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Effectiveness of Occupational Health and Safety Practices for Employees in Workplaces: A Meta-Analysis Study

Onur Doğan [1]

Abstract

The use of new machines in production lines due to technological developments makes business ecosystems more complex every day. In parallel with the changes experienced, the diversity and impact level of risks pose serious threats to employees, businesses, and the environment. Ensuring the sustainability of production can be achieved through effective and comprehensive occupational health and safety practices. Risk assessments, checklists and emergency plans are some of these practices. This study is a study conducted to reveal the impact levels of practices aimed at improving occupational health and safety. Meta-analysis method was used in the study. The data used in the analysis were obtained by searching Web of Science, Google Scholar, YÖK (The Council of Higher Education), PubMed, EBSCOhost databases without any time limitation until 31.01.2024. As a result of the comprehensive search, it was determined that 20 studies were suitable for the analysis. These studies were then included in the analysis and synthesized by meta-analysis. As a result of this meta-analysis, it was determined that occupational health and safety practices for employees were effective (SMD: 0.924, 95% CI:-0.494-1.354, Z=4.214, p=0.000, I2= 98.670%, Q=1428.054). The analysis results revealed that the variance between the studies was statistically significant ($p<0.05$). Additionally, occupational health and safety practices were found to enhance employees' sense of security and productivity, reduce workplace accidents and occupational diseases, and make a significant contribution to the development of a safety culture.

Keywords: Occupational health and safety, Safety culture, Occupational health and safety practices, Meta-analysis.

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İşyerlerinde Çalışanlara Yönelik İş Sağlığı ve Güvenliği Uygulamalarının Etkinliği: Bir Meta Analiz Çalışması

Onur Doğan[1]

Öz

Teknolojik gelişmelere bağlı olarak üretim bantlarında yeni makinelerin kullanılması işletme ekosistemlerini her geçen gün daha karmaşık hale getirmektedir. Yaşanan değişime paralel olarak risklerin çeşitliliği ve etki düzeyi, çalışan, işletme ve çevre için ciddi tehlike oluşturmaktadır. Üretimin sürdürülebilirliğinin sağlanması etkin ve kapsamlı şekilde hazırlanmış iş sağlığı ve güvenliğine yönelik uygulamalar ile sağlanabilir. Risk değerlendirmeleri, kontrol listeleri ve acil durum planları bu uygulamalardan bazılarıdır. Bu çalışma, iş sağlığı ve güvenliğini geliştirmeye yönelik uygulamaların etki düzeylerini ortaya koymak amacıyla yapılmış bir çalışmadır. Çalışmada meta-analiz yöntemi kullanılmıştır. Analizde kullanılan veriler, 31.01.2024 tarihine kadar, Web of Science, Google Scholar, YÖK (Yükseköğretim Kurulu), PubMed, EBSCOhost veri tabanlarında herhangi bir süre sınırlaması yapılmaksızın tarama yapılarak elde edilmiştir. Yapılan kapsamlı tarama sonucu analiz kullanılmak üzere 20 araştırmanın uygun olduğu tespit edilmiştir. Daha sonra bu çalışmalar analize dahil edilerek meta-analiz ile sentez edilmiştir. Bu meta-analiz sonucunda çalışanlara yönelik, iş sağlığı ve güvenliği uygulamaların etkin olduğu tespit edilmiştir (SMD:0,924, %95 CI:-0,494-1,354, Z=4,214, p=0.000, I^2= %98,670, Q=1428,054). Analiz sonuçları, çalışmalar arasındaki varyansın istatistiksel olarak anlamlı olduğunu ortaya koymuştur ($p<0.05$). Ayrıca, iş sağlığı ve güvenliği uygulamalarının çalışanların güvenlik hissini ve verimliliğini artırdığı, iş kazalarını ve meslek hastalıklarını azalttığı ve iş güvenliği kültürünün gelişimine güçlü bir katkı sağladığı tespit edilmiştir.

Anahtar Kelimeler: İş sağlığı ve güvenliği, Güvenlik kültürü, İş sağlığı ve güvenliği uygulamaları, Meta analiz.

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Introduction

Occupational diseases and injuries are critical global health issues (Konijn et al., 2018, p.91), prompting the implementation of the ILO's 2024-2030 Global Strategy. This strategy aims to improve workplace safety worldwide. It encourages ILO members to take action in three key areas: enhancing national OSH frameworks, strengthening coordination, and adapting workplace OSH management systems to sector-specific hazards (ILO, 2023). To achieve these goals, employers must implement effective safety measures and provide additional training to enhance workers' competencies (Ricci et al., 2016, p.3). Moreover, in addition to internal services, employers can hire external services to improve employees' skills. Occupational health and safety is a multidisciplinary concept, and its core aim is to create a healthy working environment by minimizing safety risks (Väyrynen, 2015, p.8). At this point, the impact of occupational health and safety practices on employees gains importance. Getting feedback from the implemented activities is also vital for the development of such studies in the future. In particular, employees should be included in practices that affect the business ecosystem, such as risk assessment and emergency action plan, and their opinions and suggestions should be taken. Workplace satisfaction surveys should be conducted periodically to determine the impact of the practices on employees. In addition, the most appropriate and efficient occupational health and safety practices can be determined by considering the studies in the literature comprehensively. Issues such as hazard class of workplaces, type of work, demographic structure of employees, technological infrastructure may be the determining constraints of occupational health and safety practices. For example, Jozan et. al., (2023) evaluated the effect of e-trainings in occupational health and safety. As a result of the study, they found that e-training is effective in improving the knowledge and skill levels of employees and is also effective in reducing occupational accidents . The technologies and methods used in today's world appear as elements that support this process. Virtual reality and security training is one of the most serious developments in this field. Studies have shown that virtual reality application increases the effectiveness of security training (Lovreglio, 2020, p.5).

Unlike traditional training methods, these trainings are given in the form of videos, online courses, safety manuals (Feng et al., 2018). Studies have shown that this type of practice is better than traditional training performance (Scorgie et al. 2024). Of course, protecting workers' health and improving their well-being in workplaces does not only depend on processes and norms. If interventions are to reduce injury and mortality rates, then it is necessary to go beyond the technical aspects of the work. At this point, organisational communication, adequacy of work processes and contributions to social areas are among the factors that affect the occupational health and safety process (Reason, 2008). These findings are some of the issues that clearly show the importance of occupational accidents and occupational diseases and the need for appropriate management (Mohammadfam et al., 2017, p.156).

The aim of this study is to determine the level of impact of practices to improve occupational health and safety on employees. Occupational health and safety is a phenomenon that closely concerns and affects not only working individuals but also the whole society. For this reason, all kinds of studies used or developed related to occupational health and safety are important in providing a safe work environment.

Based on this determination, some comparisons and various suggestions were made by taking into account the data obtained from the analysis and the literature.

Materials And Methods

This study is a meta-analysis type study. The analysis was prepared according to the checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (Checklist) (Moher et al., 2009, p.875). In order to minimise the possibility of bias in the meta-analysis study, literature search, article identification and data extraction procedures were performed and reviewed repeatedly by the researcher. Quality assessments of the studies used in the analysis were also performed by the researcher.

Inclusion and Exclusion Criteria

The studies used in this study were screened according to PICOS or inclusion criteria;

- ✓ Study group (P: Patient): Employees or those who will start the study
- ✓ Intervention (I: Intervention): Interventions for occupational safety and employee health
- ✓ Comparison (C: Comparison): Non-implementation of interventions for occupational health and safety
- ✓ Outcomes (C: Outcomes): Employees' level of knowledge on occupational health and safety
- ✓ Study design (S: Study design): Experimental, quasi-experimental studies published in English and Turkish.

Editorial letters, traditional studies and systematic studies were not included in the study (CRD, 2008; Gerrish & Lacey, 2010).

Search Strategy

The data used in the analysis were obtained by screening the Web of Science, Google Scholar, The Council of Higher Education (YÖK), PubMed and EBSCOhost databases up to January 31, 2024, without any time restrictions. The searches were conducted in English and Turkish using keywords such as "*occupational health and safety training or activity*," "*risks faced by employees*," or "*practices for occupational safety of employees and occupational safety culture*." All intervention or application studies related to occupational health and safety practices for employees were reviewed, including bibliographies of selected studies.

Selection of Studies

13034 records were accessed to be used in the study. After the duplicate studies were removed, 12942 records were examined in order to make a selection in the title and abstract. In the review, 92 studies were identified as full text. The 92 full-text studies were examined according to the inclusion and exclusion criteria, and 20 studies were included in the analysis to be conducted in this context in terms of occupational health and safety in workplaces. The studies selected within the scope of the study were conducted as shown in Figure 1.

Data Extraction

In order to reach the data obtained within the scope of the study, a data extraction tool was developed and this data tool was used. With the data extraction tool, data such as author and publication dates of the studies included in the systematic review and meta-analysis, data collection tool, study design, date of the study, study area and country, intervention method/type, sample size, ages of the participants, group nature, hazard class were collected (Table 1).

Research Ethics

This study is a meta-analysis type study based on the studies published in the literature. Within the scope of the study, it is not necessary to obtain permission from individuals or ethics committee approval.

Assessment of Methodological Quality of Studies

The quality assessment of the data used in the study was made with quality assessment tools prepared by the Joanna Briggs Institute according to the research design (The Joanna Briggs Institute Critical Appraisal Tools for Use in IBI Systematic Reviews, 2021). In this study, the evaluation tool was selected according to the designs of the studies included in the meta-analysis. In the study, evaluation tools consisting of 13 questions for randomised controlled trials (The Joanna Briggs Institute Critical Appraisal Tools for Use in IBI Systematic Reviews, 2021) and 9 questions for quasi-experimental studies (Tufanaru et al., 2017) were used. These evaluation tools include questions such as "Yes, No, Uncertain, Not Applicable" and are answered with these options. The evaluation results for each study used in our study are shown in Table 1 as "Quality score" As (Uzun and Ozmaya, 2022, p.2453).

Data Synthesis

CMA Ver 2. was used in the statistical calculation of the study. When the studies were analysed, heterogeneity between them was evaluated with Cochrane Q and Higgins I^2 tests. I2 being more than 50% is an important indicator for heterogeneity. SMD (Standardised Mean Difference) was calculated for each variable of the study at 95% confidence interval (CI). Some of the data examined in the meta-analysis were made by taking into account the quality-of-life performance score and the subscales of the relevant scales. In the analysis, the subscale scores of these data were combined with the CMA program meta-analysis during the creation of the data set. In the analysis, only one score for each data was obtained and used in the meta-analysis. In all tests, $p<0.05$ was considered statistically significant.

Findings

In this meta-analysis study, 13034 studies were reached as a result of the screening performed in the first step. After removing the repetitive studies, 92 full texts were selected according to the abstract and title. Then, after re-examining these full texts according to the inclusion criteria, 20 studies were selected to be included in the analysis (Figure 1).

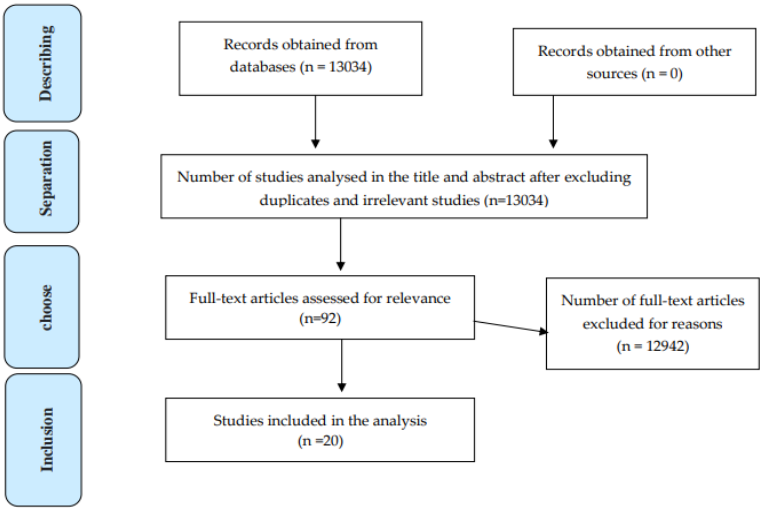

Figure 1. Selection of studies according to PRISMA flow diagram

Twenty of the studies included in the study were post-test-pre-test and control groups and quasi-experimental (Table 1).

Table 1. Characteristics and results of the included studies

Author Information	Sample group	Working pattern	Measuring tools	Sample size/ characteristic	Years	Response time	Type of intervention	Quality Score
Almos et al. 2019	Hospital staff	Semi-experimental	(OHSMS) leading indicator assessment tool	Pre Intervention:270 Last Intervention Test:286	2017	6 Week	Leading indicators in occupational health and safety health management systems	Yes:8/9 No:3/9 Uncertain: 1/9 Not applicable :1/9
Lary et al. 2019	Hospital Staff	Semi-Experimental	McNamara training program	70	2016	8 Week	The Effect of Stress Management Program on the Stress Response of Nurses in Neonatal Intensive Care Units	Yes:5/9 No:2/9 Uncertain: 1/9
Kaushik and Jyoti 2015	Hospital Staff	Semi-Experimental	Information survey and prevention (SOP) procedures	150	2015	10 Week	Operating procedures for needlestick prevention and management	Yes:5/9 No:2/9 Uncertain: 1/9

Table 1…

Author Information	Sample group	Working pattern	Measuring tools	Sample size/ characteristic	Years	Response time	Type of intervention	Quality Score
Khashaba et al. 2023	Hospital Staff	Semi-Experimental	Refresher training	133	2022	20 Week	Impact of a waste management intervention program on knowledge, attitudes and practice (CONTAINER)	Yes:9/9 No:2/9 Uncertain: 1/9 Not applicable :1/9
Lapkin et al. 2014	Health Professional students	Semi-Experimental	Theory of Planned Behaviour Medication Safety Survey	320	2014	1 Week	Evaluating the effectiveness of learning modules	Yes:6/9 No:2/9 Uncertain: 1/9
Lee and Dâhinsen 2023	Hospital Staff	Semi-Experimental	Patient Safety Attitude scale	107	2020	8 Week	Evaluation of the patient safety course	Yes:9/9
Mohammadi et al. 2023	Hospital Staff	Semi-Experimental	Health Action Model	45	2023	12 Week	Health-based education intervention action model to promote safe Behaviour	Yes:7/13 No:6/13 Uncertain: 7/13
Navidian et al. 2017	Hospital Staff	Semi-Experimental	Health and Safety Manager Occupational Stress Survey	80	2017	4 Week	Effectiveness of stress vaccination	Yes:2/9 No:4/9 Uncertain: 5/9 Not applicable :1/9
Othman et al. 2023	Hospital Staff	Semi-Experimental	Maslach Burnout Inventory, Five-Factor Mindfulness Questionnaire (FFMQ), and Self-Compassion Scale	60	2023	8 Week	Mindfulness-based effectiveness interventions on burnout and self-compassion	Yes:7/9 No:2/9 Uncertain: 3/9 Not applicable :1/9
Otu et al. 2021	Hospital Staff	Semi-Experimental	InStrat COVID-19 training app	627	2020	12 Week	E-health interventional study	Yes:13/13

Table 1…

Author Information	Sample group	Working pattern	Measuring tools	Sample size/ characteristic	Years	Response time	Type of intervention	Quality Score
Saleh et al. 2023	Hospital Staff	Semi-Experimental	Occupational Safety Scale	42	2018	3 Week	Occupational Safety Perception and Green Management Practices	Yes:7/13 No:6/13 Uncertain: 4/13
Sarbaz et al. 2017	Hospital Staff	Semi-Experimental	Data are descriptive statistics and chi-square test.	60	2017	12 Week	Effectiveness of Preventive Nursing Program in Multidrug Resistant Patients	Yes:7/13 No:6/13 Uncertain: 4/13
Wang et al. 2020	Hospital Staff	Semi-Experimental	BBP prevention program	106	2000	8 Week	An educational program to prevent occupational exposure	Yes:7/9
Park et al.. 2023	Hospital Staff	Semi-Experimental	Analysis, Design, Development, Implementation and Evaluation (ADDIE) step process	69	2021	16 Week	Cyber Bullying Cognitive Rehearsal Mobile Learning Program	Yes:13/13
Nicoletta and Alessandra 2010	Private Sector Employees	Semi-Experimental	Theory of Planned Behaviour	345	2010	3 Day	The impact of security training programs on employees	Yes:7/9 No:2/9 Uncertain: 4/9 Not applicable :1/9
Yıldırım, 2020	Hospital Staff	Semi-Experimental	Compliance with Standard Precautions Scale	50	2019	2 Week	Employee Health and Safety Improvement Program	Yes:6/9 No:2/9 Uncertain: 5/9
Bayram, 2020	Academic and Administrative Staff	Semi-Experimental	Satisfaction scale from distance OHS trainings	490	2019	1 Week	Quality of Remote Occupational Health and Safety Training	Yes: 8/9 No:2/9 Uncertain: 4/9 Not applicable :3/9

Table 1 …

Author Information	Sample group	Working pattern	Measuring tools	Sample size/ characteristic	Years	Response time	Type of intervention	Quality Score
Sen, 2019	Clothing Industry Workers	Semi-Experimental	OHS practices evaluation form	83	2007	4 Week	The Relationship between Occupational Health and Safety Practices and Quality	Yes: 9/9 No:2/9 Uncertain: 2/9 Not applicable :3/9
Sahmaran and Kar, 2023	Hospital Staff	Semi-Experimental	OHS Knowledge Score	702	2022	2 Week	Occupational Health and Safety Training Given to Hospital Personnel	Yes:8/9
Ulfiye et al. 2017	Nursing Students	Semi-Experimental	ISG information score	82	2015	8 Week	ISG educational information	Yes: 9/9 No:2/9 Uncertain: 2/9 Not applicable :3/9

As a result of the study, occupational health and safety practices for employees are important in terms of being effective for employees. In all of the studies used in the meta-analysis, it was determined that the quality of evidence met more than half (50%) of the items of the evaluation tool (Table 1). Accordingly, it is important in terms of basing the evidence quality of the information presented in the meta-analysis on studies with acceptable quality.

Meta-analysis results on the effectiveness of occupational health and safety practices for employees

In the study, two methods were used to check for publication bias. These are: (a) funnel scatter plot, (b) Egger's Regression Test (Egger et al., 1997, p.629). Funnel plot is an important method used to detect publication bias. The fact that the studies in the data set show a symmetrical distribution and are above the funnel shows us that the study has no publication bias.

Egger's method was used for publication bias among the studies used in the data set. According to this method, the cut-off point (B0) is 1.958, 95% confidence interval (-6.967, 10.883), t=0.4609, df=18 and two-way p value is 0.6503. This result shows that the study publication bias is not statistically significant (p=0.6503).

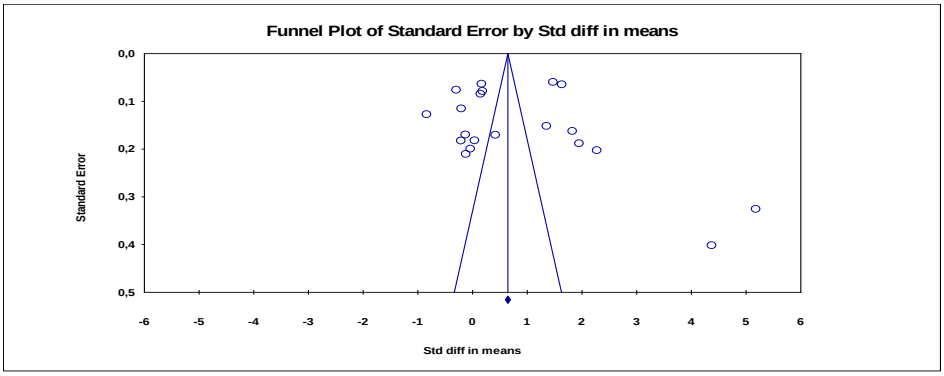

Figure 2. Funnel plot of the studies

The effect sizes of occupational health and safety practices applied to employees, standard error and lower and upper limit values according to 95% reliability interval are given in Table 2.

Table 2. Effect sizes of occupational health and safety practices applied to employees

Study name	Effect size (d)	Standard error	Variance	Lower limit	Upper limit	Z-Value	P-Value
Almos at al., 2019	0,154	0,085	0,007	-0,013	0,320	1,811	0,070
Lary at al., 2019	0,425	0,171	0,029	0,090	0,760	2,486	0,013
Kaushik and Jyoti 2015	-0,198	0,116	0,013	-0,425	0,029	-1,709	0,087
Khashaba et al., 2023	-0,833	0,128	0,016	-1,084	-0,582	-6,516	0,000
Lapkin et al., 2014	0,189	0,079	0,006	0,034	0,344	2,385	0,017
Lee and Dâhinsen 2023	1,513	0,163	0,027	1,513	2,152	11,250	0,000
Mohammadi et al., 2023	-0,115	0,211	0,045	-0,528	0,299	-0,545	0,586
Navidian et al., 2017	2,280	0,203	0,041	1,882	2,678	11,227	0,000
Othman et al., 2023	-0,204	0,183	0,034	-0,562	0,155	-1,112	0,266
Otu et al., 2021	1,640	0,065	0,004	1,512	1,768	25,117	0,000
Saleh et al., 2023	4,379	0,402	0,162	3,591	5,167	10,888	0,000
Sarbaz et al., 2017	0,044	0,183	0,033	-0,314	0,402	0,243	0,808
Wang et al., 2020	1,359	0,152	0,023	1,061	1,658	8,919	0,000
Park et al., 2023	-0,123	0,170	0,029	-0,457	0,211	-0,720	0,472
Nicoletta and Alessandra 2020	-0,290	0,077	0,006	-0,440	-0,140	-3,793	0,000

Table 2…

Study name	Effect size (d)	Standard error	Variance	Lower limit	Upper limit	Z-Value	P-Value
Yıldırım, 2020	-0,032	0,200	0,040	-0,424	0,360	-0,159	0,874
Bayram, 2020	0,172	0,064	0,004	0,047	0,298	2,692	0,007
Sen, 2019	1,955	0,189	0,036	1,585	2,325	10,361	0,000
Şahmaran and Kar, 2023	1,480	0,060	0,004	1,362	1,598	24,563	0,000
Ulfiye et al. 2017	5,185	0,326	0,106	4,546	5,825	15,899	0,000

In Table 2, the weights of the studies on the effect of employees on occupational health and safety practices are analysed. It was observed that the effect sizes of the 20 studies used in the analysis were close to each other. According to the random and fixed effects model, the average effect size of occupational health and safety practices applied to employees on employees was 0.000 according to the meta-analysis result. According to this value, it can be said that occupational health and safety practices are an effective variable on employees.

In the calculation of effect size, standardised effect sizes specified as Cohen's d or Hedges's g are used (Grissom & Kim, 2005). In the study, the effect size was calculated using Cohen's d, and the statistical significance level was 95%. In interpreting the effect sizes, the effect size classification determined by Cohen (1988) was taken into account. According to the analysis, the value between 0.15 and 0.40 indicates a small effect, while the value between 0.40 and 0.75 indicates a medium effect. The value between 0.75-1.10 indicates a large effect, the value between 1.10-1.45 indicates a very large effect, and the value greater than 1.45 indicates an excellent effect.

In the study, according to the effectiveness of occupational health and safety practices, the average effect size value (SMD) according to the effects model was calculated as ES= 0.258 (Table 2). In the calculations made, the data of 20 studies included in the meta-analysis, according to the random effects model, occupational health and safety practices were found to have an effect on employees (Cohen, 1988). The forest plot of the 20 studies included in the study is shown in Figure 2.

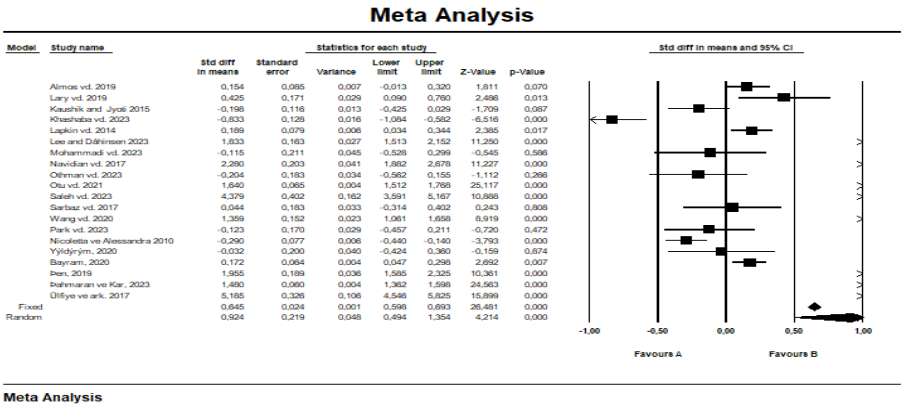

Figure 3. Forest plot of the studies

In 20 studies selected to be used in the meta-analysis, it was determined that occupational health and safety practices had an effect on employees. Figure 3 shows the standard error, effect sizes, lower-upper limits, variance and forest plot of occupational health and safety practices applied to employees. The forest plot in Figure 3 shows that the studies used in the analysis; those with positive values above 0.000, i.e. above 0.000, have a positive effect on occupational health and safety practices, while those with negative values, i.e. below this value, do not have a positive effect. In the meta-analysis based on the findings of these studies, it was determined that occupational health and safety practices applied to employees were statistically significant (SMD-Point Estimate: 0.358, 95% CI: -0.279-0.996, Z=1.101, p=0.000, I2=99%; Figure 3).

When the studies included in the meta-analysis are homogenous, the fixed effects model is applied. In case of heterogeneity, instead of the fixed effects model, random effects model or subgroup analyses, which assume that the size varies from study to study, are used. For this reason, heterogeneity-homogeneity test was performed before deciding which model to use in the study. A significant difference was found between the effect sizes of occupational health and safety practices on employees in the homogeneity test (Q=1287,389; p<.05). This result shows that the distribution is not homogeneous. In this study, I2 is accepted as highly heterogeneous with a value of 99%. The effect size averages of the studies used in the study and included in the analysis are far from each other. Therefore, since there is a heterogeneous distribution in the study, it was concluded that it would be correct to use the random effects model as a model (Table 3).

Table 3. Homogeneity test results of the effect size distribution of occupational health and safety practices on occupational health and safety

Q value	df (Q)	p	I^2 value
1428,054	19	0.000	98,670

Table 4. Moderator results regarding the impact of occupational health and safety practices applied to employees on employees

Moderator	Number of studies	Effect size	Standard error	lower limit	Upper limit	p
Measuring tool used						
OHSMS) leading indicator assessment tool	1	0,154	0,085	-0,013	0,320	0,070
McNamara training program	1	0,425	0,171	0,760	2,486	0,013
Information survey and prevention (SOP) procedures	1	-0,198	0,116	0,425	0,029	0,087
Refresher training	1	-0,833	0,128	-1,084	-0,582	0,000
Theory of planned behaviour medication safety survey	1	0,189	0,079	0,034	0,344	0,017
Patient safety attitude scale	1	1,833	0,163	1,513	2,152	0,000
Health action model	1	-0,115	0,211	-0,528	0,299	0,586
Health and safety manager occupational stress survey	1	2,280	0,203	1,882	2,678	0,000
Maslach burnout inventory, five-factor mindfulness questionnaire (ffmq), and self-compassion scale	1	-0,204	0,183	-0,562	0,155	0,266

Table 4…

Moderator	Number of studies	Effect size	Standard error	lower limit	Upper limit	p
InStrat COVID-19 training app	1	1,640	0,065	1,512	1,768	0,000
Occupational safety scale	1	4,379	0,402	3,591	5,167	0,000
Data are descriptive statistics and chi-square test.	1	0,044	0,183	-0,314	0,402	0,808
BBP prevention program	1	1,359	0,152	1,061	1,658	0,000
Analysis, design, development, implementation and evaluation (ADDIE) step process	1	-0,123	0,170	-0,457	0,211	0,472
Theory of Planned Behaviour	1	-0,290	0,077	-0,440	-0,140	0,000
Compliance with standard precautions scale	1	-0,032	0,200	-0,424	0,360	0,874
Satisfaction scale from distance OHS trainings	1	0,172	0,064	0,047	0,298	0,007
OHS practices evaluation form	1	1,955	0,189	1,585	2,325	0,000
OHS knowledge score	1	3,319	1,853	-0,313	6,950	0,073
Total	**20**	**0,451**	**0,027**	**0,399**	**0,504**	**0,000**
Year the study was conducted						
2010	**1**	**-0,290**	**0,077**	**-0,440**	**-0,140**	**0,000**
2014	1	0,189	0,079	0,034	0,344	0,017
2015	1	-0,198	0,116	-0,425	0,029	0,087
2017	3	1,691	1,385	-1,022	4,405	0,222
2019	3	0,835	0,515	-0,174	1,845	0,105
2020	3	0,501	0,404	-0,290	1,293	0,214
2021	1	-0,204	0,183	-0,562	0,155	0,266
2023	7	0,547	0,764	-0,950	2,044	0,474
Total	**20**	**-0,052**	**0,047**	**-0,144**	**0,041**	**0,273**
Country where the research was conducted						
Australia	1	0,189	0,079	0,034	0,344	0,017
Canada	1	0,154	0,085	-0,013	0,320	0,070
China	1	1,359	0,152	1,061	1,658	0,000
Egypt	3	1,067	1,023	-0,939	3,072	0,297
India	1	-0,198	0,116	-0,425	0,029	0,087
Iran	4	0,657	0,523	-0,368	1,683	0,209
Nıgeria	1	1,640	0,065	1,512	1,768	0,000
South Korean	2	0,856	0,978	-1,061	2,772	0,381
Italy	1	-0,290	0,077	-0,440	-0,140	0,000
Türkiye	5	1,709	0,512	0,705	2,713	0,001
Total	**20**	**0,531**	**0,035**	**0,001**	**0,463**	**0,000**

Table 4…

Moderator	Number of studies	Effect size	Standard error	lower limit	Upper limit	p
Duration of applications						
3 Day	1	-0,290	0,077	-0,440	-0,140	0,000
1 Week	2	0,179	0,050	0,081	0,276	0,000
2 Week	2	0,736	0,756	-0,745	2,217	0,330
10 Week	1	-0,198	0,116	0,425	0,029	0,087
12 Week	3	0,533	0,663	0,767	1,834	0,422
16 Week	1	-0,123	0,170	-0,457	0,211	0,472
20 Week	1	-0,833	0,128	-1,084	-0,582	0,000
24 Week	1	-5,279	0,260	-5,788	-4,770	0,000
3 Week	1	4,379	0,402	3,591	5,167	0,000
4 Week	1	2,280	0,203	1,882	2,678	0,000
4 Week	1	1,955	0,189	1,585	2,325	0,000
6 Week	1	0,154	0,085	-0,013	0,320	0,070
8 Week	5	1,695	0,643	0,435	2,955	0,070
Total	**20**	**0,124**	**0,032**	**0,061**	**0,188**	**0,000**
Hazard Class						
Less dangerous	4	2,262	0,837	0,621	3,903	0,007
Dangerous	15	0,665	0,245	0,185	1,144	0,007
Very dangerous	1	-0,290	0,077	-0,440	-0,140	0,000
Total	**20**	**-0,187**	**0,073**	**-0,329**	**-0,044**	**0,010**

*p < .05

The average effect size of the measurement tools used in the studies was found to be 0.451 (CI=0.399-0.504, p<.05). The variance between the studies for the moderator related to the measurement tools was statistically significant (p=0.000). It was determined that the occupational health and safety measurement tools used in the study changed the effect size on employees (Table 4). The effect size values for the year interval in which occupational health and safety practices were performed in the study were found to be -0.052 (CI=-0.144-0.041, p>.05). It was determined that time moderator did not change the effect size in occupational health and safety practices applied to employees (Table 4). In the study, the average size values of occupational health and safety practices for countries were found to be 0.531 (CI=0.001-0.463, p<.05). The variance between the studies for the countries moderator was found to be statistically significant (p=0.000).

It was determined that the effect size values of the countries changed the effect size on the practices for occupational health and safety. In the study, the mean magnitude values of the duration of occupational health and safety implementation were found to be 0.124 (CI=0.061-0.188, p<. 05). The variance between the studies for the moderator of the duration of implementation of occupational health and safety was found to be statistically significant (p=0,000). It was determined that the effect size values of the duration of occupational health and safety implementation changed the effect size of the employees on the practices given for occupational health and safety. In the study, the effect size of the hazard class of occupational health and safety practices was found to be -0.187 (CI=-0.329--0.044, p=0.010). The variance between the studies for the hazard class moderator was statistically significant (p=0,010). Accordingly, it was determined that hazard class changed the effect size on occupational health and safety practices (Table 4).

In light of these findings, it can be concluded that various factors such as the measurement tools, country context, duration of implementation, and hazard class significantly influence the effectiveness of occupational health and safety practices. The statistical significance of these moderators suggests that tailoring interventions to specific contexts, such as country-specific practices or the nature of hazards, can enhance their impact on employee outcomes. Future research should explore the interaction of these moderators and develop strategies to further optimize occupational health and safety practices in different work environments.

Conclusion and Recommendations

It has been determined that practices for occupational safety in workplaces are effective on individuals' occupational health and safety knowledge and awareness levels. In the study, it was determined that the satisfaction of distance occupational health and safety trainings was effective on the employees' satisfaction with occupational safety practices in workplaces. Similar to the study in the literature, Hutchinson et al. (2022) conducted a meta-analysis study on the effects of industry risk level on safety training outcomes. As a result of the meta-analysis, it was determined that safety training interventions had a positive effect on employees in terms of safety compliance and safety. Among similar studies in the literature in terms of content, Wong et al. (2019) conducted a meta-analysis study on the occupational health of long working hours and overtime. According to the results of the analysis, they found that workers working long hours are vulnerable to occupational health problems. Peng and Chan (2019) conducted a meta-analysis study on the relationship between ageing and occupational health and safety. According to the results of the analysis, they found that older workers are more vulnerable than younger workers, and that older workers have twice as many fatal work accidents as younger workers. Hargreaves et al. (2019) conducted a systematic meta-analysis of occupational health outcomes among international migrant workers. They made recommendations to meet the needs of this group of workers, such as meeting their needs, affordable and appropriate health services, as well as improving occupational health and safety practices. Temisola et al. (2021) conducted a scientometric review and meta-analysis of occupational health and safety of women workers in construction. According to the results of the study, they found that the main factor faced by women in the construction sector is stress or biological hazards. The moderator of the measurement tools used in the study was significant. Significant results were obtained in the study conducted on the scale of compliance with standard measures ($p<0.000$). However, when the literature was examined, no study was found in which measurement tools were used in the applications made for occupational safety in workplaces. It is thought that the use of measurement tools in similar studies may be a variable that should not be ignored. The country-continent moderators used in the study yielded significant results ($p<0.000$). However, when the literature related to the content of the study was examined, no study addressing the country-continent moderator was found. It is thought that this situation is due to the lack of studies conducted to evaluate the effectiveness of interventions for occupational safety in workplaces.

The hazard class moderator used in the study was significant ($p<0.000$). However, when the literature related to the content of the study was examined, no study addressing the hazard class moderator was found. This situation shows that there are few studies conducted to evaluate the effectiveness of interventions for occupational safety in

workplaces. It is thought that hazard class is an important variable that should be taken into consideration in future studies. The line of work moderator used in the study was significant (p<0.000). However, there is no study in the literature in which the line of work moderator is included. It is thought that the line of work is an important variable that should be included in future studies.

It was determined that occupational health and safety practices were effective on individuals' occupational health and safety knowledge and awareness levels. At the same time, the measurement tool used in the study, the country-continent where the research was conducted, hazard class, working year, implementation period and line of work moderators were found to be effective on the occupational health and safety knowledge and awareness levels of individuals. Occupational health and safety is a multidisciplinary field. It is vital in terms of ensuring employee, business and environmental safety in almost every field. The study is important in terms of examining the changes in individuals caused by occupational health and safety practices applied in different business lines.

Peer-Review	Double anonymized - Two External
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