

Health Risk Assessment in Forensic and Mortuary Services at Persahabatan General Hospital: Identifying and Mitigating Occupational Hazards

Muhammad Faisal Ratman^{1*}, Putri Dianita Ika Meilia², Ariningsih³, Ma'rifatul Mubin³

* Correspondence Author: mfaisalratman@gmail.com

¹ Occupational Medicine Specialist Program, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

² Forensic Medicine and Mortuary Unit, Persahabatan General Hospital, Jakarta, Indonesia

³ Occupational Medicine and Medical Check-Up Unit, Persahabatan General Hospital, Jakarta, Indonesia

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ABSTRACT

Forensic and mortuary personnel face significant occupational hazards, yet comprehensive health risk assessments in these settings remain limited. This study assessed workplace risks at the Forensic Medicine and Mortuary Unit of Persahabatan General Hospital using the Health Risk Assessment (HRA) framework to recommend effective control measures. Seventeen personnel participated, with data collected through interviews, questionnaires, walk-through surveys, and internal records. Environmental measurements included noise levels (sound level meters), lighting (lux meters), and air quality parameters such as PM2.5, PM10, formaldehyde, and total volatile organic compounds (TVOCs). Ergonomic risks were assessed using REBA and ROSA, while psychosocial risks were analyzed using the SV-NBJSQ. The key risks identified were low back pain, nasopharyngeal carcinoma, leukemia, computer vision syndrome, and irritant contact dermatitis. Contributing factors included manual handling, awkward postures, insufficient lighting, and exposure to formalin. Proposed solutions encompassed introducing ergonomic tools, implementing educational programs, and revising operational guidelines. These interventions aim to reduce workplace hazards, enhance worker safety, and improve overall productivity. This study provides a structured approach for implementing workplace safety interventions, offering a model that can be applied in forensic and mortuary settings globally.

Kata kunci:

Penilaian risiko kesehatan;
Kedokteran Forensik;
Pemulasaraan Jenazah;
Kedokteran kerja;
Kesehatan kerja

Personil forensik dan pemulasaraan jenazah menghadapi bahaya potensial pekerjaan yang signifikan, penilaian risiko pada populasi ini saat ini masih terbatas. Penelitian ini bertujuan untuk mengevaluasi risiko kesehatan di Instalasi Kedokteran Forensik dan Pemulasaraan Jenazah Rumah Sakit Umum Persahabatan menggunakan pendekatan Health Risk Assessment (HRA) untuk merekomendasikan langkah pengendalian yang tepat. Sebanyak 17 petugas berpartisipasi dalam penelitian ini, dengan data dikumpulkan melalui wawancara, kuesioner, survei lapangan, dan catatan internal. Pengukuran lingkungan mencakup tingkat kebisingan (sound level meter), pencahayaan (lux meter), serta kualitas udara, termasuk PM2.5, PM10, formaldehida, dan total senyawa organik volatil (TVOC). Risiko ergonomi dianalisis menggunakan REBA dan ROSA, sementara risiko psikososial dinilai dengan SV-NBJSQ. Hasil penelitian menunjukkan risiko utama seperti nyeri punggung bawah, karsinoma nasofaring, leukemia, sindrom penglihatan komputer, dan dermatitis kontak iritan. Faktor penyebab meliputi pengangkatan manual, postur kerja yang buruk, pencahayaan tidak memadai, dan paparan formalin. Langkah mitigasi yang disarankan meliputi penerapan alat ergonomis, pelatihan kesehatan, dan revisi panduan operasional. Penelitian ini menyoroti pentingnya intervensi untuk meningkatkan keselamatan kerja dan kesejahteraan pekerja di unit forensik dan mortuarium.

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INTRODUCTION

Globally, approximately 3 million deaths annually are attributed to work-related illnesses and accidents (WHO and ILO, 2021). In Indonesia, occupational accidents have increased significantly, from 297,725 cases in 2021 to 370,747 in 2023 (Ministry of Manpower, 2024).



Forensic medicine and mortuary units present unique and under-researched occupational hazards among high-risk workplaces. Personnel in these environments face daily exposure to biological agents, hazardous chemicals, ergonomic strain, and psychosocial stressors. Despite the critical role of forensic and mortuary services, there is a lack of comprehensive Health Risk Assessments (HRA) in these settings, particularly in Indonesia. This study fills this gap by conducting a structured HRA at the Forensic Medicine and Mortuary Unit of Persahabatan General Hospital, marking this facility's first comprehensive risk assessment.

Forensic medicine involves the application of medical knowledge and technologies to assist legal processes. Its practice encompasses death investigations, examinations of victims of physical or sexual violence, consultation on medical ethics and malpractice cases, and disaster victim identification (Meilia et al., 2018). Mortuary services involve caring for deceased bodies, including cleaning, covering, and storing them in compliance with religious, cultural, and health guidelines. While mortuary services are mandatory in all hospitals, forensic medicine services are only available in select facilities. Both services expose personnel to various occupational hazards, including sharp instruments, electrical risks, physical injuries, biological threats, radiation, and chemical dangers. The risk levels associated with mortuary activities vary depending on specific exposure factors (Shaha et al., 2013). A study in Saudi Arabia reported significant occupational hazards in forensic units and morgues, including needle-stick injuries and chemical risks (Madadin et al., 2022), further emphasizing the importance of structured occupational health assessments in this field.

Chemicals such as formalin are widely used in mortuary processes. Classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC, 2006), formalin poses a significant cancer risk. Additionally, handling and moving bodies create ergonomic challenges, with 72.4% of healthcare workers reporting musculoskeletal disorders (Alruwaili et al., 2023). Psychosocial hazards are also prevalent, exacerbated by shift work and nighttime duties; during the COVID-19 pandemic, 82% of healthcare workers in Indonesia reported moderate burnout (Soemarko et al., 2022). A study of a hospital mortuary unit in South Africa revealed inadequate occupational health and safety (OHS) practices among staff, underscoring the urgent need to develop and implement robust OHS programs (Molewa et al., 2021).

However, most studies on occupational health risks in healthcare settings focus on general healthcare workers rather than those working in forensic medicine and mortuary services. While (Molewa et al., 2021) highlighted inadequate occupational health and safety (OHS) practices among mortuary workers in South Africa, their study did not conduct a structured risk assessment or quantify exposure levels. Similarly, other studies on healthcare workers emphasize risks such as ergonomic strain and psychosocial stress but do not comprehensively assess the diverse hazards encountered in forensic and mortuary environments. Moreover, (Madadin et al., 2022) identified workplace hazards among forensic mortuary personnel in Saudi Arabia. Still, they lacked quantitative exposure measurements and did not assess psychosocial risks, limiting the study's ability to capture occupational health burdens in this field fully.

Occupational medicine promotes workers' optimal physical, mental, and social well-being through promotive, preventive, curative, and rehabilitative measures (PERDOKI, 2019). Its overarching goal is to maintain and improve worker productivity while preventing occupational illnesses. Key competencies of occupational medicine specialists include the

management of occupational diseases, work fitness assessments, return-to-work programs, disability evaluations, and medical surveillance. A cornerstone of this practice is conducting Health Risk Assessments (HRA), which systematically identify workplace hazards—including physical, chemical, biological, ergonomic, and psychosocial risks—to prevent occupational diseases and accidents (Peraturan Konsil Kedokteran Indonesia Nomor 90 Tahun 2020 Tentang Standar Pendidikan Profesi Dokter Spesialis Kedokteran Okupasi, 2020).

In this case, the Forensic Medicine and Mortuary Unit at Persahabatan General Hospital plays a vital role in hospital operations. Nonetheless, its tasks expose staff to significant occupational hazards, potentially leading to accidents and diseases. Although it serves as a national referral hospital providing forensic medical services and mortuary facilities, a comprehensive HRA has never been conducted. For that reason, this study aims to evaluate health risks within the unit and propose control measures through the HRA framework. Using the HRA framework, this study fills the gap by systematically identifying, categorizing, and assessing occupational hazards specific to forensic medicine and mortuary services. Unlike previous studies, which primarily focus on general healthcare risks or provide only descriptive analyses of workplace safety, this research offers a structured and detailed evaluation of occupational hazards in this specialized field, along with targeted recommendations for risk mitigation.

RESEARCH METHOD

This study employed a case study approach to conduct a Health Risk Assessment (HRA) at the Forensic Medicine and Mortuary Unit of Persahabatan General Hospital in November 2024—the research aimed to identify and evaluate occupational health risks. The study focused on personnel from the Forensic Medicine and Mortuary Unit. Participants were recruited based on predefined criteria, including active employment during the study period. Individuals with incomplete data or those who chose not to participate were excluded.

Data were collected from both primary and secondary sources. Primary data included interviewing personnel to gather insights into their work experience, job routines, health concerns, and workplace conditions. Questionnaires assessed psychosocial and ergonomic risks, such as job stress and musculoskeletal issues. Workplace assessments were conducted through walk-through surveys to identify environmental factors and potential hazards. Secondary data were obtained from internal documents, such as the unit's profile, standard operating procedures, and health and safety records. To enhance trustworthiness, this study applied triangulation by cross-verifying interview responses with environmental risk assessments. Member checking was conducted to confirm the accuracy of qualitative interpretations, and reflexivity was maintained by ensuring researcher neutrality during data analysis.

All measurements and assessments adhere to environmental health quality standards set by the Ministry of Health of the Republic of Indonesia (Peraturan Menteri Kesehatan Nomor 2 Tahun 2023 Tentang Peraturan Pelaksanaan Peraturan Pemerintah Nomor 66 Tahun 2014 Tentang Kesehatan Lingkungan, 2023). These standards specify acceptable thresholds for environmental factors, including noise, lighting, temperature, humidity, particulate matter, formaldehyde (HCHO), and total volatile organic compounds (TVOCs).



Noise levels were assessed using a Sound Level Meter (SNDWay SW523) to ensure compliance with the standard limit of ≤ 65 dB. Additionally, lighting levels were evaluated using a Lux Meter (Smart Sensor ST9620) to confirm that workplace lighting adhered to the 100–200 lux standard range. Temperature and humidity were monitored using an Air Quality Monitor, with target ranges maintained at 21–24°C for temperature and 40–60% for moisture. Air quality was further assessed by measuring particulate matter (PM2.5 and PM10) using the Air Quality Monitor, ensuring levels remained below the recommended thresholds of ≤ 100 $\mu\text{g}/\text{m}^3$ for PM2.5 and ≤ 150 $\mu\text{g}/\text{m}^3$ for PM10. Concentrations of formaldehyde (HCHO) and total volatile organic compounds (TVOCs) were also monitored using the same device.

The Rapid Entire Body Assessment (REBA) was employed for ergonomic assessments to analyze personnel postures during physical tasks, such as lifting and moving bodies. Based on observed movements and body positions, ergonomic risks were categorized as low, moderate, or high (Hignett & McAtamney, 2000). REBA is widely used in occupational health studies, as it provides a quick yet comprehensive evaluation of musculoskeletal strain, particularly in high-risk environments with common awkward postures, excessive force, and repetitive movements. The Rapid Office Strain Assessment (ROSA) was used to evaluate workstation setups and prolonged sitting risks for personnel engaged in sedentary tasks, such as administrative activities (Jayadi et al., 2020). ROSA provides a structured method for identifying poor workstation setups contributing to musculoskeletal discomfort, particularly for personnel engaged in sedentary tasks, such as administrative staff in forensic and mortuary units.

Psychosocial risks were evaluated using the Short Version of the New Brief Job Stress Questionnaire (SV-NBJSQ), which assessed job demands, control, and workplace support. Responses were rated on a 4-point Likert scale, allowing the identification of psychosocial stressor levels as either high or low. A score below 2.5 was used as the cut-off value to indicate high stressors (Adi et al., 2022). This tool is particularly suitable for forensic and mortuary personnel who experience high emotional demands, shift work stress, and limited control over their work conditions.

Additionally, musculoskeletal disorder assessments were conducted using the Body Discomfort Map, enabling personnel to report areas of pain or discomfort resulting from musculoskeletal strain. Interviews were also conducted to gather information regarding medical history and other health complaints reported by personnel within the past month.

The risk assessment was performed according to the implementation of integrated risk management regulations issued by the Ministry of Health (Peraturan Menteri Kesehatan Republik Indonesia Nomor 25 Tahun 2019 Tentang Penerapan Manajemen Risiko Terintegrasi Di Lingkungan Kementerian Kesehatan, 2019). Risk was calculated using the formula $Risk = Severity \times probability$. Severity (S) represents the potential impact of exposure on health, with ratings ranging from 1 (negligible impact) to 5 (catastrophic impact) depending on the seriousness of the health consequences. Meanwhile, probability (P) indicates the likelihood of exposure occurring in the workplace, rated from 1 (rare occurrence) to 5 (almost certain occurrence) based on the frequency and conditions of exposure. These two factors were multiplied to determine the overall risk score, helping to assess the urgency of intervention and the necessary control measures. Severity and probability were each rated on a 5-point scale.

The resulting risk levels were categorized as low, moderate, high, or very high. Based on these findings, recommendations for risk control measures were proposed and prioritized accordingly. Low risk (1–4) indicates an acceptable level of hazard that requires only routine monitoring. Moderate risk (5–9) suggests that control measures should be implemented to minimize potential harm. High risk (10–15) signifies a significant threat, necessitating urgent intervention to prevent occupational health issues. Lastly, very high risk (16–25) represents a critical danger that demands immediate corrective actions to ensure worker safety. This classification system enables the prioritization of hazard mitigation efforts, ensuring that the most severe and frequent risks receive prompt and appropriate control measures.

The study received ethical approval from the Ethics and Research Committee of Persahabatan General Hospital (No: 0229/KEPK-RSUPP/10/2024) and adhered strictly to ethical guidelines. All participants provided informed consent, and their identities were kept confidential. Additionally, all data were securely stored, with access limited to the research team to ensure privacy. The study did not involve any invasive procedures or medical interventions.

RESULTS AND DISCUSSION

This study involved 17 personnel from the Forensic Medicine and Mortuary Unit at Persahabatan General Hospital. Inclusion criteria required participants to be actively employed within the unit during the study period (November 2024), directly involved in forensic medicine or mortuary-related duties, and willing to provide informed consent. Individuals were excluded if they had incomplete occupational health data, declined participation, or were temporary workers not routinely engaged in forensic or mortuary tasks. The sample size of 17 participants represented the total workforce of this specialized unit, enabling a comprehensive occupational risk assessment specific to their unique work environment. Their demographic and job-related characteristics are presented in Table 1.

Table 1. Subject Characteristics

Characteristics	n	%
Gender		
Male	12	70.6
Female	5	29.4
Age		
≤ 35	6	35.3
> 35	11	64.7
Marital Status		
Single	2	11.7
Married	15	88.2
Educational background		
Diploma	1	5.8
Bachelor's Degree	2	11.7
Master's Degree	1	5.8
Doctoral Degree	1	5.8
High School	12	70.6
Job Type		
Administrative Staff	1	5.8
Cleaning Service	2	11.7
Forensic Medicine Specialist	2	11.7
Mortuary Attendant	9	52.9
Mortuary Technician	3	17.6

Characteristics	n	%
Work schedule		
Shift Work	14	82.3
Regular	1	5.8
Regular + On Call	2	11.7

Table 2 provides an overview of the systematic work processes implemented in the Forensic Medicine and Mortuary Unit of Persahabatan General Hospital to deliver body handling services. These processes encompass handling service requests, conducting medical procedures, and adhering to cultural, religious, and family preferences.

Table 2. Work Process

Process	Description
Request for Service	Requests for body handling services are received from hospital units or external parties.
Body Collection	Technicians collect the body from the emergency room or inpatient unit, ensuring safe and respectful handling.
Transit Room Storage	The body is temporarily stored in a transit room.
Family Briefing	Staff explain available body care services to the family and gather consent.
External/Internal Examination	A medical examination and, if necessary, an autopsy is performed following standard protocols.
Medical Device Removal	Any remaining medical devices on the body are carefully removed by trained staff.
Body Washing	The body is washed according to religious customs and family preferences.
Embalming	Formalin or other preservation methods are applied as per family request.
Body Wrapping	The body is wrapped following cultural or religious guidelines before final storage or handover.
Cooling Room Storage	The prepared body is stored in a cooling room until family arrangements are made.

Environmental Measurement

All rooms in the unit met noise level standards except for the head of the forensic unit's room, which recorded 64 dB. However, several rooms, including the head office, equipment storage, and multifunction rooms, failed to meet the minimum lighting standard of 100–200 lux. The lowest readings were observed in the head office and equipment storage room, each at 33 lux. Additionally, the autopsy room exceeded the acceptable temperature range, recording 26°C instead of the recommended 21–24°C. Air quality measurements indicated that PM 2.5, PM 10, HCHO, and TVOC levels were within acceptable limits.

Nevertheless, an unsafe practice was identified during the walk-through survey in the mortuary unit: personnel did not utilize the available fume hood, which is essential for minimizing exposure to hazardous fumes. Personal protective equipment (PPE) used by personnel was only medical masks and gloves. This unsafe practice is depicted in Figure 1.





Figure 1. Unsafe practice during formalin handling. Personnel are preparing formalin solutions without using the fume hood, increasing exposure risks.

Ergonomic Risk Assessment

The Rapid Entire Body Assessment (REBA) revealed a high ergonomic risk for tasks involving lifting and transporting bodies. The Rapid Office Strain Assessment (ROSA) also indicated a high ergonomic risk for administrative staff. Figures 2 and 3 illustrate these tasks and associated risks.

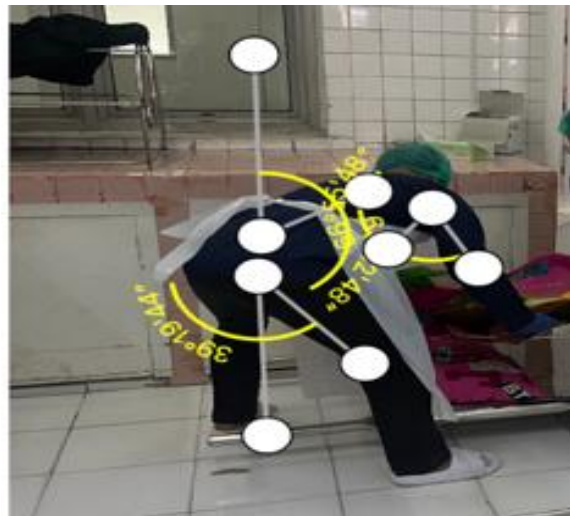


Figure 2. Lifting and transporting bodies. Personnel lifting and moving bodies in awkward positions increases the risk of musculoskeletal disorders.

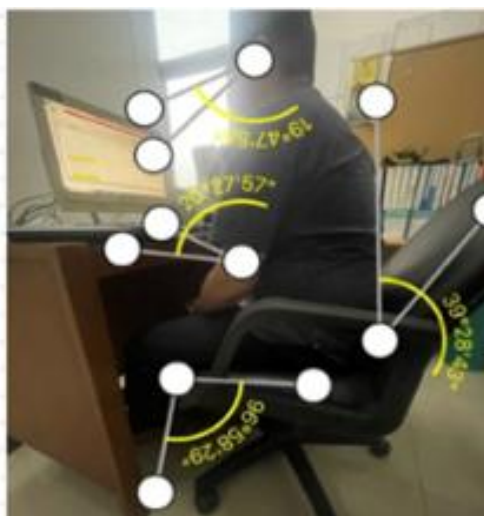


Figure 3. Administrative staff workstation. Personnel work sitting in front of a computer for a long time with a non-ergonomic chair.

Psychosocial Risk Assessment

The SV-NBJSQ results indicated low psychosocial stressors across most categories, with mean scores near 2.5. However, the quantitative workload subcategory within the job demands category showed high stressors, with a mean score of 2.24. Similarly, the work-life balance subcategory within the organizational level category exhibited high stressors, with a mean score of 2.29.

Workplace Safety Concerns

During the interviews, personnel frequently reported insufficient quality time with their families, primarily due to irregular shift schedules and unpredictable forensic and mortuary unit work hours. Shift work not only interfered with family life but also limited their ability to participate in social and community activities, leading to feelings of isolation and increased psychosocial stress. Furthermore, the shortage of forensic technicians exacerbated the workload imbalance, requiring staff who are off-duty to be summoned to assist during periods of high demand or emergencies. This issue was particularly pronounced because the current number of forensic technicians did not match the operational requirements, necessitating frequent and unpredictable call-ins. This chronic shortage contributed to increased fatigue and job dissatisfaction among workers.

Health Complaints

The results of the health complaint questionnaire for the past month revealed various issues. The most frequently reported complaint was impaired vision, including difficulty reading at a distance and close-up (five cases). Lower back pain, upper back pain, neck pain, and headaches were each reported four times. Chest pain and shoulder discomfort were also common, with three reports each. Other reported complaints included tingling in the feet, knee pain, blurred vision, light sensitivity, and shortness of breath (two cases each). Less frequent complaints included cough, hair loss, dry and cracked skin, skin itching, hip pain, abdominal pain, foot pain, and wrist pain, with one or two reports for each issue.

Body Discomfort Map

The most affected areas included the lower neck (five reports of pain) and the left shoulder (four reports of pain). Both lower limbs, particularly the lower thighs and calves, were frequently reported as experiencing numbness and pain. Discomfort was also commonly reported in the lower back (lumbar region) and the tailbone (sacroiliac region).

Medical History

Medical histories varied among personnel. Four individuals had a history of hypertension, and four reported a history of gastritis. Three individuals had a history of heart disease. Other medical conditions reported included tumors/lumps (two cases), dyslipidemia (two cases), trigger finger (one case), tuberculosis (one case), and one case each of herniated nucleus pulposus (HNP), diabetes mellitus, stroke, urinary tract infection (UTI), and tonsillitis.

Vaccination History

Most personnel had received COVID-19 vaccinations, with all 17 participants being vaccinated. Five personnel had received Hepatitis B vaccinations, four had received the diphtheria vaccine, and one had been vaccinated against typhoid.

Summary of Potential Hazards

Table 3 summarizes the potential hazards faced in the forensic and mortuary unit, categorized into physical, chemical, biological, ergonomic, and psychosocial hazards, along with their potential health impacts.

Table 3. Summary of Potential Hazards

Hazard Category	Potential Hazards	Possible Health Impact
Physical Hazards	Hot room temperatures, noise	Dehydration
Chemical Hazards	Formalin, silicone sealant, cyanoacrylate adhesive	Nasopharyngeal carcinoma, leukemia, dermatitis, conjunctivitis
Biological Hazards	Airborne and bloodborne pathogens	Infectious diseases (TB, influenza, hepatitis, HIV)
Ergonomic Hazards	Prolonged standing, repetitive motions, poor posture, manual handling of deceased bodies, inadequate lighting, visual display terminal	Low Back Pain, Tension Neck Syndrome, Carpal Tunnel Syndrome, Computer Vision Syndrome, Varicose veins
Psychosocial Hazards	High workload, shift work, lack of work-life balance	Work-related stress

Risk Calculation

Table 4 presents the health risks identified in the forensic medicine and mortuary unit of Persahabatan General Hospital. The calculations indicated four health disorders with very high and high-risk levels, including low back pain, malignancy (nasopharyngeal carcinoma and leukemia), computer vision syndrome, and irritant contact dermatitis.

Table 4. Health Risk Calculation

Health Risk	Severity	Probability	Risk Level	Risk Category
Low Back Pain	4	4	16	Very High
Nasopharyngeal carcinoma and leukemia	5	3	15	Very High
Computer Vision Syndrome	4	3	12	High
Irritant Contact Dermatitis	4	3	12	High

Other physical, biological, and psychosocial health risks were categorized as low or moderate in the forensic medicine and mortuary unit of Persahabatan General Hospital.

Low back pain is a high risk among personnel, particularly during lifting and carrying activities. These tasks are often performed in awkward postures, exacerbated by body transport vehicles that lack adjustable stretchers. Musculoskeletal screening revealed that four personnel reported experiencing low back pain. This finding aligns with previous studies, highlighting that manual lifting to and from elevated or lower surfaces, non-neutral body postures, maneuvering heavy equipment, and applying push/pull forces are associated with musculoskeletal disorders (Lee et al., 2022).

Control measures are essential to prevent low back pain. Engineering controls such as adjusting bed stretchers can help minimize awkward postures during lifting and carrying tasks. Administrative controls, including training on proper lifting techniques, are also critical. Research indicates that combining ergonomic training, mechanical aids, and organizational changes is the most effective approach for reducing injury rates and pain (Albanesi et al., 2022).

Computer Vision Syndrome (CVS) is identified as a high-risk issue. Light intensity measurements in several workspaces, particularly in the head office, revealed noncompliance with standard illumination requirements. The responsibilities of the head of the forensic medicine and mortuary unit frequently involve prolonged sitting and computer use, increasing the risk of CVS. As a forensic specialist, the head of the unit works morning shifts and is often on-call. A study has shown a significant association between physicians working morning shifts with on-call duties and the prevalence of CVS (Arttime-Ríos et al., 2022).

To mitigate this risk, engineering measures should include upgrading and optimizing lighting to improve workspace illumination. Additionally, administrative measures, such as implementing educational programs, can encourage the adoption of the “20-20-20 rule.” This rule—looking at an object 20 feet away for 20 seconds every 20 minutes—has been proven effective in reducing symptoms of digital eye strain and preventing CVS. Daily reminders significantly improve adherence to this practice and aid symptom management (Kumar & Pandey, 2024).

Nasopharyngeal carcinoma and leukemia are classified as very high-risk categories. Studies have revealed a dose-response relationship between the frequency of embalming procedures and increased mortality risks from lymphohematopoietic malignancies, particularly myeloid leukemia (Kwon et al., 2018). Although environmental measurements indicated that formaldehyde levels were within acceptable standards, the potential for long-term malignancy warrants serious consideration.

This study also categorized irritant contact dermatitis as a high-risk issue. Unsafe practices in formaldehyde handling significantly increase the likelihood of contact dermatitis among personnel. The direct effects of formaldehyde on the skin have been extensively studied through human skin patch tests. For instance, a 1995 study found that formaldehyde concentrations ranging from 0.57 to 1.12 mg/cm² caused skin irritation in individuals without prior sensitization (Fischer et al., 1995). Similarly, another study reported that a 2% formaldehyde concentration resulted in significantly more irritant reactions than a 1% concentration (Trattner et al., 1998).

Engineering controls, such as a fume hood, have been implemented to prepare formalin solutions. Fume hoods with proper ventilation are highly effective in reducing airborne formaldehyde concentrations in enclosed environments by capturing and exhausting hazardous fumes (Dugheri et al., 2021). However, personnel have yet to routinely utilize the fume hood, citing greater convenience when preparing solutions on the floor. This highlights the need to establish a standardized operating procedure for Formalin preparation and to ensure regular supervision to enforce compliance. Personal protective equipment (PPE) includes medical masks and gloves; additional education on wearing goggles is critical. Effective mitigation of formaldehyde (FA) exposure in healthcare and research settings requires a combination of technical strategies, organizational interventions, engineering controls, and proper use of PPE (Castellani et al., 2024).

This study significantly contributes to forensic and occupational medicine by highlighting key occupational hazards, such as low back pain, computer vision syndrome (CVS), malignancy risks associated with formaldehyde exposure, and irritant contact dermatitis, specifically among forensic and mortuary personnel. Unlike previous studies that have only described occupational hazards in forensic units (Molewa et al., 2021; Madadin et al., 2022), this study employed a structured Health Risk Assessment (HRA) approach, integrating ergonomic, psychosocial, and chemical exposure analysis, making it a more comprehensive evaluation of forensic workplace safety. Identifying ergonomic risks from manual handling tasks underscores the urgent need for ergonomic improvements tailored specifically to handling deceased bodies. Additionally, the findings regarding CVS highlight overlooked risks related to administrative duties in forensic medicine. The detailed analysis of formaldehyde exposure and associated cancer risks underscores the necessity of enhancing chemical safety protocols and compliance among forensic staff. By systematically identifying and categorizing these hazards through structured Health Risk Assessments (HRA), the results provide actionable, evidence-based recommendations for improving workplace safety, informing both occupational medicine specialists and forensic institutions. This approach fills existing knowledge gaps in forensic occupational health and establishes a foundation for future research and policy improvements to safeguard forensic and mortuary personnel globally.

CONCLUSION

This study significantly contributes to forensic and occupational medicine fields by providing a structured and comprehensive Health Risk Assessment (HRA) specific to forensic and mortuary personnel—a previously underexplored area. By systematically evaluating physical, chemical, biological, ergonomic, and psychosocial hazards, the research emphasizes critical occupational risks unique to forensic settings, such as ergonomic challenges during manual body handling, chronic formaldehyde exposure risks, inadequate workspace ergonomics leading to computer vision syndrome, and unsafe chemical handling practices. The detailed findings highlight specific areas requiring targeted interventions, including ergonomic training, improved workstation conditions, and stricter adherence to chemical safety protocols. These insights serve as valuable guidance for occupational health practitioners, forensic institutions, and policymakers aiming to enhance worker safety in forensic environments. Future research should include longitudinal studies assessing long-term health outcomes related to chronic formaldehyde exposure, the effectiveness of ergonomic interventions in

reducing musculoskeletal disorders, and the exploration of safer chemical substitutes in embalming practices. Additionally, further investigation into behavioral strategies to improve compliance with PPE protocols and chemical handling procedures is recommended to advance occupational safety standards globally.

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