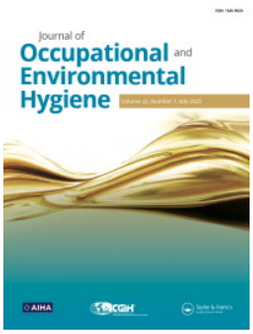

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Perspective on occupational health and safety of sterilization unit employees and unit safety

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ABSTRACT

Central Sterilization Unit (CSU) workers are exposed to various biological, chemical, physical, and psychological hazards. This study aimed to assess the occupational health and safety (OHS) awareness of workers in the CSU. This cross-sectional study included 83 employees working in CSUs affiliated with 32 public, private, and university hospitals in Kayseri. Participants' demographic characteristics, working conditions, and information related to occupational health and safety were collected through a questionnaire. A total of 71 individuals participated in the study. According to the research findings, the majority of the workers had received training on the operation of sterilization units and OHS. CSU workers reported facing issues such as injuries from sharp objects (57.7%), exposure to toxic/corrosive substances (46.5%), and contact with bloodborne pathogens (26.8%). Although the use of personal protective equipment (PPE) was widespread, the utilization rates of certain equipment were lower. The study highlights that CSU workers are exposed to various health risks and emphasizes the importance of education and the use of PPE. However, considering the limitations of the study, it is suggested that more comprehensive research and greater attention to OHS among healthcare personnel are needed.

KEYWORDS

Disinfection; employee health; ınfection control; personal protective equipment; sterilization

Introduction

Central Sterilization Units (CSUs) are specialized units designed for the sterilization and disinfection of medical devices, surgical instruments, and equipment used in healthcare facilities. CSUs play a vital role in infection control and maintaining patient safety within healthcare services. Medical instruments and materials used in various departments, including operating rooms, outpatient clinics, laboratories, endoscopy units, delivery rooms, intensive care units, and emergency services, are sterilized in CSUs to ensure they are ready for use. CSUs are extremely important for the effective operation of healthcare facilities, infection control, and for maintaining high hygiene standards (Koushki et al. 2022). The sterilization procedures utilized in CSUs typically involve methods such as steam sterilization, chemical sterilization, heat sterilization, and plasma sterilization. Routine monitoring should be conducted using a combination of mechanical, chemical, and biological indicators to evaluate the sterilization conditions indirectly, including the transfer of sterilized instruments to their areas of use, retrieval after use, physical cleaning, pre-sterilization processes, and the microbiological status of the processed products (Günaydın and Gürler 2008; Klumdeth et al. 2020; Rutala and Weber 2019).

In Turkey, sterilization unit operations are governed by the Ministry of Health's Regulation on the Operation of Inpatient Treatment Institutions (Official Gazette 1983) and the Ministry of Health's Quality Criteria in Health (Ministry of Health of Turkey 2019). Additionally, the Decontamination and Antisepsis Society (DAS) (2019) publishes training, certification, and operational procedures regarding sterilization processes. Due to the lack of a specific educational infrastructure on this subject in Turkey, personnel from various fields can work in sterilization units. According to DAS guidelines, there should be a managing physician and a responsible nurse/health technician in each CSU. Other personnel are required to receive training on CSU operations and OHS. CSU managers regularly plan and implement training in collaboration with hospital infection control teams regarding CSU practices and innovations (DAS 2019).

The international certification organization, Healthcare Sterile Processing Association (HSPA), offers a certification program for working in a sterile

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processing department (SP). To obtain this certification, two options are provided. According to the first option, before taking the qualification exam, a minimum of 400 hr of hands-on experience, either paid or voluntary, in a Sterile Processing department must be documented by a supervisor. These hours must be distributed across the following areas: decontamination (120 hr), preparation and packaging of instruments (120 hr), sterilization and disinfection (120 hr), storage and distribution (24 hr), and quality assurance processes (16 hr). The second option allows candidates to pass the certification exam first, and then within six months, complete a minimum of 400 hr of hands-on experience in a SP department, supervised and documented. These hours must be divided into the same experience areas as detailed above (Healthcare Sterile Processing Association 2023).

The OHS of personnel working in these centers is crucial, as in other hospital departments. However, unlike other departments, personnel in Central Sterilization Units (CSUs) are exposed to biological, physical, chemical, and psychosocial risks. During sterilization processes in CSUs, staff may come into contact with pathogens from medical instruments and equipment. These pathogens can include microorganisms such as bacteria, viruses, and fungi (Arslanoğlu and Urk 2015; Rutala and Weber 2015). Therefore, the use of appropriate personal protective equipment (PPE) such as masks, gloves, and gowns is necessary, and strict adherence to sterilization procedures is required. Studies have shown that noncompliance with established guidelines for disinfection and sterilization has led to numerous outbreaks of infectious diseases (Perçin 2016; Rutala and Weber 2019).

During sterilization processes, physical factors such as high temperatures and pressures may be encountered. This means that workers may face risks of burns, cuts, or other physical injuries. The appropriate use of equipment, occupational safety training, and compliance with procedures can help mitigate these risks (Arslanoğlu and Urk 2015; Morrissey et al. 2021).

Chemicals used in sterilization processes can potentially be harmful to workers. For instance, disinfectants and sterilization solutions may cause skin irritation, respiratory problems, or other health issues. Therefore, it is essential to use appropriate protective equipment when working with chemical substances and to strictly adhere to OHS procedures (Arslanoğlu and Urk 2015; Rutala and Weber 2015a).

High workloads, stress, time pressures, and job demands can affect the psychological health of employees. Particularly in sterilization units, due to the sensitivity of the sterilization processes, workers may be exposed to such stress factors. Consequently, attention should be paid to the psychosocial needs of employees, and support should be provided when necessary (Arslanoğlu and Urk 2015).

The literature review found that there were a limited number of studies available regarding the occupational risks and OHS awareness of CSU workers. In particular, the risks faced by employees working in sterilization units and the supporting units, as well as the use of PPE against these risks, have not been sufficiently addressed in the literature. Although studies conducted by Kumar et al. (2014), Xu et al. (2021), Da-Silva et al. (2021), and Carvalho et al. (2019) have emphasized the importance of understanding occupational risks encountered in SPs and the measures for the protection of workers, there remains a need for further research in this field.

This study examines the perceptions of CSU workers regarding occupational safety, educational levels, and working conditions in 32 hospitals serving a population of 1.5 million in Kayseri, Turkey. This study aimed to assess the OHS risks faced by healthcare personnel working in CSUs and their levels of awareness regarding OHS as well as to evaluate the ways to protect against these hazards, thereby contributing to the existing literature in this field.

Methods

This study is descriptive and cross-sectional and has been conducted in accordance with the STROBE criteria. The study population consisted of employees working in the CSUs affiliated with a total of 32 public, private, and university hospitals. To determine the size of the population, information regarding the number of employees was obtained from the CSU managers of the hospitals included in the study, and it was determined that the total population consisted of 83 individuals.

Participants included those who had worked in the CSU for at least one year, were over 18 years of age, of both genders, worked in morning and afternoon shifts, and consented to participate in this study. Individuals who were on leave for various reasons during the survey process, had less than one year of service, and did not agree to participate in the study were excluded.

This questionnaire, developed by the researcher, consisted of a total of eight questions to collect personal and professional characteristics. An additional

questionnaire of 20 questions developed by the researcher based on information contained in previous studies was administered regarding operation of the CSU and OHS (Carvalho et al. 2019; DAS 2019; Da-Silva et al. 2021; Kumar et al. 2014; Xu et al. 2021). Participants were asked to respond with "yes" or "no" to statements concerning the PPE used, the most common operational issues encountered, and aspects of the job that presented OHS risks in the sterilization unit. Additionally, employees who experienced a work-related accident due to at least one of the identified hazardous situations were asked to respond to statements about the accident with either "I experienced it" or "I did not experience it."

The reliability of the questions was assessed using the Kuder-Richardson (KR) 20 and 21 formulas. If the answers to the test items are binary (e.g., yes/no, true/false), the KR-20 and KR-21 formulas were used. Kuder-Richardson (KR 20–KR 21) provides a measure of consistency among all the items in a test, rather than the repetition, parallel, or two halves of a test. It provides information about the reliability of a measurement tool that has been applied once and is referred to as the "internal consistency coefficient." If the KR 20 reliability coefficient of a test is found to be high, it indicates that the items in the test measure the same attribute (the test is unidimensional). KR 21 is applied to tests where item analysis has not been performed, assuming that the difficulty indices of the items in the test are equal. If the coefficients obtained from the KR-20 and KR-21 formulas are above 0.7, the reliability is considered acceptable. While the KR-20 and KR-21 formulas provide information about the overall reliability of the test, they do not provide information about the reliability of individual items (Bademci 2011).

$$\text{KR20 for calculation } KR20 = \frac{k}{k-1}\left(1-\frac{\sum pq}{S^2}\right) \text{ formula is used.}$$

where p is the proportion of correct or yes responses for the items, q is the proportion of incorrect or no responses for the items, k is the number of items in the test, s^2 is the variance of the total scores (number of correct answers for each participant).

$$\text{KR21 for calculation } KR21 = \frac{k}{k-1}\left(1-\frac{\overline{x}\,(k-\overline{x})}{ks^2}\right) \text{ formula is used.}$$

where k is the number of items in the test, $\overline{X}$ is the mean score of the test, and s^2 is the variance of the test scores.

The reliability coefficients of the questionnaire used in this study were found to be KR-20 = 0.91 and KR-21 = 0.82. Since these values are greater than 0.70, the questionnaire was considered reliable.

Questionnaire forms were distributed between July 1 and September 30, 2022, in the CSUs of the hospitals designated by the researcher. Appointments were made with CSU managers, and the questionnaires were distributed during break times in staff rest areas, ensuring that they were completed under the supervision of the researcher.

Questionnaire results were evaluated using IBM SPSS Statistics 25.0 software. The data obtained from the study were presented using percentages, frequencies, and graphs. Fisher's exact test was used to examine the differences between independent categorical variables. The level of statistical significance was set at $p < 0.05$.

The research was conducted in accordance with the Declaration of Helsinki of the World Medical Association, with approvals obtained from the Kayseri City Hospital Clinical Research Ethics Committee (10.02.2022/575), the Provincial Health Directorate and the relevant hospital administrations. Participants were informed about the study and their consent was obtained via a consent form before participation in the survey.

Results

The study was conducted with 71 individuals who met the inclusion criteria, all of whom work in the CSUs of secondary- and tertiary-level hospitals. Secondary-level hospitals provide general healthcare services and are equipped to handle more complex treatment needs. Tertiary-level hospitals, on the other hand, offer advanced specialized treatments and are typically operated as teaching and research hospitals. These institutions treat diseases that require specialized expertise and accept referrals from other hospitals. The average age of the participants was 36.40 ± 7.9 years. Among the participants, 29.6% worked in private hospitals and 70.4% were employed in public hospitals. The average professional experience of the participants was 10.92 ± 7.33 years, and their average duration of work in the sterilization unit was determined to be 4.7 ± 3.25 years. The study included nurses (46.5%), sterilization technicians (42.3%), and other CSU personnel (11.2%), while none of the responsible physicians for the sterilization units participated in the study. Further demographic details are presented in Table 1.

Table 1. Demographic characteristics of the participants.

Demographic characteristics	N	%
Age		
20–29	15	21.1
30–39	30	42.3
40–49	22	31.0
50+	4	5.6
Gender		
Female	23	32.4
Male	48	67.6
Marital status		
Married	55	77.5
Single	16	22.5
Educational status		
High School	11	15.5
University	58	81.7
Postgraduate	2	2.8
Occupation		
Nurse	33	46.5
Sterilization technician	30	42.3
Other	8	11.2

Table 2. Most common operational issues encountered in the sterilization unit by the study group.

Issues ($n = 71$)[a]	N	%
Insufficient equipment	18	25.4
Device malfunctions	17	23.9
Positive biological test	17	23.9
Unplanned surgeries	15	21.1
Excessive stock of sterile materials	13	18.3
Damage to disposable materials due to improper storage	11	15.5
Electrical and water problems	10	14.1
Support service issues such as ventilation	10	14.1
Interruptions in textile cycle	7	9.9
Invalid sterilization results and need for resterilization	5	7.0

[a]The participants have marked multiple options.

Participants identified the person in charge of the sterilization unit as a nurse (62.0%), a health officer/sterilization technician (19.9%), an infectious disease specialist (11.5%), a microbiology specialist (5.6%), and other (1.0%). Additionally, 57.7% of participants reported having a certification to work in a sterilization unit, and 46.5% indicated that they had attended conferences related to DAS or hospital infections. A significant majority of the participants (76.5%) reported having previously attended training programs regarding the operation of sterilization units, and 95.4% reported receiving OHS training specific to sterilization units. These findings indicate that the employees possess the necessary knowledge and skills to perform their duties safely.

Operational issues threatening OHS in sterilization units are listed in Table 2. The most commonly reported issue by participants was inadequate equipment (25.4%). This was followed by equipment malfunctions (23.9%) and positive results from biological tests (23.9%). Other significant issues included unscheduled surgeries (21.1%) and excessive stock of sterilized materials (18.3%). Participants also highlighted additional operational issues, such as damage to consumables due to improper storage (15.5%), electrical and water outages (14.1%), and inadequacies in support services such as ventilation (14.1%).

Table 3. Situations threatening occupational health and safety in the sterilization unit according to sterilization unit employees.

Situations threatening occupational health and safety ($n = 71$)[a]	N	%
Sharp and penetrating tool ınjuries	41	57.7
Exposure to toxic and corrosive agents	33	46.5
Transmission of bloodborne pathogens	19	26.8
Problems related to noise	15	21.1
Burns from heat-producing devices	14	19.7
Dust aspiration from textile products	14	19.7
Respiratory system diseases, allergies, skin diseases related to disinfectant use	8	11.3
Musculoskeletal disorders	7	9.9
Trauma	3	4.2

[a]The participants have marked multiple options.

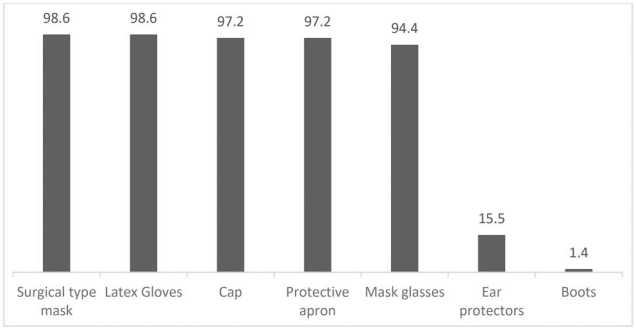

Figure 1. Preferences and usage status of personal protective equipment (PPE) by Central Sterile Services Department (CSSD) Staff.

OHS issues encountered by the study group in the sterilization units are summarized in Table 3. Participants reported experiencing sharp instrument injuries (57.7%), injuries from toxic and corrosive substances (46.5%), exposure to blood and bodily fluids (26.8%), exposure to noise (21.1%), and burns caused by steam and high temperatures (19.7%). These hazards can negatively affect the overall health and quality of life of employees. Additionally, reporting of respiratory and chemical health hazards, such as inhalation of dust from textile products (19.7%) and having experienced respiratory ailments, allergies, and dermatological issues related to the use of disinfectants, were also reported. The participants reported having experienced musculoskeletal disorders (9.9%) and trauma-related incidents (4.2%).

The study revealed that the most commonly used PPE included gloves (98.6%), masks (98.6%), protective gowns (97.2%), caps (97.2%), and goggles (94.4%) (Figure 1). In contrast, protective shoes (1.4%) and earplugs (15.5%) were the least utilized equipment. The usage rates of all PPE were found to be higher

Table 4. Distribution of PPE usage according to the demographic characteristics of the participants.

	N	Surgical type mask	Latex gloves	Cap	Protective apron	Mask glasses	Ear protectors	Boots
Occupation								
Nurse	33	100	100	100	100	96.7	9.1	0
Sterilization Technician	30	96.7	96.7	93.3	93.3	90	23.3	3.3
Other	8	100	100	100	100	100	12.5	0
X^2		1.386*	1.386*	2.813*	2.813*	1.974*	3.477*	0.25*
p		0.56	0.56	0.24	0.24	0.37	0.17	0.99
Gender								
Female	23	95.7	95.7	95.7	95.7	91.3	8.7	0
Male	48	100	100	97.9	97.9	95.8	18.8	2.1
X^2		9.657*	9.657*	9.058*	9.058*	9.328*	4.455*	0*
p		**<0.01**	**<0.01**	**0.01**	**0.01**	**0.01**	**0.03**	1.0
Educational status								
High School	11	100	100	100	100	100	54.5	9.1
Undergraduate and graduate	60	98.3	98.3	96.7	96.7	93.3	8.3	0
X^2		0.186*	0.186*	0.377*	0.377*	0.777*	0.091*	1*
p		0.84	0.84	0.54	0.54	0.50	0.76	0.61
Professional years*								
0–9	33	100	100	97	100	97	18.2	0
10–19	25	100	100	100	96	96	12	0
20–29	11	91	91	91	91	81.8	18.2	0
30+	2	100	100	100	100	100	0	50
X^2		5.532*	5.532*	2.37*	2.724*	30.97*	4.636*	1*
p		0.14	0.14	0.50	0.44	0.27	0.33	0.98

*Yates correction has been applied.

The statistical significance test results for the Gender section: The results for Surgical type mask, Latex gloves, Cap, Protective apron, Mask glasses, and Ear protectors are significant and are shown in bold.

among male sterilization unit workers compared to their female counterparts ($p < 0.05$). The effects of profession, years of experience, and education on PPE usage were examined, and no significant differences were found among the groups ($p > 0.05$) (Table 4).

Regarding hepatitis B prophylaxis, 81.7% of the participants reported having received this vaccination set, indicating that proactive measures have been taken to reduce the risk of infection. However, only a small portion of the participants reported being aware of their Anti-HBS values.

In terms of gender, women were found to be exposed to higher rates of specific risk factors, such as sharp instrument injuries (65.2%; $p = 0.27$) and exposure to toxic/corrosive substances (52.2%; $p = 0.342$), while men faced higher rates of trauma and burns from heat-generating devices (25%; $p = 0.094$). However, these differences were not statistically significant. Similarly, while participants in the 30 to 39 age group experienced less frequent exposure to most causes other than those exposures to sharp and pointed instrument (60.0%; $p = 0.34$), but no statistically significant difference was observed.

High school graduates were found to be more exposed to certain risks, such as exposure to toxic and corrosive agents (90.9%; $p = 0.05$), infection/blood and body fluid exposure (72.7%; $p = 0.03$), trauma (18.2%; $p = 0.02$), burns from heat-generating devices (63.6%; $p = 0.02$), dust inhalation from textile products (72.7%; $p < 0.01$), respiratory diseases, allergies, and skin conditions related to disinfectant use (36.4%; $p = 0.01$), and noise-related problems (100%; $p = 0.<01$). These differences were statistically significant (Table 5).

Professionally, significant differences were observed among nurses/midwives/healthcare workers, sterilization technicians, and other personnel. For instance, sterilization technicians were less exposed to toxic/corrosive substances (40.0%; $p = 0.43$), while they were at higher risk concerning respiratory ailments related to disinfectant use (27.0%; $p = 0.01$) (Table 5).

Discussion

CSUs play a critical role in combating hospital-acquired infections and operate continuously every day of the year. Healthcare service environments are considered among the most hazardous workplaces in hospitals. According to the literature, the most common workplace accidents among healthcare workers include slips and falls on wet floors, injuries from heavy medical equipment falling on workers, acute back problems resulting from heavy lifting, exposure to psychological and physical violence, needle-stick injuries, and falls and strains during patient transfers (Akgün 2015). Baylina et al. (2018) noted that healthcare workers are exposed to numerous environmental and biological risk factors in their workplaces, but psychosocial risk factors have been shown to have the most significant impact on personal well-being.

Although CSU staff are healthcare professionals, they do not have direct contact with patients.

Table 5. Distribution of work-related health problems among CSU employees according to demographic characteristics.

	N	Having experienced injury from sharp and penetrating tools %	Exposure to toxic and corrosive agents %	Transmission of bloodborne pathogens %	Trauma %	Musculoskeletal disorders %	Burns from heat-producing devices %	Dust aspiration from textile products %	Respiratory system diseases, allergies, skin diseases related to disinfectant use %	Problems related to noise %
Gender										
Female	23	65.2	52.2	13.0	0	0	8.7	13.0	8.7	13.0
Male	48	54.2	43.8	33.3	6.3	14.6	25.0	22.9	12.5	25.0
$\chi 2$		0.778	0.444	3.266	1.501	3.721	2.611	0.958	0.225	1.334
p		0.27	0.34	0.06	0.30	0.05	0.09	0.26	0.49	0.20
Marital status										
Married	55	56.4	47.3	25.5	5.5	9.1	18.2	20.0	12.7	21.8
Single	16	62.5	43.8	31.3	0.0	12.5	25.0	18.8	6.25	18.8
$\chi 2$		0.191	0.062	0.212	0.911	0.162	0.364	0.012	0.520	0.070
p		0.44	0.57	0.43	0.46	0.50	0.39	0.61	0.42	0.55
Age										
20–29	15	46.7	53.3	33.3	6.7	26.7	33.3	26.7	13.3	26.7
30–39	30	60.0	46.7	26.7	3.3	0.0	13.3	13.3	10.0	20.0
40–49	26	59.1	45.5	27.3	4.5	13.6	22.7	18.2	13.6	18.2
$\chi 2$		0.970	0.466	0.511	0.289	8.132	2.533	1.415	0.114	0.355
p		0.34	0.40	0.34	0.66	0.24	0.30	0.71	0.76	0.69
Educational level										
High school	11	63.6	90.9	72.7	18.2	18.2	63.6	72.7	36.4	100.0
Undergraduate and graduate	60	56.9	37.9	17.2	1.7	6.9	10.3	8.6	6.9	5.2
$\chi 2$		0.223	10.443	15.091	6.279	5.056	17.780	25.196	8.292	50.927
p		0.64	**0.05**	**0.03**	**0.02**	0.91	**0.02**	**<0.01**	**<0.01**	<0.01
Occupation										
Nurse	33	72.7	51.5	30.0	3.0	3.0	18.2	21.2	18.2	24.2
Sterilization Technician	30	40.0	40.0	24.2	3.3	13.3	20.0	20.0	27,0	16.6
Other	8	62.5	50.0	25.0	12.5	25.0	25.0	12.5	25.0	25.0
$\chi 2$		6.982	0.883	0.280	1.529	4.203	0.192	0.311	6.896	0.622
p		**0.04**	0.43	0.65	0.41	0.92	0.88	0.77	**0.01**	0.47

The statistical significance test results in the Education level section: The results for Exposure to toxic and corrosive agents, Transmission of bloodborne pathogens, Trauma, Burns from heat-producing devices, Dust aspiration from textile products, Respiratory system diseases, allergies, skin diseases related to disinfectant use are significant and are shown in bold.

The statistical significance test results in the Occupation section: The results for Having experienced injury from sharp and penetrating tools and Respiratory system diseases, allergies, skin diseases related to disinfectant use are significant and are shown in bold.

Therefore, they are generally shielded from incidents of violence originating from patients and their families. However, the closed nature of their work environment, along with their use of sterilization and disinfection techniques, equipment, and chemicals, exposes them to health risks that differ from those faced by other healthcare personnel. Participants in this study reported physical, biological, and chemical health issues arising from their work environments but did not mention any health problems related to psychosocial factors. Commonly reported operational problems included inadequate equipment (25.4%), equipment malfunctions (23.9%), positive biological test results (23.9%), unscheduled surgeries (21.1%), and an excess stock of sterilized materials (18.3%). These issues can adversely affect the efficiency and reliability of sterilization processes, disrupt resource management and workflow efficiencies, and require greater effort from CSU staff. Consequently, the prolonged persistence of operational problems may lead to increased stress levels among employees.

CSUs are dynamic centers that provide continuous services 365 days a year, essential for hospital operations. Despite being a fundamental infrastructure component of hospitals, these units are often poorly coordinated during planning with professional hospital planners and hospital staff. When CSUs begin to function, they may reveal issues related to basic planning and construction. Typically located on the lowest floors of inpatient treatment institutions, CSUs are often set up in areas lacking natural light and are near the hospital's utility lines and heating system pipes. It is recommended that these units be adequately planned during the hospital establishment phase (Aydın 2005).

In this study, participants from the CSUs reported experiencing various issues, including injuries from sharp instruments, injuries related to toxic and corrosive substances, contact with blood and body fluids, exposure to excessive noise from equipment, burns from heat-producing devices, and exposure to dust from textile products. The existing literature discusses the presence of biological, physical, and chemical risk factors in sterilization units and the associated potential health issues, which aligns with the findings of this study. Kumar et al. (2014) highlighted potential hazards in hospital laundries, including exposure to aerosols, infections from spills and splashes, injuries from slips and falls, and exposure to detergents, phenolic solutions, bleach powders, and soap oils. Kumar et al. (2014) also noted that occupational diseases such as dermatitis and allergic asthma could be observed in workers in these departments due to the mentioned factors. Carvalho et al. (2019) stated that CSU workers are exposed to various occupational hazards, including physical, chemical, and biological risks. Physical hazards encompass factors such as heat, cold, noise, vibration, abnormal pressures, ionizing and non-ionizing radiation, and humidity. Chemical risks involve substances, compounds, or products that can enter the body through inhalation—such as dust, fumes, mist, vapor, or gases—or through dermal contact and ingestion due to the nature of exposure. Additionally, biological hazards include bacteria, fungi, bacilli, parasites, protozoa, viruses, and other microorganisms, all of which pose significant health risks. Xu et al. (2021) identified needle-stick injuries and biological risk factors as the most commonly reported workplace accidents among healthcare workers in China and the United Kingdom, noting that biological factors have been perceived as more significant risks due to COVID-19. However, unlike the current study's research findings, the studies conducted in China and the UK emphasized that workplace and job-related stress are important potential hazards. Factors affecting stress perception among employees in these centers include time pressure, workload, salary status, and workplace stress. The combination of these factors can influence employees' stress levels (Bhui et al. 2016).

In this study, 19.7% of participants reported experiencing at least one health issue related to their work in the sterilization unit. Participants indicated they experienced musculoskeletal disorders (4.2%), exacerbation of asthma (2.8%), anemia (2.8%), and skin problems (2.8%). In this study, no detailed information was gathered regarding which type of sterilization product was most frequently used by those who reported experiencing workplace-related anemia. Therefore, there is no clear information on whether their anemia was occupationally induced. Given that ethylene oxide is classified as a carcinogenic substance in the literature, it is crucial to closely monitor the blood test results of personnel exposed to ethylene oxide. Animal studies have indicated that prolonged exposure to ethylene oxide can lead to severe health conditions, including anemia, lymphoma, and leukemia. Therefore, monitoring changes in blood parameters from the time of employment and throughout the tenure of CSU personnel is essential in this context (Jones et al. 2023; National Research Council (US) Committee on Acute Exposure Guideline Levels 2010).

Two different studies conducted on CSU workers in Brazil support these findings. Da-Silva et al. (2021) noted that female CSU workers experience more musculoskeletal issues compared to their male counterparts, while Jesus et al. (2024) reported that the prevalence of musculoskeletal disorders among CSU workers was significantly higher (66.6%) than in this study. Biswas et al. (2021), investigated the impact of gender roles on occupational risks and indicated that men are exposed to noise, vibration, medical radiation, physically demanding tasks, solar radiation, falls, biomechanical risks, chemical hazards, and blood contamination, while women are more exposed to wet work, bullying, discrimination, job stress, and biological factors. In the healthcare sector, it is noted that women are more likely to endure prolonged standing, whereas men are more prone to physical hazards. The same study reported that men in the same professions as women are more exposed to hazardous chemicals. CSU technicians in this study reported higher incidences of respiratory issues related to disinfectant use compared to other groups ($p = 0.01$).

The majority of the participants in this study meet the requirements set by the DAS criteria for sterilization unit supervisors. However, no physicians participated in the study. It is generally observed that physicians responsible for sterilization units carry out this duty as a secondary role, while their primary responsibilities remain in their respective units or clinics., Approximately, half of the participants reported being able to attend educational programs, conferences, and courses to remain current with developments in the field. In this study, 76.5% of participants reported that they had attended a training program related to working conditions in the sterilization unit, and 95.4% stated that they had received health and safety training specific to the sterilization unit. Yavuz and Gür (2021) indicated that OHS training enhances the perception of safety in the workplace. It is recommended that safety training in specialized units be completed during the onboarding process and repeated at regular intervals.

The use of PPE in sterilization units is a crucial aspect of OHS. In our study, 98.6% of participants reported using PPE such as surgical masks and latex gloves, while 97.2% used caps and protective gowns and 94.4% reported wearing goggles. Male participants reported higher usage of PPE compared to females ($p < 0.05$). This study found no significant differences in PPE usage levels based on education level, profession, or years of experience ($p > 0.05$). Carvalho et al. (2019) noted that nurses working in sterilization units recognize the necessity of using PPE to protect against occupational risks and reduce the risk of injury and illness in the event of an accident. They also emphasized the need for regular continuous training programs to improve PPE usage. According to a meta-analysis by Verbeek et al. (2020), the protective equipment used by healthcare workers, their levels of protection and evidence of protection have been standardized. Therefore, the importance of improving healthcare workers' behaviors regarding PPE usage and increasing compliance with the use of this equipment has been emphasized. Shwe et al. (2021) found that, despite 23% of clinical nurses having previously experienced splashes potentially infectious or liquid materials on their faces, the most significant factor increasing PPE usage was awareness related to the COVID-19 pandemic.

Limitations

This study was conducted with personnel working in central sterilization units (CSUs) in a single city and involved a limited number of participants. Data were collected through a questionnaire and the information regarding health risks was based on the participants' perceptions. Health information reported by the participants was not verified by a healthcare professional.

Conclusion and recommendations

According to this study's findings, although CSU employees have generally received training on the operation of sterilization units and OHS, and the use of PPE is prevalent, they still experience various OHS risks. These include exposure to sharp instruments, heavy lifting, toxic/corrosive substances, bloodborne pathogens, noise, hot surfaces, heated water vapor, which can result in burns, exacerbation of asthma, respiratory illnesses, allergic reactions, skin conditions and musculoskeletal disorders.

Considering the limitations of the study, there is a need for more comprehensive research and increased emphasis on OHS among healthcare personnel. Conducting educational programs and observational assessments within the units to ensure the OHS of CSU personnel.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics approval

The research was conducted in accordance with the Kayseri City Hospital [Clinical Research Ethics Committee (10.02.2022/575)] and the relevant hospital administrations. Participants were informed about the study and their consent was obtained via a consent form before participation in the survey.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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