Elektronik Sosyal Bilimler Dergisi www.esosder.org
Electronic Journal of Social Sciences e-ISSN:1304-0278
Ekim/October(2024) - Cilt/Volume:23 - Sayı/Issue:92 (1640-1654)

Assessment of Employees' Ergonomic Issues in The Workplace in Terms of Occupational Health and Safety Practices: A Meta-Analysis Study

Çalışanların İşyerindeki Ergonomik Sorunlarının İş Sağlığı ve Güvenliği Uygulamaları Açısından Değerlendirilmesi: Bir Meta-Analiz Çalışması

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Abstract

This study is a meta-analysis study that aims to evaluate ergonomic issues in workplaces in terms of occupational health and safety practices. Data used in the analysis were obtained through searches on databases such as Google Scholar, YÖK Thesis, EBSCO, and Web of Science without any time restrictions between January and March 2024. A total of 15 research studies were included in the search results. The data obtained were synthesized using narrative synthesis and meta-analysis methods. The total sample size of the data used in the analysis is 65,160. Based on the analysis results, it was found that the practices implemented for addressing ergonomic issues faced by employees in the workplace were effective (SMD: 0.367, 95% CI: 0.055-0.679; Z = 2.305, p = 0.021, I2 = 97.761%, Q = 625.169). The variance among studies is statistically significant according to the analysis results ($p < 0.05$). It is believed that challenges related to the structure of work in workplaces lead to various discomforts in employees, and therefore, ergonomic practices can minimize physical strains on employees, contribute to work efficiency, and enhance employee health and safety.

Keywords: Ergonomic risk factors, Quasi-experimental studies, Meta-analysis

Öz

Bu çalışma, işyerlerinde ergonomik konuların iş sağlığı ve güvenliği uygulamaları açısından değerlendirilmesini amaçlayan bir meta-analiz çalışmasıdır. Analizde kullanılan veriler Ocak-Mart 2024 tarihleri arasında herhangi bir zaman kısıtlaması olmaksızın Google Akademik, YÖK Tez, EBSCO ve Web Of Science gibi veri tabanlarında yapılan taramalarla elde edilmiştir. Arama sonuçlarına toplam 15 araştırma dahil edilmiştir. Elde edilen veriler anlatı sentezi ve meta-analiz yöntemleri kullanılarak sentezlenmiştir. Analizde kullanılan verilerin toplam örneklem büyüklüğü 65.160'tır. Yapılan analiz sonucunda, çalışanların işyerinde karşılaştıkları ergonomik sorunları ele almak için yapılan uygulamaların etkili olduğu bulunmuştur (SMD: 0.367, %95 GA: 0.055-0.679; Z = 2.305, p = 0.021, I2 = %97.761, Q = 625.169). Analiz sonuçlarına göre çalışmalar arasındaki varyans istatistiksel olarak anlamlıdır ($p < 0.05$). İşyerlerinde işin yapısıyla ilgili zorlukların çalışanlarda çeşitli rahatsızlıklara yol açtığı ve bu nedenle ergonomik uygulamaların çalışanlar üzerindeki fiziksel zorlanmaları en aza indirebileceği, iş verimliliğine katkıda bulunabileceği ve çalışan sağlığı ve güvenliğini artırabileceği düşünülmektedir.

Anahtar Kelimeler: Ergonomik risk faktörleri, Yarı deneysel çalışmalar, Meta-analiz

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Makale Türü/Article Type: Araştırma Makalesi/Research Article
Geliş Tarihi/Received Date: 29.06.2024 – Kabul Tarihi/Accepted Date: 22.08.2024
Atıf İçin/For Cite: DOĞAN O., *"Assessment of Employees' Ergonomic Issues in The Workplace In Terms Of Occupational Health And Safety Practices: A Meta-Analysis Study", Elektronik Sosyal Bilimler Dergisi, 2024;23(92):1640-1654*
https://doi.org/10.17755/esosder.1507310

1. INTRODUCTION

Ergonomics is the science of designing and organizing workplaces, products and systems to suit the people who use them, aiming to increase productivity and comfort. It is a multidisciplinary field that interacts with many other disciplines. The subject and purpose of ergonomics is the interaction of human beings with all kinds of elements such as machinery, equipment, environment both in the workplace and in daily life. Ergonomic applications help to reduce costs, increase productivity, quality, employee participation and safety culture. In addition to these issues, it will also ensure that people who feel safe will gain a sense of belonging to their workplaces.

Occupational health and safety play a crucial role in affecting the productivity all countries. Factors such as machine-human interaction, mismatches, inadequate management, and demand-worker skill levels are key elements that influence this process. Failure to take sufficient measures regarding these factors can result in injuries, decreased productivity, lower product quality, and increased costs. Ergonomics contributes to improving occupational health and safety, job satisfaction, and work efficiency. This situation affects both indirect and direct performance increases among employees (Shikdar & Sawaqed, 2004). Musculoskeletal disorders constitute significant occupational health issues globally (Ekpenyong & Inyang, 2014; Ayub & Şah, 2018; Rahman et al., 2019). Particularly, workplaces are specific areas that require attention in this regard because they are dynamic environments in every aspect. Employees need to be informed about potential risks they may encounter during and after working hours, and adequate safety measures must be taken. Employers bear a significant responsibility in this regard.

Employers are responsible for ensuring the health and safety of employees in the workplace. Situations arising from excessive physical strain can be significantly reduced through the implementation of ergonomic methods, thus reducing associated costs. Below are key elements of an ergonomic process:

Provide Management Support: Provide Management Support: Strong management is crucial to the success of ergonomics. Management should define ergonomic goals and objectives, assign responsibilities to employees, encourage the exchange of ideas and keep communication channels open. For example, a safer working environment can be created by using machine-based production systems instead of labor. This can be achieved by management taking into account the views and suggestions of employees.

Involve Employees: Elements such as employee involvement in problem-solving, direct participation in implementation, and a participatory ergonomic approach contribute to the essence of a successful ergonomic process. Employees can contribute to the process by identifying hazards, reducing exposure to risk factors, and evaluating ergonomic changes. They must be in harmony with technologies suitable for the conditions of the same age.

Provide Training: Training is one of the most important elements supporting the ergonomic process. Employees should be educated about ergonomics, its benefits, occupational diseases, and the importance of recognizing symptoms and reporting them.

Identify Problems: Early identification and assessment of hazards causing musculoskeletal disorders are essential steps in this process.

Encourage Early Reporting of Musculoskeletal Disorder Symptoms: Early reporting can accelerate the improvement and evaluation process.

Implement Solutions to Control Hazards: There are multiple solution-focused approaches to reduce or eliminate musculoskeletal disorders in workplaces.

Evaluate Progress: Regular evaluation of ergonomic activities and corrective actions are necessary for sustainability. The success of an ergonomic process should be based on assessments and ergonomic solutions (https://www.osha.gov/ergonomics). Ensuring sustainability in production and preventing workplace-related illnesses are significant economic concerns for businesses. Therefore, integrating ergonomic criteria instead of healthcare expenses is vital for enhancing productivity and ensuring employee health and safety. However, integration of ergonomic practices alone may not be sufficient. Planning, implementation, control, and evaluation stages are important for the healthy integration of ergonomic practices. There are many studies in the literature on ergonomics. Khoshakhlagh et al. (2024) conducted a study on musculoskeletal disorders among firefighters. Hong and Lee (2022) researched the prevalence of musculoskeletal symptoms among construction workers. Sina et al. (2024) studied musculoskeletal disorders among healthcare workers. Suleka et al. (2023) investigated the prevalence of work-related musculoskeletal disorders and quality of life among garment workers.

While the rapid change experienced in the industrial sector positively affects production processes, it also brings with it many risks. Today's occupational health and safety practices are based on the bitter experiences of the past. In this context, the measures taken for changing conditions and the effectiveness of these practices are also of great importance. At the same time, the dynamic structure of workplaces further increases the importance of the work done at this point. This study aims to evaluate employees' ergonomic issues in the workplace in terms of occupational health and safety practices. The data used in the analysis were obtained as a result of summary literature research. As a result of the study, similar applications were mentioned in the literature and some suggestions were made for ergonomic applications and this cleaning activity.

2. MATERIALS and METHODS

The PRISMA checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols) was taken into account in the meta-analysis study (Moher et al., 2009) to ensure minimal possibility of bias. The literature search was performed twice to minimize bias. Data extraction and article selection were performed by the researcher, followed by quality assessment after the included studies were reviewed by the researcher. In the study, evaluation tools consisting of 9 (Tufanaru et al., 2017) questions were used for quasi-experimental research. Questions in the evaluation are answered with the options "Yes, No, Uncertain, Not Applicable".

2.1. Inclusion and Exclusion Criteria

The studies used in the research were screened based on PICOS criteria or the criteria listed below (Soylemez & Uzun, 2024):

- ✓ Population (P: Patient): Employees and those starting work
- ✓ Intervention (I: Intervention): Ergonomic interventions
- ✓ Comparison (C: Comparison): Absence of ergonomic interventions
- ✓ Outcomes (O: Outcomes): The impact of ergonomics on occupational health and safety in workplaces, awareness and knowledge levels for employers and employees
- ✓ Study design (S: Study design): English and Turkish published quasi-experimental and experimental studies (CRD, 2008; Gerrish & Lacey, 2010).

Studies such as case studies, case reports, and letters to the editor were not included in the analysis.

2.2. Search Strategy

The literature search was conducted using key terms such as "ergonomics," "ergonomics and occupational safety," "ergonomic practices in workplaces," and "ergonomics and occupational diseases" in English databases including Web of Science, EBSCOhost, PubMed, and Google Scholar, and in Turkish in YÖK Tez. There was no time (historical) limitation during the literature review. It was aimed to access all studies suitable for analysis. Our study was conducted in accordance with the Principles of the Declaration of Helsinki.

2.3. Selection of Studies

The study initially identified 65,160 research records. After removing duplicate studies, 17,300 records were selected for review based on their titles and abstracts. Following this review, 113 full-text articles were retrieved for further examination. These articles were then assessed based on inclusion and exclusion criteria. Considering the specified keywords, the analysis focused on 15 studies reporting outcomes related to interventions in ergonomics. Details regarding the article selection process are provided in Figure 1.

2.4. Data Extraction

Data extraction was conducted using a data extraction tool in the research. The data extraction tool facilitated the collection of key findings related to the included studies in the meta-analysis, such as publication year, author, data collection tool, study design, country where the study was conducted, hazard class of the job, sample group, and sample size (Table 1).

2.5. Research Ethics

This study is a type of meta-analysis based on existing literature. Therefore, since the study was based on previous research, ethical approval was not required. This study was conducted in accordance with the principles of the Declaration of Helsinki and ethical standards.

2.6. Assessment of Methodological Quality of Studies

Quality assessment of the studies included in the meta-analysis was conducted using the Joanna Briggs Institute Critical Appraisal Tools for use in IBI Systematic Reviews (2021), tailored according to the study design. For randomized controlled trials, a set of 13 questions was utilized (The Joanna Briggs Institute Critical Appraisal Tools for use in IBI Systematic Reviews, 2021), while for quasi-experimental studies, a set of 9 questions was employed (Tufanaru et al., 2017). Response options in the appraisal tools included "yes, no, unclear, and not applicable."

Studies used in the analysis level of methodological quality, when less than 50% of the items are evaluated as “yes”, mediocre”, “medium quality” when evaluated as “yes” between 51-80%, When more than 80% are evaluated as "yes", it is considered "good quality" has been made (Kurnaz & Karaçam, 2023). The quality assessment for each study and the corresponding results were recorded in Table 1 as "Quality Score."

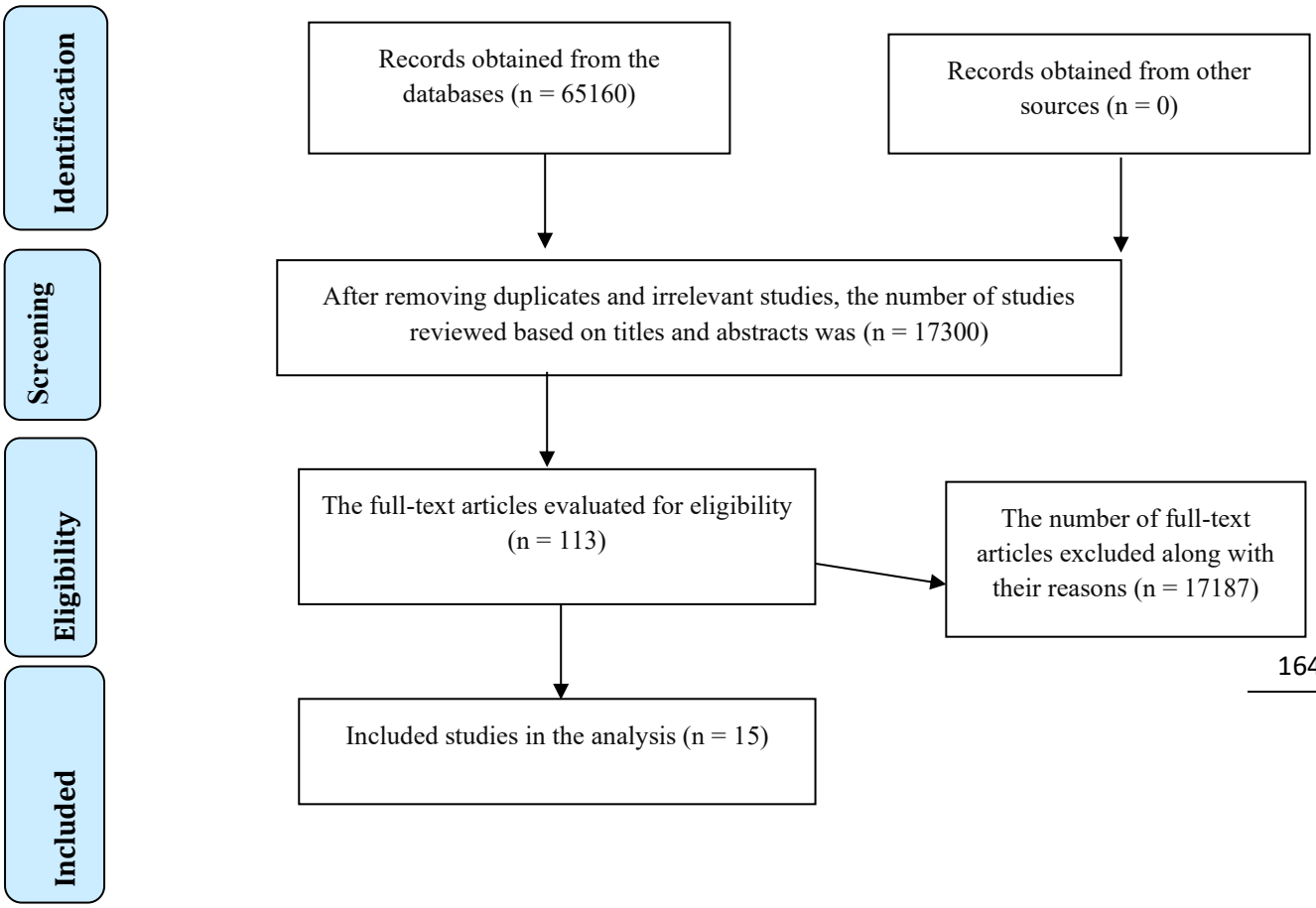
2.7. Data Synthesis

Statistical calculations for the study were performed using CMA Ver. 2. Heterogeneity among the studies included in the analysis was assessed using Higgins I^2 and Cochrane Q tests. An I^2 value exceeding 50% (specifically, I^2=97.761%) was considered a significant indicator of heterogeneity. The confidence interval (CI) for each variable was calculated at 95%, and the Standardized Mean Difference (SMD) was calculated. A p-value of less than 0.05 was considered statistically significant in all tests.

3. FINDINGS

In the initial screening, a total of 65,160 records were identified for potential inclusion. After reviewing duplicates, abstracts, and titles, 113 studies were selected for further evaluation. These studies were then assessed based on inclusion criteria, resulting in the selection of 15 studies for inclusion in the analysis (Figure 1).

Figure 1. Selection of studies according to PRISMA flow diagram



All of the studies included in the analysis are quasi-experimental studies. The sample size of the studies is the intervention group: 3898 (Table 1).

Table 1. Characteristics and results of the included studies

Author Information	Sample Group	Study Design	Measurement Tools	Sample Size/ Characteristics	Data Collection Year	Intervention Duration	Type of Intervention	Age Group	Main Findings
Michelle & O'Neill 2003	Office workers	Quasi-experimental	Ergonomics training program and assessment tools	618	2003	12 Week	Reducing musculoskeletal disorders	Young and Adults	Yes:2/9 No:1/9 Not applicable :4/9
Abdolhamid et al., 2022	Occupational health specialist	Quasi-experimental	Decision support tool	115	2022	12 Week	Paper-pencil observational ergonomic techniques	Young and Adults	Yes:5/9 No:2/9 Not applicable :2/9
Bazazan et al., 2019	Petrochemical plant workers	Quasi-experimental	Musculoskeletal Questionnaire ve Multidimensional Fatigue Inventory and RULA	188	2016	60 Week	The effect of posture correction-based intervention on the musculoskeletal system	Young and Adults	Yes:5/9 No:3/9 Not applicable :1/9
Choobineh et al., 2011	Petrochemical plant workers	Quasi-experimental	Musculoskeletal Disorders Questionnaire" ve "Job Content Questionnaire (JCQ)	134	2010	24 Week	The impact of ergonomic intervention on psychosocial factors	Young and Adults	Yes:5/9 No:2/9 Not applicable :1/9
Beyan et al., 2020	Healthcare workers	Quasi-experimental	Cornell Musculoskeletal Discomfort Questionnaire	50	2019	72 Week	The Effects of Multifaceted Ergonomic Interventions	Young and Adults	Yes: 9/9
Chau et al. 2016	Telecommunications employees	Quasi-experimental	ActiGraph devices and self-report questionnaires	31	2013	19 Week	The Effects of Sit-Stand Desk Intervention on Interview Performance	Young and Adults	Yes:4/9 No:2/9 Not applicable :2/9
Hasheminejad et al., 2021	Private sector employees	Quasi-experimental	Participatory ergonomics (PE)	138	2020	20 Week	Ergonomics Risk Assessment and Implementation of Participatory Policies	Young and Adults	Yes:3/9 No:1/9 Not applicable 4/9
Esmaeili et al., 2023	Private sector employees	Quasi-experimental	Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)" ve "direct observation of work postures	117	2022	48 Week	Long-Term Parallel Four-Group Interventions	Young and Adults	Yes:5/9 No:2/9 Not applicable :5/9
Roghieh et al., 2019	Healthcare workers	Quasi-experimental	Planned Behavior Theory	63	2017	1 Week	Digital-Based Training for Improving Occupational Health	Young and Adults	Yes:1/9 No:2/9 Not applicable :2/9
Tiainen et al., 2014	University employees	Quasi-experimental	Erggi Action Model	568	2014	72 Week	Musculoskeletal Ergonomics: Symptoms and VDU Working Conditions in the Erggi Action Model	Young and Adults	Yes:5/9 No:2/9 Not applicable :1/9
Robertson vd. 2008	Private sector employees	Quasi-experimental	Office Health and Ergonomics Training Programs	750	2008	24 Week	Flexible Workspace Design and Ergonomics Training	Young and Adults	Yes: 8/9 No:3/9 Not applicable :1/9
Laıng et al.,2007	Private sector employees	Quasi-experimental	Participant Ergonomics Implementation Plan	85	2007	44 Week	The Effectiveness of Reducing Employees' Pain Severity Through Physical Exposure Pathways	Young and Adults	Yes:5/9 No:2/9 Not applicable :1/9
Nguyen t al., 2022	Healthcare workers	Quasi-experimental	Q-LES-Q-SF: Quality of Life Enjoyment and Satisfaction Questionnaire-Short Form	162	2021	49 Week	Efficacy of Interventions to Prevent Musculoskeletal System Disorders	Young and Adults	Yes: 9/9
Laıng et al.,2005	Private sector employees	Quasi-experimental	Participatory Ergonomics Implementation Plan	97	2004	44 Week	Workers' effectiveness in reducing pain severity through physical exposure	Young and Adults	Yes:5/9 No:2/9 Not applicable :1/9
Haslam et al., 2019	Private sector employees	Quasi-experimental	Testing the experience of information stimulation	1120	2019	96 Week	Walking Works Wonders	Young and Adults	Yes:9/9

Based on the meta-analysis results, it was observed that more than 50% of the items in the evidence evaluation tool were met in all the studies included in the analysis (Table 1). This indicates that the information presented in the meta-analysis is based on studies of acceptable quality.

Evaluation of the effectiveness of ergonomic interventions in workplaces

The presence of publication bias was assessed using (a) a funnel plot and (b) Egger's Regression Test (Egger et al., 1997). The funnel plot in this dataset shows a symmetrical distribution of studies at the top, indicating the absence of publication bias.

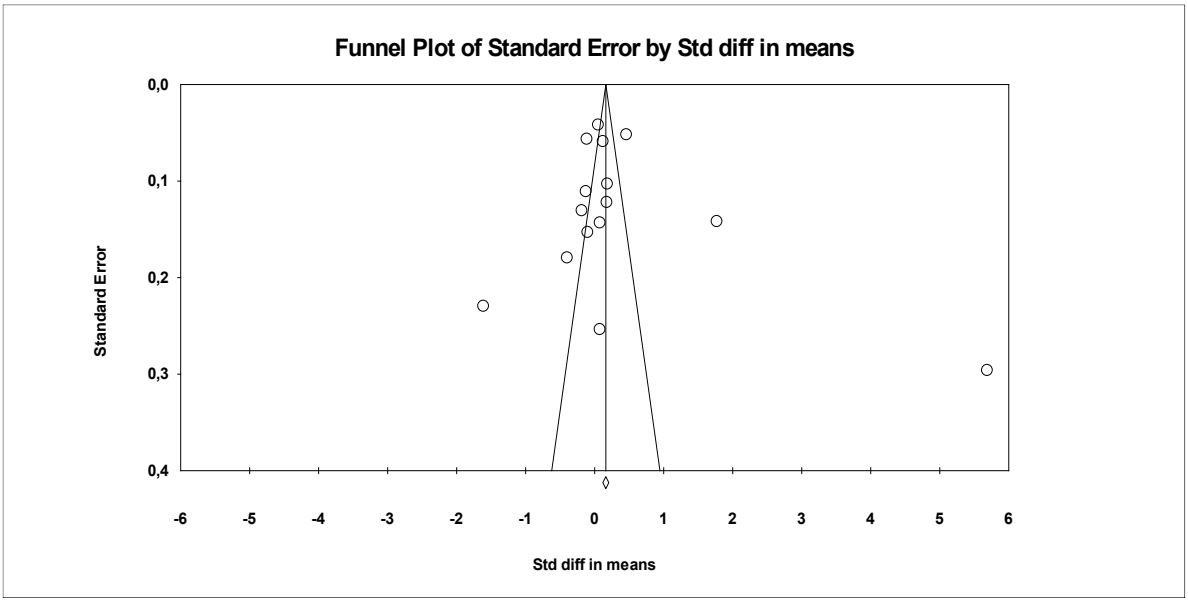


Figure 2. Funnel plot of the studies

The publication bias of the studies used in the data set was determined by Egger's method. According to Egger's method, the cut-off point (B0) is 2.538, 95% confidence interval (-4.766, 9.846), t = 0.7505, df = 13 and two-way p value is 0.4662 (A high p-value ($p > 0.05$, generally indicates that current bias is not significant). This result shows that publication bias is not statistically significant. Standardized effect sizes expressed as Hedges's g or Cohen's d are used to calculate the effect size (Grissom & Kim, 2005). In the analysis, the standardized mean difference mean Cohen's d and Hedges' g coefficients in comparing effect size values was used. In this study, effect size was calculated using Cohen's d. The significance level of the statistical calculation was found to be 95%. Cohen's (1988) effect size was taken into consideration when interpreting the effect sizes. Accordingly, a value between 0.15-0.40 indicates a small effect, a value between 0.40-0.75 indicates a moderate effect, a value between 0.75-1.10 indicates a large effect, a value between 1.10-1.45 indicates a very large effect, and a value greater than 1.45 indicates an excellent effect (Cohen, 1988). According to the random effects model of the effect size values of the studies included in the study within the scope of ergonomic activities applied in workplaces for employees, the effect size value was calculated as SMD (ES) = 0.315 (Figure 3). In line with the analysis, the data from the 15 studies included in the study showed that ergonomic practices in workplaces have a large effect on the awareness and knowledge levels of individuals according to the random effects model (Cohen, 1988). The forest plot of the 15 studies used in the meta-analysis is shown in Figure 2.

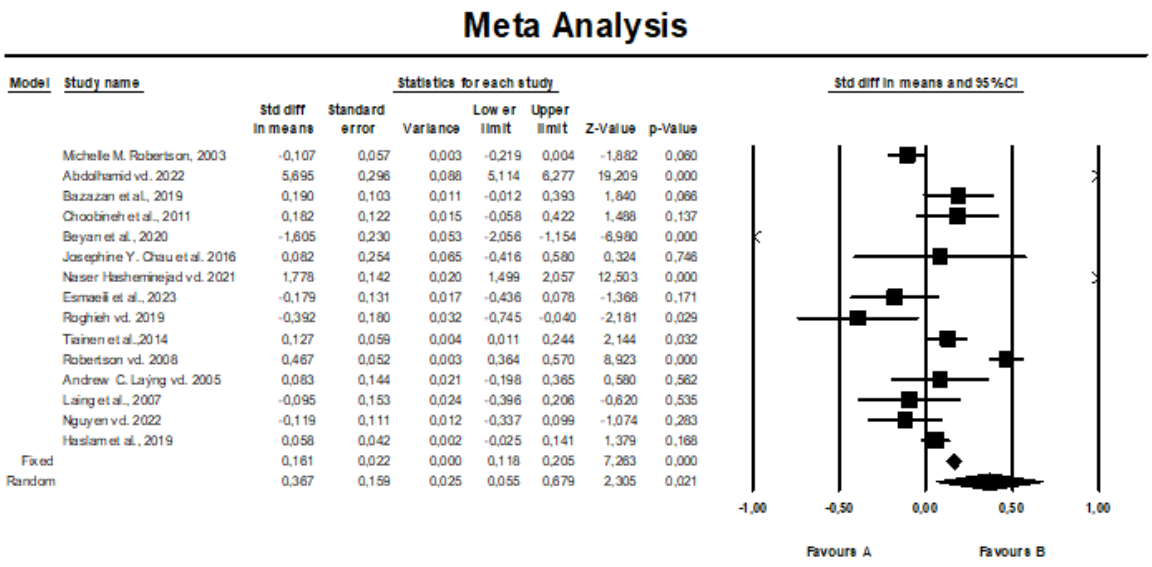


Figure 3. Forest plot for the studies

The standard error, effect sizes, variance upper and lower limits and forest plot of the 15 studies selected to be used in the meta-analysis were indicated. Considering the findings of the meta-analysis, it was determined that ergonomic practices in workplaces were effective on the people to whom they were applied (SMD: 0.367, 95% CI: 0.055- 0.679; Z= 2.305, p = 0.021, I^2 = 97.761%).

When the studies used in the meta-analysis are homogeneous, the fixed effects model is applied. When there is heterogeneity, the fixed effects model is not used. Instead, subgroup analysis or random effects model, which assumes that effect sizes vary from study to study, is applied. For this reason, the Heterogeneity/Homogeneity test was conducted before deciding which model to apply in the study. The homogeneity test showed a significant difference (Q=625 (Q-value is often used in heterogeneity testing, and a high Q-value indicates the presence of heterogeneity), 169; p<.05). According to this result, it is seen that the distribution is not homogeneous. In the analysis I^2 was found to be 97.761%. This result shows that the study is highly heterogeneous. Since the effect size averages of the studies used in the analysis were far from each other and heterogeneous, it was concluded that it would be more appropriate to use the random effects model in the study (Table 3).

Table 3. Heterogeneity Test Results of the Effect Size Distribution of Occupational Safety Practices in Workplaces

Q value	df (Q)	p	I^2 value
625,169	14	0.000	97,761

The results of the meta-analysis on the effectiveness of ergonomic interventions in workplaces are given in Table 4.

Table 4. Moderator results of ergonomic practices in workplaces

Moderator	Number of studies	Impact Size	Standard Error	Lower limit	Upper limit	p
Measurement tools						
ActiGraph devices and self-reporting surveys	1	0,082	0,254	-0,416	0,580	**0,746**
Testing the effects of knowledge adaptation	1	0,058	0,042	-0.025	0,141	**0,168**
Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) and direct observation of working postures	1	-0,179	0,131	-0,436	0,078	**0,171**
Cornell Musculoskeletal Disorders Questionnaire	1	-1,605	0,230	-2,056	-1,154	**0,000**
Erggi action model	1	0,127	0,059	0,011	0,244	**0,032**
Evaluation tools used in ergonomics training program and measurement	1	-0,107	0,057	-0,219	0,004	**0,060**
Ergonomics Program Implementation Plan	1	-0,095	0,153	0,396	0,206	**0,535**
Decision Support Tool	1	5,695	0,296	5,114	6,277	**0,000**
Musculoskeletal Disorders Questionnaire and Job Content Questionnaire (P-JCQ)	1	0,182	0,122	-0,058	0,422	**0,137**
Participatory ergonomics (PE)	1	1,778	0,142	1,499	2,057	**0,000**
Participatory Ergonomics Implementation Plan	1	0,083	0,144	-0,198	0,365	**0,562**
Satisfaction Short Form (Q-LES-Q-SF) and Kessler Psychological Distress Questionnaire	1	-0,119	0,111	0,337	0,099	**0,283**
Musculoskeletal Questionnaire and Multidimensional Fatigue Inventory and RULA	1	0,190	0,103	-0,012	0,393	**0,066**
Office health and ergonomics training programs	1	0,467	0,052	0,364	0,570	**0,000**
Theory of Planned Behavior	1	-0,392	0,180	-0,745	-0,040	**0,029**
Total	**15**	**0,586**	**0,042**	**0,504**	**0,668**	**0,000**

Table 4.(devam)

Year of study	Number of studies	Impact Size	Standard Error	Lower limit	Upper limit	p
2003	1	-0,107	0,057	-0,219	0,004	**0,060**
2005	1	0,083	0,144	-0,198	0,365	**0,562**
2007	1	-0,095	0,153	-0,396	0,206	**0,535**
2008	1	0,467	0,052	0,364	0,570	**0,000**
2011	1	0,182	0,122	-0,058	0,422	**0,137**
2014	1	0,127	0,059	0,011	0,244	**0,032**
2016	1	0,082	0,254	-0,416	0,580	**0,746**
2019	4	-0,035	0,098	-0,227	0,158	**0,724**
2020	1	-1,605	0,230	-2,056	-1,154	**0,000**
2021	1	1,778	0,142	1,499	2,057	**0,000**
2022	2	2,782	2,907	-2,917	8,480	**0,339**
Total	**15**	**0,185**	**0,028**	**0,131**	**0,240**	**0,000**
Line of business						
Office Workers	1	-0,107	0,057	-0,219	0,004	**0,060**
Occupational health specialist	1	5,695	0,296	5,114	6,277	**0,000**
Chemical plant workers	2	0,187	0,079	0,032	0,342	**0,018**
Healthcare workers	1	-0,392	0,180	-0,745	-0,040	**0,029**
Healthcare workers	2	-0,849	0,743	-2,305	0,607	**0,253**
Telecom employees	1	0,082	0,254	-0,416	0,580	**0,746**
Private sector employees	2	0,799	0,979	-1,119	2,717	**0,414**
Private sector employees	4	0,145	0,140	-0,130	0,419	**0,301**
University employees	1	0,127	0,059	0,011	0,244	**0,032**
Total	**15**	**0,108**	**0,034**	**0,042**	**0,175**	**0,001**

Table 4.(devam)

Study population	Number of studies	Impact Size	Standard Error	Lower limit	Upper limit	p
31	1	0,082	0,254	-0,416	0,580	**0,746**
50	1	-1,605	0,230	-2,056	-1,154	**0,000**
63	1	-0,392	0,180	-0,745	-0,040	**0,029**
85	1	-0,095	0,153	-0,396	0,206	**0,535**
97	1	0,087	0,144	-0,198	0,365	**0,562**
115	1	5,695	0,296	5,114	6,277	**0,000**
117	1	-0,179	0,131	-0,436	0,078	**0,171**
134	1	0,182	0,122	-0,058	0,422	**0,137**
138	1	1,778	0,142	1,499	2,057	**0,000**
162	1	-0,119	0,111	-0,337	0,099	**0,283**
188	1	0,190	0,103	-0,012	0,393	**0,066**
568	1	0,127	0,059	0,011	0,244	**0,032**
618	1	-0,107	0,057	-0,219	0,004	**0,060**
750	1	0,467	0,052	0,364	0,570	**0,000**
1120	1	0,058	0,042	-0,025	0,141	**0,168**
Total	**15**	**0,161**	**0,022**	**0,118**	**0,205**	**0,000**

*p < .05

The mean effect size of the measurement tool (independent variable) used in the study was **0.586 (CI=0.504-0668,** p<.05). The variance between the studies for the measurement moderator was statistically significant (p=0.000). It was determined that the measurement moderators in which the study was conducted changed the effect size on ergonomic practices (Table 4).

The effect size values for the year moderator used in the study were found to be 0.185 (CI=0.131-0.240, p<.05). The variance between studies for the year moderator was statistically significant (p=0.000). It was found that the study changed the effect size on ergonomic practices for the years of the study (Table 4).

The mean effect size for the line of work of the study was found to be 0.108 (CI=0.042-0.175, p<.05). The variance was found to be statistically significant (p=0.023) for the more descriptive of the line of work used in the analysis.

It was determined that the line of work used in the study changed the effect size on ergonomic practices (Table 4).

The effect size values between the studies for the moderator of the sample of the study were 0.161 (CI=0.118-0.205, p<.05). The variance between the studies for the sample moderator was statistically significant (p=0.000). In the studies, the sample moderator was found to change the effect size on ergonomic practices (Table 4).

4. DISCUSSION

This study aimed to evaluate the effectiveness of ergonomic practices implemented in workplaces. Within the scope of the study, quasi-experimental studies applied in workplaces were taken into consideration. The adaptation of ergonomics to industrial life day by day constituted the starting point of the study. As a result of the meta-analysis, it was determined that ergonomic practices in workplaces are effective in improving knowledge and awareness of individuals. In a systematic review, Cooklin et al. (2017) found that integrated workplace interventions that combine health promotion and development with occupational health and safety are effective in improving the physical or mental health of individuals (Cooklin et al., 2017). In this context, it can be said that occupational health and safety practices are very important and affect the mental, social and physical health of individuals.

The moderator for the measurement tool used in the study was significant. In the literature review, no study was found to address the measurement tool module used in the study. This is thought to be due to the fact that there are few studies conducted to evaluate the effectiveness of interventions for ergonomic practices in workplaces.

Significant results were found in the year moderator used in the study. In the literature review, no study was found that addressed the year module used. This is due to the fact that the year module was not included in the studies conducted to evaluate the effectiveness of ergonomic practices in workplaces. The line of work moderator used in the study was found to be significant as a result of the meta-analysis. In the literature review, no studies were found that discussed these measurement tools. This is thought to be due to the lack of studies conducted to evaluate the effectiveness of ergonomics interventions. Line of business is a vital element such as risks, efficiency in production, health and safety measures in an enterprise. For this reason, it is thought that the line of business moderator should also be addressed in future studies. The sample moderators used in the study were significant as a result of the meta-analysis. However, in the literature review, no study was found in which the sample moderator was addressed. This is thought to be due to the lack of any study conducted to evaluate the effectiveness of interventions for the sample moderator. Ergonomics, i.e. occupational science, is an important criterion in ensuring employee, business and environmental safety. The fact that there is still a need for labor force in the industrial industry is thought to be an important indicator that ergonomic risk factors continue to exist. For this reason, it is thought that the number of employees may be an important variable that should be addressed in future studies.

5. Conclusion and Recommendations

Ergonomics is becoming more and more important in the industrial sector. Although automation systems have taken their place in production lines, the need for labor is still important. As a multidisciplinary science, ergonomics integrates principles from fields such as engineering, psychology, and physiology to optimize human performance and well-being. Ergonomics aims to harmonize the human and business ecosystem. According to the results of the study, it has been shown that ergonomic practices in workplaces are effective on the awareness levels of individuals. The results of each analysis for meta-analysis and moderator (measurement tool, year of study, line of work and number of samples) were consistent.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

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