European Journal of Occupational Health Nursing

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Editorial

Occupational biological risk in healthcare workers

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Editor in Chief
European Journal of Occupational Health Nursing

Biohazardous occupational accidents represent a significant challenge in the healthcare field due to the constant exposure of healthcare workers to pathogens. These accidents, which include needle sticks, cuts, splashes of body fluids, and contact with contaminated materials, can lead to serious infections, such as hepatitis B (HBV), hepatitis C (HCV), and HIV.

World Health Organization (WHO) estimates that approximately two million healthcare workers experience sharps injuries annually, resulting in a significant risk of exposure to blood-borne pathogens [1]. A study conducted in hospitals in Europe revealed that the prevalence rate of needlestick injuries ranges from 10% to 30% per year, with the highest rates in areas such as surgery and intensive care [2]. The high frequency of these incidents underscores the importance of implementing effective preventive strategies to protect these workers. There are several factors that increase the risk of biological hazard occupational accidents among healthcare workers:

• Invasive Procedures: Workers involved in invasive procedures, such as surgery or catheter insertion, are at higher risk due to direct contact with blood and other body fluids. Surgeons and other specialists are particularly exposed to these risks. A study in Italy showed that surgeons have a higher incidence of needlestick injuries compared to other healthcare workers due to the nature of their tasks [3].

• Training and Awareness: Lack of adequate training on the safe handling of biological materials increases the risk of accidents. Doebbeling et al. [4] found that ongoing training programs, focusing on the correct use of personal protective equipment (PPE) and the adoption of safe practices, can significantly reduce the incidence of these accidents.

• Workload and Fatigue (Psychosocial Factors): Workload, long shifts, and fatigue are associated with an increased risk of biological accidents. A longitudinal study, conducted in developing countries, showed that healthcare workers with high levels of fatigue are 25% more likely to suffer accidents related to exposure to pathogens [5].
• Inadequate Use of Personal Protective Equipment (PPE): Although PPE is essential to protect workers, its use is often inconsistent or incorrect. Oliveira et al. [6] in a study conducted in Brazilian hospitals found that lack of adherence to the use of PPE is an important factor in the high incidence of biological accidents. The proper and consistent use of this equipment is crucial to minimize exposure to risks.

The consequences of occupational accidents due to biological risk can be serious, affecting both the physical health and psychological well-being of healthcare workers:

• Acute Infections: Exposure to biological agents can result in severe acute infections, such as HIV, HBV and HCV. Acute HCV infection, for example, can progress to chronic hepatitis in up to 85% of cases, underlining the seriousness of these exposures [7].
• Chronic Diseases: Some workplace-acquired infections can progress to chronic diseases, such as liver cirrhosis or liver cancer, which has long-term implications for worker health [8].
• Psychological Impact: The psychological stress resulting from a biological workplace accident can be significant. Workers who suffer these incidents may experience anxiety, fear, and in some cases, post-traumatic stress disorder (PTSD) [9]. This psychological impact can affect not only their general well-being, but also their job performance.

Preventing workplace accidents due to biological risk is crucial to protect healthcare workers. Effective strategies include:

• Continuing Education and Training: Providing ongoing training on identifying and managing biological risks is essential. One study showed that regular training programs can reduce the incidence of biological accidents by 30% [10]. These programs should focus on safe practices, such as proper use of PPE and compliance with safety protocols.

• Sharps Safety Protocols: Implementing strict protocols for handling and disposing of needles and other sharp objects can significantly reduce the risk of accidents. The use of safety devices, such as needles with protective mechanisms, has been shown to reduce needlestick injuries by 40% [11].

• Personal Protective Equipment (PPE): Providing and ensuring proper use of PPE is critical to preventing exposure to pathogens. One study highlighted that adequate access to and correct use of PPE is essential to preventing occupational infections [12].

• Vaccination: Vaccination is a key preventive measure, especially against HBV. Workplace vaccination campaigns should be mandatory and well coordinated to achieve high coverage. The Centers for Disease Control and Prevention (CDC) has been recommending for decades that all healthcare workers be vaccinated against HBV to reduce the risk of transmission in the workplace [13].

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European Journal of Occupational Health Nursing

EJOHN is the scientific journal of FOHNEU

Original Article

Psychosocial factors as determinants of biological accidents in healthcare workers

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ABSTRACT

Objective: To determine the influence of psychosocial factors on the prevalence of accidental biological exposures (ABE) in healthcare workers.

Methods: Observational, retrospective, cross-sectional, descriptive, retrospective study of 475 healthcare workers at the Clínico-Malvarrosa Health Department (Valencia) during 2.022. Sociodemographic and occupational characteristics, sleep quality with the Pisttsburg Questionnaire (PSQI), anxiety with the Generalized Anxiety Scale (GAD-7), stress with the Perceived Stress Scale (PSS-10), burnout with the Maslach Burnout Inventory (MBI) and physical activity with the International Physical Activity Questionnaire (IPAQ) were analysed. At the same time, we asked whether they had suffered from work-related ABE in the last year. Significant differences were sought by correlating ABE with psychosocial disturbances.

Results: Mean age was 38.4 years with a mean working time of 11.7 years. Forty-three per cent were nurses and 87% worked in hospitals and 13% in primary care. 26% suffered ABE in the past year. Most of them had poor sleep quality and anxiety. The mean score on PSS-10 was 12.6, (considerable stress). The burnout subscale of the MBI showed a mean score of 17, depersonalisation 6.1 and personal fulfilment 40.2. Forty-three per cent did not meet physical activity recommendations.

Predictor variables of ABE from multivariate analysis: age, sleep quality, anxiety, stress, depersonalisation, low personal accomplishment and hours sitting per day.

Conclusions: The health workers who suffered ABE, slept worse, had greater anxiety, stress and a tendency to burnout syndrome in terms of depersonalisation and professional burnout and sedentary lifestyle.

Keywords: Occupational risk factors; biological risk; occupational accident; healthcare workers; needle sticks; occupational health.

Article history

Received: March 17, 2024

Revised: April 21, 2024

Accepted: May 18, 2024

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Amores-Lizcano E. Psychosocial factors as determinants of biological accidents in healthcare workers. *Eur J Occ Health Nurs*. 2024; 1(1):5-21. DOI: 10.70324/ejohn.v3i1.30

Introduction

Occupational exposure to blood and body fluids is a serious concern for healthcare workers and represents a major risk factor for the transmission of infectious diseases such as hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) [(1)]. The risk of transmission by percutaneous injury is estimated to be 3-10% for HCV-infected blood and 7-30% for HBV [(2)].

Knowledge of the correct handling and disposal of sharps influences healthcare workers' behaviour and can lead to errors with serious consequences. It is therefore essential that organisational managers provide materials with biosafety devices [(3)]. Although the risk of injury cannot be eliminated with these instruments, it is significantly less than with conventional instruments. It has been reported that safety measures are more effective when healthcare workers are well trained in the use of such equipment [(4)].

Recording these accidents is another necessary measure to reduce the number of bio-injuries among healthcare workers. In this sense, the monitoring of cases makes it possible to introduce new strategies for improvement, new prevention plans and, in general, to improve the quality of the work of healthcare workers, while recognising their rights [(5)].

However, although the exposure of healthcare workers to fluid-borne pathogens is a very important issue, the risk factors that expose them to these pathogens are not well defined [(6)]. Based on published research on this topic, there is a significant association between increased psychosocial stress at work and the likelihood of accidental biological exposure (ABE) [(5,6)]. Healthcare workers are known to be exposed to high levels of psychosocial pressure, which can affect their behaviour and lead to poor concentration, impaired memory, low motivation and self-esteem, burnout, anxiety and depression, and work-related stress [(7)]. In addition, an increased workload can lead to a tendency towards burnout, which usually begins with physical and emotional exhaustion, detachment, cynicism, ineffectiveness and lack of personal fulfilment. In many cases, these symptoms may go unnoticed by the healthcare worker [(7,8)]. Similarly, lack of a healthy lifestyle, such as a sedentary lifestyle, can exacerbate the negative characteristics of healthcare workers' work and further predispose them to

psychosocial risk factors [9].

In general, hospitals can prevent or reduce ABE by creating a better working environment in terms of adequate staffing and resources, and by minimising emotional exhaustion. Healthcare facilities can reduce or even prevent such injuries by improving working conditions. This depends on the implementation of organisational policies [5].

This study aims to determine the influence of psychosocial factors in healthcare workers on the prevalence of their unintentional biological exposures.

Methods

Study design. Population. Sample

Retrospective descriptive epidemiological study. The total number of health workers in the Department of Health under study is 4.200-4.500 workers. If we take into account that the total number of health workers in the Clínico-Malvarrosa Health Department is 4.500, applying a confidence level of 95% and a margin of error of 5%, the optimal study population would be 354 health workers. We studied 475 healthcare workers from the Clínico-Malvarrosa Health Department in Valencia during the year 2022. Inclusion criteria included health workers such as nurses, doctors, residents in training, nursing assistants, midwives and stretcher bearers.

Variables and measurement instruments

The data were collected during the year 2.022, capturing the workers from the occupational health examinations and clinical sessions carried out by the Occupational Risk Prevention Service of the Clínico-Malvarrosa Health Department of Valencia. No discrimination was made between workers who had or had not suffered an ABE, in order to avoid bias. The following explanatory variables were analysed for each of the 475 workers: quality of sleep, possibility of anxiety and stress and the three subscales that define burnout syndrome -emotional exhaustion, depersonalisation and low personal fulfilment-. Each employee was also asked about possible exposure to biological accidents during the last year (outcome variable).

For the study of sleep quality, the PSQI questionnaire was used, consisting of 24 items, 19 of which are taken into account for correction. It is divided into 7 dimensions: subjective

sleep quality, latency, duration, efficiency, sleep disturbances, medication use and daytime dysfunction. It is answered on a Likert-type scale ranging from 0 to 4. For its correction, a sleep profile is obtained for each of the dimensions ranging from 0 to 3 and a total score ranging from 0 to 21 [10]. In addition to the numerical value, the results of this questionnaire were dichotomised as good sleep quality (5 points or less) or poor sleep quality (more than 5 points).

For the study of generalised anxiety, the GAD-7 questionnaire was chosen, consisting of 7 Likert-type response items from 0 to 3 that include the symptoms and disability associated with the disorder. For its correction, a total score is obtained from the sum of the scores of all the items, which can range between 0 and 21. In the original version, the authors propose a cut-off point of greater than or equal to 10 [11].

The PSS-10 questionnaire, a short version of the PSS-14 scale, was used to determine stress levels. The PSS-10 score is obtained by inverting the scores of items 6, 7, 8, and 9 and adding the 10 items together. It is a direct scale, i.e. the higher the score, the higher the stress levels [12].

For the assessment of burnout syndrome, the Maslach Burnout Inventory (MBI) questionnaire was used, consisting of 22 items in the form of statements on the feelings and attitudes of the professional at work. It measures the 3 aspects of Burnout Syndrome on the basis of three subscales:

1. Emotional exhaustion or burnout subscale: It assesses the experience of being emotionally exhausted by the demands of the job. It consists of 9 questions (1, 2, 3, 6, 8, 13, 14, 16, 20.) Maximum score 54.

2. Depersonalisation subscale: Assesses the degree to which one recognises attitudes of coldness and detachment. It is made up of 5 items (5, 10, 11, 15, 22.) Maximum score 30.

3. Self-fulfilment subscale: Assesses feelings of self-efficacy and self-fulfilment at work. It consists of 8 items (4, 7, 9, 12, 17, 18, 19, 21.) Maximum score 48 [13].

For the evaluation of the level of physical exercise, the workers were given the International Physical Activity Questionnaire - Short Form (IPAQ-SF) which contains 7 questions. This questionnaire was used to determine the total minutes of physical activity per week and the hours of sedentary time [14].

Statistical analysis

First, descriptive statistics were performed using absolute and relative frequencies for categorical variables, and mean and standard deviation (SD) for quantitative variables. Then, a bivariate analysis was performed to determine the relationship between the different socio-demographic characteristics, physical activity, sleep quality, stress, anxiety and burnout with the occurrence of a biological accident, using Pearson's chi-square test and estimating the odds ratio (OR) with its respective 95% confidence interval (CI). When the normality analysis was performed on the quantitative variables, all obtained a value of $p<0.001$, so the non-parametric Kruskal-Wallis test was used.

Finally, a multivariate analysis was performed using binary logistic regression. The aim of this analysis was to develop a predictive model of biological accident risk, using the backward stepwise variable selection system of SPSS. With the variables selected in the multivariate model, the predictive capacity was calculated using the area under the ROC curve (AUC). All statistical analysis was carried out with the SPSS statistical program.

Results

Description of the study sample

Table 1 shows the descriptive analysis of the variables analysed. The mean age of the workers studied was 38.4± 11.8 years, with a mean working time of 11.6 ± 10.8 years. Forty-three per cent of the subjects (205) were nurses and 87% (413) worked in hospitals, compared with 13% in primary care. Of the 475 workers, 26% (123) had experienced ABE in the previous year. According to the results of the Pittsburgh Scale and GAD-7, the majority of healthcare workers had poor sleep quality and high levels of anxiety. The mean score on the PSS-10 scale was 12.6 ± 6.2 (considerable stress). With regard to the MBI, the burnout subscale has a mean of 17 points ± 10.7, the depersonalisation subscale a mean of 6.1 ± 4.9 and the self-fulfilment subscale a mean of 40.2 ± 6.5. Forty-three per cent of workers (205 of the total) did not meet the physical activity recommendations.

Table 1. Descriptive analysis of the variables included in the study.

Variables		n (%)	Mean ± SD
Gender	Female	380 (80)	
	Male	95 (20)	
Age, years		475	38.4 ± 11.8
Time worked		475	11.7 ± 10.8
Occupation	Nurse	205 (43)	
	Resident nurses	23 (5)	
	Stretcher-bearer	40 (8)	
	Doctor	50 (11)	
	Resident doctors	25 (5)	
	Nurse assistant	127 (27)	
	Midwives	2 (0)	
	Others	3 (1)	
Assistance	Primary care	62 (13)	
	Hospital	413 (87)	
Service	Primary care	62 (13)	
	Surgical speciality	209 (44)	
	Medical speciality	204 (43)	
BIOLOGICAL ACCIDENTS	Yes	123 (26)	
	No	352 (74)	
Pittsburgh		475	7.3 ± 3.7
Sleep quality	Good	169 (36)	
	Poor	306 (64)	
GAD-7		475	6.6 ± 5
Anxiety	No	194 (41)	
	Yes	281 (59)	
PSS-10		475	12.6 ± 6.2
MBI	Burnout subscale	475	17 ± 10.7
	Despersonalization subscale	475	6.1 ± 4.9
	Self-fulfilment subscale	475	40.2 ± 6.5
Total minutes of physical activity		475	271.9 ± 305.5
Sitting time per day (hours)		436	12 ± 4
Compliance with WHO physical activity recommendations	Yes	270 (57)	
	No	205 (43)	

Bivariate analysis

It was performed between the quantitative variables and the risk of biological accident (Table 2), with the probability of suffering an ABE being statistically significant among younger workers, those who slept less well, those who showed more stress and anxiety, and those who showed high depersonalisation, exhaustion and low personal fulfilment. Qualitative variables and ABE were then analysed (Table 3). A statistically significant association was found with being a nurse, reporting poor sleep quality or showing high levels of anxiety.

Table 2. Analysis of quantitative variables in relation to exposure or not to biological accidents.

	Biological accidents (Mean ± SD)		***p***			
	YES	**NO**	**Kruskal-Wallis**	**OR 95%CI**	***OR 95%CI**	***p***
Age, years	35.5 ± 9.8	39.4 ± 12.3	0.004	0.030 (1.012-1.050)	0.034 (1.011-1.058)	0.002
Time worked	10.8 ± 9.7	11.9 ± 11.2	0.924	0.010 (0.991-1.030)		
Pittsburgh	9 ± 3.4	6.7 ± 3.7	<0.001	-0.161 (0.804-0.901)		
GAD-7	8.9 ± 5	5.7 ± 4.7	<0.001	-0.123 (0.848-0.923)	-0.140 (0.808-0.935)	<0.001
PSS-10	13.9 ± 6.6	12.1 ± 6.1	0.033	-0.046 (0.924-0.987)	0.111 (1.053-1.186)	<0.001
MBI Sub. burnout	20.9 ± 9.9	15.6 ± 10.6	<0.001	-0.045 (0.937-0.974)		
MBI Sub. despersonalization	8.4 ± 4.2	5.3 ± 4.9	<0.001	-0.127 (0.843-0.920)	-0.062 (0.891-0.991)	0.021
MBI Sub. self-fulfiment	37.2 ± 5.7	41.3 ± 6.5	<0.001	0.091 (1.061-1.132)	0.085 (1.040-1.139)	<0.001
Total minutes PA	281.8 ± 311.1	268.4 ± 303.9	0.702	0 (0.999-1.001)		
Sitting time per day (hours)	3.8 ± 2	12 ± 4.2	0.067	0.096 (0.987-1.227)	0.134 (1.013-1.291)	0.026

Multivariate analysis

The next step in the analysis was to develop a predictive model of biological accident risk (Table 2 and Table 3). The multivariate analysis showed age with an OR of 0.34 (95% CI: 1.011-1.058), sleep quality (good or poor) with an OR of -1.045 (95% CI: 0.184-0.672), GAD-7 questionnaire score with an OR of -0.14 (95% CI: 0.808-0.935), PSS-10 questionnaire with an OR of 0.111 (95% CI: 1.053-1.186) and MBI with an OR of -0.062

(95% CI: 0.891-0.991), and for self-fulfilment with an OR of -0.062 (95% CI: 0.891-0.991) and self-fulfilment with an OR of 0.085 (95% CI: 1.040-1.139) and sitting hours per day with an OR of 0.134 (95% CI: 1.013-1.291).

The ROC AUC (Figure 1) of this model was 0.802 (95% CI: 0.76-0.85), which is considered good predictive ability according to Swets' criteria [15].

Figure 1. ROC curve

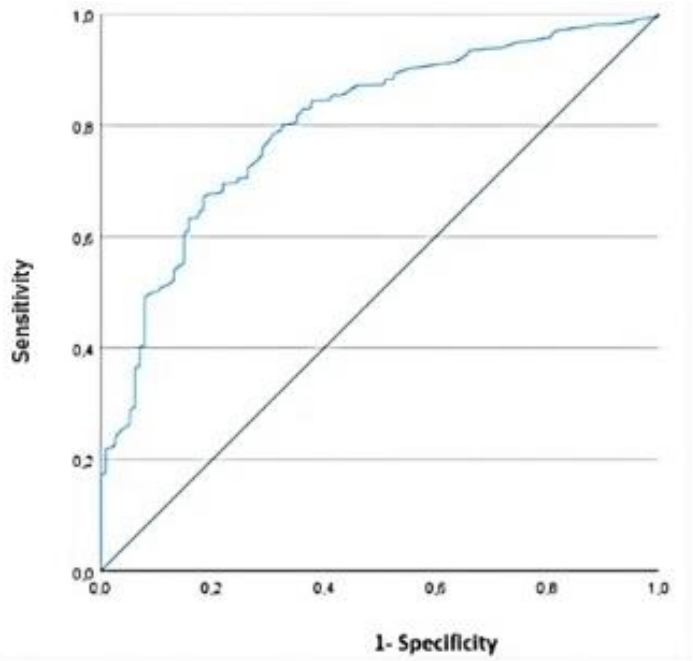

Table 3. Analysis of qualitative variables in relation to exposure or not to biological accidents

		Biological accident n(%)		*p*			
		YES	**NO**	**Chi²**	**OR 95%CI**	***OR 95%CI**	***p***
Gender	Female	99 (80)	281 (80)	0.875	reference		
	Male	24 (20)	71 (20)		0.041 (0.622-1.747)		
PROFESSION	Nurse	71 (58)	134 (38)	<0.001	reference		
	Resident nurses	5 (4)	18 (5)		0.646 (0.680-5.352)		
	Stretcher-bearer	2 (2)	38 (11)		2.309 (2.360-42.948)		
	Doctor	14 (11)	36 (10)		0.309 (0.690-2.692)		
	Resident doctors	11 (9)	14 (4)		-0.394 (0.291-1.563)		
	Nurse assistant	20 (16)	107 (30)		1.042 (1.623-4.950)		
	Midwives	0 (0)	2 (1)				
	Others	0 (0)	3 (1)				
ASSISTANCE	Primary care	24 (20)	38 (11)	0.013	reference		
	Hospital	99 (80)	314 (89)		0.695 (1.146-3.503)		
SERVICE	Primary care	24 (20)	38 (11)	0.032	reference		
	Surgery speciality	54 (44)	155 (44)		0.595 (0.997-3.295)		
	Medical speciality	45 (37)	159 (45)		0.803 (1.214-4.102)		
SLEEP QUALITY	Good	17 (14)	152 (43)	<0.001	reference	reference	0.001
	Poor	106 (86)	200 (57)		-1.556 (0.121-0.367)	-1.045 (0.184-0.672)	
ANXIETY	No	23 (19)	171 (49)	<0.001	reference		
	Yes	100 (81)	181 (51)		-1.413 (0.148-0.401)		
Compliance with WHO physical activity recommendations	Yes	66 (54)	204 (58)	0.408	reference		
	No	57 (46)	148 (42)		-0.174 (0.556-1.269)		

Discussion

The objective of this study was to know the influence of psychosocial factors on the prevalence of biological accidents among healthcare workers. The results show that workers who have suffered an ABE are younger, have poorer sleep quality, greater stress, anxiety and sedentary lifestyle and worse results on the MBI in the personal accomplishment and depersonalization subscales.

On the one hand, age seems to be a determining factor when experiencing ABE. Other studies have shown how the majority of these accidents occur in workers between 20 and 30 years old, which may be due to their lack of experience, something that would lead them to feel unsafe when performing procedures [16]. There could, therefore, be a correlation between lower ability –linked to age or years of experience– and ABE [17].

On the other hand, poor sleep quality may also be influencing ABE [18]. 32% of healthcare workers report that they do not get enough sleep. Drowsiness and fatigue can reduce attention, increase the probability of making errors during work and affect the safety of both the patient and the worker themselves [19,20]. A study of Australian nurses confirmed that the frequency of work errors increased considerably when they were tired [19]. This may be determined by long working hours and shift work [18,19]. Valent et al. [21] demonstrated that Emergency Medical Services workers experienced biological accidents up to approximately two times more in the case of lack of sleep and three times more in the case of fatigue. Employees who work in shifts are more particularly exposed to fatigue, thus confirming that the design of good work schedules, the establishment of work strategies, as well as an adequate periodic evaluation of the quality of workers' sleep can be very useful.

It has been proven that fatigue caused by the work day can negatively interfere with the activities carried out during work since it causes not only tiredness, but also difficulty concentrating, irritability, poor communication skills and worse emotional coping at work. Neurocognitive performance decreases, encouraging work-related accidents and psychological illnesses and negatively affecting patient care [21-23]. García-Batista et al. (24) confirmed the association between sleep problems and work-related injuries. Specifically, we can talk about a 1.6 times greater risk of injury at work among workers who sleep poorly, with approximately 13% of work injuries attributable to sleep problems. Likewise,

the possibility that healthcare workers have worsened their sleep quality after the SARS-CoV-2 pandemic must be considered. Masoumi et al. [25] concluded that the average duration of night time sleep decreased by 38 minutes among health professionals after the pandemic.

If we want to reduce the risks associated with poor sleep, it is important to make sleep a priority in work organization systems among healthcare workers. As stated by Uehli et al. [23] in their meta-analysis, organizational managers should make periodic evaluations to examine the extent to which work schedules may be affecting performance, alertness, sleep, and, therefore, injuries, work errors and other incidents.

In addition to this, the present study also corroborates that high levels of anxiety and stress are associated with an increase in ABE. A study carried out in March 2.019 with 1.257 healthcare workers showed that more than half of them presented symptoms of depression, anxiety, insomnia and anguish [24].

High stress scores in healthcare workers have a lot to do with long work hours, staff shortages, managing life-threatening illnesses, working in emergency situations, teaching colleagues, patients do not comply, exposure to biological fluids, excess noise, complex procedures, as well as dealing with family members [21,26]. This is very relevant if we take into account that work stress can decrease empathy towards patients, increase aggressiveness and, therefore, affect the quality of the services provided. Furthermore, high levels of stress are associated with care errors towards both the patient and the healthcare provider themselves, demonstrating the correlation with ABE [24]. Some of the interventions that may be beneficial to reduce work stress would be: clearly defining the tasks and roles of each worker, educating in safe work practices or good communication between colleagues [27]. If we pay attention to the psychological aspects of our healthcare workers, we will not only be promoting health in this group, but we will also be making an investment in the quality of the care provided [20]. This would increase the feeling of security at work and could significantly influence ABE rates [27].

Associated with high levels of stress and anxiety would be professional burnout or burnout syndrome. This condition appears as a response to a prolonged situation of interpersonal stressors caused by work and manifested by exhaustion, depersonalization and reduced personal fulfilment. Its control and prevention involves the implementation of

interventions focused on the individual, as well as structural and organizational measures [28].

Lastly, the study shows a greater exposure to biological accidents among sedentary healthcare workers. Overall, 1 in 4 adults currently do not meet the global physical activity recommendations set by the World Health Organization (WHO). Physical activity can and should be integrated into the environments in which people live and work [29]. Promoting healthy behaviours among healthcare workers can improve well-being and professional performance in addition to setting a better example for patients [30]. Research in the United States shows that nurses who worked shifts for more than 20 years had less healthy lifestyles [31] and an association has been seen between mental conditions such as anxiety and stress and lack of physical activity [32]. In general, people who practice physical exercise have greater psychological well-being [33], so if the reduction in levels of stress and anxiety can be associated with the reduction of ABE, the increase in physical activity can also [32].

Limitations of the study

It should be considered that psychosocial factors affecting healthcare workers are not always work-related, but can also be influenced by personal circumstances.

Conclusions

The health workers who suffered ABE were those who were younger and had worse results in sleep quality, higher levels of anxiety, stress, as well as a greater tendency to burnout syndrome in terms of depersonalization and professional burnout. Likewise, these workers presented results indicative of a sedentary lifestyle in the IPAQ questionnaire.

Final observations

Training in ABE prevention for workers, especially the most inexperienced, should be insisted on. On the other hand, it would be necessary to carry out a good work organization, with adequate staff rotations that facilitate rest, as well as, to the extent possible, conveniently structure the workload with the aim of controlling levels of anxiety, stress or burnout syndrome among workers. A good instrument for this could be the promotion of physical activity that favours the psychological well-being of healthcare workers.

Acknowledgements

Our thanks to the workers of the Clínico-Malvarrosa Health Department of Valencia for their collaboration in filling out all the relevant scales, as well as to the Occupational Risk Prevention Service, for facilitating the recruitment of the sample.

This work has not required funding.

The author declares that she has no conflicts of interest.

At all times, the data provided by the participants in the study have been protected, with the surveys being guarded exclusively by the main researcher. All procedures carried out during the study were carried out in accordance with current ethical standards. The data obtained was anonymous since the information was collected by assigning a fictitious identifier. Access to these data was exclusive to the researcher, guarding and using them only to fulfil the purposes of the study. The procedures were followed in accordance with the Helsinki Declaration revised in 2.013.

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European Journal of Occupational Health Nursing

EJOHN is the scientific journal of FOHNEU

Short Original Article

Collaboration between nurses in a vaccination day against Covid-19 in a meat industry in Lleida health region (Spain)

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ABSTRACT

The need for a collaboration between the public health system (PHS) nurses and the occupational nurses from occupational risk prevention services (ORPS) was made evident during the Covid-19 pandemic. In Catalonia, several examples of beforementioned necessity were seen. This document analyses the experience both PHS nurses and ORPS nurses had during the vaccination program of a meat industry workers. It was concluded that coordination and synchronization between both parts is, not only possible, but also key in bettering health markers at a community level. Planning and intervention from an occupational standpoint have proven effective and opens the door to future collaborations between occupational nurses and other nursing specialties.

Keywords: Occupational risk factors; biological risk; occupational accident; healthcare workers; needle sticks; occupational health.

Article history

Received: June 10, 2023

Revised: October 13, 2023

Accepted: January 6, 2024

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Soler-Saña M, Puiggené-Vallverdú M. Collaboration between nurses in a vaccination day against Covid-19 in a meat industry in Lleida health region (Spain). *Eur J Occ Health Nurs*. 2024; 3(1):22-28. DOI 10.70324/ejohn.v3i1.29

Introduction

The Covid-19 pandemic has demonstrated the vital role that health and safety at the workplace plays in safeguarding the worker's health, the well-functioning of society and the maintenance of continued economic and social activity. Therefore, economic growth and reactivation of productivity depends on a renewed compromise of making health and safety at work a priority and improving synergies between health and safety at work and public health policies[1].

Workplaces during and after the pandemic have grown in complexity, for this reason, an updated vision of the world of work that is in constant transformation is necessary. The COVID-19 pandemic has emphasized these complexities and has made health, safety at work and public health policies intertwine more than ever[1].

The occupational nurses from occupational risk prevention services (ORPS) have collaborated actively throughout the pandemic from their workplace, extending their activity to circumstances that affect the health of workers[2], carrying out different actions such as the study and management of cases and contacts, study and management of vulnerable people and workers especially sensitive in relation to infection by the SARS-CoV-2 and the performance of microbiological diagnostictests. All these actions have been carried out in cooperation with the health authorities and public health services[3].

We can safely state that the collaboration between nurses from the public health system (PHS) and the occupational nurses of ORPS has intensified during the COVID-19 pandemic. In Catalonia we have had several examples of this collaboration, one of them has been the exemplary vaccination campaign carried out in 2021.

The great task carried out by the nurses in Catalonia, leading the vaccination against COVID-19, with more than 14,000,000 doses administered in just over a year, makes the nursing profession claim its key role and the need for experience to face the high complexity that hides behind the immunization process[4]. This task has been of great significance in the labor market in Lleida. The aim of this study is to assess, using de SWOT analysis, the weaknesses, threats, strengths and opportunities how the collaboration between the different professional teams was perceived during the vaccination program against COVID-19 for the meat industry workers in LLeidaHealth Region.

Methods

A qualitative study of situation assessment was carried out using a SWOT analysis. The data source to conduct the assessment were four individual interviews with each team coordinator. The interviews were held by phone to facilitate the response of the professionals from each of the areas that intervened in the immunization action. All the participants agreed to the interview voluntarily and expressed their consent explicitly. An *ad-hoc* questionnaire was used, designed specifically to assess the strengths, weaknesses, opportunities and threats that were perceived during the collaboration amongst the different teams that participated in the vaccination campaign. The questionnaire consisted of 15 open questions directed to the coordinator of the vaccination team of the PHS, the coordinator of the ORPS, the coordinator of Vaccination plan to the COVID-19 in Health Region Lleida and the coordinator of the Occupational Health Service in Health Region Lleida.

The questions were the following:

1. Do you think it was positive for the users/workers to have more human resources with qualified healthcare personnel?
2. Do you think vaccinating in the company installation was a good strategy to facilitate access to the vaccine to the working population?
3. Do you think there was good predisposition to collaborate amongst the different teams that intervened in the campaign?
4. Do you think the facilities where the vaccination task took place were adequate for that purpose? Why?
5. Do you think the sanitary conditions where the vaccination task took place were adequate for that purpose? Why?
6. Was the organization carried out by the company adequate? Why?
7. Do you think that a specific sector of the population could be accessed more easily? Which one?
8. Did the vaccination campaign make it possible to carry out health promotion?
9. Did the vaccination campaign make it possible to publicize the occupational risk prevention service?
10. Do you think that the users/workers believed false myths about vaccines?

11. Do you think the users/workers were reluctant to use the company healthservices?
12. Do you think that users/workers had decent access to health care?
13. In general, how do you assess the action taken in the company?
14. In general, how do you rate the experience of working with health professionals from other health fields?
15. Would you recommend carrying out future health actions together with health professionals from other fields in the work environment?

Ethic principals

The procedures followed in this analysis were in line with the Helsinki Declaration revised in 2013.

Results

Strengths

- More qualified health personnel. Resource optimization
- Good understanding between professionals from different fields, collaboration and clear objectives
- The company collaborated; provided data, provided space and time
- The action generates respect and trust towards the health system as well as decent access to health care

Weaknesses

- The workspace was not optimal, not adapted to the usual use of sanitary processes
- Minimum sanitary conditions, occasionally lack of space and ventilation
- Cadence not respected, temporary space between line stoppages hinders thespeed of the action and its proper organization

Opportunities

- Future collaborations, for the good development shown in the coordination
- Introduce the company's occupational risk prevention service (ORPS) to the Support for

health professionals of the public health service of Catalonia (SISCAT), tothe company and workers from another perspective

- Access to the most disadvantaged population, difficult to attract or temporaryworkers
- The implicit action of health promotion
- The ORPS is identified as the one that watches over the health of workers
- Excellent, positive and necessary collaboration
- Learning and opportunity

Threats

- False myths about vaccines held by some workers
- Reluctance to use the company's medical services due to fear
- Language barrier, difficulty in understanding
- Limited time of action to carry out health promotion

Having more qualified health personnel at a time when there was a shortage of qualified health labor capable of participating in immunization program was a positive point of consensus in the assessment of all the professionals surveyed. It is also worth noting, the good understanding among the professionals of the different areas shown throughout the day, the clear and common objective brought out an empathetic and beneficial collaboration between them.

All the professionals valued the collaboration as excellent, positive and necessary in the context of the pandemic. The perception of the participants was that the program was an opportunity to work with "colleagues" from different professional backgrounds and to learn about different ways of working.

All the professionals agreed that the false myths surrounding vaccination, the language barrier and the difficulty of understanding between the professionals and some of the workers constituted a threat to the proper development of the program.

The limited time of action was insufficient to carry out health promotion in a desirable way according to the perception of the nursing professionals.

Conclusions

Coordination and synchronization between professionals of the public health system, outside the Support for health professionals of the public health service of Catalonia (SISCAT), with companies and the ORPS is possible.

The importance of planning and intervention from the workplace perspective to improve community health is strategic.

The good outcome of this project and the evidence of the possibility of carrying out joint actions opens the door to future actions between occupational nurses and nurses from other specialties of the public health system.

Conflict of interests

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Acknowledgments

To all the health and administrative personnel who contributed to the good development of the vaccination campaign and especially to the coordinators who represented their team and responded to the survey.

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European Journal of Occupational Health Nursing

EJOHN is the scientific journal of FOHNEU

Original Article

Addressing health disparities. Measuring body composition as a complementary predictor of cardiovascular risk

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ABSTRACT

Introduction. Obesity, increased waist circumference and elevated visceral fat are positively correlated with cardiovascular disease (CVD) risk, in contrast to Mediterranean Diet. Objective: To analyze the association between increased waist circumference (WC), visceral fat (VF), body mass index (BMI), age, sex, total cholesterol, total fat percentage, muscle mass and adherence to a Mediterranean Diet.
Methods. 566 office workers with increased WC (WHO criteria) were included in this multicentre, cross-sectional observational study, when they attended to their job-specific health checkup in Madrid (2023). BMI and body fat distribution (VF, total fat and muscle mass) was obtained using bioimpedance (TANITA™). Sex, age, waist circumference, total cholesterol and PREDIMED questionnaire (adherence to Mediterranean diet) were also collected.
Results. 95.3% of the employees were obese or overweight (BMI). 76.3% had increased TF or were in the obese range. 63% had medium or low adherence to the Mediterranean diet. 50.5% had normal visceral fat. 51.2% had normal cholesterol levels. High VF showed a statistically significant association (P<0.001) with BMI ≥30 (obesity).Being male was associated to greater obesity (P<0.001), high VF (P<0.001) and lower adherence to the Mediterranean diet (P<0.03).Being a woman was associated to high TF (P<0.001).A low adherence to the Mediterranean diet was associated to more VF (P<0.017).
Conclusions. Individual CVR prediction can be completed by clinicians using tools like bioimpedance that considers sex, VF, TF, in addition to BMI and WC.
Keywords: abdominal circumference, mediterranean diet, obesity, total fat, visceral fat.

Article history

Received: March 17, 2024

Revised: April 21, 2024

Accepted: May 18, 2024

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Alcañiz-Martín F, Arenal-Ferreira E, Martínez-Martínez V, Gómez-Paredes L, Muñoz-Gutiérrez J, Pérez-Herreras MC. Addressing health disparities. Measuring body composition as a complementary predictor of cardiovascular risk. *Eur J Occ Health Nurs*. 2024; 1(1):29-43. DOI 10.70324/ejohn.v3i1.39

Introduction

Obesity is a public health problem with a major impact on quality of life and healthcare costs worldwide[1-4]. Spain is no exception, where its prevalence is increasing, also in the working population[1,5,6].

For their classification we use different indeces such as body mass index (BMI)[7,8], waist circumference (WC)[7,9,10,] or visceral fat (VF)[2]. High levels of any of these (BMI ≥ 30 kg/m2, WC ≥ 88 cm in women and 102 cm in men and/or VF ≥ 13) are associated with increased risk of developing insulin resistance, diabetes mellitus and cardiovascular disease (CVD)[2-3,6-8,11-14].

In fact, all three indices are part of cardiovascular risk modifiers (CVR). The European Guideline on Cardiovascular Prevention of 2021[15] aims to improve the prediction (discrimination and reclassification) of a patient's CVR by evaluating these risk modifiers.

However, while BMI and WC are widely used, the same is not true for total body fat percentage (TF) or VF. The relationship between the four indices is not straightforward[2,16]. Furthermore, subclinical atherosclerosis[2] development may be affected differently by VF accumulation than BMI or TF percentage.

Recent studies indicate that accurate knowledge of specific body fat distribution may be more useful than BMI alone in the management of obesity. Analyze body fat and where it is located, may improve the estimation of CVR and better predict insulin resistance and its complications at the individual level[1-2]. For all these reasons, some authors consider the inclusion of this assessment in daily clinical practice to be a priority[8,12].

Bioimpedance analysis (BIA)[17-19] can help make this a reality. This method estimates the percentage of FT and FV in a few seconds. It is a non-invasive, inexpensive, and accessible technique for both the patient and the healthcare professional.

Accurate and individual information about the patient's CVR, can lead to the prescription of appropriate treatment and to improve their cardiometabolic health.

Regardless of this, it is known that benefits can be obtained through a multidisciplinary approach that combines increased physical activity and a proper diet[20]. Specifically, the Mediterranean diet[21-24], which is included among the recommended dietary patterns, it has shown positive effects on most CVRFs (decreases in BMI, WC, lipids, blood pressure and endothelial inflammatory markers).

On the other hand, dyslipidaemia[15,25-26] has been shown to be associated with atherogenesis. Currently, in healthy individuals, the desirable total cholesterol level is below 200 mg/dl. Although for CVR management and therapeutic decisions we rely on low-density lipoprotein or LDL-cholesterol levels. However, the specific association of total cholesterol or its fractions, dietary cholesterol with obesity and cardiovascular disease outcomes remains under review[27]. Some studies have found a positive relationship: the higher the visceral fat, the higher the total cholesterol levels[28].

The main objective of this study was to analyze the relationship between increased WC and other obesity indices (VF or obesity according to BMI) in individuals of different age, sex, total cholesterol, total fat percentage (TF) or muscle mass (MM).

In addition, the adherence to the Mediterranean diet was quantified to measure its relationship with the different obesity indices.

Methods

Study design. Population. Sample

A multicenter, cross-sectional observational study was performed to measure body composition among active workers in a multinational company in the Spanish banking sector. The workers who agreed to participate in our study, were selected by convenience, through attendance to their job-specific health checkup at their company's own Occupational Risk Prevention Service in the Community of Madrid (Spain) between April and December 2023.

A total of 5206 employees participated in the health examination at that time. For a confidence level of 95 % and with a margin of error of 5 %, the representative sample had to include data from at least 358 employees.

Inclusion criteria were being older than 18 years and having elevated WC according to WHO criteria[29] (WC ≥ 88 cm in women and 102 cm in men). Pregnant or postpartum women (none) and 14 individuals were excluded because we did not have all the study outcomes collected. Finally, 566 employees were included in the study, 10.87% of the total, after signing the authorization consent form.

Ethical considerations

All procedures were performed in accordance with the ethical standards of the 2013 Declaration of Helsinki on clinical research[30].

Confidentiality was always respected in accordance with the Spanish law on personal data protection 3/2018[31]. In addition, the employee´s permission was obtained to extract data, anonymously and globally, to conduct epidemiological studies.

Data collection

The occupational nursing staff collected pre specified demographic and clinical measures. Data were collected with WinMEDTRA software and exported to an anonymous Excel spreadsheet.

Variables and measurements

- Demographics. *Age*: in years. *Sex*: male or female.
- Clinical measures.

  WC (waist circumference)[29]: in centimeters (cm). A GulicK™ II tape measure model 67020 was used. The measurement was made at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest.

  Height: in cm. A Seca™ measuring rod was used. Feet together, back straight, heels resting on the measuring rod. The head was in a position that allowed the lower margin of the orbit and the auricular fissure above the swallow to be in the same horizontal plane.

  Weight: in kilograms (kg). The individual was weighed using a Tanita BC 601[32] scale. The worker remained lightly clothed but took off his shoes and removed superfluous weight (pockets, belt, etc.). The individual's characteristics in terms of age, sex, height, and level of physical activity were entered to obtain personalized results. *BMI:* Was calculated automatically by the Tanita BC 601[32] scale based on the kg/m2 formula. Its categories according to the WHO are:

  - Normal: BMI between 18.50 and 24.9
  - Overweight: BMI between 25 and 29.9
  - Obesity: BMI ≥ 30

Body composition: the Tanita BC 601[32] scale took segmental readings of legs, arms, and trunk based on age, sex. Through bioimpedance it reported the following results that were read according to the manufacturer's indications:

a. Percentage of total fat (TF): see Figure 1.

b. Visceral Fat Index (VF): fat in the abdominal cavity. The following categories were considered according to the manufacturer:

- 0 to 12 healthy fat level.
- From 13 to 59 excessive fat level

c. Muscle mass (MM): Counts the amount of muscle in the body (kg).

Total cholesterol levels: blood samples were obtained by peripheral venipuncture after a 10-hour fasting period and were sent to the reference laboratory. They were processed within 48-72 hours.

Total cholesterol levels were determined by automated enzymatic methods and expressed in mg/dl:

- Normal: <200 mg/dl
- Elevated: ≥ 200 mg/dl

Dietary assessment: Adherence to the Mediterranean diet was assessed with the validated PREDIMED[33-34] questionnaire. It consists of 14 direct questions on the frequency and quantity of food consumption: olive oil, fruit, vegetables, pulses, fish, nuts, wine, white meat, red meat, processed meats, and industrial bakery products. Four categories were considered: high adherence 12 -14 points, medium[8 -11], low[5-7] and very low[5].

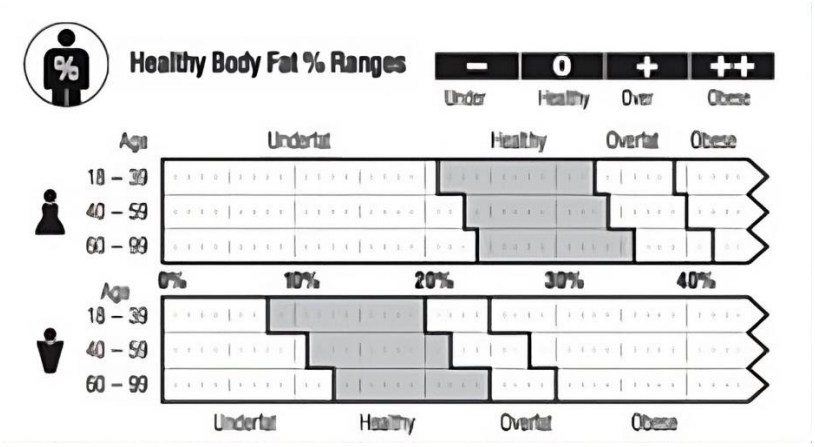

Figure 1. Percentage of total body fat (TF). Tanita Results.

Statistical analysis

Analyses were performed at the individual level. SPSS software version was used.

Quantitative variables were described using the mean and standard deviation (SD).

Qualitative variables were described using absolute frequency and relative frequency by percentages.

Chi-square tests were used to analyze relationships between prevalence of variables.

Results

566 workers were included: 43.9 % (246) were female and 56.1 % (320) male. Most people were 46-55 years old, representing 46.2 % (Table 1). The mean age was 47.84 ± 1.62 years (SD).

Table 1. Sample distribution according to age groups

Age (years)	Absolute Frequency (n)	Relative Frequency (%)
25-35	50	8.8
36-45	186	32.9
46-55	262	46.3
56-65	68	12
Total	566	100

According to their BMI, 95.4 % of individuals with increased WC were either obese (53.89 %) or overweight (41.52 %). Exceptionally, 26 workers (4.59 %) were classified as normal weight.

A total of 76.3 % of the sample had high percentage of TF or were in the obese range.

50.5 % had normal VF (286 employees) and 51.2 % had total cholesterol levels less than 200 mg/dl. A value was statistically significant if $p < 0.05$. Elevated GV and obesity established by BMI were statistically significantly related to $p < 0.001$ (Table 2).

Table 2. Sample distribution according to Visceral Fat Index (VF)

	Visceral fat		Total
BMI	Excess (n)	Normal (n)	
Normal weight	0	26	26
Overweight	219	86	305
Obese	61	174	235
Total	280	286	566

In terms of adherence to the Mediterranean diet, 63 % scored low or medium adherence. By sex, being male was associated with greater obesity (p <0.001), higher VF (p <0.001, Table 3) and lower adherence to the Mediterranean diet (p <0.03) tan being women.

Table 3. Visceral Fat Index (VF) according to sex

	Visceral Fat		Total
Sex	Excess (n)	Normal (n)	
Women	24	222	246
Men	256	64	320
Total	280	286	566

Female sex was statistically significantly (p < 0.001) related to having higher TF (Figure 2). Increased VF was associated with lower adherence to the Mediterranean diet (p < 0.017).

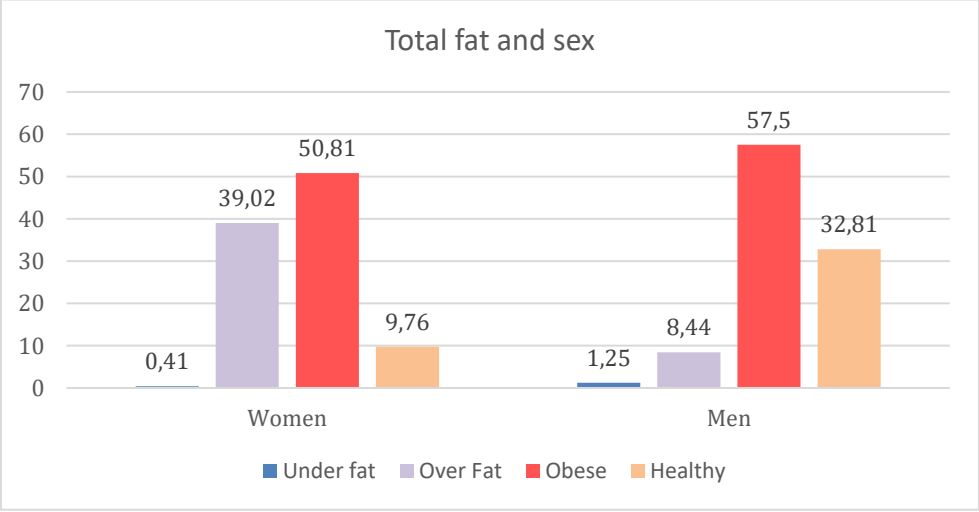

Figure 2. Percentage of total fat (TF) and sex

Discussion

Of the 5206 individuals who participated in their occupational health checkup, 580 employees, 11.14 %, had abdominal obesity based on waist circumference. 566 were included in the study, 10.87 %. The remaining 14 individuals, 0.27 %, were excluded because they did not have all the study outcomes collected.

As this is a specific population, active office workers with criteria for abdominal obesity, we consider the sample size of this study to be adequate. It exceeds some of the studies consulted, such as that published by Jabłonowska-Lietz et al.[13], whose sample size was 106 obese individuals, or that of Strauss et al.[10] which was 46 German office workers.

However, it is smaller than other studies, conducted in the Spanish working population. A 2006 study[5] analyzed the prevalence of CVRF in the Spanish working population in a sample of 216,914 workers. López-González et al.[6] examined the coexistence of obesity and diabetes in 420,000 workers in their 2022 study. However, these authors included workers from all sectors, and they did not select the sample based on body composition or BMI.

The prevalence of obesity in the Spanish working population varies according to the study consulted and the index used to measure it[1,4-6]. Sanchez-Chaparro´s[5] study found that 14.9% of workers had abdominal obesity, with more men (15.5%) than women (13.3%). In Goday-Arnó's research[1] the obesity rate was 14.5 % (17 % in men, 7.7 % in women). It was higher in primary sector workers than in tertiary sector workers (16.4 % versus 10.9 %). In the study by López-González et al.[6], using BMI, obesity also affected more men (19.6 %) than women (16.4 %). However, if the Deuremberg fat mass index was applied, the opposite was true: 68.5 % of Spanish female workers met the criteria for obesity compared to 48.2 % of male workers.

The prevalence results obtained in this research are lower: 11.14 % of the active workers who underwent occupational health screening showed abdominal obesity according to WC. The figures do agree with those published specifically in the tertiary/non-manual[1] working population, which are lower than those reported by workers in the primary or manual sector.

Regarding age, our results agree with previous findings: waist circumference tends to increase over the years[5].More than the half of the workers studied, 58.3 % were over 45 years old.

Likewise, the gender differences observed in this study is in line with previous studies[6]: there were more men, and they also had a higher percentage of individuals with BMI ≥ 30 and a higher VF index, while women had a higher percentage of high TF.

According to BMI, 26 workers, 4.5 %, were classified as normal weight. These results are consistent with the findings observed in other investigations[7], where 3 % of individuals with normal weight were diagnosed of abdominal obesity.

In all normal weight workers, bioimpedance analysis showed a healthy VF index despite increased WC. This percentage decreased as the BMI increased. In the case of overweight, 74.04 % of workers had VF in healthy range, as well as 28.3 % of obese.

76.3 % had elevated TF or in the obese range while only 49.5 % had VF in the unhealthy range. In addition, having excess VF was statistically significantly related to obesity according to BMI. The accumulation of adipose tissue in the upper body[3-13] (abdominal region) is associated with the development of obesity-related comorbidities and even all-cause mortality. We therefore consider this difference in percentages relevant to clinical practice.

Regarding adherence to the Mediterranean diet, the conclusions of this study are like those published by George et al[23]. Their nutritional intervention, based on the Mediterranean diet, found significant improvements in participants' VF. In our study, workers with a lower adherence to the Mediterranean diet showed higher VF.

More than half of the workers had total cholesterol levels in the desirable range, 51.2 %. In contrast to what was published by Lupattelli et al[28], no statistically significant differences were observed in our study between total cholesterol levels and the different obesity indices.

Limitations of the study

Some of the limitations of this study relate to the efficacy of body composition analysis at the population level. A validated cut-off value for the bioimpedance VF index associated with cardiometabolic risk in the European population is still to be determined[8]. Further research is needed. In this analysis only total cholesterol levels were considered whereas cholesterol fractions were not.

Conclusions

- Increased waist circumference affects mainly the middle-aged population (46-55 years), more men than women.
- Increased waist circumference is related to obesity and overweight, high total fat and low or medium adherence to the Mediterranean diet.
- High visceral fat level is correlated to obesity according to BMI, and low adherence to the Mediterranean diet.
- According to sex, men had a higher level of obesity, higher visceral fat and lower adherence to the Mediterranean diet, while women had higher total fat.

Beyond BMI and WC, we consider it necessary to personalize the estimation of individual cardiovascular risk according to gender, body composition and fat location (percentage of total fat and/or visceral fat), to reduce the limitations of these indexes or the classic CVRFs. Occupational Risk Prevention Services can make a difference because they have an easy access to working population.

Acknowledgments

We would like to thank and recognize the support and collaboration of the entire team that works in the Medical Service, especially Dr. María Antonia de Miguel Rodríguez, Jorge Alfonso López Heredero and Patricia Martín Carrillo, for their contribution to the administrative and supervisory tasks of the present article, and to Manuel Gonzalez Guirado for his collaboration.

Conflict of interest. The authors declare no conflict of interest.

Funding. None.

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European Journal of Occupational Health Nursing

EJOHN is the scientific journal of FOHNEU

Original Article

Adhesion to use individual protection equipment during the Covid-19 pandemic: a phenomenological study with nurse managers

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ABSTRACT

Objective: To understand, according to the perception of Nurse Managers of a hospital, the adhesion to the use of personal protective equipment (PPE) by health professionals during the Covid-19 pandemic.
Methods: Qualitative phenomenological study, involving 17 Nurse Managers of a hospital in the North of Portugal, during the first wave of the pandemic. A semi-structured interview and content analysis were used to process the data.
Results: Facilitators of adherence to the use of PPE; hinderers of adherence to the use of PPE and strategies that promote adherence were the resulting categories.
Conclusion: Fear and the perception of risk were the facilitators that most impacted on changing behaviors, while compromised use of PPE was the biggest hinderer. Supervision of the team and care delivered stands out as a central strategy of Nurse Managers. The Nurse Manager must implement strategies that promote behavioral changes and enhance adherence.

Keywords: Hospitals, Nursing, Personal Protective Equipment, Work Environment.

Article history

Received: May 14, 2024

Revised: June 6, 2024

Accepted: June 26, 2024

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Borges E, Camilo A, Trindade L. Adhesion to use individual protection equipment during the Covid-19 pandemic: a phenomenological study with nurse managers. Eur J Occ Health Nurs. 2024; 3(1):44-59. DOI 10.70324/eiohn.v3i1.35

Introduction

The Covid-19 pandemic represents one of the greatest crises in recent human history. Organizations face major challenges in combating and managing it, focusing attention on workplaces, identifying populations at risk, understanding the mechanisms of propagation and implementing control and prevention measures, ensuring safety and health at work (1).

The higher risks of transmission in health professionals, imply specific control measures, in order to reduce the risk of exposure and transmission and include, among others, the selection of Personal Protective Equipment (PPE), assuming that only the appropriate use can guarantee the protection of the health care professionals (1,2).

Although the use of PPE is recognized by health professionals as one of the most effective preventive measures in individual protection, reality is that its recommendations have not been fully incorporated into clinical practice (3).

The low adherence to the use of PPE is based on multifactorial aspects, related to the experienced environmental context, but also on individual values and beliefs, related to the perception of professionals about the risks to which they are exposed and their susceptibility to these same risks (4).

From the environmental factors it stands out the staffing and the consequent overload of work, training and technical competence, inadequacy or absence of equipment/structures, organizational culture and environment, the involvement of management and the leader's profile (3).

Fear can also have a positive effect on the use of recommended guidelines, as it emphasizes the danger and potential harm, highlighting the perception of the disease severity and the benefits of PPE use (5).

It is undeniable that the correct use of PPE has never been more notorious for the prevention of biological risk as in Covid-19, so behavioral changes in health professionals and greater attention from institutions are expected, assuming this issue as a central element of their safety (6).

It is worth highlighting the role of the Nurse Manager in the prevention of biological risk through the control and supervision of the correct PPE use, as an essential condition preventing the transmission of Covid-19 (6,7).

Therefore, this article aims to understand, according to the perception of Nurse Managers of a hospital, the adhesion to the use of PPE by health professionals during the COVID-19 pandemic.

Methods

This is a qualitative study with a phenomenological approach.

Participants

The study was carried out in a hospital in Northem of Portugal, between March and April of 2021. The study population consisted of all the nurse managers working during the first wave of COVID-19, in a total of 21. For reasons of absence, unavailability and illness situations, the research included 17 participants.

Data collection and analysis

A semi-structured interview was used to collect information, with an average duration of 30 minutes, based on a script consisting of open guiding questions, which aimed to meet the proposed objectives (Table 1). The interviews were face-to-face, scheduled and carried out by the researcher according to the availability of the participants. It was decided to record them, after obtaining consent from the participants.

The interviews were fully transcribed. In order to obtain data meanings, it was done content analysis (8).

The data was organized and systematized through exhaustive reading and later coded, proceeding to group the information according to the thematic, from which emerged the categories, subcategories and units of record. In the last phase of the analysis, the results were treated, inferred and interpreted.

Ethical considerations

The study was approved by the Ethics Committee for Health at the institution's Board of Directors (10/CES/JAS) and informed consent was obtained from the participants. Anonymity was ensured through coding with the attribution of the letter E (Interviewee), ordering them numerically from 1 to 17, according to the order of the interviews.

Table 1. Interview guide

THEME	GUIDING QUESTIONS
Work conditions	Do the physical characteristics of the department allow to provide safe care in a safe environment? Do the material resources available cover the needs? Are staffing numbers in line with the amount of hours needed to provide care?
Promoting safe work environments	Is biological risk a problematic topic concerning health professionals' safety? Regarding biological risk prevention, what is the importance that you give to the correct use of PPE? Is PPE available in the right quantity and does PPE have appropriate quality? Is biological risk prevention part of the department training plans? Are there in the institution procedures or structures that enhance the use of PPE by professionals? In terms of organizational policy what kind of support is provided to Nurse Managers to promote adherence to the correct use of PPE?
Adherence to the use of PPE during the Covid-19	Do you consider that adherence to the correct use of PPE is a problem for the professionals' safety? Do you think that adherence to the correct use of PPE can have an impact on preventing the biological risk associated with Covid-19? Do you perceive difficulties in adherence to the PPE use by professionals? If yes, can you specify which ones? Do you identify adherence failures to the use of PPE? To which PPE specifically and why? Did you identify changes in the adherence to the use of PPE by professionals during the Covid-19, compared to the phase before the pandemic? If yes, can you specify why?
Determinants in the use of PPE	During the Covid-19, what factors may have boosted adherence to the use of PPE? During the Covid-19, what factors may have made it more difficult to adhere to the use of PPE? Do you consider the involvement of top management an important factor in the adherence to the use of PPE? What is the role of middle management in the adherence to the use of PPE?
Strategies to enhance adherence to the use of PPE	Does your department use some type of strategy to enhance adherence to PPE? Do you use any instrument to assess the effectiveness of your strategy? If yes, how often?

Results

Study participants were mostly female, with an average age of 54.3 years, average professional experience of 32 years of service and average of 26.2 years working for the institution. Participants work mainly in inpatient departments. It was found that participants had differentiated academic instruction, with a predominance of postgraduate training in Administration and Management in health services, in addition to Infection control and Health and Safety at work. Most participants had the professional category of Manager Nurse followed by Specialist Nurse. Participants have been in practice as a Nurse Manager for an average of 14.8 years.

From the categorical analysis carried out, 3 categories and 24 subcategories emerged, shown in table 2, as well as the frequency that the recording units emerged in the speeches.

Table 2. Categorical analysis

Categories	Subcategories	Frequency of occurrence
Facilitators of adherence to the use of PPE	Emotional state conditioners	64/17
	Impact of the pandemic on adherence to the PPE use	40/17
	of teams for PPE use	27/17
	PPE availability	17/17
	Teamwork	15/17
	Attributes of organizational culture	10/17
	Personnel management	9/17
	Favorable structural and physical conditions	9/17
Hinderers of adherence to the use of PPE	Compromised use in the adherence to PPE	52/17
	Information management	30/17
	Weaknesses in the organizational culture	26/17
	Problems in structural and physical conditions	17/17
	Problems in Personnel management	13/17
	Discomfort in the use of PPE	8/17
	Difficulties in managing PPE	7/17
	Constraints in the training processes	7/17
	Non compliance with adherence during breaks	7/17
Strategies that promote adherence to the PPE	Supervising the team and the care provided	28/17
	Identifying reference professionals	14/17
	Promoting training processes	13/17
	Promoting comunication strategies	12/17
	Managing material resources	12/17
	Enhancing processes of continuous improvement	8/17
	Recognizing work performance	4/17

Facilitators of adherence to the use of PPE

All participants were unanimous in stating that they perceived a more adherence to the PPE use

…changed a lot …Before…No, this was never done E1… with the pandemic, people adhered to PPE much more… E11.

It was evidenced that the **Emotional state conditioners** were the ones that had the greatest impact on this behavioral change, having emerged 64 times in the speeches. Related to this subcategory, fear was the most mentioned emotion

…I think there is now a click for us, fear changed everything…E2.

Changes in risk perception also enhanced adherence to the use of PPE

… for the first time, we thought we could get sick … the perception of the risk they could have E3.

Training of teams for PPE use has always been an important topic within the Institution's training plans, being a tool to promote the acquisition of skills

… massive training … led people to raise awareness, to change behaviors… E11.

Likewise, the **PPE availability,** considered an essential condition for the protection of professionals, was assured by the institution, in addition to the attention given to the selection of distribution sites

…. There is a requirement in the Institution for good management, but there is also no lack of resources… E12.

Changes in interpersonal relationships were noticed during this phase. **Teamwork** had a positive impact on the group in terms of adopting protective behaviors

… everyone was aligned with the same purpose, … always a spirit of mutual help, … E15.

Personnel Management, related to the staffing of professionals, was taken care of by the institution, not jeopardizing the development of safe practices,

…sufficient ratios,… with expertise… with some time of experience, and therefore… safety in care… E12

Related to the **Attributes of organizational culture**, the existence of policies aimed at risk prevention was perceived, encouraging the adoption of adherence behaviors,

… the institution … have and emanate normative and informative documents, … they help the manager and, in this case, in the guidelines to be given to the teams E16.

Regarding the **Structural and Physical Conditions**, it was perceived by the nurse managers that they did not constitute an increased risk.

Yes… negative pressure… it helped a lot to maintain security and the fact that we have private rooms as well. E17.

Hinderers of adherence to the use of PPE

Of the nine subcategories obtained, **compromised use in adherence to PPE** was felt as a problem in the safety of professionals, emerging as the most referenced subcategory. The failures detected were related to the excessive use of PPE and the correct placing and removal of equipment

… there are failures in dressing and undressing…. There is a lot of error in the technique…. More in taking off than putting on… E12.

Information management, related to excessive production, often contradictory, compromised the effectiveness of messages, creating instability in the teams, with a direct impact on compliance with guidelines related to adherence to the use of PPE.

The constant change in procedures… today this PPE is used, tomorrow it is no longer necessary, … the transmission to the information management team…, we were not able to create strong and safe procedures to work with E17.

Weaknesses in the organizational culture related to the lack of follow-up, monitoring and availability were perceived by the nurse managers

….I felt completely alone because I didn't have support… the organization should support us in terms of helping guarantee the safety of workers E11.

In the subcategory **Structural and physical conditions problems**, participants saw existing conditions worsened, related to the organization and adequacy of spaces, lack of material or equipment and problems related to the renewal of the air

…. *Patients are very close to each other, … the nurses is caring for the patients, clean the curtains with their backs, it is a risk for professionals E16.*

Problems in personnel management further exposed the weaknesses felt, as there was no capacity to ensure the planned staffing that would answer to increased needs

… we always had to have someone else from the outside, a mirror. We had to improvise… E13.

Discomfort when using PPE was perceived as a barrier and caused resistance in the adherence to the PPE's

… the difficulty of using for many hours … that is not comfortable …, people leave completely soaked, even the glasses are all foggy, they can't see what they have in front of them… E17

Regarding the subcategory **Difficulties in managing PPE**, there were several constraints associated with the reorganization of the Institution, in order to respond to the increased needs,

… I had many difficulties in the PPE… There was a very large deficit… the professionals did not have masks, we didn't have the necessary protection to give care E11.

Constraints in the training processes were based on the absence of standardized training plans that were disseminated among all professionals, absence of institutional training and respective supervision

… We do not include the medical part and we have major constraints, because we are not all at the same pace E8.

Associated with the social moments, it was perceived **Non-compliance with adherence during breaks**,

... the social part among professionals, that's when people were more careless... people started to make it easier there, when they weren't wearing a mask E6.

Strategies that promote adherence to the PPE

Supervising the team and the care provided is the most frequently mentioned subcategory. It was highlighted the importance of monitoring and guiding professionals while providing care as a fundamental strategy to ensure the correct use of PPE,

…. You have to walk in the middle…. Being the reference… if you give greater or lesser importance to a certain aspect, of course this will be noticed more in that team,… E9.

It was mentioned the importance of **Identifying reference professionals** within the teams as a vehicle for promoting adherence

… it is necessary to know the team well,… know how to use key people to achieve changes… the vehicles… if not for a model, at least not to be resistant… E2.

In the subcategory **Promoting of training processes**, the importance that Nurse Managers assign to the training processes is reflected, for the training of professionals and their role in promoting evidence-based practices,

... he is (Nurse Manager), responsible for training... sharing this training with employees and carry out skills training to use PPE E11.

Promoting communication strategies by using new technologies was favorable to interpersonal relationships and communication between different professionals, responding to the demands for clear and continuous information

… we started using WhatsApp,…. Pictures were taken,… information all the time, it was placed everywhere, so the information was too much to disseminate very quickly and to implement yesterday,… E12.

The management of material resources was a concern of the nurse managers, simultaneously guaranteeing the protection and safety of the professionals and also the sustainability in access to equipment

... I often showed the price… of those masks… to raise awareness a little… to use the equipment well… protecting as much as we can, but in a rational way… E10.

Enhancing processes of continuous improvement through the use of indicators, highlights the need to monitor work processes and the consequent correction of behaviors,

…the fact that you have to ask for PPE every day… you managed daily, you started to see how was the adhesion, …This is my process and result indicator E1.

Recognition of work performance it was a tool used to maintain high levels of motivation and security

... Our health care assistants, …show them how important is their work... then, they felt more valued … E6.

Discussion

From the Nurse Managers' point of view, the pandemic brought visibility and appreciation to the proper use of PPE, drawing attention to the consequences of exposure to Covid-19 and the consequent need to promote adherence to its correct use by health professionals (6), thus being a facilitating factor.

When analyzing the determinants that underlie this change, fear and changes in risk perception were the most mentioned emotions. Moderate levels of fear can have a positive effect on behavior change, resulting from the individual's perception of desirable consequences, as opposed to perceived threats, constituting a determinant to be considered in the processes of changing the behavior of health professionals. It was also mentioned the role that the information transmitted daily by the media had in changing behaviors, conceptualizing them as a source of motivation (5).

On the other hand, there were changes in the social representations associated with risk, i.e. changes in the perception of risk about the impact and severity of Covid-19, as well as the perception regarding the benefits of adhering to the use of PPE and that may have increased adherence to the use of PPE (4,5).

The positive impact that teamwork assumed is highlighted directly interfering with the motivation to adhere to PPE use and, consequently, in the safety of the work environment (9). It was noted by the Nurse Managers an increase in the levels of resilience, versatility and multidisciplinary team support, which was attributed to the fact that professionals in times of crisis assume different work dynamics from the usual ones, allowing self-regulation associated with the correct use of PPE (10)

Concerning group relationships, the distortion perceived in moments of break is highlighted, like the disbelief that in these moments they could be more vulnerable to being infected by colleagues, also not perceiving benefits that promote the use of PPE during break times (4).

The study participants experienced different situations related to human resources management, noting that, according to the frequency of occurrence, the constraints were more evident related to the reorganization of staffing numbers in order to fulfill the requirements adapted to the new clinical situation. In this context, it was essential to define

strategies that ensured the staffing for each professional category and quick recruitment forms and integration, related to the need to allocate dedicated professionals and respond to high rates of absenteeism related to Covid-19 (6).

This reorganization required the reinforcement of the teams with professionals with differentiated skills, the requalification of these skills and the inclusion of professionals with no work experience, without integration time. These were situations that were felt as negative experiences by the teams, creating instability, insecurity and affecting the training in the use of PPE, which implied, from the Nurses Managers, extra care to ensure their management, in terms of availability and skills, to guarantee safety and that the best possible care was provided to patients (9).

The use of professionals considered references for the teams was highlighted in the interviews as a way of monitoring, helping and contributing to these teams and, consequently, becoming the model for training in the use of PPE for less experienced professionals (7). On the other hand, it was recognized that the physical environment, especially in inpatient services, could compromise the prevention of biological risks, risking the physical integrity of workers (10, 11).

The contribution of the nurse manager in the control of these work environment is highlighted, with regard to the structural conditions, but also in the rationalization of material resources, namely PPE. Rational access to PPE was considered a challenge for nurse managers, who had to implement new strategies, based on a global management of access and use, using daily requests for PPE, control in allocation, individual distribution and development of processes of monitoring their use, ensuring the supply, training of professionals and the implementation of measures that minimize its need and inappropriate use (6,12).

It was found that the ease and availability of PPE was mentioned more frequently and an effort by the institution was perceived to make this equipment available mainly in dedicated areas, however, there were situations in which it was necessary to resort to improvised practices, in an attempt to fill the existing gaps that further increased the risk of exposure by incorporating these practices into daily activity, accepting them as normal and safe (13).

It should be noted that, although an increase in the use of PPE was perceived, it is inappropriate use related to excessive use and errors in use was felt as the main problem in the safety of professionals, being the basis of self-contamination, referring to the importance of the co-responsibility of professionals in the adoption of self-protection measures and, in this context, in the correct adherence to the use of PPE, selecting the most appropriate protection barriers and compliance with the guidelines for its use (10,11).

Also to be considered is the quality and inadequacy of PPE as barriers to the adherence processes, as it promotes the loss of technical skill and causes discomfort to professionals, so these should be aspects to be considered by managers as resistance to adherence to PPE use (14).

Investment in knowledge, training of professionals and training on the use of PPE were essential for professionals to be able to develop their activity in a context different from what they were qualified for (11). The Nurse Manager assumed a prominent role through the organization in formal and informal training moments, moment of practice and respective supervision, which according to the participants were key to acknowledge the norms and procedures, these had a great impact on the training of professionals for the use of PPE (1,12).

The flows and constant production of new information during the pandemic were perceived as hindering to the adherence to PPE use, related to the guidelines to be followed. In organizational terms, the difficulties were linked to decentralized strategy flows and actions that promote constant changes in practices, generating uncertainty and insecurity in relation to the decisions to be taken. According to nurse managers, communication policies should, in addition to ensuring the quality of information, reach a higher number of people simultaneously, which would help in raising awareness and standardizing the procedures (6,15).

To achieve objective communication flows, with clear and continuous information in their teams, it was necessary for Nurse Managers to resort to new communication strategies, using different tools (pre-shift team meetings, check-ins, updated newsletters, team groups on social networks), ensuring transversal information, safe environments and eliminating sources of dissatisfaction and conflict (9,16).

This study highlights the impact that the organizations' leadership style and the managers can have on work environments and on the ability to model postures and behaviors related to decision-making for PPE use, by eliminating perceived barriers and beliefs that individuals associated with the use of this equipment, through the development of favorable conditions to the promotion of healthy environments (9,16).

It was perceived that institutional guidelines about the protection of professionals are based on imposed policies, not acknowledged by health professionals, which makes sustained behavior changes difficult. The lack of involvement and commitment from different management levels was also perceived by the different levels of management, which negatively impacts the construction of safe environments (2).

In this sequence, the need for monitoring and control of activities was evidenced by Nurse managers in compliance with the rules related to adherence to PPE, which implied full availability in monitoring professionals and constant monitoring of working processes by Nurse managers, enhancing safety within teams and promoting feelings of belonging, integration, recognition and sharing of goals, which resulted in increased well-being, increased motivation and, consequently, increased quality of care (1,9).

In the interviews was also highlighted the importance of appreciation by hierarchical superiors and their recognition regarding the risk to which professionals are exposed, in addition to providing emotional support, with an impact on personal satisfaction and motivation, which in turn can be perceived as a stimulus to the compliance with guidelines related to adherence to the PPE use (9).

Limitations of the study

The limitations of the study are related to the fact that the methodology used prevents generalization, also being carried out in a hospital and in a pandemic context.

Conclusions

The environmental conditions had a direct impact on the professionals' perception of biological risks and on the relevance attributed to the different adherence conditioners found, taking into account that, depending on the contexts, several subcategories were perceived by the Nurse Managers as facilitating or hindering adherence to the use of PPE.

In addition to environmental factors, the importance of the impact of personal factors on the behavior of professionals should be highlighted, considering the frequency of occurrence obtained in the interviews, namely the conditioning factors of emotional states with the greatest impact on promoting adherence and the compromised use of adherence to PPE with the greatest impact on the safety of health professionals, enhancing exposure to risk.

Strategically, the need for the involvement of nurse managers in the safety of professionals is highlighted through the development of proximity practices, assuming that the management profile is directly related to the appreciation that professionals give to the correct use of PPE.

The role of Nursing managers is highlighted through their skills in the demystification associated with biological risk and the use of PPE and that only the development of strategies that promote safe environments allows sustained behavioral changes, regardless of the pandemic context.

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