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Research Article

伊拉克纳杰夫医院医务人员对室内空气化学污染物知识的评估

Zahra N. Dhaief Altamimi[1], Ahmed A. abd-alameer AL-Khafagi[2], Oday M. Hadi Zwain[3]

[1]Department of Community Health Techniques, Al Najaf Health Directorate, Iraq
[2]Anesthesia Techniques Department, College of Health and Medical Techniques, Al-Mustaqbal University, Babylon, Iraq
[3]College of Health & Medical Technology, Department of Community Health Techniques, Al-furat Al-awsat Technical University Najaf, Iraq

通信作者，E-mail: zahraa.dhaief.chm@student.atu.edu.iq

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【摘要】：
背景：生命的延续取决于对化学污染物的有效控制和预防。医护人员是医院室内空气中各种有毒物质的主要防御者。然而，由于这些专业人员缺乏知识，感染控制的有效性可能会受到影响。目的：本研究旨在评估医护人员对医院室内空气中化学污染物的了解，并评估他们的知识水平与各种独立变量和因变量之间的关系。方法：2023 年 12 月中旬至 2024 年 3 月下旬， 在纳杰夫的三家医院进行了一项横断面分析研究。 通过随机选择的自我报告问卷从 515 名医护人员收集数据， 随后使用统计方法进行分析。 结果： 研究结果显示， 大多数参与者（51.8%） 是女性， 主要年龄在 20 至 29 岁之间。 一半的受访者拥有学士学位，54.6% 的受访者拥有不到五年的专业经验。 此外，30.1% 的参与者接受过职业培训， 27.0% 的参与者在实验室工作。 值得注意的是， 只有 27.8% 的受访者表现出对化学污染物的一 般知识水平相当。 除性别外， 所有社会人口特征都与知识水 平显著相关， 性别与知识水平没有显著相关性。 此外， 相当一部分卫生专业人员 （68.0%） 仅表现出中等程度的理解。 结论： 地方当局必须持续为卫生保健工作者提供有关室内化学空气 污染的培训， 以提高他们的知识。 我们的分析显示， 培训计划的参与度和知识水平之间存在很 强的相关性。 此外， 还发现卫生保健人员的教育程度与年龄之间 存在显著关系， 大多数参与者 都很年轻， 而且刚入行不久。
【关键词】：知识、卫生工作者、化学污染、空气污染、横断面。

Evaluation of Medical Staff Knowledge about Chemical Pollutants in the Indoor Air of Hospitals in Najaf, Iraq

【Abstract】:
Background: The preservation of life depends on effective control and prevention of chemical pollutants. Healthcare professionals serve as the primary defense against various toxic substances found in the indoor air of hospitals. However, the effectiveness of infection control may be compromised by a lack of professional knowledge. **Objective:** This study aimed to evaluate healthcare personnel's understanding of chemical contaminants in hospital indoor air and to assess the relationship between their knowledge levels and various independent and dependent variables. **Methods:** A cross-sectional analytical study was conducted across three hospitals in Najaf between mid-December 2023 and late March 2024.

Data were collected from 515 healthcare professionals through a randomly selected self-report questionnaire, which was subsequently analyzed using statistical methods. **Results:** The findings revealed that the majority of the participants (51.8%) were women, primarily aged between 20 and 29 years. Half of the respondents held bachelor's degrees and 54.6% had less than five years of professional experience. Additionally, 30.1% of the participants had received vocational training, while 27.0% had worked in laboratory settings. Notably, only 27.8% of the respondents demonstrated a commendable level of general knowledge regarding chemical pollutants. All sociodemographic characteristics were significantly correlated with knowledge level, except for sex, which showed no significant correlation. Furthermore, a significant proportion of the health professionals (68.0%) exhibited only moderate levels of understanding. **Conclusions:** It is crucial for local authorities to consistently provide training for healthcare workers on the topic of chemical indoor air pollution to enhance their knowledge. Our analysis revealed a strong correlation between participation in training programs and knowledge level. Additionally, a significant relationship was found between the educational attainment of healthcare personnel and their age, with most participants being young and relatively new to the profession.

【Keywords】: knowledge, health workers, chemical pollution, air pollution, cross-sectional.

1. Introduction

In addition to climate change, air pollution is a significant threat to human health. Approximately 99% of the global population resides in regions where air pollution levels exceed World Health Organization [1]. According to the Lancet Commission on Pollution and Health, diseases caused by pollution in 2015 were responsible for approximately 9 million premature deaths, accounting for 16% of all fatalities globally [2]. "Indoor air quality" (IAQ) pertains to the overall condition of the air within and around buildings and structures, specifically with regard to the health and comfort of the people occupying them. Given that most individuals spend a significant amount of time inside, indoor air quality (IAQ) and the resulting health issues are significant global concerns [3].

As argued in [4], healthcare facilities should be intricate edifices designed to enhance health and well-being. Healthcare personnel, staff, and customers devote over 30% of their working hours indoors; ensuring good indoor air quality (IAQ) is crucial for the safety of patients and the occupational health of individuals in healthcare settings [5]. Hospitals provide unique attributes and more complex indoor air quality than residential and occupational environments. As a result of the hospital's round-the-clock activity, there is a continuous release of biological, chemical, and other contaminants as well as pathogenic organisms [6].

The individual interior air environment of each hospital department and room determines the presence of indoor air pollutants, which is influenced by their respective usage [7]-[8]. The ventilation needs of hospitals vary significantly depending on the specific locations and treatments conducted [9].

The most common chemical pollutants studied in the indoor air of hospitals include carbon monoxide, carbon dioxide, ozone, fibers, gases, volatile organic compounds (VOCs), particulate matter (PM), and organic and inorganic contaminants [10]. The concentration of particulate matter (PM) in air can be influenced by both external air conditions and indoor human movement [11]. Particulate matter (PM), specifically PM2.5, refers to very small particles with diameters of less than 2.5 μm. These particles are known to cause both mortality and morbidity [12]. There is little knowledge regarding volatile organic compounds (VOCs), which are chemical pollutants, and their prevalence in this particular environment. Volatile Organic Compounds (VOCs) are a fascinating group of pollutants emitted by many construction materials and activities [13]-[14]. Additionally, external influences such as vehicular pollution can affect building conditions [9], [15]. Individuals can come into contact with volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) through ingestion, skin contact, and inhalation, depending on whether these chemicals are in gaseous or particulate forms [16]. The connection between organic chemicals and certain health issues is now generally recognized [17]–[18]. Nevertheless, the air inside hospitals contains extra volatile organic compounds (VOCs) as a result of many operations conducted within the facilities, including the use of cleaning supplies, detergents, disinfectants, hand sanitizers, anesthetic gases, and pharmaceutical products. These emissions can lead to a substantial accumulation of volatile organic compounds (VOCs) in indoor environments [19].

2. Methodology

2.1. Data Collection

To accomplish the objectives of the study, a cross-sectional analytical study was conducted at three hospitals situated in Najaf City: Al-Sadr Teaching Hospital, Al Zahra Gynecology Obstetric and Pediatrics Hospital, and Al-Hakim General Hospital. The study was conducted from December 24, 2023, to March 20, 2024. A total of 515 health workers participated in the data-collection process. The data were collected on average 5-6 days per week using a self-administered questionnaire that was randomly distributed. Data were collected and evaluated using a statistical software.

Data on various chemical pollutants often found in the interior air of hospitals were collected using a self-administered questionnaire based on an Arabic model. This study included 515 individuals from all hospital departments.

2.2. Preparation of the Questionnaire

Following the supervisors' evaluation, the revised questionnaire was distributed to 10 experts from various fields to evaluate the relevance and accuracy of the study, as well as to address some study-related inquiries. The research objective can be accomplished using these questions. The questionnaire comprised two components. The Introduction comprises seven paragraphs that provide social and demographic information. The variables to consider include age, gender, years of professional experience, years of formal education, and involvement in chemical and biological safety training initiatives. The second component focuses on the understanding of healthcare practitioners regarding the existence of chemical-based indoor air pollution. This section comprises a grand total of sixteen inquiries, and the permissible options for each query are restricted to "yes," "no," or "I am uncertain."

2.3. Assessing and allocating numerical values

The interview was based on a well-structured questionnaire form that was pre-tested in a pilot study and subsequently updated by a literature review to ensure reliable information according to WHO criteria after being presented to experts. The questionnaire consisted of two parts: the first part contained some demographic characteristics and the second consisted of the knowledge and attitude domains.

2.4. Statistical Analysis

The second part of the study evaluated healthcare professionals' level of understanding regarding the presence of chemical pollutants in indoor air. This portion of the 16 questions was evaluated using a Likert scale consisting of three response options: affirmative, negative, and uncertain. The questions in both domains were evaluated using a 3-point Likert scale, with scores ranging from 1 (low) to 3 (high). The correct answer score, which was 3, was computed based on the mean score for each question. Incorrect responses were assigned a score of 1 and ambiguous responses were assigned a score of 2. Consequently, the final score was calculated by averaging individual scores.

2.5. Quantitative Analysis of Data Using Statistical Methods

The data were analyzed using SPSS Version 27, a Statistical Package for the Social Sciences. The second part of the survey evaluated the level of understanding of bacterial pollution in indoor air among health workers. This was done using a three-point Likert scale, which included the response alternatives "yes," "no," or "I am uncertain."

3. Results

3.1. Sociodemographic characteristics of health workers

The study sample comprised 515 healthcare professionals ranging in age from 20 to 59 years, with an average age of 31.06 years and a standard deviation of 8.480 years. Additionally, the data displayed a Gaussian distribution (Table 1).

表 **1**

Table 1 Distribution of health staff based on social and demographic features

Socio-demographic	Groups	No.	Percentage
Age Groups (years)	20-29	302	58.6
	30-39	120	23.3
	40-49	58	11.3
	50	35	6.8
	Mean ± SD	31.06± 8.480 yrs.	
Gender	Male	248	48.2
	Female	267	51.8
Level of Education	High school	21	4.1
	Diploma	173	33.6
	Bachelors	281	54.6
	Postgraduate	40	7.8
Specialty	Physician	17	3.3
	Dentist	10	1.9
	Pharmacy	100	19.4
	Nurses	136	26.4
	Laboratory	139	27.0
	Biology	41	8.0
	others	72	14.0
Experience	<1	41	8.0
	1-4	229	44.5
	5-9	120	23.3
	10-14	59	11.5
	≥15	66	12.8
	M± SD	6.68±7.865	
Training	Yes	155	30.1
	No	360	69.9

The age group between 20 and 59 years constituted the most significant segment, accounting for 58.6% of the total population. Conversely, individuals aged 50 years or older constituted the smallest proportion (6.8%). The average age ± standard deviation (31.06 ± 8.480 years) of the individuals participating in our study was consistent with the results of a comparable study carried out in Accra, Ghana. The findings of this study indicate that individuals aged 29 years or younger accounted for the largest proportion, specifically 45.4%, while those aged 60 years or older had the lowest proportion, specifically 2.9% [20].

The high representation of this particular age group in the study sample can be linked to the Ministry of Health's initiatives to recruit numerous graduates from private medical colleges and institutes annually for employment in the public sector.

The majority of health workers (51.8%) were female, while 48.2% were male. The findings of this study were consistent with those of a previous investigation conducted in the USA [21], which showed that the majority of participants were women (54.4%), while men accounted for 44.3%.

The researcher ascribed the higher number of females to the random selection process and the lower rate of female refusal to participate in the questionnaire.

The survey included health staff with varying levels of education, including 54.6% with a bachelor's degree, 33.6% with a diploma, 4.1% with a high school education, and 7.8% with a post-graduate degree.

The results were consistent with another study conducted in Nigeria, indicating that most participants

(70.3%) held bachelor's degrees, while the smallest proportion (2.1%) consisted of individuals with only a high school education [22].

The report claims that the increased prevalence of individuals with a bachelor's degree among healthcare workers can be ascribed to the widespread growth of commercial and public healthcare and medical institutions. The rise in the number of individuals with bachelor's degrees can be ascribed to the presence of four private and three state institutions exclusively in Najaf, as well as a significant number in other governorates [23].

Furthermore, those who have acquired diplomas from recognized institutions can pursue a bachelor's degree in the corresponding subject of study as their diploma, as authorized by the Ministry of Health.

The occupation with the highest proportion of professionals was laboratory technicians, representing 27.0% of the total. By contrast, dentists comprised the smallest proportion, accounting for only 1.9% of the total. The survey documented the following levels of engagement: physicians, 3.3%; nurses, 19.4%; pharmacists, 26.4%; biologists, 8.0%; and other disciplines, 14.0%.

The researcher posits that the variations in participant numbers and observed variability in the studies can be ascribed to the stochastic selection of medical personnel and unequal allocation of healthcare workers among hospitals.

Most health workers (44.5%) had between one and four years of experience, with the lowest number having less than one year of experience.

This finding was in line with another survey conducted in Nigeria, which revealed that most participants (52.8%) had less than five years of experience [22]. The limited years of experience among healthcare workers can be attributed to the high number of young employees and the influx of recent graduates from medical and healthcare colleges in 2023, particularly in hospital settings.

Alternatively, there is education on the principles of biological and chemical safety. According to input from healthcare professionals, 69.9% of them did not sign up for or participate in training programs, whereas 30.1% of the participants stated that they either completed or were already in the process of enrolling in courses.

3.2. Workers' Understanding of Chemical Pollutants in Hospital Environments

Approximately 27.7% of health professionals had good knowledge of chemical pollutants in the indoor air of hospitals. On the other hand, 68.0% of respondents had satisfactory understanding, whereas 4.3% had insufficient information.

This finding is similar to that of a study conducted in Thi-Qar, Iraq, which showed that the overall knowledge of medical and para-medical staff was moderate [24].

A study conducted in Nigeria showed that respondents (57.6 %) had a high level of knowledge, while (42.4 %) had a low level of knowledge [22].

Another study conducted in Iran demonstrated that 49.3% of the participants had adequate awareness and knowledge [25].

A study conducted in India showed that the majority of the participants (69.8%) possessed a high level of understanding of workplace dangers and safety precautions [26].

This moderate level of proficiency may not be sufficient, given its important function in hospitals and frequent exposure to biological and chemical pollutants. The absence of training programs for control, prevention, management, and ongoing education, coupled with the lack of testing to verify the knowledge and skills of healthcare workers as well as inadequate or non-existent policies and initiatives addressing the chemical hazards of indoor air, all contribute to this problem.

表 **2**
Table 2 Overall knowledge of the study participants

Scale	M ± SD	Score	No.	%	Ass.
Overall knowledge 35 Q	77.13±9.223	Poor	22	4.3	Fair
		Fair	350	68.0	
		Good	143	27.8	
		Total	515	100.0	

M: Mean total score; SD: standard deviation

Level of assessment [Poor = 35-58.33; Fair= 58.34-81.66; Good= 81.67-105]

The research findings indicate that a substantial percentage (68.0%) of medical personnel had a satisfactory understanding of indoor air pollution caused by chemicals, as evidenced by their average scores (77.13±9.223).

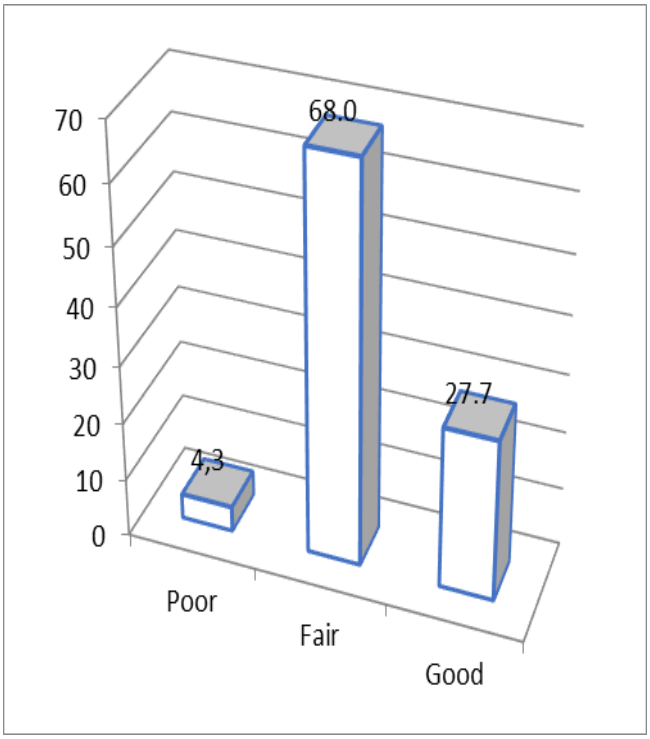

图 **1**
Fig.1 Overall knowledge

The Kruskal-Wallis H test revealed statistically significant differences in medical staff knowledge, with all variables of our study being less than (0.05) except for gender (p-value= *0.874* > 0.05); thus, there was no significant association with overall knowledge (Table 3).

表 **3**
Table 3. Statistically significant differences in medical staff knowledge according to the variables

Variables	*Sig.*
Age	0.001
Gender	0.874
Level of Education	0.001
Specialty	0.001
Experience	0.004
Training	0.020

These findings are similar to those of another study conducted in Northern Cyprus, which illustrated that all sociodemographic features except gender have a significant association with health workers' knowledge [27].

Another study conducted in India found that the variables (age, education, occupation, and working experience) have significantly associated with knowledge, whereas training programs had no significant association [26].

According to [28], healthcare workers' knowledge increases with increasing number of training courses.

A study conducted in Palestine revealed that training courses had a positive impact on participants' overall knowledge [29].

5. Conclusion

According to the findings of our recent study, we determined that approximately 27.7% of healthcare professionals possess a high level of understanding of chemical pollution in the indoor air of hospitals. Consequently, enhancing these standards through continuous training in biological safety is imperative. Our findings indicated a strong correlation between training programs and knowledge in this area. Furthermore, a significant percentage of healthcare experts are younger and have recently entered this field. Research has demonstrated a statistically significant association between educational level and years of experience.

Moreover, a significant proportion of participants were younger and did not participate in the training sessions. The sociodemographic variables of gender did not independently influence the level of knowledge about bacterial contamination.

Limitations of the Study

1) Obtaining information can be challenging on certain days because of excessive occupancy in certain apartments.

2) Some healthcare workers refused to fill out the questionnaire because of time constraints or concerns about potential conflicts with their supervisors.

Declarations

Author Contributions

Zahra N. Dhaief Altamimi contributed to research conceptualization, completion of the practical section, and visualization of the research data. **Ahmed A. abd-alameer AL-Khafagi** contributed by writing the abstract, introduction, and references. **Oday M. Hadi Zwain** contributed to the statistical analysis of the data and writing of the Discussion section.

Ethical Approval and Consent to Participate

This research proposal was presented to the Al-Najaf Al-Ashraf Health Department. Authorization was performed prior to data collection. All three main hospitals in Al-Najaf were provided with a cover letter containing an information sheet detailing the study objectives and time required to complete the questionnaire. The cover letter also includes a consent form. Every healthcare expert provided verbal consent for data collection after receiving comprehensive information about our objectives, methodologies, and potential advantages of the study for their field.

Conflict of interest

The authors declare that they have no conflicts of interest.

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