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Employee Involvement and Safety Behavior: A Serial Mediation Model[1]

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Abstract

It is of critical importance for employees to exhibit safety behaviors to prevent occupational accidents and injuries. Safety culture has emerged as one of the key factors shaping employees' safety behaviors and promoting workplace safety. Accordingly, this study aims to investigate the relationships between employee involvement, safety awareness and competency, reporting culture, which represent key dimensions of safety culture, and safety behavior, and to examine the serial mediation effect of safety awareness and competency and reporting culture in the relationship between employee involvement and safety behavior. Research data were collected through a questionnaire administered to 276 participants working in 24 enterprises operating in the metal sector, and the analyses were conducted using data obtained from 253 participants. The data were analyzed using a serial mediation model implemented in Mplus. The findings indicate that safety awareness and competency, together with reporting culture, have a serial mediation effect on the relationship between employee involvement and safety behavior. In this context, the research results indicate that employee involvement alone may not be sufficient for employees to exhibit safety behaviors and highlight the importance of enhancing safety awareness and competency alongside employee involvement, as well as promoting the broader implementation of reporting culture.

Keywords: Occupational Health and Safety, Safety Behavior, Employee Involvement, Safety Awareness and Competency, Reporting Culture

JEL Codes: J28

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1. Introduction

Despite extensive global efforts to improve occupational health and safety (OHS), occupational accidents and diseases continue to pose a serious threat to workers' health and safety. Approximately three million workers worldwide lose their lives each year due to such accidents and diseases (ILO, 2023; ILO, 2025; ILOSTAT, 2025). Similarly, in Turkey, occupational accidents remain among the most critical issues in working life. According to data from the Social Security Institution (SSI), the number of insured having work accident in Turkey increased from 221,366 in 2014 to 733,646 in 2024 (SSI, 2014; SSI, 2024). Over the past decade, the number of insured having work accident has increased by approximately 231%. This situation highlights that ensuring a safe and healthy working environment remains one of the fundamental priorities of working life.

Metals and metal alloys are widely used as raw materials in a variety of industrial branches due to their durability and quality. This has resulted in the metal sector becoming a significant component of the manufacturing chain. The metal sector, which holds strategic importance for the Turkish economy due to its economic scale and employment capacity, is among the sectors where workplace hazards and risks are particularly prominent and where occupational accidents occur frequently (Bayram et al., 2022). Many operations in the metal sector involve exposure to chemical hazards such as heavy metals, dust, gasses, fumes, and vapors; physical hazards including noise, high temperatures, electricity, radiation, and vibration; as well as ergonomic risk factors such as manual lifting, repetitive movements, and inappropriate posture (Altundaş Hatman et al., 2024; Fuentes-Bargues et al., 2025), all of which may contribute to the occurrence of occupational accidents and diseases.

In this context, identifying the causes of occupational accidents is essential for developing effective preventive measures and establishing safe and healthy working environments (Fuentes-Bargues et al., 2025; Dursun, 2013). The literature emphasizes that a large proportion of preventable occupational accidents result from employees' unsafe behaviors (Li et al., 2025). Research indicates that unsafe behaviors play a significant role in more than 80% of all recorded occupational accidents (Barkhordari et al., 2019; Bayram et al., 2022; Li et al., 2025). This highlights the critical importance of the human factor and safety behavior in preventing occupational accidents or at least minimizing their occurrence (Fernández-Muñiz et al., 2007; Ünal et al., 2021; Amirah et al., 2024).

Safety culture has emerged as one of the key concepts emphasized in the OHS literature for promoting employees' safety behaviors and preventing occupational accidents (Fernández-Muñiz et al., 2007; Fernandez-Muniz et al., 2009; Dursun, 2013; Amirah et al., 2024; Kovacic et al., 2025). Many studies in the literature (Fernández-Muñiz et al., 2007; Lin et al., 2008; Håvold and Nesset, 2009; Zhang et al., 2020, 80; Ünal et al., 2021; Bayram et al., 2022) consider employee involvement, safety awareness and competency, and reporting culture as core dimensions of safety culture. In this context, the present study aims to investigate the relationships among employee involvement, safety awareness and competency, reporting culture, and safety behavior, and to test the serial mediation effects of safety awareness and competency and reporting culture in the relationship between employee involvement and safety behavior. The fact that metal sector employees are at high risk of occupational accidents and diseases constitutes one of the main reasons for conducting this study in this sector. The literature includes numerous studies examining the relationships between safety behavior and various dimensions of safety culture, such as managers' commitment, safety awareness and competency, safety training, and safety priority. However, studies that directly examining the mediating relationships among the variables within the framework of the model proposed in this study remain limited. In this regard, including safety awareness and competency and reporting culture as mediator variables and examining their mediating roles in the relationship between employee involvement and safety behavior distinguishes this study from previous research. In the following sections of the paper, the relevant literature is first reviewed and the hypotheses formulated for the study are presented. This is followed by a description of the research method. Subsequently, the findings are presented and discussed. Finally, the conclusions of the study are evaluated, and the limitations of the research are addressed.

2. Literature Review and Hypothesis Development

2.1. Safety Behavior

It is widely acknowledged that the human factor constitutes one of the primary causes of occupational accidents (Wadsworth and Smith, 2009; Fernandez-Muniz et al., 2009; Subramaniam et al., 2016; Barkhordari et al., 2019). In this regard, employees' behaviors are considered one of the most important determinants of workplace safety (Hrenov et al., 2016). Employees' exhibition of safety behaviors plays a significant role in reducing occupational accidents, occupational diseases, and material damage (Bayram et al., 2022; Amirah et al., 2024).

In this context, effective risk management is closely associated with employees' behaviors (Wadsworth and Smith, 2009). Accordingly, safety culture is regarded as an important managerial tool that shapes employees' safety-related attitudes, values, beliefs, and behaviors. The aim of a positive safety culture

is to establish a work environment in which employees are aware of workplace risks and continuously take precautions against them (Vredenburgh, 2002; Fernández-Muñiz et al., 2007; Fernandez-Muniz et al., 2009). By focusing on employees' attitudes and behaviors, safety culture plays a crucial role in promoting safety behaviors in the workplace (Vredenburgh, 2002; Dursun, 2013; Abeje and Luo, 2023; Tekeli Kaya and Ergör, 2024). In this regard, the literature frequently emphasizes that safety behavior is associated with key dimensions of safety culture, including employee involvement, safety awareness and competency, and reporting culture. Accordingly, the relevant literature is reviewed in the following subsections.

2.2. Employee Involvement

Ensuring employees' involvement in safety-related processes is of critical importance for establishing a healthy and safe working environment (Bayram et al., 2022). Employee involvement plays a fundamental role in the development and effective implementation of safety culture (Zhang et al., 2020; Lu, 2016). The presence of practices that encourage employees' involvement in safety-related activities can be considered one of the key indicators of safety culture. Employees' awareness of the importance of safe work practices, their compliance with regulations and work procedures, their active participation in meetings, and their willingness to propose improvements related to workplace safety can all be regarded as reflections of a positive safety culture (Fernández-Muñiz et al., 2007).

Employees can be directly involved in decision-making processes related to workplace safety through participation in safety committees (Subramaniam et al., 2016). Their active involvement in decision-making and problem-solving strengthens their commitment to OHS (Fernandez-Muniz et al., 2009). In the literature, it is stated that employees' involvement in the design, implementation, monitoring, and follow-up of the safety management process supports the adoption of OHS practices by employees and, ultimately, contributes to reduction of occupational accidents and injury rates (Subramaniam et al., 2016).

For employees to demonstrate safety behaviors, it is essential that they clearly recognize their critical roles in promoting workplace safety, that is, actively involved in the development of work instructions, procedures, and safety rules (Fernandez-Muniz et al., 2009). The relationship between employee involvement and safety behavior has been widely examined in the literature (Fernández-Muñiz et al., 2007; Fernandez-Muniz et al., 2009; Dursun, 2012; Dursun 2013; Subramaniam et al., 2016; Zhang et al., 2020; Ismail, 2020; Ünal et al., 2021). The findings reported by Dursun (2013) indicate that employee involvement has a significant and positive effect on safety behavior. According to the results of that study, employees' being involved in the development of safety procedures and the improvement of working conditions enables employees to exhibit safer behaviors while performing their tasks. Ünal et al. (2021) found that employee involvement plays a mediating role in the relationships between managers' commitment and safety behavior (OHS performance), safety awareness and competency, and reporting culture. Their findings further indicate that employees' involvement in OHS contributes to the development of positive attitudes toward OHS and positively influences safety behavior. Based on these findings, the following hypothesis was formulated: "Employee involvement has a significant and positive effect on safety behavior" (Hypothesis 1).

2.3. Safety Awareness and Competency

Today, safety threats constitute a significant challenge in many sectors, and insufficient safety awareness and the inability to properly assess workplace hazards are among the primary contributing factors. This situation can directly or indirectly influence many industrial incidents that result in employee injuries, hour loss, and equipment damage (Kumar et al., 2025). In this context, safety awareness can be defined as individuals' ability to identify workplace hazards, understand safety procedures, and anticipate risks before they develop into accidents. Safety awareness can be understood as a cognitive attribute that influences the way workers perceive and respond to safety instructions, ultimately shaping both rule compliance and proactive safety behaviors (Alshammari et al., 2025; Esmaeili et al., 2025). Safety awareness is particularly important for organizations in ensuring the effective implementation of safety rules and procedures and, consequently, in contributing to the reduction of occupational accidents (Jaafar and Ahmad, 2023). Although employees' safety awareness is important, the prevention of accidents is also associated with safety competencies. It is widely acknowledged that safety competency play an important role in the development of a safety culture (Rahman et al., 2022, 2). Safety competency refers to the practical knowledge and technical skills required to perform a task safely (Alshammari et al., 2025). Employees with higher levels of competency are more capable of preventing occupational accidents and reducing the severity of their consequences (Rahman et al., 2022, 2).

Employees' involvement in safety-related activities fosters a sense of responsibility for safety actions, enabling them to adopt a proactive approach to safety management and enhancing their awareness of workplace safety risks (Tsao et al., 2017). Accordingly, workplaces that encourage employees' involvement in OHS-related activities are reported to experience

improvements in hazard awareness (Subramaniam et al., 2016, 230). The findings reported by Tsao et al. (2017) indicate that employee involvement significantly promotes teamwork, ultimately enhancing employees' safety awareness and safety behavior. In this direction, the hypothesis, "Employee involvement has a significant and positive effect on safety awareness and competency" (Hypothesis 2) was formulated in the research.

Safety awareness plays a fundamental role in the development of employees' safety behaviors (Alshammari et al., 2025). The relationship between safety awareness and competency and employees' safety behaviors has been widely emphasized in the literature (Dursun, 2012; Ünal et al., 2021; Dursun and Keser, 2014; Uzuntarla et al., 2020; Jaafar and Ahmad, 2023; Alshammari et al., 2025; Esmaeili et al., 2025). The findings reported by Uzuntarla et al. (2020) indicate a significant and positive relationship between safety awareness and safety behavior. According to the results of that study, increases in employees' safety awareness levels lead to improvements in their safety behaviors. Similarly, the findings reported by Alshammari et al. (2025) suggest that greater awareness of workplace risks and safety procedures contributes to the demonstration of safer behaviors. Their study also revealed that safety behavior is largely influenced by employees' perceptions of their own skills, abilities, and confidence in dealing with workplace hazards. Within this framework, as a result of the study, it was stated that safety awareness and competency play an important role in shaping of employees' safety behaviors. Based on these findings, the following hypothesis was formulated: "Safety awareness and competency have a significant and positive effect on safety behavior" (Hypothesis 4).

2.4. Reporting Culture

The reporting of occupational accidents and near-misses is often hindered by various barriers. Fear of punishment, along with feelings of shame and guilt, are among the most prominent obstacles to reporting (Hasanspahić et al., 2023; Karakavuz and Gerede, 2025). In addition, employees may refrain from reporting incidents because the reporting process is frequently perceived as time-consuming (Pedrosa et al., 2025). These challenges underscore the importance of establishing a strong reporting culture. Reporting culture represents a key component of safety culture and reflects employees' willingness to report occupational accidents and near-misses openly, honestly, and without hesitation (Håvold and Nesset, 2009; Douglas et al., 2014; Lu, 2016; Hasanspahić et al., 2023).

According to Reason (1997), establishing an effective safety culture requires the presence of a reporting culture in which employees are willing to report errors and near misses. Organizations that foster a well-established safety culture are more likely to experience fewer occupational accidents and injuries, higher levels of hazard and irregularity reporting, and greater employee motivation to participate in preventive activities. In other words, these organizations are more likely to adopt a proactive approach OHS. In such work environments, employees are encouraged to share suggestions and voice concerns without fear of negative consequences (Kovacic et al., 2025; Reason, 1998). By encouraging the consistent and accurate reporting of incidents and near misses, reporting culture contributes to data-driven decision-making processes (Ghahramani et al., 2025). In this context, an effective safety reporting system constitutes a keystone for the prevention of occupational accidents (Jones et al., 1999; Tsao et al., 2017).

Employee involvement contributes to the establishment of a good reporting culture (Tsao et al., 2017). As employee involvement increases, employees' willingness to report OHS-related issues also tends to increase (Ünal et al., 2021). The findings reported by Ünal et al. (2021) indicate a significant and positive relationship between employees' involvement in OHS and reporting culture. Similarly, the results of the study conducted by Tsao et al. (2017) show that employee involvement significantly influences safety reporting. Based on these findings, the following hypothesis was formulated: "Employee involvement has a significant and positive effect on reporting culture" (Hypothesis 3).

Safety awareness supports employees' proactive behaviors, such as hazard reporting (Alshammari et al., 2025). Indeed, safety awareness encourages individuals to take initiative, report potential dangers, and comply with safety regulations, thereby contributing to the reduction of occupational accidents and injuries (Esmaeili et al., 2025). Based on this perspective, the following hypothesis was formulated: "Safety awareness and competency have a significant and positive effect on reporting culture" (Hypothesis 6).

However, the findings reported by Dursun (2013) indicate that reporting culture has a significant and positive effect on employees' safety behavior. Similarly, Aytaç and Dursun (2018) found a significant and positive relationship between reporting culture and safety behavior. Hrenov et al. (2016) emphasized that the reporting of near-miss incidents constitutes an important tool for improving employees' behaviors. Reported near-miss incidents and occupational accidents play a crucial role in improving workplace safety and enable the prevention of similar undesirable events (Hasanspahić et al., 2023). The findings reported by Tsao et al. (2017) suggest that employee involvement may contribute to the development of a good reporting culture, which in turn can enhance employees' safety behaviors. These findings highlight the importance of reporting culture in shaping employees' safety behavior. Based on these findin-

gs, the following hypothesis was formulated: "Reporting culture has a significant and positive effect on safety behavior" (Hypothesis 5).

Previous studies (Fernández-Muñiz vd., 2007; Fernandez-Muniz vd., 2009; Dursun, 2013; Lu, 2016; Tsao vd., 2017; Ünal vd., 2021; Bayram vd., 2022; Esmaeili vd., 2025; Karakavuz and Gerede, 2025) have shown that employee involvement is associated with safety awareness and competency, reporting culture, and safety behavior. In addition, safety awareness and competency have been reported to be associated with reporting culture and safety behavior (Uzuntarla ve diğerleri, 2020; Rahman et al., 2022; Jaafar and Ahmad, 2023; Alshammari vd., 2025). Based on these findings, it was proposed that safety awareness and competency and reporting culture may play a serial mediating role in the relationship between employee involvement and safety behavior. Accordingly, the main hypothesis of the study was formulated as follows: "Safety awareness and competency and reporting culture have a serial mediation effect in the relationship between employee involvement and safety behavior" (Hypothesis 7). The serial mediation model proposed in this study is presented in Figure 1.

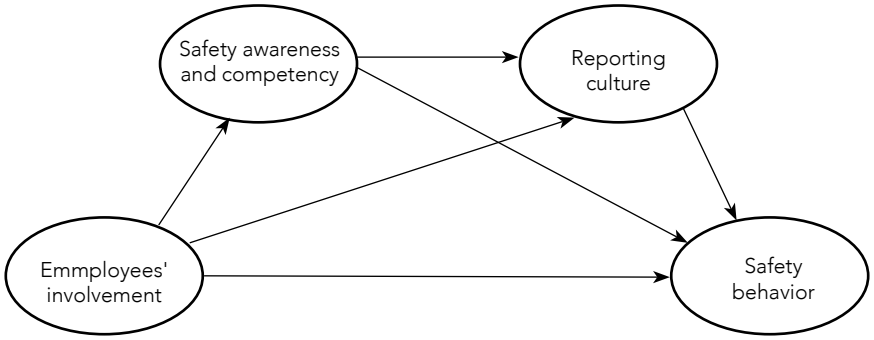

Figure 1. The Research Model

3. Method

3.1. Research Design

This study was conducted using a cross-sectional quantitative research design to examine the relationships among employee involvement, safety awareness and competency, reporting culture, and safety behavior, and to test the serial mediation model presented in Figure 1. In analyses involving multiple mediators, serial mediation models are preferred when the mediator variables are not only associated with the independent and dependent variables but also exhibit a causal sequence and interaction (mediational chain) among themselves (Taylor et al., 2008). Therefore, this study utilises a serial mediation model—also conceptualised as a mediational chain—wherein the total effect of the independent variable on the dependent variable is transmitted through a sequence of mediators operating in a causal order (Hayes, 2018a). The defining theoretical distinction between serail and parallel mediation models lies in the causal specification and the directional flow among the mediators. Unlike parallel models, which assume mediators operate independently, the serial mediation framework tests a sequential causal mechanism. In this structure, the independent variable is hypothesised to trigger a change in the first mediator, which subsequently influences the second mediator, ultimately culminating in an effect on the dependent variable (Hayes, 2022). To theoretically validate this model, the specified sequence must exhibit clear logical or temporal precedence. Empirically, the specific indirect effect traversing this seqential chain is evaluated by multiplying the corresponding path coefficients, thereby isolating the precise mechanism of the serial transmission (Rijnhart et al., 2021).

3.2. Study Group

In this study, data were collected from a total of 276 employees working in 24 enterprises operating in the metal sector in the Manisa Organized Industrial Zone (MOSB) in Turkey. Participants were recruited on a voluntary basis using a convenience sampling method (Gravetter and Forzano, 2018). The inclusion of participants from different enterprises was intended to improve the generalizability of the sample to the population and to provide a certain degree of variability in the responses.

During the evaluation of the suitability of the data for multivariate analyses, outliers were removed to prevent them from adversely affecting the results of the regression analyses (Hair et al., 2010). Consequently, the analyses were conducted using the data obtained from 253 employees. Table 1 presents the sample sizes of the data collected from the enterprises.

Table 1. Number of Employees from Each Enterprise

Enterprise	Sample Size (Full Data)		Sample Size (Outliers removed)	
	N	Percentage (%)	N	Percentage (%)
A	57	20.7	57	22.5
B	28	10.1	28	11.1
C	27	9.8	26	10.3
D	23	8.3	16	6.3
E	17	6.2	15	5.9
F	15	5.4	12	4.7
Other	109	39.5	99	39.1
Total	**276**	**100.0**	**253**	**100.0**

Following the removal of outliers, the distribution of employees across enterprises was examined (Table 1). Employees from Enterprise A represented the largest proportion of the sample (22.5%), followed by those from Enterprise B (11.1%) and C (10.3%). The "Other" category included employees from 18 different enterprises. As the number of employees from each of these enterprises was relatively small, they were combined and reported as a single category. Following the examination of the data and the removal of outliers, the characteristics of the sample were determined and are presented in Table 2.

Table 2. Characteristics of the Study Group

Variable	Category	Frequency	Percentage (%)
Gender	Female	58	22.9
	Male	195	77.1
Age	18-24	44	17.4
	25-39	126	49.8
	40-54	73	28.9
	55+	10	4.0
Educational Level	Primary school	3	1.2
	Middle school	13	5.1
	High school	188	74.3
	Associate degree	24	9.5
	Bachelor's degree	19	7.5
	Postgraduate	6	2.4
Job Position	Worker	188	74.3
	Foreman	17	6.7
	Technician	20	7.9
	Occupational safety specialist	6	2.4
	Occupational nurse	4	1.6
	Manager	6	2.4
	Other	12	4.7
Tenure at the Current Workplace	Less than 1 year	9	3.6
	1-5 years	62	24.5
	6-10 years	87	34.4
	11-20 years	56	22.1
	21 years or more	39	15.4

Work Experience	Less than 1 year	6	2.4
	1-5 years	61	24.1
	6-10 years	65	25.7
	11-20 years	37	14.6
	21 years or more	84	33.2
Total		**253**	**100.0**

An examination of Table 2 indicates that the majority of the participants were male (77.1%), whereas females accounted for 22.9% of the sample. This distribution may be associated with the higher proportion of male employees in the metal sector where the study was conducted. Regarding age distribution, nearly half of the participants (49.8%) were between 25 and 39 years of age. In terms of educational level, a substantial proportion of the participants (74.3%) were high school graduates. The majority of the participants (74.3%) were workers. In addition, a considerable proportion of the participants (33.2%) had 21 years or more of experience in their current job, indicating that a notable segment of the sample possessed long-term work experience.

3.3. Data Collection Tools

The questionnaire used in this study consisted of the employee involvement, safety awareness and competency, reporting culture, and safety behavior scales, along with a personal information form.

Personal Information Form: This form included questions designed to collect information on employees' socio-demographic and occupational characteristics, such as age, gender, educational level, job position, total work experience, and tenure at the current workplace.

Employee Involvement: This scale was developed by Fernández-Muñiz et al. (2007). Consisting of four items, the scale measures employees' compliance with safety procedures and their involvement in improving working conditions. A sample item is: "Employees participate actively in devising, executing and monitoring safety plans". In the culture in which the scale was originally developed, the Cronbach's alpha coefficient was reported as 0.761, with RMSEA and CFI values of 0.059 and 0.963, respectively. In their own study, Ünal et al. (2021) reported a Cronbach's alpha coefficient of 0.869, an average variance extracted (AVE) value of 0.719, a composite reliability (CR) value of 0.911, and factor loadings ranging from 0.592 to 0.754.

Safety Awareness and Competency: Developed by Lin et al. (2008), this five-item scale measures employees' safety awareness and their competency in dealing with safety related issues. Representative items include "I understand the safety rules for my job" and "I can deal with safety problems at my workplace". In the culture in which the scale was originally developed, the Cronbach's alpha coefficient was reported as 0.835, with factor loadings ranging from 0.61 to 0.84. In their own study, Ünal et al. (2021) reported a Cronbach's alpha coefficient of 0.899, an AVE of 0.713, a CR of 0.926, and factor loadings ranging from 0.587 to 0.736.

Reporting Culture: Developed by Håvold and Nesset (2009), this scale consists of five items. The scale measures willingness to report accidents, near misses, and unsafe conditions. In addition, it reflects perceptions regarding the importance of reporting culture within the organization. The scale includes items such as "Reporting accidents/incidents is important for working safely in our organisation" and "People are willing to report near misses". As can be inferred from the items, reporting culture encompasses employees' perceptions. In the culture in which the scale was originally developed, the Cronbach's alpha coefficient was reported as 0.76, with factor loadings ranging from 0.47 to 0.73. In their own study, Ünal et al. (2021) reported a Cronbach's alpha coefficient of 0.897, an AVE of 0.709, a CR of 0.924, and factor loadings ranging from 0.615 to 0.686.

Safety Behavior: Developed by Neal et al. (2000), this scale measures employees' safety behaviors in performing their work. The scale consists of six items across two subdimensions: safety compliance and safety participation. Representative items include "I use the correct safety procedures for carrying out my job" and "I voluntarily carry out tasks or activities that help to improve workplace safety". In their own study, Ünal et al. (2021) reported a Cronbach's alpha coefficient of 0.930, an AVE of 0.741, a CR of 0.945, and factor loadings ranging from 0.698 to 0.774.

The Turkish adaptations of the scales used in this study were carried out by Dursun (2012). All measurement instruments were administered using a five point Likert scale. Participants were asked to read each item and indicate the response that best reflected their views on a scale ranging from "strongly disagree" (1) to "strongly agree" (5).

3.4. Data Collection

This study was approved by the Social and Human Sciences Scientific Research and Publication Ethics

Committee of Karamanoğlu Mehmetbey University (Decision No: 14-2025/323). The data were collected between 09 December 2025 and 13 January 2026. During the data collection process, the researcher informed the managers of the participating enterprises about the purpose of the study and obtained permission to conduct the research within their enterprises. Subsequently, an employee from each enterprise facilitated the distribution of the digital questionnaire to the employees. During the data collection process, participants were provided with a written explanation outlining the purpose and procedures of the study before completing the digital questionnaire. Informed consent was obtained from all participants prior to their participation, and the data collection forms were administered in a digital format. In addition, the importance of providing sincere responses was emphasized through instructions presented on the digital questionnaire, and participants were asked to complete the questionnaire with due care. They were also informed that they could discontinue their participation at any time.

3.5. Data Analysis

The analysis began with an examination of the reliability coefficients. The internal consistency of all scales used in the study was assessed using Cronbach's α coefficients. The reliability coefficients obtained from the data collected in this study are presented in Table 3.

Table 3. Reliability Coefficients of the Scales

Scale	Cronbach's α
Safety Awareness and Competency	0.911
Employee Involvement	0.898
Reporting Culture	0.839
Safety Behavior	0.899

The Cronbach's α values were calculated as 0.911 for the Safety Awareness and Competency scale, 0.898 for the Employee Involvement scale, 0.839 for the Reporting Culture scale, and 0.899 for the Safety Behavior scale. These results indicate that the scales demonstrate high reliability and are suitable for use in line with the objectives of the study.

Evidence regarding the validity of the scales was examined using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results are presented in this section. The EFA results are presented in Table 4.

Table 4. EFA Results

		Scale			
		Safety Awareness and Competency	**Employee Involvement**	**Reporting Culture**	**Safety Behavior**
	Item				
Factor Loadings (EFA)	1	0.858	0.805	0.294	0.815
	2	0.917	0.880	0.795	0.844
	3	0.816	0.807	0.860	0.908
	4	0.859	0.834	0.880	0.856
	5	0.828		0.846	0.678
	6				0.740
	Factor				
Eigenvalues	1	3,667	2,770	2.947	3,940
	2	.480	.756	.969	.666
	3	.375	.273	.633	.575
	4	.299	.201	.282	.419
	5	.179		.170	.222
	6				.179
Explained Variance		**73.349**	**69.245**	**58.932**	**65.659**

When the EFA results of the scales used in the study were examined, the factor loadings of the Safety Awareness and Competency Scale ranged from .816 to .917, those of the Employee Involvement Scale ranged from .805 to .880, those of the Reporting Culture Scale ranged from .294 to .880, and those of the Safety Behavior Scale ranged from .678 to .908. With the exception of one item ($\lambda = 0.294$), all factor loadings were above the recommended threshold value. The theoretical literature suggests that when an item is considered important to a scale's content validity, it may be retained despite a relatively low factor loading (Crocker and Algina, 1986). Since the item's factor loading was close to the threshold and it was considered important for content coverage, it was retained in the scale. In the CFA, the factor loading for this item was re-examined and found to exceed the threshold (Table 5). Following the examination of the reliability and EFA results, CFA was conducted using Mplus, and the results are presented in Table 5.

Table 5. CFA Results

		Scale			
		Safety Awareness and Competency	**Employee Involvement**	**Reporting Culture**	**Safety Behavior**
	Item				
Standardized Factor Loadings (CFA)	1	0.830	0.874	0.505	0.892
	2	0.924	0.925	0.825	0.881
	3	0.765	0.867	0.904	0.988
	4	0.805	0.901	0.953	0.863
	5	0.755		0.914	0.784
	6				0.767
χ^2		25.953	84.022	208.056	109.196
df		5	2	5	9
CFI		0.975	0.976	0.953	0.981
TLI		0.950	0.927	0.906	0.968
RMSEA		0.129	0.403	0.401	0.210
SRMR		0.025	0.057	0.044	0.033

The CFA results indicated that the factor loadings ranged from .805 to .924 for the Safety Awareness and Competency Scale, from .867 to .925 for the Employee Involvement Scale, from .505 to .953 for the Reporting Culture Scale, and from .767 to .988 for the Safety Behavior Scale. Examination of the model fit indices revealed that the CFI exceeded .95 and the TLI exceeded .90, while the RMSEA and SRMR values were below .403 and .057, respectively. Simulation studies have shown that RMSEA imposes a disproportionately harsher penalty on relatively small models with a limited number of variables and low degrees of freedom (Nevitt and Hancock, 2000). Based on these considerations, because RMSEA and χ^2 statistics are sensitive to sample size, the use of CFI and TLI alongside these indices is recommended when evaluating model fit (Hu and Bentler, 1999; Kline, 2023). The results obtained from the model fit indices provide evidence for the construct validity of the scales (Crocker and Algina, 1986).

Following the examination of the CFA results, additional analyses were conducted to assess the presence of common method bias. The results of Harman's single-factor test (Tehseen et al., 2017) indicated the presence of four factors with eigenvalues greater than 1. The first factor accounted for 49% of the total variance, whereas the remaining factors explained between 5% and 8% of the total variance. According to the criteria of Harman's single-factor test, the fact that the first factor explained less than 50% of the total variance suggests that common method bias is not a serious concern. In addition, all scale items were loaded onto a single factor, and the model fit of this one-factor structure was examined using CFA. The analysis was conducted in Mplus. The results yielded CFI and TLI values of 0.684 and 0.647, respectively. The poor fit of the one-factor model provides further evidence that common method bias is unlikely to be a significant issue in the study (Podsakoff et al., 2012).

Subsequently, the suitability of the data for multivariate analyses was assessed by examining the Durbin Watson, VIF, and tolerance values. The Durbin Watson value was 1.770, while the VIF values ranged

between 1.637 and 1.879 and the tolerance values ranged between 0.532 and 0.611. A Durbin Watson value between 1.5 and 2.5, a tolerance value greater than 0.20, and a VIF value lower than 10 indicate the absence of multicollinearity among the variables and confirm that the data are appropriate for multivariate analyses (Hair et al., 2010). Following this step, a multiple regression analysis was conducted among the study variables, and the serial mediation model was subsequently tested (Hayes, 2018b; Stride et al., 2015). In testing the serial mediation model, the total scores obtained from the scales were used and the analysis was conducted with observed variables. SPSS 27.0 and Mplus software were used for the analysis.

4. Findings

Correlation analysis, hierarchical multiple regression analysis, and serial mediation analysis were employed to examine the relationships among safety behavior, safety awareness and competency, employee involvement, and reporting culture. The findings are presented in this order. The relationships among the variables are presented in Table 6.

Table 6. Correlations among the Variables

	Safety Behavior	Safety Awareness and Competency	Employee Involvement
Safety Behavior	1.00		
Safety Awareness and Competency	0.719*	1.00	
Employee Involvement	0.559*	0.622*	1.00
Reporting Culture	0.679*	0.577*	0.544*

*p<.001

The correlation analysis revealed strong, positive and statistically significant relationships between safety behavior and safety awareness and competency (r=0.719, p<.001), employee involvement (r=0.559, p<.001), and reporting culture (r=0.679, p<.001); between safety awareness and competency and employee involvement (r=0.622, p<.001) and reporting culture (r=0.577, p<.001); and between reporting culture and employee involvement (r=0.544, p<.001). The presence of moderate to strong correlations (r>0.50) among the variables suggests that further examination of their predictive relationships is warranted. Therefore, the results of the regression analyses were subsequently examined.

In the hierarchical multiple regression analysis, the predictors were entered into the model in successive steps according to the proposed theoretical framework. The results of the hierarchical multiple regression analysis are presented in Table 7.

Table 7. Model Summary

Model	R	R^2	Adjusted R^2	Standard Error	ΔR^2	p
1	0.719	0.517	0.515	1.96	0.517	.000
2	0.788	0.622	0.619	1.74	0.105	.000

The results of the hierarchical multiple regression analysis indicate that the model is statistically significant (F(1, 251)=268.538, p=.000). When the predictor variables were entered into the model, safety awareness and competency and reporting culture emerged as significant predictors (p<.01), whereas employee involvement was not a significant predictor. Safety awareness and competency explains 51% of the variance in Model 1; when reporting culture is added in Model 2, the explained variance reaches 61%. Among the predictors, safety awareness and competency emerged as the strongest predictor of safety behavior. The model coefficients are presented in Table 8.

Table 8. Model Coefficients

Model		B	Standard Error	β	t	p	Confidence Interval Lower Bound	Confidence Interval Upper Bound
1	Constant	7.852	1.172				5.544	10.160
	Safety Awareness and Competency	0.846	0.052	0.719	16.387	.000	0.744	0.947
2	Constant	3.680	1.154		3.189	.002	1.407	5.952
	Safety Awareness and Competency	0.577	0.056	0.490	10.291	.000	0.466	0.687
	Reporting Culture	0.473	0.057	0.396	8.317	.000	0.361	0.585

Examination of the regression coefficients indicate that, in Model 1, safety awareness and competency had a strong predictive effect on safety behavior (β=0.719, p=.000). When reporting culture was added to the equation in Model 2, the effect of safety awareness and competency on safety behavior decreased but remained statistically significant (β=0.490, p=.000). This finding shows that there is a significant relationship between safety awareness and competency and reporting culture. Employee involvement was not a significant predictor of safety behavior. Based on the regression results, it can be inferred that safety awareness and competency, along with reporting culture, play a mediating role in the effect of employee involvement on safety behavior. Based on this inference, a serial mediation model was tested, and the results are presented in Table 9.

Table 9. Serial Mediation Model Results

Hypothesis	Direct Effect	B (S.E.)	95%CI (Lower, Upper)	β (S.E.)	p	Result
1	EI→SB	0.080 (0.058)	-0.030, 0.194	0.069 (0.048)	.163	Rejected
2	EI→SAC	0.655 (0.068)	0.530, 0.771	0.658 (0.038)	.000	Accepted
4	SAC→SB	0.589 (0.069)	0.455, 0.727	0.504 (0.056)	.000	Accepted
3	EI→RC	0.299 (0.064)	0.168, 0.422	0.299 (0.066)	.000	Accepted
6	SAC→RC	0.384 (0.073)	0.237, 0.524	0.381 (0.067)	.000	Accepted
5	RC→SB	0.415 (0.061)	0.294, 0.517	0.359 (0.054)	.000	Accepted
Hypothesis		**B (S.E.)**	**95%CI (Lower, Upper)**		**p**	**Result**
7	EI→SAC→SB	0.386 (0.055)	0.286, 0.500		.000	Accepted
	EI→RC→SB	0.124 (0.032)	0.069, 0.199		.000	
	EI→SAC→RC→SB	0.105 (0.025)	0.064, 0.167		.000	
	Total indirect effect	0.615 (0.060)	0.509, 0.745		.000	
	Total effect	0.695 (0.068)	0.570, 0.835		.000	

EI: Employee involvement, SAC: Safety awareness and competency, RC: Reporting culture, SB: Safety behavior

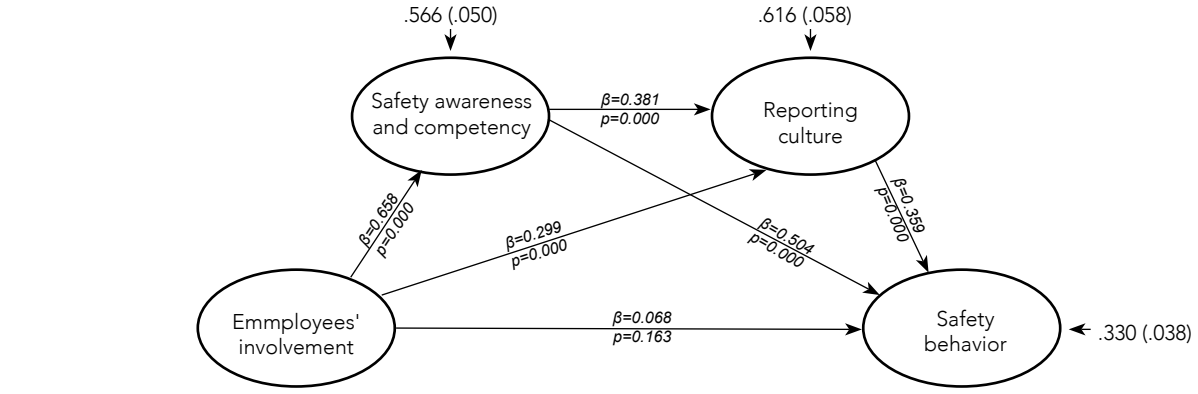

Figure 2. Path Diagram of the Model and Its Results

The model results indicated that, after the mediator variables were included in the model, the direct effect of employee involvement on safety behavior was not statistically significant (β=0.080, p=0.163). It was found out that employee involvement significantly and positively predicted safety awareness and competency (β=0.655, p<.001) and reporting culture (β=0.299, p<.001). Safety awareness and competency also significantly and positively predicted reporting culture (β=0.384, p<.001). In addition, safety awareness and competency (β=0.589, p<.001) and reporting culture (β=0.415, p<.001) were found to positively and strongly predict safety behavior.

Examination of the indirect effects revealed that safety awareness and competency (B=0.386 [95%CI = 0.286, 0.500], p<.001) and reporting culture (B=0.124 [95%CI = 0.069, 0.199], p<.001) had significant mediating roles in the relationship between employee involvement and safety behavior. The serial mediation analysis indicates that employee involvement affects safety behavior indirectly through safety awareness and competency and subsequently reporting culture. The serial mediation pathway (B=0.105 [95%CI = 0.064, 0.167], p<.001), the total indirect effect (B=0.615 [95%CI = 0.509, 0.745], p<.001), and the total effect (B=0.695 [95%CI = 0.570, 0.835], p<.001) were all significant. Overall, the effect of employee involvement on safety behavior is transmitted sequentially through safety awareness and competency, and reporting culture. Safety awareness and competency explain 43% of the variance in safety behavior, while reporting culture explains 38% of the variance in safety behavior. The model's explanatory power for the dependent variable was calculated as 67%.

5. Discussion

This study explored the relationships between employee involvement, safety awareness and competency, reporting culture, and safety behavior, and examined which mechanisms employees' safety behaviours are shaped through. In this regard, the findings indicate that employee involvement, safety awareness and competency, and reporting culture collectively contribute to the shaping of employees' safety behaviors by influencing one another.

The findings of the study indicate that employee involvement has a significant and positive effect on safety awareness and competency. This finding indicates that employees' involvement in safety-related activities contributes to employees' being able to see safety at work as a priority, being able to comprehend their responsibilities regarding workplace safety, being able to understand the safety rules required by their work, and comply with these rules, and increasing their competency in coping with safety problems (Fernández-Muñiz et al., 2007; Lin et al., 2008). The present finding is consistent with previous studies (Lu, 2016, 82; Tsao et al., 2017; Ünal et al., 2021) reporting that employee involvement contributes to increased safety awareness. Lu (2016) also considers employee involvement as one of the important indicators influencing safety culture and states that employees' involvement in safety contributes to the increase of awareness toward safety issues and to the more effective management of safety risks. This may be explained by the fact that employees who directly perform the tasks may have a better understanding of the hazards and risks related to their jobs and work environment (Karakavuz and Gerede, 2025, 106).

The findings obtained reveal that safety awareness and competency have a significant and positive effect on safety behavior. Similar findings were reported by Dursun and Keser (2014), who emphasized that activities and regulations aimed at increasing employees' safety awareness encourage employees to demonstrate safer behaviors while performing their work. The present finding is also consistent with other studies (Dursun, 2013; Uzuntarla et al., 2020; Filiz et al., 2024; Alshammari et al., 2025; Esmaeili et al., 2025) showing that safety awareness supports employees' safety behaviors. Increased safety awareness enables employees to better identify and unders-

tand potential hazards in the workplace, thereby contributing to the development of safety behaviors (Esmaeili et al., 2025). Indeed, employees who are more aware of the potential consequences of unsafe practices are considerably more likely to comply with established safety procedures, use personal protective equipment, and avoid risk-taking behaviors (Alshammari et al., 2025).

The findings indicate that safety awareness and competency have a significant and positive effect on reporting culture. This finding indicates that employees' seeing safety at work as a priority, their better comprehension of their responsibilities regarding workplace safety and safety rules, increase employees' willingness to report accidents, near-misses, and unsafe conditions (Lin et al., 2008; Håvold and Nesset, 2009). Similarly, previous studies (Filiz, et al., 2024; Esmaeili et al., 2025; Alshammari et al., 2025) have reported that higher levels of safety awareness support employees in reporting potential hazards and complying with safety regulations.

The findings indicate that reporting culture has a significant and positive effect on safety behavior. This finding indicates that employees' being encouraged to report unsafe conditions, reporting being regarded as important in terms of working safely, and the increase in employees' willingness to report accidents and near-misses support employees' behaviors such as using safety equipment while carrying out their tasks, complying with safety procedures, and making extra efforts to improve safety at work (Håvold and Nesset, 2009; Neal et al., 2000). Similarly, previous studies (Håvold and Nesset, 2009; Dursun, 2012; Dursun 2013; Aytaç and Dursun, 2018) have emphasized the importance of reporting culture in promoting the development of safety behaviors. Supporting this finding, Desai et al. (2025), in their qualitative study, reported that an effective reporting system fosters greater attention to safety issues among employees and increases their likelihood of their compliance with safety protocols. The views expressed by participants in the study further revealed that employees are encouraged to take proactive steps in OHS, supported in proposing improvements to the work environment, and able to contribute to quicker decision-making on safety-related issues through the reporting mechanism. In this respect, reporting culture may help organizations identify potential hazards and take necessary precautions before they develop into more serious incidents (Asif et al., 2022).

The findings of this study indicate that safety awareness and competency and reporting culture have a serial mediation effect on the relationship between employee involvement and safety behavior. In the initial analyses examining the relationship between employee involvement and safety behavior, a strong correlation and a relatively high regression coefficient were observed. However, when safety awareness and competency and reporting culture were included in the model in subsequent multivariate analyses, the direct relationship between employee involvement and safety behavior disappeared. Although the statistically significant positive correlations between employee involvement and safety behavior is consistent with findings reported in previous studies (Dursun, 2012; Dursun 2013; Ünal et al., 2021) the results of the regression and mediation analyses suggest that other variables play an important role in this relationship. In this context, the findings point to the fact that employee involvement may not directly be reflected in safety behavior; that employee involvement increases safety awareness and competency, strengthens the reporting culture, and that as a result of these interactions employees exhibit safety behaviors.

Given that the metal sector is characterized by labor-intensive and hazardous working environments that pose substantial risks for occupational accidents and diseases, and that effective approaches are needed to prevent these risks, fostering a positive safety culture and promoting employees' safety behaviors are of critical importance in metal sector enterprises (Asif et al., 2022; ILO, 2023; Fuentes-Bargues et al., 2025). The findings of this study suggest that the effect of employee involvement on safety behaviors is mediated by safety awareness and competency and reporting culture. In this regard, the findings suggest that, in addition to encouraging employee involvement, implementing practices that enhance safety awareness and competency and strengthen reporting culture may play an important role in promoting employees' safety behaviors in metal sector enterprises.

6. Limitations

This study has several limitations. First, the research is limited to data obtained from employees working in enterprises operating in the metal sector in MOSB in Turkey. Therefore, the findings may vary across different countries and sectors. Future research is encouraged to replicate similar studies in different national and sectoral contexts. Second, this study relies on self-report data based on participants' perceptions. Future studies may benefit from complementing self-report measures with field observations of employees' safety behaviors or with objective indicators such as occupational accident and near-miss records. Third, the findings indicating that the effect of employee involvement on safety behavior is mediated by safety awareness and competency and reporting culture are based on cross-sectional data and therefore do not capture longitudinal effects. Accordingly, future longitudinal studies may provide further insights into how these variables evolve over time.

7. Conclusion

As is known, a substantial proportion of occupational accidents and injuries occurring in workplaces is attributed to employees' unsafe behaviors. This indicates that employees' behaviors constitute one of the key factors in ensuring workplace safety. As for safety culture at work, it is effective in shaping employees' behaviors. In workplaces where a positive safety culture prevails, employees' safe behaviors tend to be positively influenced. Accordingly, this study examined the relationships between employee involvement, safety awareness and competency, and reporting culture—considered key dimensions of safety culture—and safety behavior. In addition, the study investigated the serial mediation effects of safety awareness and competency and reporting culture in the relationship between employee involvement and safety behavior. The findings indicate that safety awareness and competency and reporting culture have a serial mediation effect on the relationship between employee involvement and safety behavior.

In the metal sector, where the prevention of occupational accidents and the improvement of workplace safety are of paramount importance, practices that foster a positive safety culture and support employees' safety behaviors play a crucial role. The findings of this study suggest that, in shaping employees' safety behaviors in workplaces, it is important to develop practices that not only encourage employee involvement but also enhance safety awareness and competency and promote a strong reporting culture. These findings provide valuable insights into strengthening safety culture and improving workplace safety in the metal sector, which is considered one of the high-risk sectors with respect to occupational accidents and diseases.

Based on these findings, in addition to increasing employees' involvement in safety-related activities at work, carrying out activities toward promoting safety awareness, developing employees' knowledge and skills necessary for safe work, and creating a reporting culture that encourages the reporting of accidents, unsafe conditions, and near-misses may contribute to the development of employees' safety behaviours. Within this framework, it is important to develop practices that support employees in recognizing and fulfilling their responsibilities for ensuring workplace safety. In addition, training and awareness activities should be organized to ensure that employees are informed about potential hazards they may encounter in the workplace and the preventive measures required to address these hazards. In this regard, safety training represents one of the key activities contributing to the development of employees' safety behaviors.

Moreover, accessible and effective reporting mechanisms should be established to enable employees to report unsafe conditions, accidents, and near-misses without hesitation. Such mechanisms can facilitate the early reporting of these events and conditions, thereby contributing to risk reduction and the prevention of potential occupational accidents. In addition, recognizing and rewarding employees who contribute to the creation of a safer and healthier work environment through such reporting may encourage greater employee involvement reporting practices. Furthermore, providing feedback regarding unsafe conditions, accidents, and near-misses reported by employees, sharing the improvement actions implemented in response to these reports with employees, and making employees' contributions visible may contribute to strengthening the reporting culture.

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