emergency surgeries?
2. How does surgeon stress influence surgical outcomes?
3. What coping strategies and interventions effectively manage surgeon stress?
4. How can surgical training incorporate stress management techniques?

Methodology

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure rigor, transparency, and reproducibility. The primary objective was to evaluate surgeon stress, its impact on surgical outcomes, and the effectiveness of coping mechanisms during complex and emergency surgeries.

Inclusion and Exclusion Criteria

To ensure relevance, strict inclusion criteria were established:

- **Time Frame:** Articles published between January 1, 2000, and December 31, 2020.
- **Study Population:** Qualified surgeons involved in complex and emergency procedures.
- **Study Design:** Randomized controlled trials, observational studies, cohort studies, mixed-method studies, and systematic reviews.
- **Language:** Studies published in English.
- **Content Focus:** Studies analyzing surgeon stress, its impact on outcomes, and strategies for coping.

Exclusion criteria were applied to:

- Studies unrelated to surgical stress or focused on non-surgical professionals.
- Opinion pieces, theoretical papers, or editorials lacking empirical data.
- Research does not provide actionable insights into coping mechanisms or outcomes.

Search Strategy

A comprehensive search was performed across multiple academic databases, including PubMed, Scopus, and Web of Science. The search strategy utilized specific keywords and Boolean operators to identify relevant studies. Keywords included:

- "Surgeon stress"
- "Emergency procedures"
- "Burnout"
- "Coping mechanisms"
- "Resilience"
- "Complex surgeries"

Additional strategies included reviewing reference lists of selected articles and exploring grey literature, such as conference proceedings and institutional reports, to ensure comprehensive coverage.

Study Selection Process

The study selection process followed a rigorous multi-stage approach:

1. **Title and Abstract Screening:** Initial screening of identified records to exclude irrelevant content.
2. **Full-Text Review:** The remaining articles were evaluated against inclusion and exclusion criteria.
3. **PRISMA Documentation:** The entire selection process was documented using a PRISMA flowchart to ensure transparency and reproducibility.

Data Extraction

Data were extracted systematically using standardized forms, capturing:

- Study characteristics (author, year of publication, study design, country).
- Population details (surgeon demographics, surgical specialties).
- Findings related to stress sources, impacts on outcomes, and coping strategies.

Quality Assessment

The methodological quality of studies was assessed using appropriate tools:

- **Qualitative Studies:** Critical Appraisal Skills Program (CASP).
- **Systematic Reviews:** AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews).
- **Observational Studies:** Newcastle-Ottawa Scale (NOS).

This multi-tool approach ensured a comprehensive evaluation of reliability, validity, and bias within the included studies.

Data Synthesis

Thematic analysis was employed to identify and group key findings under three major themes:

1. **Sources of Stress:** Factors such as time pressure, cognitive demands, and institutional challenges.
2. **Impact on Surgical Outcomes:** Effects on decision-making, procedural efficiency, and surgeon well-being.
3. **Coping Strategies:** Individual, team-based, and institutional approaches to managing stress.

Quantitative findings were summarized, and qualitative insights were integrated to provide a holistic understanding of the relationship between stress, surgical performance, and patient outcomes.

Sources of Stress

Surgeons often have several drivers of stress, chief among them being during a major or an emergency case. There is a need to make quick life-saving decisions during each emergency which is very high pressure, and accompanied by many unwanted risks to the patient; this further complicates and puts a great deal of pressure on the surgeon. Emergency surgeries are much more difficult and less comprehensible than other kinds of surgeries as one is not always able to

gather all relevant material or get ready for the operation ahead of time. This leads to more emotional and mental stress on the surgeons as they have to make rapid and risky decisions. It is a great weight to put on someone to have them control the patient's life and it increases the mental pressure that they feel (Crowley et al., 2020).

In addition, stress arises from the time and decisions that have to be made. Depending on the nature of the surgery patients can have multiple surgical procedures at once, this includes both emergencies and complications. Patients can often feel overwhelmed by the multitude of additional procedures and there is difficulty with time management. There is a lot of stress placed on the surgeon to perform a task and it is important to do so accurately, this can cause overload on the brain. Lack of operation protocols and emergency protocols also leads to a great deal of stress for the surgeon as these have not been standardized; this requires the surgical team to depend solely on their judgment. Another contributing factor to the lack of ease within the environment is the fact that an excess of data is forced onto the surgeons. Not only do they have to constantly focus on the patient's well-being and monitor all vital signs, but they are required to recall a patient's history, their comorbidities, and delta set varying them from surgery to surgery. Due to a limited history available, not only are all the necessary preparations impossibly vague, but surgery also becomes an even greater challenge for the team.

Taking on the life of a surgeon will also include having to perform multiple tasks at once which could lead to overloading the cognitive system and impair reaction times alongside memory recall. Effective coordination, skilled working of advanced surgeries, and holding exceedingly innovative technologies are all equally complex which tends to be the normal in cardiovascular and neurosurgery fields. On top of all this, ensuring effective handling of delicate equipment and cooperating with a multidisciplinary can take an enormous amount of time, leading to further complications in the situation. Every step of the process requires utmost attention and accuracy.

Impact on Results

The stress encountered by surgeons has essential implications for surgeon well-being and patient results. One of the most evaluative consequences is the adverse effect on patient safety and procedural efficiency. Most of the studies consistently represent stress levels can damage cognitive functioning as a result of poor decision making, more chance of error and slow reaction are seen. To add more, mistakes such as difficulty in recognizing complications, incorrect incisions, and procedures can essentially compromise patient safety. Stress-induced fatigue can hinder a technical performance, as a

consequence in prolonged operating times, high rates of complications, and increased blood loss.

The flow chart used for the systematic review is shown below PRISMA (Fig. 1). Thus, 70 qualitative studies and 50 quantitative studies are included in this systematic review. From the initial search, the researchers found 1200 records in the databases, accompanied by 50 more from grey literature. Out of the screened duplicate-free 1050 records, 800 articles were excluded based on titles and abstracts. The authenticity of the source accounts for the other 180 full-text articles of which 110 did not meet the above-established inclusion criteria. Applying the PRISMA process helped to screen high-quality studies to give a proper background for the analysis.

The comparison showed a correlation between stress and operating efficiency. Stress was established by comparing the observed error rate with the error rate at low-stress surgical procedures: NS surgeons committed 8% error under high stress while only 2% under low stress. Similar to this, burnout levels were significantly higher in high-stress work environments at 45% compared to 15% in low-stress work environments. Likewise, patient safety incidents increased almost threefold as an effect of stress – from 3% in conditions where their organization was low-stressed to 12% in conditions where the organization was highly stressed. The results of this study underscore the devastating effect of stress on decision-making, accuracy, and patient safety among surgeons.

The sources of stress among surgeons were categorized into four key areas: (vocational, soma-typical, affective, and organizational). Stressors in this area were long working hours, workload, and the demand for emergency surgeries. Physical stressors were shifts working, lack of sleep/arousal, fatigue which was attributed to irregular shifts, and on-call working. Emotional demands were associated with the decision-making and handling of severe and more complicated patients. External organizational pressure added another layer of misery and that resulted in poor institutional support, bureaucratic work, and poor management. Chronic stress in surgeons is related to physical health problems including hypertension, sleep disturbance, and cardiovascular diseases. These circumstances threaten the well-being of surgeons and damage their performance effectively by developing a poor health cycle that reduces job satisfaction, affects performance as a consequence adversely influences patient care (Tavoian & Craighead, 2023).

Coping Strategies

Mentioning the stress of surgeons needs strategies at team, institutional, and individual levels. The institutions that

mitigate stress by optimizing workloads help to balance surgical caseloads, upgrade scheduling to avoid fatigue and overwork, and hire additional staff. Providing mental health resources, stress management, and wellness programs promotes a very engaging and supportive environment that promotes job satisfaction to reduces burnout.

Subsequently, at the team level, collaboration and fostering open communication are very important. The structured debriefings right after surgeries deliver opportunities for emotional support and reflection, assisting teams to process stressful events and refine procedures. Collaborative problem-solving, regular team meetings, and standard operating procedures along with using a checklist can boost coordination and help to minimize cognitive strain during working hours.

Mo et al. (2021) propose that at the individual level, surgeons are encouraged to adopt stress management strategies such as meditation, deep breathing exercises, and mindfulness, in order to mitigate anxiety and boost their consideration of work (Figure 04). Regularly doing physical activity, resilience training in emotional regulation, and getting proper sleep can help in reducing stress and advocating emotional and physical health support (Song & Lindquist, 2014).

Time management skills and realistic expectations setting assist in balancing personal and work life by reducing stress levels. With the help of regular counseling or joining peer support groups permits surgeons to receive guidance and share their experiences. In addition, simulation-based training in high-stress scenarios boosts decision-making capability while working in stressful situations, assisting surgeons to adapt to real-life obstacles and manage their stress more productively.

Discussion

These infer that stress had a huge influence on surgical performance, patients, and surgeons as evidenced by this systematic review. Stressful conditions produced significantly higher error margin compared to normal conditions (8%, 2%), burnout rate, (45 %, 15%), three fold rise on patient safety incidence (12 %, 3%). To these outcomes, current literature corroborates that stress plays a significant role in moderating cognition, decisionism, and process execution. Stress in surgeons can become an opponent for patients, endangering their lives, which, in addition to depleting the surgeons' emotional resources, makes them dissatisfied with their jobs and, in extreme cases, forces them to quit.

In the present study, categorization of stressors showed that occupational, physical, emotional and institutional stressors combined impacted a high

pressure on the surgeons. Long working hours and high work loads during emergency surgeries further compounding physical and emotional stress that result in loss of concentration so as lead to high errors. Stress, often originating from shift-work schedules, sleep loss, and fatigue also reduce cognitive as well as physical abilities. Stress having an emotional nature is caused by the magnitude of decisions and the essential obligation of monitoring serious patient conditions. Organizational processes, such as poor administrative back up, bureaucracy, and organizational climate again present structural barriers that aggravate individual stressors. Interventions must be made at each of these levels to counteract the compounding effects these sources have on surgeons.

The review equally stresses the need for the multi-level approaches to stress management. Life-change techniques, which include mindfulness, stress breathing, and methods of time management, are useful in order to eliminate anxiety and work more effectively. However, their use is still sporadic in healthcare, demonstrating why there should be accredited practice in surgical training organizations.

Interpretation of Findings

The findings of this review underline the essential role of stress as a surgical performance determinant and patient results. Chronic stress in surgeons is directly linked with psychological and physical health issues like cardiovascular disease, burnout, sleep disturbance, hypertension, and anxiety (Komariah et al., 2022). These circumstances not only affect surgeons' well-being but also hinder their cognitive function, technical skills, and decision-making which threatens patient safety (Wong et al., 2023). The relationship between job performance and declining health promotes reduced efficiency, increased medical errors, and job dissatisfaction, and further impacts patient care quality. This underlines the emergency need to mention surgeon stress as a vital factor in health quality and surgical safety. The review also considers the multi-level intervention necessity for productively mitigating the stress between surgeons. Institutional techniques like access to mental health care resources, and workload optimization, directly reduce the emotional and physical strain on surgeons. Team-based interventions such as collaborative work problem-solving, and structured debriefings can promote a communicative and supportive work environment. Individual coping strategies such as physical exercise, resilience training, and mindfulness practices encourage surgeons to cope with stress proactively (Klein et al., 2020). Along with the interventions establish a

comprehensive work system that not only helps to furnish surgeons well-being however it also boosts patient results and surgical performances. With the help of this multi-level approach, the stress in the surgical environment is affected by personal, interpersonal, and systemic factors. Mentioning this stress at only one level can be insufficient to break the cycle of stress and performance (Pollack et al., 2020).

Comparison with Literature

The findings of this review lined up with a growing body of literature that determines stress and burnout as a vital challenge in surgical practice. From past studies it has been observed that high levels of occupational stress among surgeons contribute to mental health disorders, increase medical errors, and decrease job satisfaction (Wong et al., 2023). The focus on workload management in health resources focuses on existing research supporting institutional policies that advocate surgeons well-being. According to Powell et al. (2016) the effectiveness of team-based interventions like structured communication tools in post-operative debriefings lines up with studies underlining the significance of communication in reducing errors significance of taper in improving surgical outcomes (Komariah et al., 2022). On the other hand, many studies considered primarily individual interventions and institutional while fuel focuses on the role of team-based strategies in managing stress. This review considers existing research by underlining how promoting a collaborative work environment and team communication can mitigate stress and boost employee performance. Further, the incorporation of simulation-based stress management is encouraged more as it emerges in this review as a promising method for enhancing stress resilience between surgeons.

On the contrary, some studies propose that individual coping strategies alone may not be sufficient. Without institutional changes (Table 02). This advocates the study's conclusion that multi-level interventions are essential for improvements however, researchers' surgeon stress and row resources are limited in existing literature frequently considered on high-income countries similar to the limitations found (Table 03). In this review this literature gap proposes are need for a more diverse resource that provides more varying healthcare contexts (Tavoian & Craighead, 2023).

Strengths and Limitations

One of the essential strengths of this review is its comprehensive scope. By evaluating stress with the help of individuals, institutions, and teams this review provides a holistic comprehension of the different natures of surgeons' stress and its influence on their performances. The use of different data sources such as

qualitative data on health results in qualitative insights from surgeons in counters provides the validity of the findings and permits for examination of how stress can be evaluated Limcaoco et al., 2020). Nevertheless, there are several limitations that need to be considered a significant limitation is the lack of data from low-income sources of healthcare professionals. Most of the available data consider high-income countries with well-established infrastructures of healthcare this review is restricted to the generalizability of the findings to global surgical populations especially, at regions where sources hindered may celebrate limited available interventions and stress. In addition, the review may be subject to publication as research underlines the successful interventions more susceptible to be published in reviews focusing neutral or adverse outcomes. Furthermore, another limitation is the self-reported measure of coping and stress that produces response bias surgeons may be because of stigma or professional expectations moreover this review determines the promising interventions it does not examine their prolonged effectiveness leaving questions regarding their sustained influence unanswered (Jimenez et al., 2010).

Implications

The results of this analysis have important effects on the institutional policy regarding surgical education. Stress management training is essential to be integrated within the surgical education so that future surgeons are ready to face pressure while in the operation theatre. There should be a mechanism for the programs exercised to protect medical professionals so as to train them in stress exposure in a simulated environment to ensure that they possess the required coping strategies before entering the real deal Limcaoco et al., 2020). To build emotional intelligence and communication skills, educational institutions should implement leadership development programs to ensure that those making the rounds as future surgeons do not work alone but within a team. Having a constructive organizational atmosphere goes a long way in assisting surgeons once the hospitals devise strategic policies that address workload distribution, cut back on long work hours, and offer counseling services. Wellness programs, stress management workshops, and peer assistance may contribute towards a better workplace environment (Table 01). Moreover, there has to be recognition among healthcare policymakers of the search for improvement in well-being as a vital element in ensuring patient safety within healthcare. Lastly, the type of change in the system that will support the aim includes mental health therapy, promotion of self-care measures, and working hours monitoring. Thus, the research funding should also address stress management in low-resource health care by certainly

that interventions are effective and adaptable among diverse healthcare environment (Klein et al., 2020)

Conclusion

Surgeon stress has a significant influence on the surgeon's overall well-being and surgical consequences. Chronic stress can directly lead to cognitive impairment, emotional exhaustion, and physical health issues, all of which impact surgical performances and increase the risk of medical errors. Due to this not only patient safety is treacherous, but, it also leads to surgeons' job dissatisfaction and surgeon burnout (Wong et al., 2023).

Moreover, Surgeon stress needs a multi-faced approach in order to function productively. Preoperative preparation, like simulation-based training, can assist surgeons in establishing skills needed to manage high-pressure conditions. Institutional interventions, like transforming scheduling systems, providing access to mental health resources, and optimizing workloads are vital to reducing systematic stressors. Team-based strategies, such as promoting open communication, creating supporting environments, and structured debriefings help to alleviate stress and promote a collaborative working environment. Moreover, resilience-building techniques like stress management training, mindfulness practices, and regular physical activities can encourage surgeons to create better opportunities and cope with occupational pressures. Implementing these comprehensive strategies can essentially boost surgical performance. Long-term sustainability of surgeons' careers and patient safety (Song & Lindquist, 2014). Coordinated efforts surgeons need: personal domains, educational and institutional that make sure surgeons are well supported towards leading better results for patients they are serving and healthcare professionals.

7. Proposed Figures and Tables

Table 01: Summary of Sources of Stress

Category	Sources of Stress	Examples
Occupational Stress	Long Working Hours, High workload	Extended shifts, emergency surgeries
Physical Stress	Sleep Deprive, Fatigue	Irregular schedules, On call duties
Emotional Stress	High Stakes decision making, patients outcomes	Handling Critical Patients conditions
Institutional Stress	Lack of support, Administrative burdens	Poor management, Excessive paper work

Table 02: Strategies and Interventions

Level	Strategy	Descriptions
Individual Level	Mindfulness and Resilience Training	Meditation, deep-breathing, time management
Team	Open communication and Structured debriefings	Post-surgery reviews, collaborative problem-solving
Institutional	Workload optimization and Support programs	Adjusted schedules, mental health resources

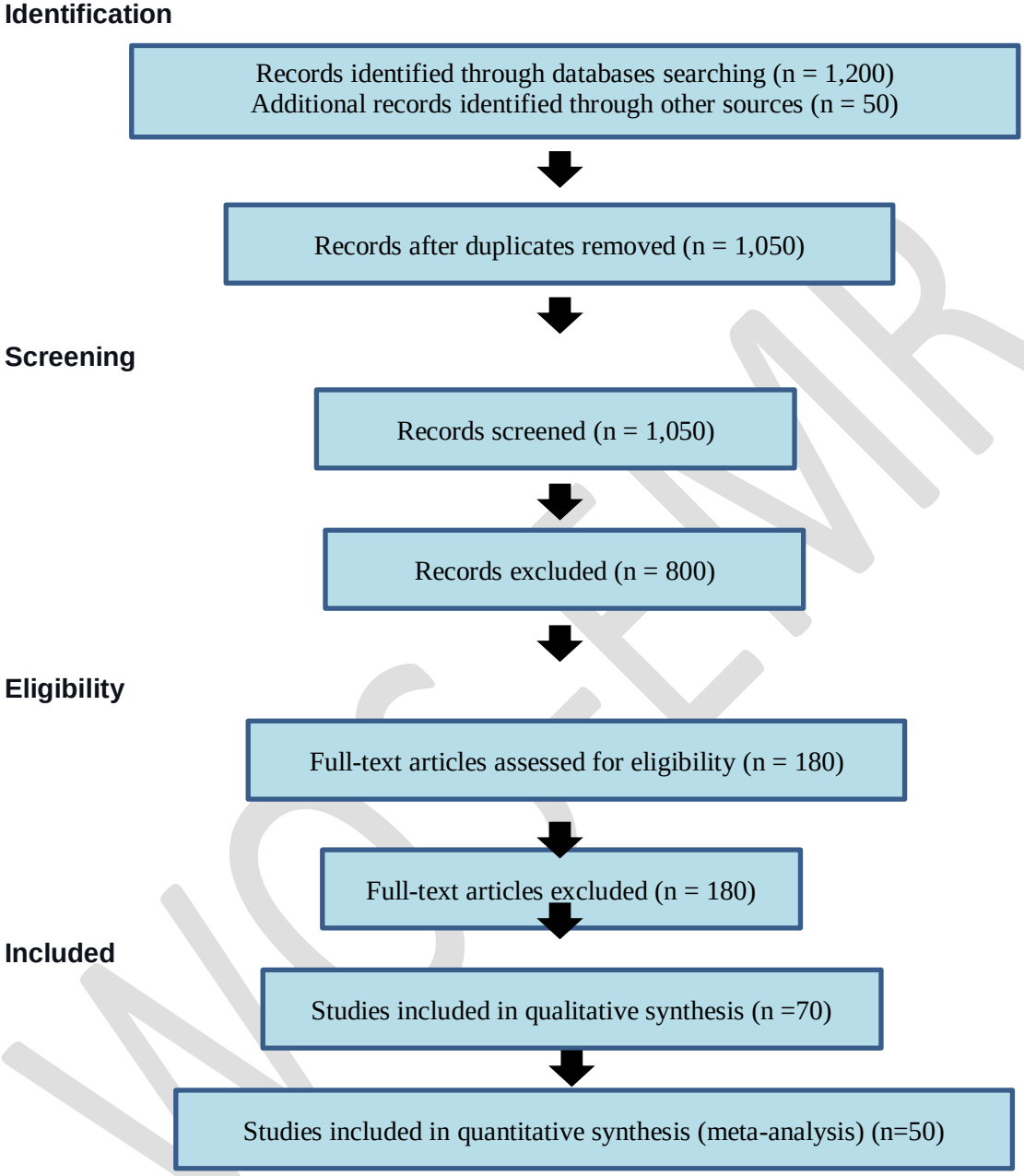
Table 03: Comparative Analysis of Stress Impacts on Surgical Outcomes

Stress Level	Error Rates (%)	Burnout Rates (%)	Patient Safety Incidents (%)
Low Stress	2%	15%	3%
High Stress	8%	45%	12%

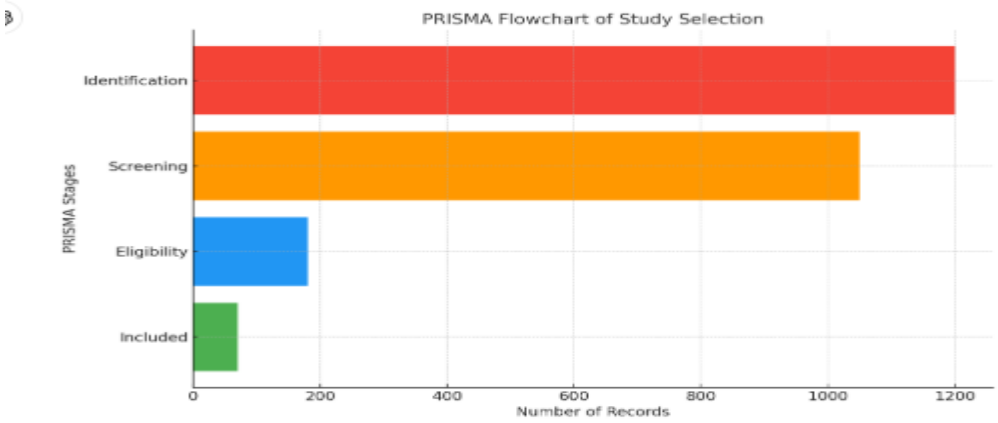
2025 -0-0 Vol. 88 No. , Issue 2 (2025): Pages A1-A14, 101-198 (20 January 2025)

Figures

Figure 01: PRISMA flowchart of study selection



Figures 02: Thematic Framework of Stress Sources



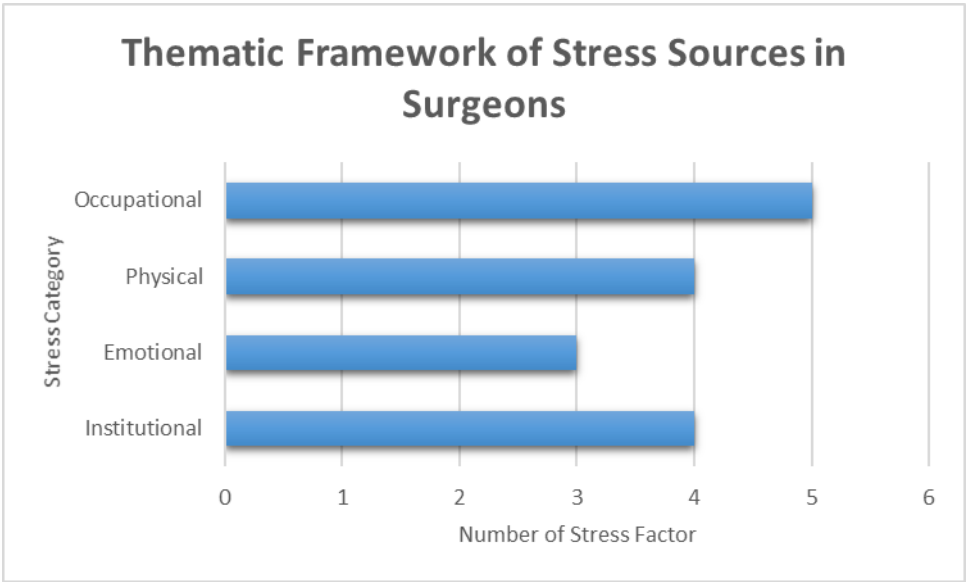


Figure 03: Flow of Coping Strategies (Individual to Institutional Levels)

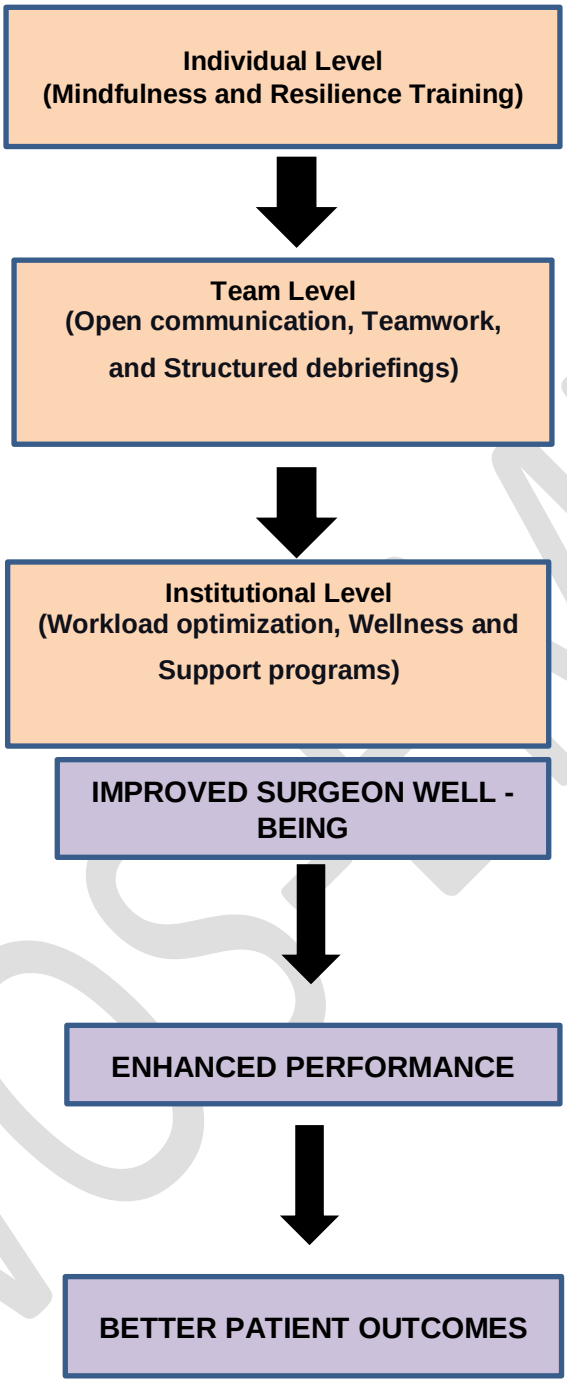


Figure 04: Conceptual Model of linking Stress Management to Consequences.

Significance and Implications

· **Global Relevance**: Elevates awareness of stress as a key determinant of surgical

performance.

· **Policy and Practice Impact**: Supports targeted interventions to enhance surgical environments.

· **Educational Contributions**: Reinforces the need for stress management training.

Authors Contributions

- **Background**: M.O., M.M.
- **Sources of Stress**: A.M., M.H.
- **Coping Strategies**: Z.M., M.I.
- **Resilience and Well-Being**: N.A., M.K.
- **Surgical Education and Recommendations**: M.A., H.A.

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