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# Assessment of Workplace Safety Climate among Healthcare Workers: A Case Study of the Public Sector Hospitals in Greece

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## Abstract

Safety climate assessment is considered an effective tool to investigate employees' perceptions of workplace safety practices, attitudes, and behaviors. **Scope and Aims:** The purpose of the survey is to assess the lesser studied field of the climate of workplace safety among employees in the Greek public healthcare sector, with the following objectives: a) to identify the most decisive factors that determine the climate of safety at work in order to prioritize interventions, and b) to subserve commitment to create a positive climate of safety among both management and employees. **Methods:** For this

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purpose, a cross-sectional study was conducted in 23 hospitals, which concerned all employees. The tool used was the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50) and data collection took place during 2023-2024. **Results:** The results showed that the safety climate among healthcare workers was quite negative and that there was a need for interventions (minor or major). Parameters with high statistical variation (< 0.0001) were identified, such as working position (employee or leader), employment status (tenure), age, hospital of origin, and specialty of the employee. **Conclusion:** To address the gaps identified, efforts need to be made to promote an effective and positive safety climate in all hospitals in the study, to emphasize prevention, and to strengthen the commitment of both management and employees in this direction.

**Keywords:** NOSACQ-50 questionnaire, occupational health and safety, healthcare, safety leadership

## Introduction

Occupational Safety and Health (OSH) is the study and application of health and safety in the workplace, with an emphasis on hazard prevention at the primary level. Its objective is to stop accidents and human injury caused by work-related activities (IOE, 2024). OSH is considered an integral part of public health. OSH concept and significance has been upgraded since June 2022, when it was incorporated -as a fifth pillar- in the pre-existing framework of fundamental principles and rights at work (ILO, 2022). OSH's requirements represent primary factors of the social pillar of sustainable development, so initiatives to reduce occupational accidents and diseases are imperative (Nawaz et al., 2019). This need is exacerbated, as almost two million workers die each year due to exposure to work-related risks (WHO/ILO, 2021). Literature has highlighted several factors that can influence the occurrence and increase of occupational accidents, such as working conditions, organizational factors, personal characteristics, training and supervision, the nature of work (Ford & Tetrick, 2008; Berhanu et al., 2019; Kang et al., 2022; Debela et al., 2022), work-related stress (Kploanyi et al., 2020), but also behaviors (Bowdler et al., 2023), aroused by psychosocial factors prevalent in the workplace (Amoadu et al., 2023; Abbasi et al., 2021). The climate of safety at work can be a critical factor that influences employees' behavior within organizations (Schwatka et al., 2016). Another crucial factor affecting workplace safety systems is safety that has been formed within organizations. Safety climate and safety culture are for organizations the means to build their safety systems and incorporate elements such as employee perceptions of safety, commitment to safety on an individual and administrative basis, security communication, and the security system that exists during task performance. Ayim Gyekye and

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Haybatollahi (2014) showed that justice is an additional factor affecting organizations' capacity for safety. This study concluded that employees with positive fairness perceptions had better perspectives on workplace safety, were more compliant with safety policies, and were less likely to be involved in accidents. Therefore, a strong safety culture and a positive safety climate lead to decreased occupational injuries and have a positive effect on workplace safety (Cook et al., 2016; Ajslev et al., 2017; Fargnoli & Lombardi, 2020). A study among employees in Denmark showed that employees' perceptions of the workplace safety climate are an important predictor of occupational accidents (Ajslev et al., 2018). Occupational accident prevention in the long-term leads to increased productivity and lower costs for both businesses and society. This conclusion is supported by an international study by OSHA-EU, according to which economic indicators show an annual burden on society from "bad" OSH practices, estimated at 3.9% of global gross domestic product (GDP), i.e., €2680 billion (Elsler et al., 2017). Another important finding on workers' health and safety across Europe is highlighted in the ESEVER survey in 2019 (OSHA-EU, 2022). This research showed that there are varied approaches to managing OSH, not only between different countries but also within different facilities in the same country.

Assessing workplace safety could contribute to the convergence of these differentiations, as it provides the organization with an understanding of the perceptions and attitudes of its workforce related to safety. In addition, it can be used as a diagnostic tool to help identify elements within the organization that need improvement, providing the necessary impetus for further evaluation. In fact, according to Liao et al. (2014), employee safety beliefs can be thought of as indicators of representation of organizational safety culture. Considering the above OSH framework, safety climate assessment is considered a robust research approach, which has often been the focus of many researchers (Bamel et al., 2020). In the literature, one finds that in various sectors of occupation such as industry, construction, and mining (Kvalheim & Dahl, 2016; Balogun et al., 2020; Fargnoli & Lombardi, 2019; Kim et al., 2019; Mosly & Makki, 2020; Møller et al., 2021; Ghahramani et al., 2015; Luo et al., 2018), nuclear facilities (Martínez-Córcoles et al., 2011), transportation (Huang et al., 2016; Lee et al., 2019; Nævestad et al., 2018), aviation (O'Connor et al., 2011), safety climate has been investigated most often. However, safety climate measures in healthcare are not often the subject of research. Safety culture and theories about climate are clearly limited (Alsalem et al., 2018), as limited are the studies focusing on safety performance in hospitals, although healthcare professionals play a leading role in improving and maintaining safety not only for themselves but also for patients (Ausserhofer et al., 2012; Heier et al., 2021). Numerous scientific data support this point of view and highlight the strong connection between

Occupational Health and Safety in healthcare and both the quality of services provided and patient safety (Lundstrom et al., 2002; Pousette et al., 2017; Dyrbye et al., 2017; Berry et al., 2020; Tawfik et al., 2019). Employees in hospitals and healthcare facilities in general are a working group of special interest because of its characteristics: the large number of employees worldwide (there are 136 million workers in the field of health and social work) **(**WHO, 2024a), the great heterogeneity, and the multiple risks to which they are exposed (physical, chemical, biological, ergonomic, radiation, psychological, social, etc.) (WHO, 2024b). These risks are constantly changing because of rapid development in science and technology. In addition to these risks, health workers had to deal with the COVID-19 pandemic, which has had a catalytic impact on health systems around the world. Workers in healthcare and social care suffer more injuries and illnesses than workers in any other sector of occupation, and that continues to grow (U.S. BLS, 2020). In the EU, the incidence of non-fatal accidents in human health activities increased significantly from 2010 to 2020 (an increase of 42.8%). Healthcare, for the year 2021, is the second sector -after industry- with the most non-fatal accidents and seventh among twenty-one economic sectors in fatal accidents (Eurostat, 2023). In Greece and for the same period (2021), accidents in healthcare and social security represent 4.1% of the total workplace accidents (ELSTAT, 2023). Unsafe working conditions for health professionals, leading to occupational diseases, injuries, and absenteeism, are also a significant economic cost for the healthcare sector. According to WHO (2022), improving the health, safety, and well-being of healthcare professionals globally reduces the cost of occupational harm (estimated up to 2% of health expenditure) and contributes to the minimization of patients' harm (estimated up to 12% of health expenditure). Yet only one-third of countries have a national policy to protect the health, safety, and well-being of healthcare workers. Greece regarding occupational health and safety has national legislation. In 2010, the government passed Law 3850/2010, which incorporated the European Directive 89/391/EEC-OSH "Framework Directive." This legislative framework applies to all businesses, private and public. It is the duty of employers to guarantee the health and safety of their workers to avoid illnesses and accidents at work and to remove any hazards associated with the project's working environment. The specific health and safety services that must be provided to employees are outlined in this law. The bare minimum of services needed are Safety Technician (ST), Occupational Physician (OP), Workers' Health and Safety Committee (HSC) or Workers' Representative, and the existence of a written risk assessment (RA) prepared by ST in cooperation with the OP.

In healthcare, it is important to identify the factors associated with risks in the workplace to formulate a safety policy and a system that will promote

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improvement of productivity and overall well-being (Prajwal et al., 2020). Following this strategy, the benefits are multiple for healthcare professionals, patients, and the healthcare system itself, but also for the wider society and economy.

## Methods

This study was designed to assess the climate of safety in healthcare organizations in public hospitals in Greece, and to develop a short and effective measuring tool, as their complex and unique characteristics require further research. For the first time in Greece, an attempt is being made to determine the level of safety climate among health professionals in public hospitals. This survey includes a large population of health professionals (workers and managers from all specialties) employed in twenty-three hospitals and aims, among other things, to find the determining factors that shape the climate of safety.

*Sampling frame:* The subject of our study is the total number of employees (n = 23,941) in the public hospitals (n = 23), within the 1st Health Region of Attica. To achieve a representative sample, cluster sampling was applied. First, all hospitals were classified into five groups according to their special purpose and the services offered, as follows: a) General/Main Duty hospitals, b) Pediatric hospitals, c) Special Purpose hospitals, d) Other/Supportive hospitals and 5) Oncology hospitals. Subsequently, the staff of the above hospitals was classified into four clusters based on their specialties, namely: a) medical, b) nursing, c) administrative/technical, and d) other (all other specialties). Of the total number of employees (23.941), 69% are employed in General/Main Duty hospitals, 13% in Pediatric hospitals, 7% in Special Purpose hospitals, 3% in Other/Supportive hospitals and 8% in Oncology hospitals. Also, 27% are physicians, 40% are nurses, 11% are administrative/technical personnel, and 22% belong to other categories. For the sample (n) of each group to be representative, the following have been set: N = 23,941 (total population), Z = standard deviation for 95% confidence level (Z = 1.96), D = acceptable difference (3%). Considering the above, the total sample size (n) corresponds to 1022 employees. The proportion of staff per hospital category was then maintained in the sample, as well as the ratio of groups of employees.

*Tools:* The Nordic Safety Climate Questionnaire (NOSACQ-50), presented by Kines et al. (2011), was used to assess the climate of safety in the hospitals of the study, after the author's permission (NFA, 2024). This questionnaire serves our purposes, as mentioned above, as it provides a comparative evaluation in terms of structure and financial, both nationally, and internationally and creates opportunities regarding the acquisition of knowledge that can be cross-checked and shared, as there is a database created

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by the National Center for Research on the Working Environment (NFA) of Denmark. This questionnaire has been tested in various studies in many occupational sectors, and its reliability and validity have been proved (Fargnoli & Lombardi, 2020; Lagerstrom et al., 2019; Khoshakhlagh et al., 2023). The questionnaire aims to assess the safety climate in the healthcare sector that will provide the possibility of benchmarking at the same structure level (hospital) but can also be used more widely in other facilities with a similar work object. The conclusions of such a survey can be an incentive to launch a more effective policy in this area, with the active involvement of all stakeholders. To this study and to enhance the credibility of the research, a pilot survey was conducted among thirty healthcare workers (HCW) to assess the acceptance, validity, and reliability of the questionnaire. The responses and general comments received were found to meet the needs of the study.

The questionnaire consists of fifty questions, describing seven dimensions of the safety climate. Statements of each dimension examined are listed in Table 1, and the interpretation of the results is in Table 2. As for the evaluation criteria, a four-point Likert scale is used. In addition, the questionnaire included basic information on gender, age, job, specialty, employment status (tenure), years of experience, etc. Each questionnaire came with a short letter clearly outlining the purpose of the survey and the confidentiality and anonymity of responses and informed consent from participants. Questionnaires were distributed in the required number per hospital and per working group (within each hospital) by the main researcher and were filled out voluntarily by the adequate employees. Data collection took place from May 2023 to February 2024.

**Table 1**: Set of statements for each of the seven dimensions (Dim1 to Dim7) of the Nordic Safety Climate Questionnaire (NOSACQ-50) (source: NFA, 2022)

| *Dimensions* | *Dimension's description* | *Content and numbers of statements provided* | *Positively formulate items* | *Reversed formulate items* |
|---|---|---|---|---|
| Dim1 | Management safety priority, commitment, and competence | Workers' perception of safety management: 9 statements | 5 | 4 |
| Dim2 | Management safety empowerment | Workers' perception of management empowerment and support to participate in safety issues: 7 statements | 5 | 2 |
| Dim3 | Management safety justice | How workers perceive accidents' management: 6 statements | 4 | 2 |
| Dim4 | Workers' safety commitment | How workers perceive their own commitment to safety: 6 statements | 3 | 3 |
| Dim5 | Workers' safety priority and risk non-acceptance | Workers' risk-taking attitude and safety prioritization in their working tasks: 7 statements | 1 | 6 |
| Dim6 | Safety communication, learning, and trust in co-workers safety competence | How workers perceive the exchange of safety knowledge and experiences among themselves: 8 statements. | 7 | 1 |
| Dim7 | Trust in the efficacy of safety systems | Workers' perception of benefits derived from safety planning, training, monitoring, etc: 7 statements | 4 | 3 |

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**Table 2**: Interpretation of results of the Nordic Safety Climate Questionnaire (NOSACQ-50) (source: NFA, 2022)

| *Score* | *Level* | *Meaning* |
|---|---|---|
| >3.30 | Good | Maintaining and continuing developments of the safety climate dimension |
| 3.00–3.30 | Fairly good | The safety climate dimension is in slight need of improvement |
| 2.70–2.99 | Fairy low | The safety climate dimension is in need of improvement |
| <2.70 | Low | The safety climate dimension is in great need of improvement |

*Data Analysis:* To analyze the demographic characteristics of the study participants, we used the Excel Microsoft 360 (Office) plan. Data gathered from the questionnaires were analyzed, using the same program, to calculate the mean and standard deviation for each dimension of every respondent in the first phase, for each hospital afterwards, and for all hospitals finally. For further statistical processing of the data, we used Prism software package 10.2.2. to perform t-test analysis and one-way ANOVA. The statistical significance p-value was set < 0.05%.

## Results

At the end of the survey period, 1022 questionnaires were collected (100% of the required number). The demographic characteristics of the participants are presented in Table 3. To check the reliability of the results, an alpha Cronbach test was performed separately for employees and leaders responses, in each of the seven dimensions examined. The test showed that all sets of elements were in an acceptable to good alpha Cronbach score range (0.70-0.90) between the seven dimensions in both categories. Dimension One (management safety priority, commitment, and competence) scores highest for both employees and leaders (0.90). The results of the alpha Cronbach test are shown in Table 4.

**Table 3:** Demographic characteristics of respondents to the Nordic Safety Climate Questionnaire (NOSACQ-50)

| *Characteristic* | *n (%)* |
|---|---|
| ***Age, years (n=1017)*** | |
| <40 | 248 (24.4%) |
| 40-59 | 687 (67.3%) |
| ≥60 | 85 (8.4%) |
| ***Gender (n=1020)*** | |
| male | 292 (28.7%) |
| female | 728 (71.3%) |
| ***Hospital category (n=1022)*** | |
| main (11) | 710 (69,5%) |
| pediatric (3) | 137 (13,4%) |
| special (4) | 57 (5,6%) |
| other supportive (3 ) | 33 (3,2%) |
| oncological (2) | 85 (8,3%) |
| ***Personal categories (n=1022)*** | |
| doctors | 274 (26,8%) |
| nurses | 414 (40,5%) |
| administrative/technical | 115 (11,3%) |
| others | 219 (21,4%) |
| ***Educational background (n=1022)*** | |
| elementary | 31 (3,0%) |
| high school | 145 (14,2%) |
| university | 378 (37,0%) |
| master/PhD | 468 (45,8%) |
| ***Job position (n=1022)*** | |
| workers | 813 (79,5%) |
| leaders | 209 (20,5%) |
| ***Employment relationship (n=1022)*** | |
| permantent | 717 (70,2%) |
| contract | 305 (29,8%) |
| ***Total working Years in the Hospital (n=1007)*** | |
| *<10* | 416 (41,3%) |
| *10-19* | 225 (22,3%) |
| *20-29* | 188 (18,7%) |
| *30-39* | 164 (16,1%) |
| *≥40* | 16 (1,6%) |

**Table 4:** Distribution of Cronbach's alpha reliability test in seven dimensions according to the job position (leaders/workers)

| | ***Job position*** | |
|---|---|---|
| **Dimensions** | **leaders** | **workers** |
| Dim1 | 0,90 | 0,90 |
| Dim2 | 0,89 | 0,86 |
| Dim3 | 0,89 | 0,84 |
| Dim4 | 0,85 | 0,82 |
| Dim5 | 0,75 | 0,70 |
| Dim6 | 0,82 | 0,82 |
| Dim7 | 0,83 | 0,76 |

Studying the results initially for the groups of workers and leaders, we observe that in both groups there is no dimension in which the score reaches the level of "good" (> 3.30). In the leaders, the level of "low" corresponds to one dimension but to four in the workers, which indicates on the one hand a need for great improvement and on the other hand a difference in the perceptions between the two groups. This fact is confirmed by the result of the t-test conducted to determine if there was a statistically significant difference

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between the two groups of staff in all 7 dimensions. The analysis shows very high statistical significance (<0.0001) in the first six dimensions and quite high (0.0016) in the seventh. At the same time, as shown in Fig. 1, a comparison was made with the data contained in the NOSACQ-50 database (source: NFK, 2024). This comparison shows that in both categories (leaders-workers) and for all dimensions, average scores are lower in the present study. The trend of average grades to be higher among leaders is also shown in the results of the NOSACQ-50 database. The total results are shown in Fig. 2.

The influence of gender on the perception of safety climate was studied subsequently. The t-test analysis performed showed that statistically significant differences exist only in two dimensions, DIM 2 and DIM 4 (p=0.0397 and p=0.0303), respectively. Total results are shown in Fig. 2.

**A**

| | ***Job position (n=1022)*** | | | *NOSACQ-50 database* ***Job position (n=95.743)*** | |
|---|---|---|---|---|---|
| | ***n=209*** | ***n=813*** | | ***n=22.943*** | ***n=72.800*** |
| *Dimensions* | *leaders mean (SD)* | *workers mean (SD)* | *t-test * p value* | *leaders mean* | *workers mean* |
| *Dim1* | *2.86 (0,56)* | *2.53 (0.59)* | *<0.0001**** | *3.28* | *3.08* |
| *Dim2* | *2.74 (0.53)* | *2.47 (0.53)* | *<0.0001**** | *3.18* | *2.98* |
| *Dim3* | *2.90 (0.57)* | *2.60(0.52)* | *<0.0001**** | *3.22* | *3.00* |
| *Dim4* | *3.19 (0.49)* | *3.02 (0.48)* | *<0.0001**** | *3.29* | *3.19* |
| *Dim5* | *2.61 (0.45)* | *2.46 (0.42)* | *<0.0001**** | *3.16* | *2.99* |
| *Dim6* | *3.07 (0.39)* | *2.90 (0.41)* | *<0.0001**** | *3.29* | *3.16* |
| *Dim7* | *3.24 (0.46)* | *3.13 (0.42)* | *0.0016** | *3.36* | *3.24* |

**p<0,05* ***p ≤0,01* ****p ≤0,001* *****p≤0,0001*

**B**

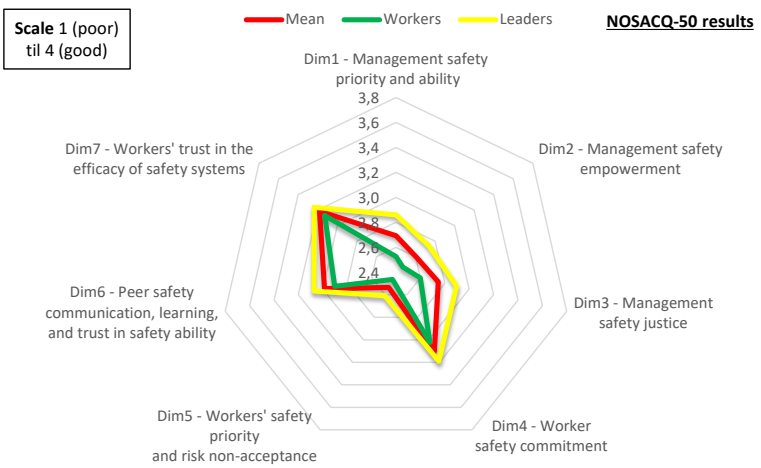


**Figure 1.** (A) Safety Climate Dimension (DIM), Mean Scores and Standard Deviation for all respondents (workers and leaders) in hospitals, and t-test for all dimensions for workers vs. leaders. The 2 columns on the right present data from the Nordic Safety Climate Questionnaire (NOSACQ-50) database (source: NFK, 2024). (B) Radar diagram of safety climate survey results by dimension for workers and leaders

**A**

| *Dimensions* | *male mean (SD)* | *female mean (SD)* | *t-test *p value* |
|---|---|---|---|
| | ***Gender (n=1020)*** | | |
| *Dim1* | *2.61 (0.62)* | *2.59 (0.58)* | *0.448* |
| *Dim2* | *2.57 (0.56)* | *2.50 (0.53)* | *0.0397** |
| *Dim3* | *2.67 (0.56)* | *2.65 (0.53)* | *0.4937* |
| *Dim4* | *3.00 (0.50)* | *3.08 (0.48)* | *0.0303** |
| *Dim5* | *2.50 (0.45)* | *2.49 (0.43)* | *0.8856* |
| *Dim6* | *2.90 (0.40)* | *2.95 (0.42)* | *0.1123* |
| *Dim7* | *3.13 (0.45)* | *3.16 (0.43)* | *0.2582* |

* $p < 0.05$

**B**

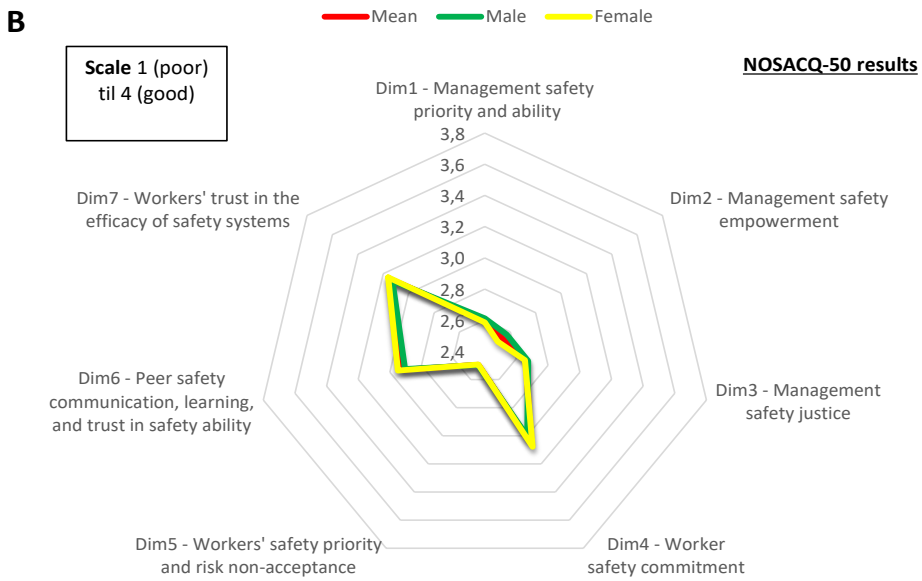


**Figure 2.** (A) Safety Climate Dimension (DIM), Mean Scores and Standard Deviation separate for male and female in hospitals, and t-test for all dimensions male vs. females. (B) Radar diagram of safety climate survey results by dimension for males and females

An important statistical differentiation was revealed by the t-test in the subdivision of the sample based on the employment status. Six dimensions are of statistical significance (DIM 1, 2, 3, 4, 6, and 7), of which the first three, concerning the perceptions of the organizational safety of hospitals from the point of view of administrations, demonstrate a very high statistical significance ($p = <0.0001$) and a particularly low score of the average values of the (time-limited) contract staff group shows a smaller difference. The overall results are shown in Fig. 3.

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**A**

| *Dimensions* | *Employment relationship (n=1022)* permantent mean (SD) | contract mean (SD) | *t-test* *p value |
|---|---|---|---|
| *Dim1* | *2.66 (0.56)* | *2.44 (0.64)* | *<0.0001**** |
| *Dim2* | *2.59 (0.53)* | *2.37 (0.54)* | *<0.0001**** |
| *Dim3* | *2.71 (0.53)* | *2.54 ( 0.55)* | *<0.0001**** |
| *Dim4* | *3.08 (0.50)* | *3.01 (0.46)* | *0.0487** |
| *Dim5* | *2.51 (0.44)* | *2.46 (0.42)* | *0.1409* |
| *Dim6* | *2.96 (0.41)* | *2.88 (0.43)* | *0.0087*** |
| *Dim7* | *3.17 (0.44)* | *3.10 (0.41)* | *0.0192** |

**p<0,05* ***p ≤0,01* ****p ≤0,001* *****p≤0,0001*

**B**

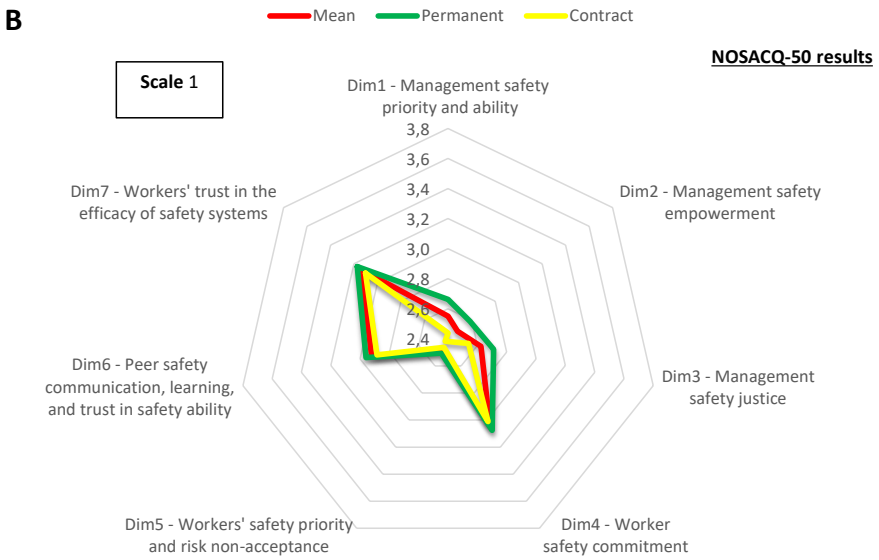


**Figure 3.** (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for permanent and contract respondent in hospitals, and t-test for all dimensions permanent vs. contract. (B) Radar diagram of safety climate survey results by dimension for permanent and contract

Age also seems to be linked to the answers shown in Fig. 4, as the age group <40 y.o. gave the lowest scores. All first three dimensions come with an extremely low score. DIM 5 appears to be consistently low across all age groups. Employee perceptions in the >60 y.o. category score higher in the top three than in the other two groups. In fact, in these dimensions, one-way Anova showed high statistical significance. Two dimensions, DIM 4 and DIM 7, scored fairly "good" in all age groups. The remaining five dimensions correspond to a level in need of improvement. The overall results are shown in Fig. 4.

**A**

| *Age, years (n=1017)* | | | | |
|---|---|---|---|---|
| *Dimensions* | *<40* | *40-59* | *≥60* | *One-way ANOVA* |
| | *mean (SD)* | *mean (SD)* | *mean (SD)* | **p value* |
| *Dim1* | *2.39 (0.65)* | *2.65 (0.56)* | *2.72(0.56)* | *<0.0001***** |
| *Dim2* | *2.36 (0.53)* | *2.57 (0.53)* | *2.64 (0.55)* | *<0.0001***** |
| *Dim3* | *2.50 (0.53)* | *2.69 (0.55)* | *2.83(0.46)* | *<0.0001***** |
| *Dim4* | *3.01 (0.43)* | *3.07(0.50)* | *3.06 (0.52)* | *0.2877* |
| *Dim5* | *2.44 (0.42)* | *2.51 (0.43)* | *2.51(0.44)* | *0.0584* |
| *Dim6* | *2.89 (0.42)* | *2.95 (0.41)* | *2.93 (0.40)* | *0.079* |
| *Dim7* | *3.12 (0.39)* | *3.16 (0.44)* | *3.13 (0.51)* | *0.3499* |
| | | *** | **** | |
| * p < 0.05 | **p≤0,01 | p≤0,001 | *p≤0,0001* | |

**B**

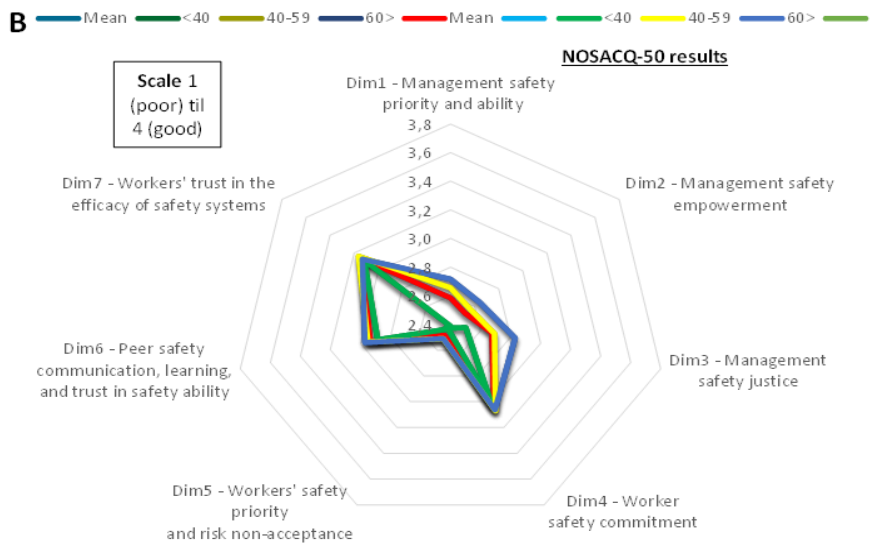


**Figure 4**. (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for 3 age groups, and one-way ANOVA for all dimensions per group. (B) Radar diagram of safety climate survey results by dimension for 3 age groups of respondents

The relationship between age and employment status seems to coincide with the results of Fig. 5, which shows scores based on years of working experience in the hospital. Workers with fewer years of experience scored lower average scores than those with more years, mainly in the first 3 dimensions. These dimensions, according to the one-way ANOVA exhibit high statistical significance. Statistical significance also occurs in dimension DIM 6. The overall results are shown in Fig. 5.

**A**

*Total working Years in the Hospital (n=1009)*

| Dimensions | <10 mean (SD) | 10-19 mean (SD) | 20-29 mean (SD) | 30-39 mean (SD) | ≥40 mean (SD) | *One-way ANOVA* *p value* |
|---|---|---|---|---|---|---|
| Dim1 | 2.49 (0.65) | 2.61 (0.53) | 2.72 (0.55) | 2.72 (0.54) | 2.66 (0.48) | *<0.0001**** |
| Dim2 | 2.42(0.55) | 2.56 (0.53) | 2.65 (0.52) | 2.60 (0.50) | 2.64 (0.40) | *<0.0001**** |
| Dim3 | 2.59 ( 0.55) | 2.70 (0.50) | 2.75 (0.55) | 2.69 (0.54) | 2.81 (0.45) | *0.0052*** |
| Dim4 | 3.02 (0.48) | 3.03 (0.47) | 3.12 (0.50) | 3.12 (0.51) | 3.15 (0.59) | *0.0564* |
| Dim5 | 2.48 (0.44) | 2.47 (0.42) | 2.52 (0.46) | 2.51( 0.40) | 2.52 (0.44) | *0.7073* |
| Dim6 | 2.90 (0.41) | 2.92 (0.43) | 2.97 (0.42) | 3.00 (0.38) | 3.15 (0.46) | *0.0189** |
| Dim7 | 3.13 (0.41) | 3.17 (0.44) | 3.20 (0.44) | 3.10 (0.48) | 3.19 (0.40) | *0.2623* |

*p<0,05 **p ≤0,01 ***p ≤0,001 ****p≤0,0001

**B**

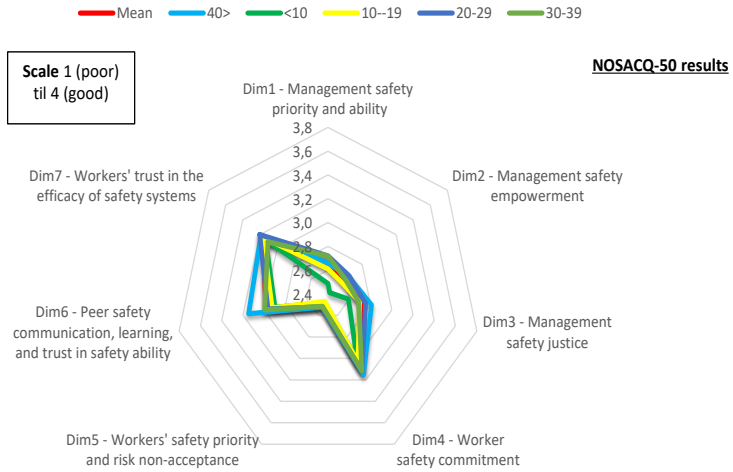


**Figure 5**. (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for 5 groups based on total working years in the hospital, and one-way ANOVA for all dimensions per group. (B) Radar diagram of safety climate survey results by dimension for 5 groups of respondents based on total working years in the hospital

Figure 6 presents the results according to the educational background of the study participants. Classification does not show statistical significance in the first five dimensions. The latter two show statistical significance, according to the one-way ANOVA. Especially DIM 7 (trust in the efficacy of safety systems) has the highest score in the data analysis so far (M = 3.20). The elementary category, with the exception of DIM 3, has the lowest average scores in all dimensions, with DIM 5 being particularly low (M = 2.32), which is the lowest score in all subdivisions of the sample that have been carried out. The overall results are shown in Fig. 6.

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**A**

| Dimensions | *Educational background (n=1022)* elementary mean (SD) | high school mean (SD) | university mean (SD) | master/PhD mean (SD) | *One-way ANOVA* **p value* |
|---|---|---|---|---|---|
| Dim1 | 2.51 (0.44) | 2.58 (0.55) | 2.60 (0.62) | *2.60 (0.60)* | 0.8302 |
| Dim2 | 2.47 (0.38) | 2.54 (0.52) | 2.52 (0.55) | *2.52 (0.55)* | 0.9266 |
| Dim3 | 2.67 (0.55) | 2.64 (0.55) | 2.66 (0.53) | *2.67 (0.55)* | 0.9735 |
| Dim4 | 2.88 (0.53) | 3.03 (0.55) | 3.09 (0.46) | *3.05 (0.49)* | 0.0966 |
| Dim5 | 2.32 (0.38) | 2.47 (0.44) | 2.53 (0.43) | *2.49 (0.44)* | 0.0557 |
| Dim6 | 2.75 (0.53) | 2.90 (0.43) | 2.93 (0.36) | *2.97 (0.44)* | 0.0195* |
| Dim7 | 3.00 (0.59) | 3.09 (0.42) | 3.12 (0.42) | *3.20 (0.44)* | 0.0017** |
| | * p < 0.05 | **p≤0,01 | | | |

**B**

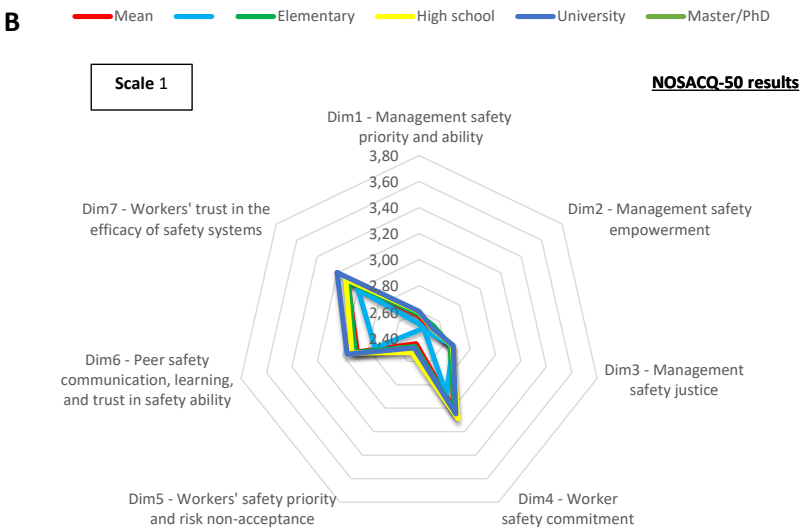


**Table 6**. (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for four groups based on educational background, and one-way ANOVA for all dimensions per group. (B) Radar diagram of safety climate survey results by dimension for the four groups of respondents based on educational background

The classification of the sample by hospital type and by working group are two main parameters, according to the design of the study. The results of these groups are presented in Figs. 7 and 8, respectively. According to the analysis of the results based on the type of hospital the employees come from, a one-way ANOVA showed that there are statistically significant differences in the majority of dimensions. Looking at the average scores depicted in Fig. 7, we see that pediatric hospitals have lower scores in all dimensions, with the exception of dimension 5, where the main hospitals have a score of (M = 2.44 vs. M = 2.57). In DIM 6, pediatric hospitals have the same score as main hospitals. Employees at these two hospital types appear to have the lowest scores compared to other types. Scores are better when it comes to special purpose and supporting hospitals. Oncology hospitals maintain consistently in all dimensions an average position (the 3$^{rd}$) when compared to the other subdivisions. The DIM 5 dimension scores very low in all hospitals, with the

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lowest in the main hospitals (M = 2.44), followed by paediatrics (M = 2.57), where the need for action is demonstrated.

**A** *Hospital category (n=1022)*

| Dimensions | main mean (SD) | pediatric mean (SD) | special mean (SD) | other supportive mean (SD) | oncological mean(SD) | One-way ANOVA *p value |
|---|---|---|---|---|---|---|
| Dim1 | 2.56 (0.57) | 2.41 (0.64) | 2.97 (0.49) | 3.11 (0.52) | 2.71 (0.61) | <0.0001**** |
| Dim2 | 2.50 (0.52) | 2.33 (0.54) | 2.88 (0.46) | 2.89 (0.55) | 2.61 (0.55) | <0.0001**** |
| Dim3 | 2.64 (0.53) | 2.51 (0.54) | 2.92 (0.46) | 3.08 (0.46) | 2.72 (0.59) | <0.0001**** |
| Dim4 | 3.04 (0.49) | 3.05 (0.45) | 3.14 (0.51) | 3.17 (0.48) | 3.11 (0.50) | 0.2095 |
| Dim5 | 2.44 (0.42) | 2.57 (0.47) | 2.70 (0.37) | 2.64 (0.41) | 2.59 (0.42) | <0.0001**** |
| Dim6 | 2.92 (0.40) | 2.92 (0.48) | 3.00 (0.36) | 3.04 (0.49) | 3.00 (0.43) | 0.1965 |
| Dim7 | 3.13 (0.44) | 3.12 (0.41) | 3.25 (0.39) | 3.31 (0.43) | 3.22 (0.44) | 0.0253* |

*p<0,05 **p ≤0,01 ***p ≤0,001 ****p≤0,0001

**B**

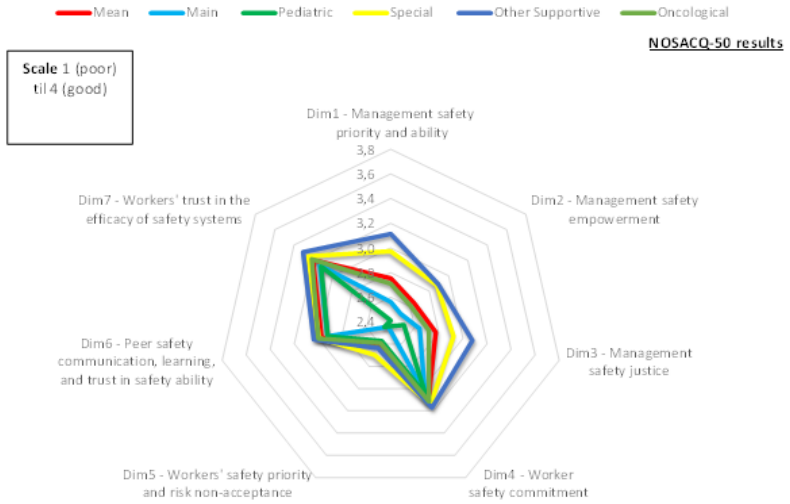


**Figure 7.** (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for five groups based on hospital category and one-way ANOVA for all dimensions per group. (B) Radar diagram of safety climate survey results by dimension for the five groups of respondents based on hospitals category

Finaly, the responses of study participants, based on the category of staff they belong to, are presented in Fig. 8. According to one-way ANOVA, statistical significance was found in all dimensions among different categories of staff. Comparing the average scores of all categories of staff, we see that doctors' perceptions of the safety climate in their workplace have the lowest score in all dimensions. The exception is DIM 5, in which doctors score as low as nurses. The category of all other health professionals follows physicians with the lowest mean scores in DIM 1, 2, 3, 4, and 5 (after nurses) and 7. Nurses scored the highest of all in two dimensions: DIM 4 (M = 3.12) and DIM 7 (M = 3.18). The administrative/technical group had the highest average scores overall, but only two dimensions scored at the "fairly good" level. Dimension 5 is at the same level in all categories with the lowest average

score. This dimension requires a great need for improvement intervention, especially for doctors and nurses. The overall results are shown in Fig. 8

A

**Personal category (n=1022)**

| Dimensions | doctors | nurses | administrative/ technical | others | One-way ANOVA |
|---|---|---|---|---|---|
| | mean (SD) | mean (SD) | mean (SD) | mean (SD) | *p value |
| Dim1 | 2.44 (0.61) | 2.64 (0.56) | 2.82 (0.65) | 2.59 (0.56) | <0.0001**** |
| Dim2 | 2.43 (0.58) | 2.57 (0.51) | 2.66 (0.58) | 2.50 (0.49) | 0.0003*** |
| Dim3 | 2.59 (0.54) | 2.67 (0.52) | 2.84 (0.61) | 2.63 (0.53) | 0.0002*** |
| Dim4 | 2.97 (0.47) | 3.12 (0.51) | 3.09 (0.44) | 3.03 (0.48) | 0.0008*** |
| Dim5 | 2.47 (0.42) | 2.47 (0.41) | 2.62 (0.51) | 2.50 (0.44) | 0.0104* |
| Dim6 | 2.87 (0.41) | 2.99 (0.41) | 2.93 (0.37) | 2.94 (0.43) | 0.0029** |
| Dim7 | 3.08 (0.41) | 3.18 (0.45) | 3.21 (0,44) | 3.15 (0.43) | 0.0164* |
| *p<0,05 | **p ≤0,01 | ***p ≤0,001 | ****p≤0,0001 | | |

B

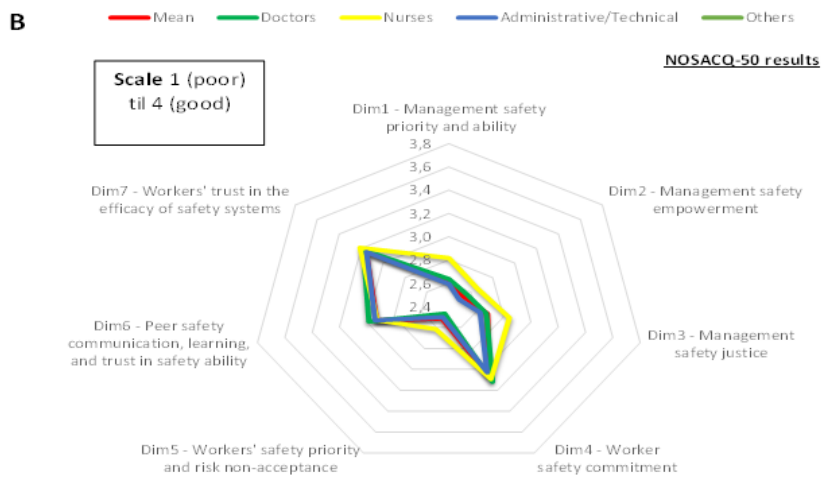


**Figure 8**. (A) Safety Climate per Dimension (DIM 1-7), Mean Scores and Standard Deviation separate for four groups based on personal category and one-way ANOVA for all dimensions per group. (B) Radar diagram of safety climate survey results by dimension for the four groups of respondents based on personal category

## Discussion

Our study provides an exploratory and descriptive analysis on the perception of safety climate among public hospital workers in Greece's most populous health region. The study aimed to bring to light issues related to occupational safety in this sector and to provide insight into workers' perceptions of risks, safety, and safety management.

Examining the overall results, we conclude that all dimensions of the safety climate examined for both groups (workers/leaders) need improvement (<3.30), and given that most dimensions are at the almost low and low level, a negative perceived safety climate of employees in their workplaces emerges. Compared to the NOSACQ-50 data, the hospitals in this study scored lower across all dimensions. Literature has shown that a good safety climate can intervene positively in the relationship between the organizational climate and

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employee safety, leading to safer behaviors and resulting in a reduction in accidents (Ajslev et al., 2017; Luo, 2020; Kalteh et al., 2021).

An interesting fact that emerges from our study is that DIM 5 (priority to worker safety and non-acceptance of risk) consistently scored the lowest score in all subdivisions of the sample. This finding shows that employees perform their jobs accepting risk-taking, accept risky behaviors, violate safety rules, and have developed a tolerance for risk as they consider it to be an inevitable part of their job. These conclusions can be drawn from the analysis of the questions corresponding to this dimension. The further in-depth analysis of the data, combining the DIM 5 score with the also low <2.70 average score of employees in DIM 3 (management safety justice), which corresponds to the management's effort to manage accident prevention, demonstrates the need for immediate actions to improve the safety climate and strengthen the perceptual organizational support of employees for this. According to Mori et al. (2024), organizations, in order to enhance the perceptual organizational support of employees, should develop competencies that appear to work in practice, e.g., fairness, supervisor support, rewards, favorable working conditions, and human resource management practices.

On the other hand, it is particularly encouraging that three out of the 4 dimensions (4, 6, and 7) that are most focused on safety management from the employees‘ point of view scored at the level of 3.00–3.30 (fairly good), corresponding to a slight need for improvement, meaning that employees are aware that commitment to safety is required. They trust the effectiveness of security systems and the benefits derived from safety planning, safety inspections and audits, clearly defined safety objectives, and training, but also communication, trust, and exchange of knowledge and experience, according to the questions answered in these dimensions. These dimensions are very important, especially in healthcare, as healthcare professionals, in addition to their own safety, also place high priority on patient safety. In fact, several times they have risked their own safety and health to provide safety to patients, according to the findings of Strid et al., 2021. Therefore, a good climate of safety enhances safe patient care and at the same time ensures the safety of HCW (Pousette et al., 2017; Agnew et al., 2013; Taylor et al., 2012). Scores in the dimensions of safety climate, as presented in this study, show that variables concerning the management side, such as priority of safety, commitment, and safety management skill (DIM 1), garnered very low scores, which contrast with the high scores obtained by the corresponding variables indicating employees’commitment to safety (DIM 4). Management safety priority expresses the employee's sense of management's behavior in actions related to the safety hierarchy, even when production pressure is high. In these circumstances, as already mentioned, healthcare professionals involved in our study accept risk-taking. Risk acceptance, according to the data in the Figure

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1, concerns both employees and leaders. This finding shows that great needs for improvement are required with everyone's participation. When managers have a strong commitment to safety principles and take action, employee behaviors can be improved. When a low level of safety prevails, managers and employees tend to consider that responsibility for safety lies with others and not with themselves. These findings converge with the results of the study of Prussia et al. (2003), which further states that in an environment where managers and employees share the responsibility of safety as a common concern, the safety climate tends to become stronger. Luo (2020) supported that the overall safety climate consists of four dimensions, the first being the attitude of the senior supervisor, the others were security oversight, security production environment, and the implementation of safety training. The fact that both employees and managers scored relatively high on the safety commitment dimension suggests a high priority of safety on their part, but eliminating imminent risks requires both management commitment and capacity to create a strong safety climate. These are also evident from the findings of a multinational study by Zwetsloot et al. (2017), in which 27 European companies adopted "Zero Accident Vision" (ZAV).

The ZAV survey results were compared with the NOSACQ-50 questionnaire, with managers consistently garnering higher scores than employees. This is confirmed in the present study. Although higher, average leaders' scores still remain low. This can be attributed to the fact that leaders in the hospitals in the study play a dual role, often being employees and managers simultaneously, as a result of which they have learned exposure and risk response in a similar way. In organizational dimensions, leaders as already discussed have higher average scores (still lower than desired) than employees. This could be explained by the fact that this group overestimates the safety and competence of management, which enhances the image of management and indirectly their own (Marín et al., 2019). On the other hand, this could be explained by the assumption that managers and employees have different levels of expertise and therefore face risk differently, but such a characteristic cannot be taken into account in the other subdivisions analyzed. In particular, the level of expertise is not confirmed to be decisive, as in the one-way ANOVA, it did not show significant differences in categories based on age and years of experience compared to DIM 5, which counts exactly that. Therefore, the hypothesis that older and therefore more experienced workers take on a higher risk is not confirmed in this study of healthcare workers. On the contrary, there are studies in other areas that show that more experienced employees are prone to risky behaviors (Ji et al., 2018; Martín et al., 2009) and overestimate their ability to cope with high-risk situations in their workplace (Arcury et al., 2015; Stoesz et al., 2020).

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The employment status (tenure) differentiates employees perception of safety issues in this study. Non-permanent workers, who are generally of younger age, appear to have a better perception of safety issues, which is reflected in their low scoring. In addition, the employment status of employees, according to a cross-sectional study by Sønderstrup-Andersen et al. (2011) in Denmark, confirms the result of the present study, namely that salaried employees had higher and more favorable scores for the safety climate than those who did not have a permanent employment relationship.

The significant statistical correlations identified in the age parameter, especially in Dim 1 (priority, commitment, and management's ability to manage safety) in this study, are consistent with numerous studies in this field (Fargnoli & Lombardi, 2020; Jafari et al., 2014; Sønderstrup-Andersen, 2011; Wu et al., 2007), and confirm that younger people perceive safety more negatively than employees of an older age in the same workplace. A further analysis of the demographics brings up another interesting feature. The vast majority of workers (75.7%) are over 40 years old, of which 8.4% are over 59 years old. Ageing workers need special attention because, although young workers are more likely to be involved in accidents at work than older workers, fatal and serious accidents occur relatively more frequently among older members of the workforce (OSHA-EU, 2023).

Gender is another parameter of this study with special interest. Literature, mainly in industry, is controversial, as it has been shown that men are usually more exposed to serious injury since they are more often involved in more dangerous jobs and tend to be riskier (Gyekye (GAS) & Salminen, 2011). In our research, men and women seem to perceive the climate of safety in a similar way (both giving low scores) and tend to be equally risky. Notable differences -statistically significant-concern DIM 2 and DIM 4. Consequently, women perceive a lower level of management empowerment to support and participate in safety issues and a higher level of perception of their commitment to safety. The same results regarding these two dimensions were shown by the study of Fargnoli & Lombardi (2020) concerning the agricultural sector in Italy.

Regarding the parameters, type of hospital, and staff group, the study revealed significant differences in the perception of the safety climate. Based on these differences, central (e.g., by the supervising health region) intervention prioritization seems necessary. It also highlighted the groups of workers that require major and immediate improvement interventions (e.g., physicians). Furthermore, data analysis attracts focus on the need for specified interventions in particular sub-groups, such as young doctors with a time-limited employment contract.

Taking into account all the above, this study comes to contribute to the literature on the safety climate in the health care sector, identifying the

variation in perceptions of the safety climate in a wide range of parameters (job position/specialty, size and type of hospital, employment relationship, age, gender, years of experience, etc.) in a fairly large and representative sample.

Limitations: This study concerns employees in 23 hospitals belonging to one supervising health region. In order to conduct the research, permits had to be obtained from each hospital separately. This bureaucratic process was time-consuming, lasting as long as the data collection period. Encouragingly, however, all hospitals have given their approval and are awaiting the results in order to promote corrective actions.

## Conclusions

This paper is the first study assessing on a larger scale the climate of safety among employees in Greek public hospitals. Our results show an overall low score, indicating the need for interventions and improvement. Perception of work climate is different between leaders and employees, almost in all dimensions examined, and scores are lower when compared to international data. Statistically significant observations came up when studying parameters such as gender, age, employment status, type of hospital, and occupation. Employees score lower than leaders. Age, when associated with employment status and the years of working experience, showed that younger people understand and identify gaps in safety better. The same awareness, on an even larger scale, is found particularly in pediatric hospitals and among physicians.

Concluding, these results can be used to design constructive interventions to improve the safety climate and safety culture and to address the identified malfunctions, prioritizing the parameters that emerged from this study.

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**Declaration for Human Participants:** Approval by the Research Ethics Committee of the University of West Attica (No. 37230/05-04-2023) and from all hospitals. The principles of the Helsinki Declaration were followed.

**Conflict of Interest:** The authors reported no conflict of interest.

**Data Availability:** All data are included in the content of the paper.

**Funding Statement:** The authors did not obtain any funding for this research.

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