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The Influence of Trauma and Mental Workload after an Aircraft Accident/ Incident on ATC Situational Awareness In Indonesia

Imam Sonhaji[1], Aldela Ayu Titi Nurhawani[2], Dhian Supardam[3], Rifqi Raza Bunahri[4]
Politeknik Penerbangan Indonesia[1,2,3], Politeknik Penerbangan Jayapura[4]

***Correspondence:**
imam.sonhaji@ppicurug.ac.id

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ABSTRACT

The **research questions** is to explore the possible impact on ATC (Air Traffic Controller) situational awareness problem as a result of trauma and mental workload following an accident/incident. In this context, situational awareness is a key element in aviation safety, where the ability of air traffic controllers to understand the surrounding conditions in a timely and accurate manner is vital. **Using quantitative research methods** and a survey approach, this study involved 60 ATCs in Indonesia who have experienced supervising aircraft that have experienced accidents or incidents. The use of Likert scales in the questionnaire aimed to obtain in-depth data on the variables of Post-accident/incident Trauma (X1), Mental Workload (X2), and Situational Awareness (Y). Multiple linear regression analysis highlighted the important finding that there is a significant influence between post-accident/incident trauma and mental workload on ATC situational awareness. **These results** suggest that traumatic experiences and mental workload experienced by air traffic controllers can negatively affect their ability to understand and respond appropriately to situations. In the highly dynamic world of aviation, where decisions made within seconds can have a huge impact, lowering the level of situational awareness can increase safety risks. The implications and results of this study emphasize the importance of paying attention to the psychological well-being of ATCs and their workload management.

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INTRODUCTION

Aviation safety is a core principle that emphasizes the importance of orderly, safe, and comfortable flights. In an effort to achieve these standards, the role of the Air Traffic Controller (ATC) is vital, overseeing aircraft navigation and regulating air traffic according to strict procedures (Susanto et al., 2021; **Shi, 2024**). D. Despite the importance of ATC duties, there are high levels of stress and significant mental workload, especially following an aviation accident or incident (Nakamura & Kageyama, 2019). This can create "critical incident stress" in ATC, which can affect their mental well-being. Hence, the importance of situational awareness in the work of ATC is crucial, as an optimal level of situational awareness enables them to identify, understand and respond to changes in the air traffic environment, which in turn maintains overall flight safety (Lestary et al., 2023). Significant developments have taken place in the Indonesian aviation world along with the times. Today, a number of civil and commercial airlines operate in Indonesia, while airports continue to be built in almost every province (Rachmadina & Puspitadewi, 2019). However, safety remains a major issue in Indonesian aviation (Bunahri, 2023). Several aviation accidents have given the country's air transportation system a bad reputation. Aviation in Indonesia faces various challenges, including the condition of its

infrastructure and human resources. A major challenge arises when an aircraft incident occurs that can cause trauma and high stress to the ATC. Such incidents could be aircraft accidents or other emergency situations that require a quick and precise response (Yang et al., 2022). As a result, ATCs may experience significant psychological distress, feel guilty, or experience anxiety that can affect mental well-being. In the world of aviation, vigilance in observing, analyzing and responding to situations is crucial (Ahmad & Wiwi, 2019). Psychological distress such as post-incident trauma and high mental workload may impair ATCs' ability to maintain optimal levels of situational awareness (Luh et al., 2022). This research is expected to provide insight into how these factors can affect ATC performance and overall flight safety.

In the world of aviation, the implementation of national aviation aims to achieve orderly, regular, safe, secure and comfortable comfortable flights (Bunahri et al., 2023; **Ng., Su., & Ng., 2023).**.One important element in achieving this goal is the role of the Air Traffic Controller (ATC), which is tasked with providing navigation services and ensuring the smooth flow of air traffic in accordance with strict guidance procedures. The level of flight safety is one of the top priorities in ATC work (International Civil Aviation Organization, 2018). Air Traffic Controllers (ATC) play an important role in maintaining the safety and smoothness of air traffic. According to the Flight Safety Foundation, ATC is responsible for controlling and guiding aircraft in the air and on the ground, as well as coordinating flights to prevent collisions. However, the job is highly stressful and can demand a significant mental workload (Seftiyana, 2021). As explained earlier, the air traffic controller (ATC) is responsible for the safe and smooth operation of flights by ensuring that each aircraft operates within its assigned airspace and is safe from collisions. In this context, a high level of situational awareness is a key factor that enables ATC to identify, understand and respond to changes that occur in the air traffic environment. Situational awareness itself has several crucial factors including; perception, understanding, and projection as important parts of the three levels of situational awareness. Situational awareness is the perception of something around the environment, understanding its meaning and predicting it in the form of decisions (Endsley, 2015). However, we must also realize that aviation accidents and incidents can occur, often due to a mismatch between operational and expected conditions, caused by errors or failures (Poerwanto & Mauidzoh, 2016). Aviation accidents are divided into two categories, namely accident and incident (International Civil Aviation Organization, 2018). Whenever an aviation accident or incident occurs, it can leave a profound impact on the Air Traffic Controller involved in regulating the flight. Even in relatively minor critical situations, ATCs can experience what is referred to as "critical incident stress" (Eurocontrol, 2020).

In addition, post-incident trauma can also affect ATC mental workload (Saputra et al., 2022). According to Rubin Khoddam, who is a clinical psychologist and founder of COPE Psychological Center in Los Angeles, suggests that trauma can affect our central nervous and endocrine systems, making us more reactive to stress and more likely to increase the stress hormone cortisol. This can impact one's ability to think clearly and make sound decisions, especially in demanding and stressful situations such as an ATC. For example, Thomas Morin, an ATC with 23 years of experience at Boston Airport, admitted that being a first-hand witness to the critical events on September 11, 2001 caused him significant stress (Čekanová et al., 2016). Such situations suggest that stress regulation and mental health management are crucial for ATCs involved in incidents or accidents during the course of their duties. Meanwhile, the daily tasks of ATCs are already demanding jobs that require high focus and constant monitoring of complex data and instructions. High mental workload can result from the amount of information to process and decisions to be made in a short period of time. The combination of post-incident trauma and high mental workload can seriously impact ATC's ability to maintain optimal situational awareness. Thus, the presence of trauma and increased mental workload post-incident can have a negative impact on situational awareness. For example, increased mental workload may make it more difficult for ATC to maintain a clear picture of the current air traffic situation (Utami et al., 2022). Similarly, post-event trauma can cause excessive stress and cognitive impairment that can interfere with ATC's ability to maintain situational awareness (Brindley & Tse, 2016).

Based on Aviation Safety Network data, in the last two decades there have been 45 fatal aircraft accidents in Indonesia. A total of 30 fatal accidents occurred during the 2002-2011 period, while 15 other fatal accidents in 2012-2021. In the last two decades, the most fatal aircraft accidents occurred in 2009, namely 7 accidents. One of the most recent plane crashes in Indonesia occurred on Sriwijaya Air

in 2021. The Boeing 737-524 aircraft on the Jakarta-Pontianak route with flight number SJ182 crashed around Laki Island, Thousand Islands, DKI Jakarta, on Saturday. The Sriwijaya Air tragedy is one of 3 fatal aviation accidents that occurred in Indonesia throughout 2021. The accident claimed 62 lives, consisting of 56 passengers and 6 crew members. There are several studies that show that aviation accidents or incidents can leave a deep impact on the mentality of the ATC involved. In a study conducted by Susanti (2016), it was shown that workload and role conflict are important factors affecting ATC burnout and job stress. In addition, based on a study by Gustiani (2020), it is known that 92% of ATC officers in Indonesia experience job burnout while carrying out their duties. Disruption or danger in flight is one of the impacts of this fatigue, which can result in decreased productivity at work. Previous research has shown that mental workload can affect ATC performance (Cañas et al., 2020)). There are also other studies that show that mental workload, fatigue, and sleepiness can affect the level of alertness of ATC officers (Hamid et al., 2023).

Previous research has shown that mental workload can affect ATC performance, but there is insufficient understanding of its impact on situational awareness, especially in the context of ATC work in Indonesia, which has unique air traffic characteristics and dynamics. Therefore, further research is needed to explain the relationship between post-event mental workload and ATC situational awareness. In addition, the differences in geographical context, infrastructure, and human resources make it important for more focused research on aviation conditions throughout Indonesia. By filling this research gap, it is hoped that this study can provide a more comprehensive understanding of the impact of trauma and post-event mental workload on ATC situational awareness. Thus, this study aims to analyze the effect of trauma and mental workload after an accident/incident has a significant effect on the situational awareness of ATC (Air Traffic Controller).

METHOD

The research method applied in this study is quantitative with a survey approach. The survey involved questioning a number of respondents, in this case, Air Traffic Controllers (ATCs) in Indonesia. The intended population included 1,669 ATCs registered in 2022. The sampling technique used is Purposive Sampling, where the selection of respondents is based on subjective considerations and relevance to the research objectives. In this case, the researcher selected 119 ATCs who had experienced supervising an aircraft that experienced an accident or incident as the sample. The data collection method was carried out through the use of a questionnaire using a Likert scale. This research instrument is designed to produce accurate data related to the variables of Post accident/incident Trauma (X1), Mental Workload (X2), and Situational Awareness (Y). The data analysis methodology encompasses examinations of instrument validity and reliability, along with classical assumption assessments like normality, multicollinearity, and heteroscedasticity. Multiple linear regression analysis was employed to scrutinize the hypotheses, with the F test, t test, and coefficient of determination serving as principal tools to assess the relationships among the variables under investigation.

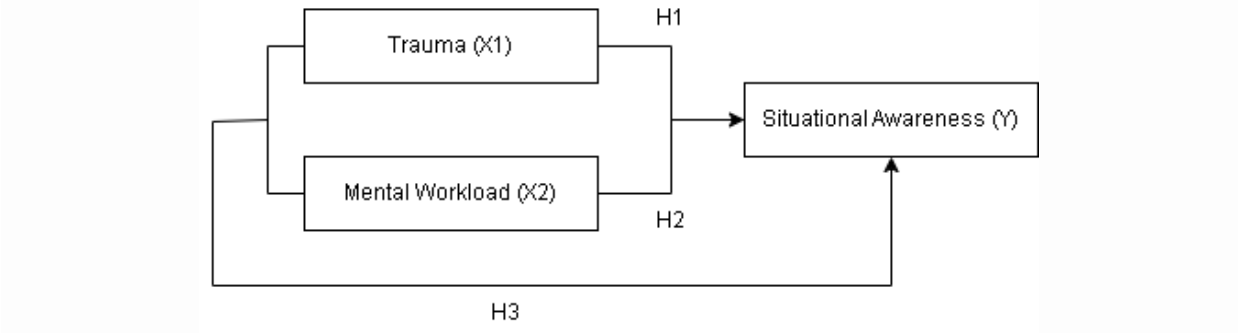

Figure 2. Research framework

RESULTS AND DISCUSSION

Before the enactment of Law No. 1 of 2009 concerning Aviation and Government Regulation (PP) No. 77 of 2012 concerning the Public Company (Perum) of the Indonesian Aviation Navigation Service Provider Agency (LPPNPI), the administration of flight navigation systems was directly

managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) alongside the Ministry of Transportation, which oversees Technical Service Unit airports across Indonesia. The concept of establishing a unified administrator of navigation services stemmed from two primary concerns: the responsibilities handled by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero), and the findings of the International Civil Aviation Organization (ICAO) audit conducted on flights in Indonesia in 2005 and 2007, which concluded that Indonesia's flights did not meet the minimum standards of international safety regulations. The initiation of Perum LPPNPI commenced with the formulation of the Government Regulation (RPP) in September 2009 and was ratified as PP 77 Year 2012 on September 13, 2012, by President Susilo Bambang Yudhoyono. Subsequently, following the implementation of PP 77/2012, all navigation services previously overseen by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) were transferred to AirNav Indonesia on January 16, 2013. AirNav Indonesia, whose ownership is entirely held by the Republic of Indonesia and represented by the Ministry of State-Owned Enterprises (SOEs), is committed to enhancing flight navigation services in Indonesia by adopting a cost recovery business model. With the establishment of AirNav Indonesia, the management of aviation navigation safety and services can be more effectively streamlined, addressing the prior issue of dispersed navigation services among multiple agencies, resulting in discrepancies in service quality and lack of focus. As the sole provider of flight navigation in Indonesia, AirNav Indonesia marks a significant milestone in the national aviation industry.

In accordance with PP No. 77 of 2012, the formation of Perum LPPNPI is aimed at providing flight navigation services in adherence to established standards, thus enhancing flight efficiency and effectiveness both domestically and internationally. As a corporate entity, AirNav Indonesia's performance is primarily evaluated based on safety criteria, encompassing various aspects including personnel, equipment, and procedures, all of which must adhere strictly to the evolving standards outlined in the Civil Aviation Safety Regulations (CASR). Vision:"To become an international standard flight navigation service provider". Mission:"Providing flight navigation services that prioritize safety, flight efficiency and environmental friendliness to meet service user expectations".

This data description aims to determine the characteristics of respondents in order to describe the circumstances or conditions of respondents who can provide additional information to understand the results of the study. The summary of the characteristics of respondents in this study can be seen in the following table.

Table 1. Respondents Characteristics

No	Category	Total	Percentage (%)
1.	**Gender**		
	Male	80	67,2%
	Female	39	32,8%
2.	**Age**		
	21-30 Years Old	21	17,65%
	31-40 Years Old	55	46,22%
	41-50 Years Old	36	30,25%
	>50 Years Old	7	5,88%
3.	**Education**		
	D.II	2	1,7%
	D.III	69	57,9%
	D.IV	11	9,2%
	S1	34	28,6%
	S2	3	2,5%
4.	**Working Period**		
	1-10 Years	39	32,77%
	11-20 Years	40	33,61%
	21-30 Years	34	28,57%
	> 30 Years	6	5,04%

Table 1 respondent characteristics presents data describing the demographic profile and educational qualifications and work experience of the study participants. There were 119 respondents involved in this study, the majority of whom were male (67.2%) compared to female (32.8%). With respect to age, the distribution of respondents showed significant variation. Respondents aged 31-40

years made up the majority group (46.22%), followed by respondents aged 41-50 years (30.25%). The 21-30 years and above 50 years age groups accounted for 17.65% and 5.88% of the total respondents respectively. The respondents' latest education covers a wide range of levels, with the majority having a DIII educational background (57.9%), followed by S1 (28.6%), DIV (9.2%), S2 (2.5%), and DII (1.7%). Meanwhile, in terms of length of service, the distribution of respondents also varied. Respondents with 11-20 years of service accounted for the highest proportion (33.61%), followed by 1-10 years of service (32.77%), 21-30 years (28.57%), and more than 30 years (5.04%).

The validity test is conducted by comparing the r-count and r-table values. If the r-count exceeds the r-table value, the indicator is considered valid; conversely, if the r-count is less than the r-table value, the indicator is deemed invalid. In this study, the r-table value is derived from the distribution table of the r-Table value, where df = n-k or 119-3 = 116 (where k represents the number of independent variables and n denotes the number of samples). With a significance level of 0.05, the obtained r-Table value is 0.181. It is observed that each statement item has an r-count greater than the r-table value (0.181) and is positive. Consequently, each statement is deemed valid and suitable for further research.

The reliability test can be seen from the magnitude of the cornbach alpha value of each variable. Cornbach alpha is used to show the consistency of respondents in responding to all statement items. In the reliability test, the questionnaire is said to be reliable if the cornbach alpa value is greater than 0.60.

Table 2. Hasil Uji Reliabilitas

Variable	Cronbach Alpha	Keterangan
Post-incident Trauma (X1)	0,934	Reliabel
Mental Workload (X2)	0,949	Reliabel
Situational Awareness (Y)	0,958	Reliabel

Based on table 2, it is known that each variable has a good level of reliability. The Cronbach's Alpha value of all variables exceeds the recommended value (0.60), so the data used in this study is declared as reliable based on the Cronbach's Alpha value obtained. This shows that the measurement instruments used in this study have good internal consistency, and the data obtained from respondents can be relied upon for further analysis.

Table 3. Normality Test

			Unstandardized Residual
N			119
Normal Parameters[a,b]	Mean		,0000000
	Std. Deviation		4,13224195
Most Extreme Differences	Absolute		,097
	Positive		,097
	Negative		-,061
Test Statistic			,097
Asymp. Sig. (2-tailed)			,008[c]
Monte Carlo Sig. (2-tailed)	Sig.		,205[d]
	99% Confidence Interval	Lower Bound	,195
		Upper Bound	,216

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. Based on 10000 sampled tables with starting seed 2000000.

According to the findings of the normality test utilizing the Komogorov-Smirnov statistical test as shown in table 3, the Monte Carlo significance value (2-tailed) indicates a value of 0.205, which is higher than 0.05. Thus, it can be inferred that the residual data follows a normal distribution.

a. Multicolliniearity Test

Table 4. Multicollinearity Test

Variable	VIF Value	VIF Standart	Tollerance Value	Tollerance Standart	Description
X1	2,232	< 10	0,448	> 0,01	No Multicollinearity
X2	2,232	< 10	0,448	> 0,01	

It is evident that the Variance Inflation Factor (VIF) values for the independent variables Post-accident/incident trauma (X1) and Mental Workload (X2) are below 10.0 (VIF < 10.0), and their tolerance values exceed 0.10 (tolerance > 0.10). Hence, it can be inferred that there is no multicollinearity present among the independent variables in the regression model.

The heteroscedasticity test is carried out with the aim of knowing whether in a regression model there is an inconvenience in the variance of the residues between observations with one another or not. To detect the presence or absence of heteroscedasticity can be done in several ways. One of them is by looking at the presence or absence of certain patterns in the scatterplot graph as follows.

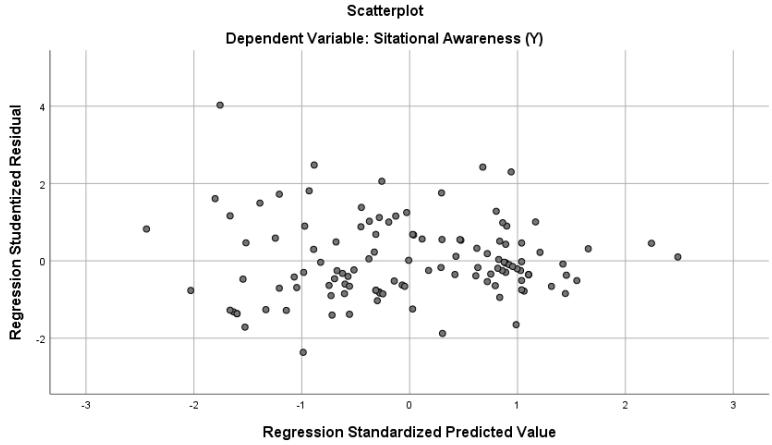

Figure 3.. Heteroscedasticity Test

According to the illustration provided, there is a lack of ambiguous trends, and the data points in the visualization are evenly distributed both above and below the zero mark on the Y-axis. As a result, it can be inferred that there is no heteroscedasticity present within the regression model examined in this study.

b. Results Of Multiple Regression Analysis

Table 5. multiple regression analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	8,985	1,753		5,126	,000		
	Post-Incident Trauma pasca (X1)	-,189	,071	-,212	-2,658	,009	,448	2,232
	Mental Workload (X2)	-,623	,077	-,648	-8,110	,000	,448	2,232

a. Dependent Variable: Situational Awareness (Y)

Based on table 5, the regression coefficient of each variable is obtained, while the multiple linear regression equation Y = 8.985 - 0.189 X1 - 0.623 X2 + e. The results of the multiple linear regression equation above can be interpreted as follows.Intercep (Constant), the constant coefficient (8.985) is the estimated value of the dependent variable (Situational Awareness) when all independent

variables (Post accident/incident trauma and Mental Workload) are at zero value. That is, when there is no post-accident/incident trauma and mental workload, Situational Awareness has a value of about 8.985. While coefficient of X1 (Post accident/incident trauma), the coefficient of X1 is -0.189. This indicates that each one unit increase in the post accident/incident Trauma variable (X1) will result in a decrease of approximately 0.189 units in Situational Awareness (Y), if other variables remain constant. This indicates that the higher a person's post accident/incident trauma, the lower the level of Situational Awareness. Lastly, coefficient of X2 (Mental Workload), this indicates that each one unit increase in Mental Workload (X2) will result in a decrease of approximately 0.623 units in Situational Awareness (Y), if other factors remain constant. This indicates that, the higher the mental workload a person receives, the lower the level of Situational Awareness.

c. F Test

Essentially, the F-test is utilized to assess the collective impact of independent variables on the dependent variable in multiple linear regression. If the calculated F-value exceeds the critical F-value at a significance level of <0.05, it indicates that the independent variables collectively have a significant impact on the dependent variable. Conversely, if the calculated F-value is less than the critical F-value, it suggests that the independent variables do not collectively influence the dependent variable significantly. With a significance level (α) set at 0.05, the critical F-value obtained from the F-statistics table is 2.683. The outcomes of the F-test conducted in this study are presented in the subsequent table.

Table 6. F test

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4065,100	2	2032,550	-117,016	,000[b]
	Residual	2014,900	116	17,370		
	Total	6080,000	118			

a. Dependent Variable: Situational Awareness (Y)
b. Predictors: (Constant), Beban Kerja Mental (X2), Trauma pasca accident/incident (X1)

From the provided table, it is evident that the F-count value is -117.543, with a significance value of 0.000. Comparing this to the previously obtained F-table value of 2.683, it's apparent that the F-count value exceeds the F-table value (-117.543 > -2.683), and the significance value is less than the predefined probability level (0.000 < 0.05). Thus, the alternative hypothesis (Ha) is accepted. These findings signify that the regression model utilized is statistically significant, indicating its capability to elucidate variations in the dependent variable (Situational Awareness) with statistical significance.

The purpose of the Coefficient of Determination test is to evaluate the extent to which the model can elucidate variations in the dependent variable. A small R2 value implies that the capacity of the independent variables to account for the variation in the dependent variable is quite restricted.

Table 7. Coefficient of Determination test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,818[a]	,669	,663	4,168	1

a. Predictors: (Constant), Beban Kerja Mental (X2), Trauma pasca accident/incident (X1)
b. Dependent Variable: Situational Awareness (Y)

It is evident from the findings of this study that the model exhibits a robust R Square value of 0.669. This suggests that approximately 66.9% of the variability in Situational Awareness can be accounted for by the collective influence of the independent variables in the model, while the remaining 33.1% variability is attributed to factors beyond the scope of the model.

Hyphotesis Test (t Test)

In this research, the method employed for hypothesis testing is the T-test. The T-test, or t-statistical test, essentially evaluates the extent to which an individual independent variable influences the variation in the dependent variable. Decision-making is based on whether the t-count exceeds the t-table value, or if the negative t-count is less than the negative t-table value, indicating acceptance of the alternative hypothesis (Ha) and rejection of the null hypothesis (H0). To derive the t-table value in this study, reference is made to the t-statistics table with degrees of freedom (df) equal to n-k, where k represents the number of independent variables and n denotes the sample size, resulting in df = 119 - 3 = 116. With a significance level set at 0.05 and a two-sided test, the obtained t-table value is 1.981. The outcomes of the hypothesis testing (t-test) based on Table 5 are expounded upon as follows. For the post-accident/incident Trauma variable (X1), the t-count value is -2.658. Consequently, the negative t-count exceeds the negative t-table value (-2.658 > -1.191), and the significance value of 0.009 is lower than the predetermined probability threshold (0.009 < 0.05). Thus, the alternative hypothesis (Ha) is accepted, indicating that the post-accident/incident Trauma variable (X1) partially exhibits a significant impact on Situational Awareness (Y). In the case of the Mental Workload variable (X2), the t-count value stands at -8.110. It is observed that the negative t-count surpasses the negative t-table value (-8.110 > -1.191), and the significance value of 0.000 is below the predetermined probability level (0.000 < 0.05). Consequently, the alternative hypothesis (Ha) is accepted, indicating that the Mental Workload variable (X2) partially exerts a significant influence on Situational Awareness (Y).

1. Discussion

a. Post-incident trauma and mental workload on ATC situational awareness

The results of the analysis in this study show that the coefficient for post accident/incident trauma obtained at -0.189 has a relevant interpretation of the decrease in situational awareness when there is a one unit increase in the post accident/incident trauma variable, assuming other variables remain constant. In more detail, this result shows that an increase in the level of trauma after an accident or incident has the potential to cause a decrease of about 0.189 units in situational awareness in respondents. Therefore, it can be concluded that the higher the level of post-accident/incident trauma experienced by ATCs, the lower their level of situational awareness. The statistical significance analysis also supports this finding. With a -t-count of -2.658, which is greater than the -t-table of -1.191, and a significance value of 0.009 which is smaller than the probability level of 0.05, it can be concluded that the post accident/incident trauma variable has a significant effect on situational awareness. This result indicates that there is a real relationship between the experience of post-accident or incident trauma and the respondents' level of situational awareness. Thus, it can be explained that ATCs who experience post-accident/incident trauma experience a decrease in the quality of their situational awareness. Trauma, as an adverse psychological experience, can create cognitive and emotional distractions that affect an ATC's ability to detect and respond appropriately to situations. Feelings of fear or anxiety arising from such trauma can inhibit concentration and information processing abilities, thereby reducing the level of situational awareness.

Situational awareness is important for air traffic controllers (ATC), as they are responsible for monitoring and managing air traffic efficiently and safely. The impact of post-accident trauma on decreased situational awareness can be a serious concern in aviation safety. A traumatized ATC will have difficulty detecting changes in the surrounding conditions, recognizing information related to aircraft position, and even making critical decisions in emergency situations. Therefore, these findings have implications especially in jobs or activities that demand a high level of situational awareness, especially in aviation or jobs that involve great responsibility for safety. The management of post-accident trauma is important in improving an ATC's situational awareness, and efforts to help ATCs overcome the psychological impact of trauma are necessary to ensure optimal levels of situational awareness.

The results of the analysis in this study show that the coefficient for mental workload obtained of -0.623 has a relevant interpretation of the decrease in situational awareness when there is a one unit increase in the mental workload variable, assuming other variables remain constant. In more detail, this result shows that an increase in the level of mental workload has the potential to cause a decrease of approximately 0.623 units in situational awareness in

respondents. Therefore, it can be concluded that the higher the mental workload experienced by an ATC, the lower the level of situational awareness. The statistical significance analysis also supports this finding. With a -t-count of (-8.110) greater than the -t-table (-1.191), and a very low significance value ($0.000 < 0.05$). Thus, it can be concluded that the mental workload variable partially has a significant effect on situational awareness. This implies that there is a strong relationship between the level of mental workload and the ability of ATCs to understand and respond to the situation around them. As such, this finding provides insight into how mental workload can be a key factor influencing an ATC's level of situational awareness. Reduced levels of situational awareness associated with increased mental workload can be understood as a result of cognitive distraction or mental fatigue arising in the work environment. ATCs who experience high levels of mental workload will find it difficult to focus attention, process information, and respond to situations quickly and accurately.

The importance of understanding the impact of mental workload on situational awareness becomes increasingly relevant in the context of work that demands high responsiveness to changing situations in aviation or industrial sectors that require optimal levels of situational awareness. The findings also reinforce the argument that psychological aspects have a significant impact on an individual's cognitive performance (Annisa et al., 2024). Considering strategies to support the mental well-being of ATCs may be useful to minimize their negative impact on situational awareness. Therefore, these findings highlight the need for attention to mental well-being in the ATC work environment. Efforts to understand and reduce mental stress can play a key role in improving ATC performance and creating a safer work environment. Providing psychological support, stress management training, and strategies to manage mental workload may be necessary measures to improve situational awareness.

b. Psychological treatment for ATC who experienced critical incident stress

Appropriate psychological treatment for air traffic controllers (ATCs) experiencing critical incident stress is essential based on the findings in this study. It was found that post-accident/incident trauma and mental workload had a significant impact on situational awareness, indicating a potential negative influence on the mental well-being of ATCs. Therefore, it is necessary to develop appropriate psychological intervention approaches to help ATCs cope with the impact of stress that may arise after experiencing a critical event (Puspitasari & Kustanti, 2018). One strategy that can be adopted is the implementation of a critical incident stress management (CISM) program. CISM is a crisis intervention system that involves trained peers providing psychological support to individuals who are experiencing stress due to a specific incident. This initiative has proven effective in helping workers, including ATC, to manage post-incident stress and trauma (Čekanová et al., 2016). The article also mentions that CISM efforts involve defusing and debriefing sessions, where trained peers provide space for individuals to share their experiences. Defusing is done briefly after the event to identify feelings and provide initial support, while debriefing is a more structured session to detail and process the experience. In addition, setting up peer support groups, as planned by the Air Traffic Control Guild in India, can be an additional means of providing emotional support and sharing experiences, strengthening cohesion within the ATC community (Witjaksono & Noviati, 2018).

It should be noted that psychological treatments are not only reactive but also proactive. Mental resilience training can be an integral part of prevention strategies to reduce the negative impact on situational awareness (Bidari et al., 2019). ATCs can be trained to strengthen their ability to manage stress, identify symptoms of post-critical event stress, and implement relaxation or meditation techniques that can help reduce mental strain. The development of this resilience can increase individuals' psychological resilience to stress and trauma, helping them to recover more effectively (Saleh et al., 2022). In developing a psychological coping program, it is also important to consider organizational policies and practices that support ATC mental well-being (Setyadevi, 2023). This involves the introduction of a supportive work environment, adequate leave policies for recovery, as well as efforts to reduce excessive mental workload. Workload management through task reassessment and effective resource allocation can contribute to reducing stress levels and improving overall psychological well-being (Ulfah &

Prokosawati, 2022). In addition, there needs to be an ongoing monitoring and evaluation mechanism of the effectiveness of this psychological treatment program (Prakoso et al., 2018). By gathering feedback from ATCs who have attended the program, the organization can assess its positive impact and make adjustments as needed. By better understanding the psychological challenges and needs of air traffic controllers, the treatment program can be tailored to achieve optimal results. Thus, appropriate psychological treatment for ATCs experiencing critical incident stress should be holistic, encompassing aspects of individual counseling, resilience training, group support, and organizational policy changes. These measures will provide a strong foundation to support the mental well-being of air traffic controllers, which in turn can improve their level of situational awareness and maintain safe flight operations.

CONCLUSION

Based on the findings in the study, it can be concluded that there is a significant influence between post-accident/incident trauma and mental workload on situational awareness in Air Traffic Controller (ATC). Both partially and simultaneously, these two variables contribute significantly to ATC situational awareness. This highlights the importance of paying attention to psychological aspects and mental workload in maintaining situational awareness of air traffic controllers. Knowing that post-accident/incident trauma and mental workload have a negative influence on situational awareness, indicates the need for appropriate treatment measures. Psychological approaches such as individual or group counseling programs can be a solution to overcome the impact of post-accident/incident trauma. In addition, mental workload management involving stress management training and strengthening internal support in the work environment also needs to be considered as an integral part of the treatment effort. Thus, the implementation of these strategies can help improve situational awareness and safety in air traffic operations.

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