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**The Effect of Safety Climate on Safety Behaviour: the Mediating Role of Safety Motivation and Safety Knowledge**

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**Abstract**

Safety behavior is an important element in maintaining safety and preventing accidents. This study aims to analyze the effect of the safety climate on safety behavior through safety motivation and safety knowledge as mediating variables.

Type of this research is explanatory research with a quantitative approach. The population of this research is the crew machinist of PT. KeretaApi Indonesia (Persero), amounting to 3000 machinists with the sampling technique using purposive sampling with a sample size of 100 respondents. The data collection method used a questionnaire. The data analysis method used is the path analysis method using the Smart PLS tool.

The partial results of hypothesis testing of the safety climate have a positive and significant effect on safety motivation. The safety climate has a positive and significant effect on safety knowledge. The safety climate has a positive and significant effect on safety behavior. Safety motivation has a positive and significant effect on safety behavior. Safety knowledge has a positive and significant effect on safety behavior. The results of testing the indirect effect of using or mediation found that safety motivation and safety knowledge were able to mediate the effect of safety climate on safety behavior

**Keywords:** Safety climate, safety motivation, safety knowledge, safety behavior

**1. Introduction**

Railway transportation is one of the services that consistently exhibits a significant increase in passenger numbers each year. This is evident from the high public interest in utilizing railway transportation services. In January 2022, the number of railway passengers reached 17 thousand people, marking a 35 percent year-on-year increase ([www.bps.go.id](http://www.bps.go.id), accessed on August 10, 2023). Rail transport is envisioned to be a viable solution for rapid mass transportation due to its ability to reduce traffic congestion, minimize accidents, promote environmental friendliness, conserve energy, and reduce pollution (PT. KeretaApi Indonesia (Persero), 2014). Therefore, PT. KeretaApi Indonesia (Persero) (Hereafter, PT.KAI), as the railway service operator, consistently strives to enhance the quality of its services by prioritizing the safety, comfort, and well-being of railway passengers (customer-oriented). Nevertheless, railway accidents continue to occur

frequently in Indonesia. To assess the operational performance at PT KAI, Key Performance Indicators (KPIs) related to the company's core business lines are presented in the following data:

Summary of Operational KPI Achievement at KAI  
(Train Accident)

Year	Train Accident	Control norm (tolerance)
2017	14 times	16 times
2018	14 times	16 times
2019	11 times	14 times
2020	18 times	14 times
2021	17 times	14 times

Source: Directorate of Operations, PT KAI

From the data above, it is evident that the railway accidents tends to increase from 2017 to 2021, although there was a decrease in 2019. This indicates that railway travel is still within an unsafe range, as in the past two years, it has exceeded the established tolerance limits. Over the past two years, the number of incidents has exceeded the predetermined tolerance limits. This is closely related to railway travel safety, particularly the safety of passengers. Therefore, it is necessary to investigate the factors contributing to train travel safety. The data related to these factors is presented in the graph below:

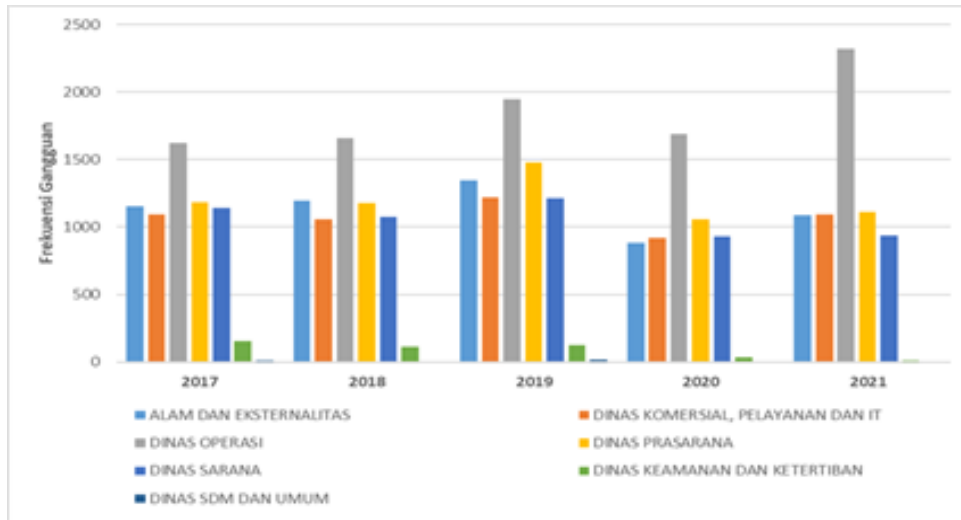


Figure 1.1

Frequency of Train Incidents Based on Their Contributing Factors for the Period 2017 – 2021

Source: Dashboard Sipoka V2

The above figure illustrates disruptions affecting the safety of train travel based on various contributing factors, ranging from natural and external factors to security and order factors. From 2017 to 2021, it is evident that operational factors consistently remained the primary cause of disruptions in railway travel each year. This performance reflects the achievement derived from the competencies and potential possessed by a particular human resource, in this case, the operational personnel of PT KAI, namely train driver. A train driver is responsible to fulfill the primary aspect of railway travel, namely safety. The high incidence of railway accidents indicates that safety behavior among PT KAI's train driver is suboptimal.

Safety behavior refers to actions undertaken by individuals out of their concern to minimize or prevent a disaster (Neal and Griffin, 2006). Therefore, the importance of safety behavior lies in creating a safe working environment by actively participating in minimizing or even preventing workplace accidents. Safety behavior, which represents employees' safety practices in performing their duties, is influenced by safety climate (He, McCabe, Jia, Sun, 2020). Safety climate is a perceptible attribute within an organization driven by its policies and practices in maintaining safety in the workplace (Niskanen, 1994). Safety climate is an integral part of daily work involving operational processes and work practices within an organizational environment. A positive safety climate has the potential to influence safety behavior (Panuwatwanich, Haadir, Stewart, 2016). Safety behavior can be improved by cultivating a favorable safety climate within an organization (Neewaz, Davis, Jefferies, Pillay, 2016). A strong safety behavior can manifest through a conducive safety climate within an organization (Deboeck, 2017). When organizations create a favorable safety climate, it has the capability to enhance safety behavior (Lyu, Hon, Chan, Wong, Javed, 2018). High levels of safety behavior can be realized through a supportive safety climate within an organization (Lee, Lu, Yang, Chang, 2019).

Differences in research findings were discovered by Ancarani, Mauro, Giammanco (2017), where their study found that safety climate does not significantly influence safety behavior. This result represents an unsatisfactory predictive outcome that requires further explanation. The study presents an opportunity to develop a research model on the effect of safety climate on safety behavior by including safety motivation and safety knowledge as mediating variables, which is expected to obtain more satisfactory predictive results. Safety motivation involves the motivation to engage in safety activities and adhere to safe work practices (Griffin and Curcuruto, 2016). Safety motivation is a determinant of compliance in maintaining safety and participating in various safety contexts within an organization. Safety climate affects safety motivation (De Boeck, Mortier, Jacksen, Dequidt, Vlerick, 2017; Bunner, Prem, Korunka, 2018; Mavaji, Borghelpour, Tehrani, 2018), and in turn, safety motivation affects safety behavior (Panuwatwanich, 2016; Xia, Xie, Hu, Wang, Meng, 2020). Safety knowledge refers to the understanding of information related to safety and security in carrying out one's job (Burke and Sarpy, 2002). Safety knowledge may enhance behavior, awareness, and a realistic understanding of safety in carrying job-related tasks. Safety knowledge is affected by safety climate (Deboeck et al., 2017; Mavagi et al., 2018; Bunner et al., 2018). Furthermore, safety knowledge affects safety behavior (Kao, Spitzmueller, Cigularov, Thomas, 2019; Mavaji et al., 2018; Deboeck et al., 2017; Lee, Lu, Yang, Chang, 2019).

The present research involved train drivers at PT. KAI. PT. KAI, as a railway service operator faces several issues related to safety behavior among its train drivers. Railway accidents

continue to occur frequently at PT.KAI. The following are the issues related to safety behavior among train operators at PT. KAI. A notable phenomenon that occurred at PT. KeretaApi Indonesia (Persero) from 2017 to 2021 is the signal violations, with the highest number being in 2017 with 9 incidents and 10 incidents in 2018. The highest instances of exceeding speed limits occurred in 2021, totaling 4 incidents. During train travel, train drivers must pay close attention to signal and semaphore information provided by the central control. The high number of violations committed by train drivers reflects a poor level of safety behavior.

This research aims to analyze the issues regarding the decline in safety behavior at PT. KeretaApi Indonesia (Persero). Based on the aforementioned phenomena, this study examines safety behavior through the mediation of safety climate, safety motivation, and safety knowledge.

## **2. Literature Review and Hypothesis Development**

### *2.1. Safety Climate*

Safety climate is defined as a set of attributes that can be perceived by an individual and is driven by an organization's policies and practices in carrying out work (Niskanen, 1994). Safety climate represents the perception of safety policies and the working environment (Cabrera, 1997). It closely relates to the operational aspects of work practices, as well as the policies and management within them.

Safety climate encompasses management policies, safety procedures, and practices at a given time (Dov, 2008). Safety climate can be used as an antecedent to safety behavior within an organization. The dimensions of safety climate consist of: safety climate of top management, safety climate of supervisors, and safety climate of co-workers. These dimensions reflect the actual priorities set by top management, supervisors, and co-workers in promoting workplace safety (Brondino et al., 2012). According to Susanto, Budiawan, and Fardiansyah (2018), indicators of safety climate include *communication and support, adequacy of procedures, relationships, and safety rules*.

### *2.2 Safety Motivation*

Motivation is a set of psychological processes that result in direction, initiation, and persistence in carrying out actions or behaviors (Frey, 2005). Motivation in individuals can be divided into intrinsic and extrinsic motivation. Intrinsic motivation drives individuals to engage in an activity because they are interested in and enjoy the activity, while extrinsic motivation is connected to activities for instrumental reasons, such as motivation driven by rewards (Locke and Latham, 2004).

Safety motivation refers to the motivation to participate in safety activities and adhere to work practices to create a safe working environment (Griffin and Curcurato, 2016). Safety motivation is a key factor in compliance with safety measures and safety participation within an organization. It pertains to an individual's willingness to make efforts in performing safety behavior and related activities (Chen and Chen, 2014). Safety motivation is influenced by the perceived workplace risks, where these risks affect the decision to perform actions safely and subsequently promote safety behavior (Vinodkumar and Bhasi, 2010). It specifically refers to the motivation for safety in carrying out a task (Neal and Griffin, 2006). Research suggests that safety motivation is a determinant of safety behavior (Christian et al., 2009). Indicators of safety

motivation, according to Bunner, Prem, and Korunka (2018), include motivation to comply with safety regulations, motivation to minimize accidents, motivation to create safety, and motivation to implement safety programs.

### *2.3 Safety Knowledge*

Safety knowledge encompasses an individual's understanding and information related to safety, including safety facts, regulations, and operational procedures (Burke & Sarpy, 2002). Safety knowledge enhances awareness and understanding of the reality of maintaining safety and security in the workplace (Rosenbloom, Haviv, Peleg, & Nemrodov, 2008). It allows employees to have safety instructions, comprising their knowledge of safety procedures and practices. Knowledge of safety procedures and practices is related to an understanding of workplace hazards and safety behavior itself in job performance (Fabrigar et al., 2006). Safety knowledge can be described as awareness and understanding associated with an attitude.

Empirical studies explain that improving safety knowledge can influence the formation and change of attitudes (Zhu and Xie, 2015). Such attitudes are influenced by the lack of information and an individual's tendency to develop or strengthen attitudes towards knowledge targets and their features (Tormala and DeSensi, 2008). Safety knowledge has been reported to affect behaviors, and these alternative behaviors can shape evaluations of behavioral engagement (Fabrigar et al., 2006). Individuals with safety knowledge can enhance their behavior and modify their evaluation of safety behavior (Bang et al., 2000). According to Bunner, Prem, and Korunka (2018), indicators of safety knowledge include knowledge of safety procedures, knowledge of work practices, knowledge of workplace hazards, and knowledge of working safely.

### *2.4 Safety behavior*

Safety behavior is defined as behavior that supports safety practices in accordance with safety and health requirements to prevent workplace accidents. Borman and Motowidlo (1993) explained that in performing tasks, including task performance and contextual performance, there are distinctions regarding safety behavior in the workplace. First, in task performance, compliance with safety describes primary safety activities and the maintenance of workplace safety itself, such as wearing personal protective equipment. Second, in contextual performance, participation in safety behavior describes how one participates in carrying out safety behavior with a level of awareness. This helps in developing a safe working environment (Schutte, 2010). Safety behavior can be observed during work performance in the workplace (Geller, 2001). The approach to implementing safety behavior would be practically successful if it is supported by approaches and methods that encourage behavioral change from unsafe to safe as an effort to prevent workplace accidents. This behavioral change may lead to the more conducive environment. Safety behavior is also defined by Beus et al. (2015) as behavior aimed at ensuring the safety of oneself and the workplace environment from physical threats and workplace accidents. The components of safety behavior, according to Neal and Griffin (2000), include safety compliance and safety participation. Safety compliance relates to task performance, focusing on an individual's need to maintain a safe workplace environment. Safety participation relates to contextual performance and refers to behaviors contributing to safety and the development of a conducive environment that supports safety progress. Indicators of safety

behavior, according to Neal and Griffin (2006) and Vinodkumar and Bhasi (2010), include using safety equipment, performing work safely, making extra efforts to enhance safety, and adhering to safety regulations.

### *2.5 Safety climate and safety motivation*

Safety climate is defined as a set of attributes that can be perceived by an individual and is driven by an organization's policies and practices in carrying out work (Niskanen, 1994). When a positive safety climate is established, it can enhance safety motivation, which aligns with research findings by De Boeck, Mortier, Jackson, Dequidt, Vlerick (2017); Bunner, Prem, Korunka (2018); Mavaji, Borgheipour, Tehrani (2018), which found that safety climate positively influences safety motivation.

H1. Safety climate positively affects safety motivation.

### *2.6 Safety climate and safety Knowledge*

Safety climate pertains to the perception of safety policies and the working environment (Cabrera, 1997). Creating a positive safety climate within an organization can also enhance safety knowledge, which is in line with research by Deboeck (2017); Mavagi et al., (2018); Bunner et al., (2018) that found a positive influence of safety climate on safety knowledge.

H2. Safety climate positively affects safety knowledge.

### *2.7 Safety climate and safety behavior*

Safety climate is characterized by management policies, safety procedures, and practices at a given time (Dov, 2008). When established by an organization, a positive safety climate can enhance safety behavior, consistent with the findings of research by Kao, Spitzmeller, Cigularov, Thomas (2018); Mavaji et al., (2018); Deboeck (2018); Lee, Lu, Yang, Chang (2018) that identified a positive influence of safety climate on safety behavior.

H3. Hypothesis 3 (H3): Safety climate positively affects safety behavior.

### *2.8 Safety Motivation and safety behavior*

Safety motivation is a set of psychological processes that result in direction, initiation, and persistence in carrying out actions or behaviors (Frey, 2005). It can be categorized into intrinsic and extrinsic motivation. Intrinsic motivation drives individuals to engage in activities because they are interested in and enjoy them, while extrinsic motivation is based on instrumental reasons. Safety motivation should be fostered by organizations to enhance safety behavior because high levels of safety motivation can have a positive impact on improving safety behavior. This aligns with research findings by Panuwatwanich (2016) and Xia, Xie, Hu, Wang, Meng (2020), which found that safety motivation positively influences safety behavior.

H4. Safety motivation has a positive impact on safety behavior.

### *2.9 Safety knowledge and safety behavior*

Safety knowledge encompasses an individual's understanding and information related to safety, including safety facts, regulations, and operational procedures (Burke & Sarpy, 2002). Safety knowledge enhances awareness and understanding of the reality of maintaining safety and security in the workplace (Rosenbloom, Haviv, Peleg, & Nemrodov, 2008). It enables employees

to have safety instructions, comprising their knowledge of safety procedures and practices. Knowledge about safety is capable of fostering employee behavior in maintaining workplace safety. In other words, the higher the knowledge about safety, the more it can enhance safety behavior. This is consistent with research findings by Kao, Spitzmeller, Cigularov, Thomas (2018); Mavaji et al., (2018); Deboeck (2017); Lee, Lu, Yang, Chang (2018), which found that safety knowledge has a positive impact on safety behavior.

H5. Safety knowledge positively affects safety behavior.

### **3. Methods**

#### *3.1 Research Design*

This study was categorized as an explanatory research, which aimed to elucidate the relationships among variables that cause changes in other variables (Cooper and Schindler, 2017). Explanatory research used correlational or regression hypothesis tests. The population in this study consisted of train drivers in PT. KAI, totaling 3000 individuals. The sampling technique utilized was purposive sampling, which involves recruiting participants based on the characteristics, experience, attitudes, and perceptions related to the research variables. The sampling criteria in this study included locomotive engineers with over 5 years of experience and possessing a locomotive competency certificate. Data were collected using questionnaires.

#### *3.2 Measurement*

The variables in this study were assessed using several items from different studies found in the existing literature. All items were measured using a five-point Likert scale, where respondents had to indicate their level of agreement with various statements (1: strongly disagree to 5: strongly agree). Measurement of safety climate consisted of 4 items (Susanto, Budiawan, Fardiansyah, 2018). Measurement of safety motivation utilized 4 items (Bunner, Prem, Korunka, 2018). Measurement of safety knowledge comprised 4 items (Bunner, Prem, Korunka, 2018). Measurement of safety behavior included 4 items (Neal and Griffin, 2006; Vinodkumar and Bhasi, 2010).

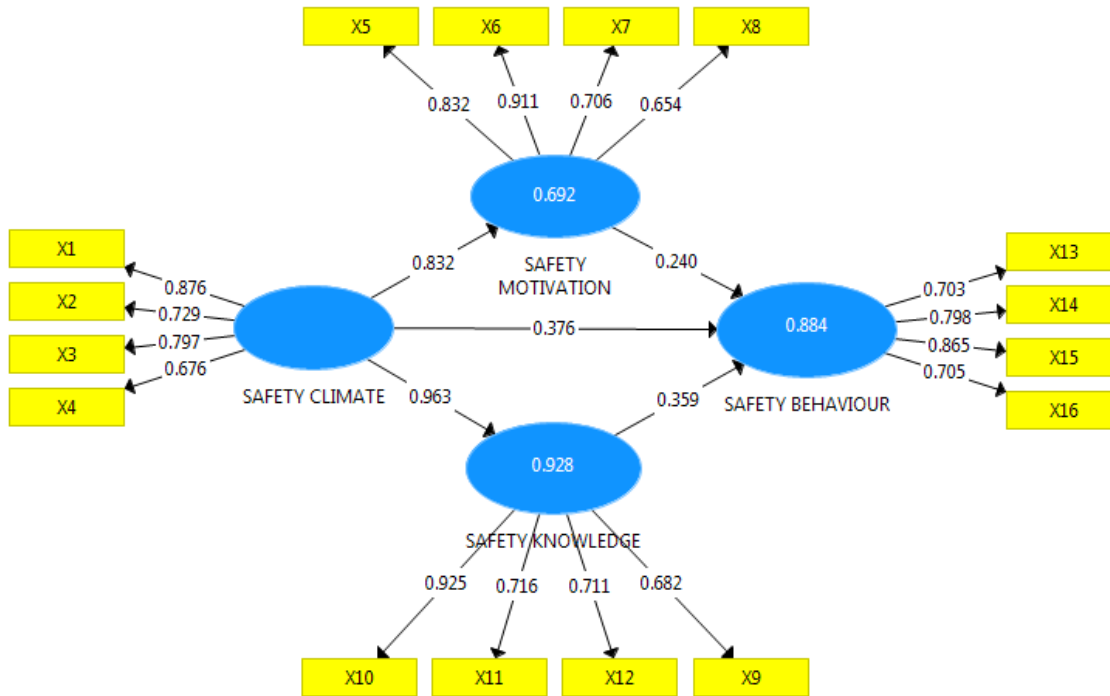
#### *3.3 Data Analysis Method*

Confirmatory analysis was employed to determine the validity of each indicator and the reliability of the variables in the study (Haier et al., 2017). Hypothesis test was conducted as the next step to ascertain the outcomes of the hypotheses used in the research. Path analysis was utilized to determine the magnitude of the influence among the variables, facilitated by the Smart PLS tool.

### **4. Result**

#### *4.1 Reliability and validity of the scales*

Figure 1. Confirmatory Analysis



Source: Primary Data, 2020

Construct validity can be assessed based on the loading factor (LF), with a rule of thumb stating that values greater than 0.5 are considered valid. According to the test results, all indicators in the model had loading factors (LF) that were deemed satisfactory. The construct reliability was measured using the Cronbach's alpha value and Composite Reliability. For all constructs, Cronbach's alpha values should be above 0.70. The test results indicated that the Cronbach's alpha values were above 0.70, suggesting that the indicators were consistent in measuring their respective constructs.

Table 1. Construct Reliability

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Safety Climate	0.773	0.813	0.855	0.598
Safety Motivation	0.784	0.843	0.861	0.612
Safety Knowledge	0.758	0.792	0.847	0.585
Safety Behavior	0.772	0.815	0.853	0.594

Source: Primary Data, 2020

The table above displays Cronbach's Alpha values for all constructs above 0.70, indicating that the indicators are consistent in measuring their respective constructs. The Cronbach's Alpha



values for safety climate (0.773), safety motivation (0.784), safety knowledge (0.758), and safety behavior (0.772) all exceeded the 0.70 threshold. The examination of construct reliability based on Composite Reliability involves assessing the Composite Reliability values to indicate the variance captured by the indicators within each construct. The threshold value for Composite Reliability is  $\geq 0.5$ . The results for Composite Reliability are as follows: safety climate (0.855), safety motivation (0.861), safety knowledge (0.847), and safety behavior (0.853), all exceeding the threshold. The examination of construct reliability based on convergent validity involves looking at the AVE values to demonstrate the amount of variance captured by the indicators within each construct. The threshold value for AVE is  $\geq 0.5$ . The results for AVE are as follows: safety climate (0.598), safety motivation (0.612), safety knowledge (0.585), and safety behavior (0.594).

4.2 R-square

Table 2. R-square

Variable	R Square
The effect of <i>Safety climate</i> on <i>safety motivation</i>	0.692
The effect of <i>Safety climate</i> on <i>safety Knowledge</i>	0.928
The effect of <i>safety climate, safety motivation, and safety knowledge</i> on <i>safety behavior</i>	0.884

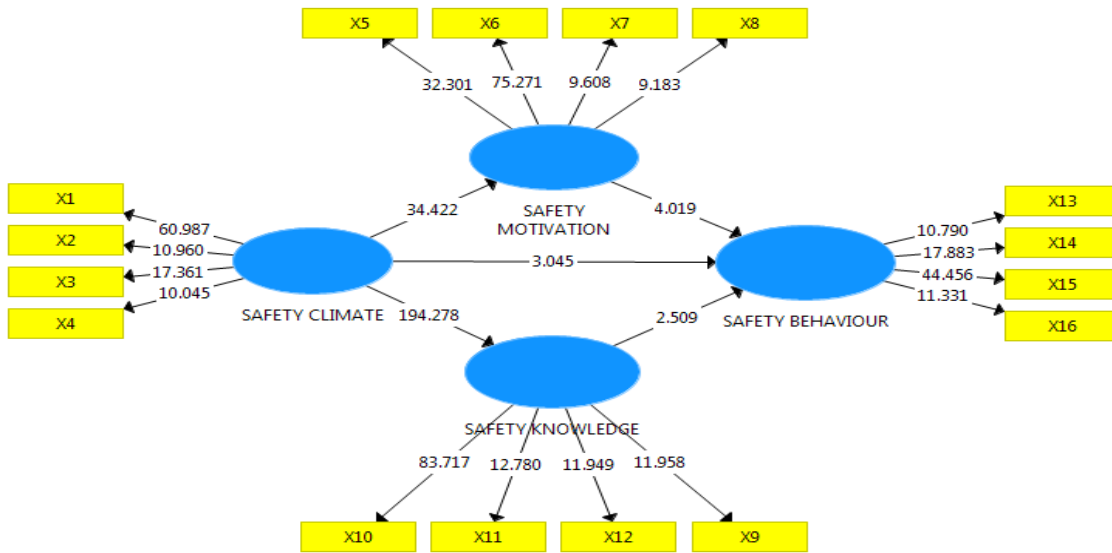
Source: Primary Data, 2020

Based on the table above, the R Square value for the model of the influence of safety climate on safety motivation is 0.692. This indicates that safety climate is capable of influencing safety motivation by 69.2%, while the remaining 31.8% is explained by other variables not examined in this study. The R Square value for the model of the influence of safety climate on safety knowledge is 0.928. This suggests that safety climate can influence safety knowledge by 92.8%, while the remaining 7.2% is explained by other variables not examined in this study. The R Square value for the model of the influence of safety climate, safety motivation, and safety knowledge on safety behavior is 0.884. This means that safety climate, safety motivation, and safety knowledge can collectively influence safety behavior by 88.4%, while the remaining 11.6% is explained by other variables not examined in this study.

4.3 Hypothesis Test

The hypotheses proposed were tested using structural equation modeling. The results shows that all hypotheses H1, H2, H3, H4, H5 were accepted, with t-values greater than 1.96 and significance below 0.05. The structural model test, as depicted in the diagram, shows a good fit with the data.

Figure 2 Hypothesis Test



Source: Primary Data, 2020

Table 4. Structural Model Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
<i>Safety climate -&gt; safety motivation</i>	0.832	0.834	0.024	3.045	0.000
<i>Safety climate -&gt; Safety knowledge</i>	0.963	0.0963	0.005	194.278	0.000
<i>Safety climate -&gt; Safety behaviour</i>	0.376	0.385	0.124	3.045	0.003
<i>Safety motivation -&gt; Safety behaviour</i>	0.240	0.244	0.060	4.019	0.000
<i>Safety knowledge -&gt; Safety behaviour</i>	0.359	0.347	0.143	2.509	0.014
<i>Safety climate -&gt; Safety motivation -&gt; Safety behaviour</i>	0.200	0.3203	0.049	4.046	0.000
<i>Safety climate -&gt; Safety knowledge -&gt; Safety behaviour</i>	0.345	0.334	0.318	2.510	0.000

Source: Primary Data, 2020

## **5. Discussion**

The test demonstrates that safety climate positively affects safety motivation, indicating that better safety climate leads to higher safety motivation. Safety climate, through communication, adequacy of procedures, relationship, and safety rules, can enhance safety knowledge. This is in line with the findings of previous studies by De Boeck, Mortier, Jacksen, Dequidt, Vlerick (2017); Bunner, Prem, Korunka (2018); Mavaji, Borgheipour, Tehrani (2018) that suggest safety climate improves safety motivation. Safety climate also has a significant positive impact on safety knowledge, meaning that a better safety climate leads to higher safety knowledge. A positive safety climate within an organization, characterized by support, effective communication, well-defined procedures, positive working relationships, and sound safety regulations, can contribute to increased safety knowledge. This aligns with the results of studies conducted by Deboeck (2017); Mavagi et al., (2018); Bunner et al., (2018), which found that a better safety climate enhances safety knowledge. The results indicate that safety climate significantly influences safety behavior, suggesting that a better safety climate leads to higher safety behavior. Safety climate has the ability to enhance safety behavior, which includes the use of safety equipment, performing tasks safely, making efforts to improve safety, and adhering to safety regulations. This aligns with the findings of studies by Kao, Spitzmeller, Cigularov, Thomas (2018); Mavaji et al., (2018); Deboeck (2018); Lee, Lu, Yang, Chang (2018), all of which discovered that safety climate has a positive impact on safety behavior. The research results regarding safety motivation's influence on safety behavior show that safety motivation has a significant positive effect on safety behavior. Safety motivation, through motivation to comply with safety regulations, motivation to minimize accidents, motivation to create safety, and motivation to implement safety programs, can contribute to an increase in safety behavior. This is supported by the findings of Panuwatwanich (2016); Xia, Xie, Hu, Wang, Meng (2019), which indicate that safety motivation can enhance safety behavior. Safety knowledge also has a significant positive influence on safety behavior. The higher the level of safety knowledge, the higher the safety behavior. Safety knowledge, encompassing knowledge of safety procedures, knowledge of workplace practices, knowledge of workplace hazards, and knowledge of safe work practices, can enhance safety behavior. This is consistent with the results of studies by Kao, Spitzmeller, Cigularov, Thomas (2018); Mavaji et al., (2018); Deboeck (2018); Lee, Lu, Yang, Chang (2018), all of which found that safety knowledge positively impacts safety behavior.

## **Conclusion**

This study concludes that safety climate significantly and positively influences safety motivation. Additionally, safety climate has a significant positive impact on safety knowledge. Furthermore, safety climate, safety motivation, and safety knowledge all significantly and positively affect safety behavior. Regarding the mediating effects, safety motivation and safety knowledge mediate the influence of safety climate on safety behavior.

## **Limitations and suggestions for future study**

This study focused solely on safety climate as the independent variable and safety motivation and safety knowledge as intervening variables influencing safety behavior. Future research

should consider incorporating additional relevant independent variables that may affect safety behavior. For future studies, it is recommended to investigate the influence of safety climate on safety behavior through safety motivation and safety knowledge in different organizational contexts or industries.

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