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ORIGINAL

Effects of individual characteristics and work factors on work stress in aircraft maintenance engineers

Los efectos de las características Individuos y los factores Laborales en el Estrés Laboral de Los Ingenieros de Mantenimiento Aeronáutico

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ABSTRACT

Introduction: working as an Aircraft Maintenance Engineer (AME) can cause significant work-related stress, given the enormous responsibility of ensuring flight safety. The pressure to maintain high safety standards, deal with urgent technical problems, and maintain strict flight schedules can increase the level of stress experienced by professionals in this field.
Method: this study used a quantitative approach with a cross-sectional design. The sample of this study was 106 respondents selected by simple random sampling. Measurement of age, tenure, marital status, using questionnaires, social support using the Job Stress Questionnaire by the National Institute for Occupational Safety and Health (NIOSH), mental workload using NASA-TLX, physical workload using %CVL (Cardio Vascular Load), work stress using cocorometer. Data analysis using SPSS (Statistic Package for Sosial Science).
Results: based on the analysis at 95 % confidence level (α = 0,05), Based on the results of bivariate analysis, it was found that there was a relationship between age and work stress (p = 0,040), social support and work stress (0,021) mental workload and work stress (0,012), and physical workload (0,009). Meanwhile, there was no relationship between tenure and work stress (p = 0,331) or marital status and work stress (p = 0,325). Multivariate analysis results the social support variable has a significance value of 0,059, indicating a relationship that is close to the significance threshold for work stress. The Wald value of 3,579, which is close to the threshold of 3,84 shows that social support has the strongest influence compared to other variables. Meanwhile, the variables of age (0,341) mental workload (0,129) and physical workload 0,279 (p > 0,05) show no significant effect on work stress levels.
Conclusions: work stress among AMEs is influenced by age, social support, mental workload, and physical workload.

Keywords: Age; Tenure; Marital Status; Social Support; Physical Workload; Mental Workload; Work Stress.

RESUMEN

Introducción: el trabajo como ingeniero de mantenimiento de aeronaves (AME) puede causar estrés laboral significativo, dada la enorme responsabilidad que conlleva garantizar la seguridad de los vuelos. La presión por mantener altos estándares de seguridad, lidiar con problemas técnicos urgentes y cumplir con estrictos de vuelo puede aumentar el nivel de estrés que experimenta los profesionales de este campo.
Método: este estudio utilizó un enfoque cuantitativo con un diseño transversal. La muestra de este estudio fue de 106 encuestados seleccionados mediante muestreo aleatorio simple. Se midieron la edad, la antigüedad en el puesto y el estado civil mediante cuestionarios, el apoyo social mediante el Cuestionario de Estrés Laboral del Instituto Nacional de Seguridad y Salud Ocupacional (NIOSH), la carga de trabajo mental

mediante la NASA-TLX, la carga de trabajo físico mediante el %CVL (Carga Cardiovascular) y el estrés laboral mediante el cocómetro. El análisis de los datos se realizó con el programa SPSS (Paquete Estadístico para Ciencias Sociales).
Resultados: según el análisis con un nivel de confianza del 95 % (α = 0,05), a partir de los resultados del análisis bivariado, se supervisa que existe una relación entre la edad y el estrés laboral (p = 0,040), el apoyo social y el estrés laboral (0,021), la carga de trabajo mental y el estrés laboral (0,012) y la carga de trabajo físico (0,009). Por otra parte, no se encontró ninguna relación entre la antigüedad en el puesto y el laboral (p = 0,331) ni entre el estado civil y el estrés laborales (p = 0,325). Los resultados del análisis multivariante muestran que la variable de apoyo social tiene un valor de significación de 0,059, lo que indica una relación cercana al umbral de significación para el estrés laborales. El valor de Wald de 3,579, que se aproxima al umbral de 3,84, muestra que el apoyo social tiene la mayor influencia en comparación con otras variables. Por otra parte, las variables de edad (0,341), carga de trabajo mental (0,129) y carga de trabajo físico 0,279 (p > 0,05) no muestran un efecto significativo sobre los niveles de retención laboral.
Conclusiones: el estrés laboral entre los AME está influenciado por la edad, el apoyo social, la carga de trabajo mental y la carga de trabajo físico.

Palabras clave: Edad; Antigüedad; Estado Civil; Apoyo Social; Carga de Trabajo Físico; Carga de Trabajo Mental; Estrés Laboral.

INTRODUCTION

Stress can be defined as a condition or experience that is considered beyond one's control or unpredictable, as well as an unpleasant experience.[1] Stress is a natural condition that arises from human activities and is often expressed through phrases such as "I'm stressed," "I'm too stressed about life's problems," "my job makes me feel depressed," and so on.[2] According to the National Institute for Occupational Safety and Health (NIOSH), 40 % of workers experience serious stress due to work-related issues, and 1 in 4 respondents stated that work is the biggest source of stress in their lives. When this stress occurs continuously, psychological and physiological defense mechanisms will decline and have a negative impact.[3] Based on data from the 2018 Basic Health Research (Riskesdas), the prevalence of Indonesians aged 15 years and older experiencing emotional mental disorders or stress increased by 19,8 %.[4]

In general, older employees will have more experience than younger employees, enabling them to be more capable of dealing with stressors based on their experience. However, as a person ages, organ function and physical condition tend to decline, making older employees more vulnerable to stress.[5] Based on the results of research conducted by Cullen et al. on commercial pilots, employees with longer tenure experience higher stress due to the many responsibilities they have and increased pressure from the company.[6] Marital status can affect a person's stress levels. A harmonious marriage can help a person reduce or prevent stress, as the support provided by a spouse or family can lessen the negative impact of work.[7] However, married employees can also face high levels of stress due to their responsibility to provide for their families.[8] Work stress is an impact that arises from the interaction between high psychological demands in a job, control over that job, and low social support received by an individual.[9] Based on the results of an analysis conducted on employees of PT Angkasa Pura I Makassar, there is a significant relationship between social support and work stress. The social support received by an individual can have a significant impact on their mental and physical well-being, especially in carrying out their daily responsibilities. When individuals receive a high level of support, their tendency to experience work stress tends to decrease. Conversely, if the level of support received is low, the risk of stress due to work pressure will increase.[10] Research conducted on air traffic controllers at Adi Soemarmo International Airport in Solo found that work stress is caused by high workloads, both mentally and physically. These workloads stem from high levels of physical activity, as well as activities that involve mental exertion, such as maintaining full concentration for several hours, making accurate and quick decisions, and not being allowed to make mistakes.[11]

Airports operate 24 hours a day, particularly in technical areas, requiring technicians to work with a high level of professionalism. This situation is further complicated by increasingly busy domestic and international flight schedules, which require technicians to always be ready and work under tight deadlines. This places a heavy burden on technicians, who are often faced with excessive work demands that can cause stress. The pressure of heavy workloads and long working hours has a significant impact on stress management levels.[11] Sultan Hasanuddin International Airport is one of the busiest airports in Indonesia. Based on data from Flighradar24.com, the total number of flights at Sultan Hasanuddin Airport in Makassar reaches 969 flights per week.[13]

According to the Federal Aviation Administration (FAA) in 2023, one of the most common health problems

experienced by aircraft technicians is work-related stress. This can occur due to high job demands and short deadlines. Aircraft maintenance is one of the main functions in airlines. This field has attracted a lot of public attention due to the increasing number of accidents related to maintenance. It is estimated that human error is the root cause of 30 to 90 percent of aircraft accidents.[14] An Aircraft Maintenance Engineer (AME) is a person responsible for aircraft maintenance.[15] AME performs important tasks to ensure the efficiency and quality of flight operations. Their responsibilities include performing preventive and corrective maintenance on aircraft, which is essential to ensure flight safety and punctuality.[16] Aircraft maintenance includes all activities related to maintenance and ensuring that system equipment can work optimally.[17] Aircraft maintenance is an activity that includes inspection, repair, service, overhaul, and replacement of parts to keep the aircraft in good condition.[18]

Working as an Aircraft Maintenance Engineer (AME) can cause significant work stress, given the enormous responsibility of ensuring flight safety. The pressure to maintain high safety standards, deal with urgent technical problems, and comply with tight flight schedules can increase the level of stress experienced by professionals in this field. Based on the above description, the researcher is interested in conducting research related to the influence of individual characteristics and work factors on work stress in Aircraft Maintenance Engineering (AME) at Sultan Hasanuddin International Airport in 2025.

METHOD

This study is a quantitative analytical observational research using a cross-sectional design, conducted at PT. X and PT. Y, located in the airside area of Sultan Hasanuddin International Airport, Makassar, South Sulawesi. The research was carried out from March to July 2024. The study population consisted of all active workers at PT. X and PT. Y during the research period. A total of 106 respondents were selected using the Lemeshow formula and a purposive sampling technique. Inclusion criteria included employees who had worked for at least one year, were present during data collection, and agreed to participate by signing informed consent. Exclusion criteria were workers with diagnosed cardiovascular, chronic hypertension, or psychiatric disorders, and those with incomplete data or invalid physiological readings. The variables analyzed included age, tenure, marital status, social support, mental workload, physical workload, and work stress. Social support was measured using the NIOSH Job Stress Questionnaire (JSQ), mental workload using the NASA-TLX, and physical workload using an oximeter.

Work stress was assessed using a cocorometer, a non-invasive, rapid, and practical device that differentiates between eustress and distress through changes in enzyme activity. This tool has been validated in previous studies as an effective method for evaluating psychological and occupational stress. All instruments were adapted and content-validated by experts to ensure contextual relevance. Data were collected directly at the workplace through questionnaire completion and physiological measurements. Secondary data were obtained from PT. X and PT. Y, as well as relevant publications and official websites. Data analysis included univariate, bivariate (chi-square), and multivariate (ordinal logistic regression) analyses using SPSS version 25. This research was approved by the Health Research Ethics Committee of the Faculty of Public Health, Hasanuddin University, under approval number 04790/UN4.14.8/PT.01.04/2025. All participants provided written informed consent, and confidentiality of personal data was strictly maintained.

RESULTS

PT X and PT Y are companies engaged in aircraft Maintenance, Repair, and Overhaul (MRO) and have branches located at the Airside of Sultan Hasanuddin International Airport. In general, both companies carry out line maintenance tasks in the form of daily checks, transit checks, minor maintenance, and emergency technical handling to ensure flight safety.

Table 1. Distribution of Respondents' Characteristics and Research Variables

Variables	Category	Frequency (n)	Percentage (%)
Age	55 - 65	2	1,9
	45 - 55	5	4,7
	36 - 45	31	29,2
	26 - 35	61	57,5
	17 - 25	7	6,6
Education	Senior High School	35	33,0
	Diploma	54	50,9
	Bachelor's Degree	15	14,2
	Master's Degree	2	1,9

Tenure	> 5 Years	97	91,5
	≤ 5 Years	9	8,5
Marital Status	Married	78	73,6
	Unmarried	28	26,4
Social Support	Less	64	60,4
	Good	42	39,6
Mental Workload	High	73	68,9
	Low	33	31,1
Physical Workload	High	51	48,1
	Low	55	51,9
Work Stress	High	5	4,7
	Medium	11	10,4
	Low	6	5,7
	Normal	84	79,2

Based on table 1, the majority of respondents were aged 26–35 years (57,5 %), followed by those aged 36–45 years (29,2 %). Most respondents had a Diploma degree (50,9 %), and the majority had a tenure of more than 5 years (91,5 %). In terms of marital status, most respondents were married (73,6 %), while 26,4 % were unmarried. Regarding social support, 60,4 % of respondents reported receiving less social support while 39,6 % perceived good social support. The majority of respondents experienced a high mental workload (68,9 %), with 31,1 % reporting a low mental workload. For physical workload, the proportion of respondents with low (51,9 %) and high (48,1 %) workloads was relatively similar. Finally, in terms of work stress, most respondents were categorized as having a normal stress level (79,2 %), followed by low (5,7 %), medium (10,4 %), and high (4,7 %) levels of stress.

Table 2. Cross tabulation of age on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Age	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
Older	12	31,6	26	68,4	106	100,0	0,040
Younger	10	14,7	58	85,3	106	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 2 with a total of 106 respondents, it was found that the proportion of work stress was higher in older respondents, with 12 respondents (31,6 %), compared to younger respondents, with 10 respondents (14,7 %). Based on the results of the Chi-Square statistical test, the p-value was 0,040. Thus, p-value < 0,05 meaning that there is a significant relationship between age and work stress.

Table 3. Cross tabulation of tenure on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Tenure	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
Longer	19	19,6	78	80,4	97	100,0	0,331
Shorter	3	33,3	6	66,7	9	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 3 with a total of 106 respondents, it was found that the proportion of work stress was higher among respondents with longer tenure, with a proportion of 19 respondents (19,6 %) compared to those with shorter tenure, with a proportion of 3 respondents (33,3 %). Based on the results of the Chi-Square statistical test, the p-value was 0,331 > 0,05 therefore concluded that there is no relationship between length of service and work stress.

Table 4. Cross tabulation of Marital Status on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Marital Status	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
Married	18	23,1	60	76,9	78	100,0	0,325
Unmarried	4	14,3	24	85,7	28	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 4 with a total of 106 respondents, it was found that the proportion of work stress was higher among respondents who were married, namely 18 respondents (23,1 %), compared to respondents who were not married, namely 4 respondents (14,3 %). Based on the results of the Chi-Square statistical test, the p-value was 0,325 > 0,05 indicating that there was no significant relationship between marital status and work stress.

Table 5. Cross tabulation of Social Support on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Social Support	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
Less	18	28,1	46	71,9	64	100,0	0,021
Good	4	9,5	38	90,5	42	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 5 with a total of 106 respondents, it was found that the proportion of work stress was higher in respondents with poor social support, namely 18 respondents (28,1 %), compared to those with good social support, namely 4 respondents (9,5 %). Based on the results of the Chi-Square statistical test, the p-value was 0,021 < 0,05 indicating a significant relationship between social support and work stress.

Table 6. Cross tabulation of Mental Workload on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Mental Workload	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
High	20	27,4	53	72,6	73	100,0	0,012
Low	2	6,1	31	93,9	33	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 6 with a total of 106 respondents, it was found that the proportion of work stress was higher in respondents with heavy mental workload, namely 20 respondents (27,4 %), compared to those with light mental workload, namely 2 respondents (6,1 %). Based on the results of the Chi-Square statistical test, the p-value was 0,012 < 0,05 indicating a significant relationship between mental workload and work stress.

Table 7. Cross tabulation of Physical Workload on work stress of Aircraft Maintenance Engineer in PT X and PT Y Sultan Hasanuddin International Airport

Physical Workload	Work Stress				Total		P-Value
	Stress		Normal				
	n	%	n	%	n	%	
High	16	31,4	35	68,6	51	100,0	0,009
Low	6	10,9	49	89,1	55	100,0	
Total	22	20,8	84	79,2	106	100,0	

Based on table 7 with a total of 106 respondents, it was found that the proportion of work stress was higher in respondents with heavy physical workloads, namely 16 respondents (31,4 %), compared to those with light physical workloads, namely 6 respondents (10,9 %). Based on the results of the Chi-Square statistical test, the p-value was 0,009 < 0,05, indicating a significant relationship between physical workload and work stress.

Table 8. Partial Test Result

	Variable	Estimate	Std. Error	Wald	df	Sig.
Threshold	Stres = 1	-3,774	0,885	18,189	1	0,000
Location	Age	-0,536	0,562	0,909	1	0,341
	Social Support	-1,165	0,616	3,579	1	0,059
	Mental Workload	-1,270	0,836	2,310	1	0,129
	Physical Workload	-0,678	0,626	1,172	1	0,279

**p-Value* < 0,05: There is a significant effect

Based on the multivariate logistic regression analysis, the results show the effect of independent variables on the dependent variable (work stress). The analysis used was the partial test (Wald test), which aims to assess the effect of each variable individually. The variables analyzed included age, social support, mental workload, and physical workload. The social support variable has a significance value of 0,059, which indicates a relationship that is close to the significance threshold for work stress. The Wald value of 3,579, which is close to the threshold of 3,84, shows that social support has the strongest influence compared to other variables, although it is not yet statistically significant (0,059 > 0,05). Meanwhile, the variables of age 0,341 (p > 0,05), mental workload 0,129 (p > 0,05), and physical workload 0,279 (p > 0,05) show no significant effect on work stress levels.

DISCUSSION

This study explored the relationship between individual characteristics and occupational factors with work stress among Aircraft Maintenance Engineers (AMEs) working at PT. X and PT. Y, Sultan Hasanuddin International Airport, Makassar. The analysis revealed that work stress among AMEs was mainly influenced by physiological and psychosocial aspects rather than demographic factors. Variables such as age, social support, mental workload, and physical workload were found to be associated with levels of work stress, whereas tenure and marital status did not show a meaningful effect. These findings highlight that the interaction between physical demands and social relationships plays a more prominent role in determining workers' stress levels than personal background characteristics. The multivariate analysis further supported the pattern observed in the bivariate findings, suggesting that the identified factors collectively contribute to the variation in stress levels among workers.

Although the individual effects of each factor were modest, the overall model demonstrated that work stress is shaped by a combination of physical strain, cognitive burden, and social dynamics within the work environment. Among these, social support emerged as a particularly relevant factor, indicating that strong interpersonal connections and responsive communication within the workplace can mitigate the psychological impact of demanding tasks. In summary, this study underscores that work stress among AMEs is a multidimensional phenomenon resulting from the cumulative influence of physical workload, mental demands, and social interactions. The findings emphasize the need for an integrated approach to occupational health—one that not only addresses ergonomic and workload factors but also prioritizes supportive supervision, teamwork, and mental well-being as essential components of a safe and sustainable aviation maintenance environment.

Effect of Age on Work Stress among Aircraft Maintenance Engineers (AME)

The analysis confirmed a significant relationship between age and work stress. Older AMEs experienced greater levels of fatigue and stress, consistent with the natural decline in physical capacity and stamina over time.[19] Frequent walking between distant aircraft stands, bending during inspections, and lifting components contribute to physical strain, which amplifies fatigue. A similar pattern was found at PT. X, where employees above 35 years experienced higher stress.[20] Comparable findings were reported by Ramadhan et al.[21], who found that older bus drivers in Makassar were more prone to fatigue due to decreased physical endurance and prolonged working hours. They argued that aging affects metabolic and cardiovascular efficiency, which reduces resistance to stress and fatigue. These physiological and ergonomic vulnerabilities explain the strong association between age and occupational stress among AMEs. Younger workers, in contrast, may show impulsivity and weaker emotional regulation [22] yet their physical resilience helps offset the physiological burden of stress.

Effect of Tenure on Work Stress among Aircraft Maintenance Engineers (AME)

Tenure did not show a significant correlation with work stress, suggesting that both experienced and newer workers face similar occupational demands. This finding supports research from the Surakarta Customs Office.[5] where employees across service lengths reported comparable stress levels. It is likely that long-serving workers develop adaptive coping strategies, while new employees maintain enthusiasm and learning motivation. However, long tenure also increases exposure to accumulated fatigue and potential occupational diseases.[23] Similarly, Rombedatu et al.[24] found no strong association between tenure and fatigue among industrial workers, arguing that task variation and adaptive behavior help maintain equilibrium over time. In this sense, the ability to self-regulate and manage workload cognitively may serve as a buffer against the stress effects of extended employment duration.

Effect of Marital Status on Work Stress among Aircraft Maintenance Engineers (AME)

Marital status had no significant effect on work stress, indicating that most workers successfully compartmentalized personal and professional stressors. This is consistent with previous findings at PT. X.[25] Although marital disharmony can reduce concentration and psychological stability, emotional maturity and support from family members may mitigate these risks. This finding aligns with Khairunnysa et al.[26] who observed that psychosocial stability and job satisfaction are more influenced by work engagement and leadership support than by marital status. Thus, interpersonal and organizational factors appear more predictive of stress than family structure among AMEs.

Effect of Social Support on Work Stress among Aircraft Maintenance Engineers (AME)

A strong negative relationship was found between social support and work stress. Workers who lacked prompt communication and feedback from supervisors reported higher levels of psychological strain.[27] These findings are in agreement with earlier studies emphasizing the buffering role of social support in reducing workplace stress.[28] Effective peer interaction and supervisor empathy promote emotional comfort and confidence, helping employees adapt to high-pressure conditions.[29] Likewise, Ismah et al.[30] demonstrated that higher work engagement and interpersonal support were significantly related to job satisfaction among hospital staff, reducing perceived stress and improving morale. In the high-stakes environment of aviation maintenance, fostering mutual support and open communication is therefore vital for maintaining psychological stability and operational efficiency.

Effect of Mental Workload on Work Stress among Aircraft Maintenance Engineers (AME)

Mental workload was a significant predictor of work stress. AMEs are required to maintain high levels of attention, precision, and analytical judgment under strict time constraints. This cognitive burden, combined with the need for error-free performance, substantially contributes to stress. The finding is consistent with studies among Citilink employees, where excessive workload led to elevated stress.[31] As Mugniyah et al.[32] found in their analysis of physical and non-physical work environments, mental demands such as decision-making pressure and task complexity are critical determinants of occupational stress. In the aviation sector, mental fatigue can impair attention and judgment, directly affecting safety outcomes.[33] Mental workload is one of the triggers of work stress. Several factors that cause workers to experience workload include the heavy responsibilities they carry, the level of difficulty in performing tasks, and the fact that workers must work with the skills to carry out their workload. Excessive workload that is not immediately addressed has the potential to become a source of stress for workers, both at a severe and mild level.[34]

Effect of Physical Workload on Work Stress among Aircraft Maintenance Engineers (AME)Stress

Based on the results of statistical analysis, it was concluded that there is a relationship between physical workload and work stress. The job of an aircraft maintenance engineer (AME) requires high physical involvement, such as lifting heavy aircraft components, especially during the aircraft tire replacement process. In addition, this job also requires workers to work in non-ergonomic body positions, such as bending over or being in confined spaces, as well as standing for long periods of time. Based on the results of a study conducted at Kenneth Kaunda International Airport (KIAA) in Lusaka, Zambia, on ground handling workers with a total sample of 70 people, it was found that heavy workloads are one of the main factors contributing to work-related stress. This aspect refers to the level of stress experienced by individuals due to the perception that they are unable to handle or be productive with the amount of work assigned to them.[35]

The findings of this study carry several important implications for occupational health management, organizational policy, and the broader field of aviation safety. Work stress among Aircraft Maintenance Engineers (AMEs) is not merely a personal or psychological issue—it directly influences operational reliability, maintenance quality, and flight safety. Therefore, addressing the identified determinants of stress requires a holistic and multidisciplinary approach encompassing individual resilience, organizational support, and systemic reform. From

an organizational health perspective, companies such as PT. X and PT. Y should institutionalize comprehensive occupational health programs that focus on both physical and psychological well-being. Regular medical check-ups (MCUs), worksite ergonomic evaluations, and routine fitness or stretching sessions can mitigate the effects of physical workload and aging. These preventive measures help sustain musculoskeletal health, minimize fatigue, and consequently reduce stress-related absenteeism. Fatigue management through physical conditioning and rest-period design is critical in industries with high physical intensity.[24]

From a psychosocial standpoint, enhancing social support mechanisms within the workplace is vital. This includes strengthening supervisor–employee communication, establishing peer support groups, and cultivating a non-punitive safety culture where feedback and emotional well-being are valued. Strong social support and high work engagement improve satisfaction and performance, thereby indirectly reducing work stress. Supervisory training in empathetic communication and psychological first aid can create a more supportive and psychologically safe work environment. Furthermore, mental workload management should be prioritized through task redesign, shift rotation, and cognitive recovery strategies. AMEs operate under time pressure and safety-critical conditions, making them highly susceptible to cognitive overload. Organizations should therefore integrate human factors engineering principles into workflow design to prevent mental fatigue. This includes balancing task distribution, ensuring adequate rest between shifts, and using digital tools to automate repetitive administrative tasks.

At the policy level, aviation authorities and occupational health agencies could use these findings to inform regulatory frameworks that protect maintenance engineers' mental and physical health. Policies mandating ergonomic compliance, mental health screening, and stress risk assessments could become part of broader aviation safety audits. Introducing fatigue risk management systems (FRMS), similar to those used for pilots, could further ensure that maintenance personnel are fit for duty, thereby reducing the risk of human error. From an educational and developmental perspective, periodic training and awareness programs on stress management, emotional regulation, and teamwork should be conducted. Promoting self-efficacy and adaptive coping mechanisms will empower workers to manage stressors proactively rather than reactively. These initiatives should also be incorporated into the occupational health curriculum for aviation technicians and maintenance trainees, emphasizing the importance of psychological resilience as part of technical competence.

Finally, at a strategic level, fostering a culture of work–life balance and organizational justice is essential. Companies must recognize that workers' psychological well-being is a strategic asset, not a cost. Investing in mental health support—such as confidential counseling services, peer mentoring, and open communication platforms—can yield substantial long-term benefits, including reduced turnover, improved performance, and enhanced organizational reputation. By embedding well-being into the corporate identity, organizations contribute not only to the safety and reliability of aviation operations but also to the sustainability of human capital in a high-risk industry. In summary, the implications of this study extend beyond individual stress management. They advocate for systemic, evidence-based reforms that address physical ergonomics, cognitive demands, and social relationships in the workplace. Through these integrated interventions, aviation organizations can enhance both worker well-being and flight safety, reinforcing the critical link between human factors and organizational performance.

Several limitations must be acknowledged. First, the cross-sectional design prevents causal inference, as it captures stress levels at a single time point. Longitudinal studies could better assess temporal dynamics and adaptation. Second, the use of self-reported instruments may introduce recall or desirability bias. Third, this study did not include environmental variables—such as temperature, noise, and lighting—that have been identified as potential stressors in similar occupational settings. Finally, the study's scope was limited to two organizations, which may affect the generalizability of findings to other aviation contexts. Future research should integrate environmental and psychosocial factors, as well as explore intervention effectiveness across different occupational settings.

CONCLUSION

Based on the results of research on the Influence of Individual Characteristics and Work Factors on Work Stress in Aircraft Maintenance Engineers conducted at PT X and PT Y located at Sultan Hasanuddin International Airport in Makassar, it can be concluded that age, social support, mental workload, and physical workload significantly affect work stress in bivariate tests. Meanwhile, the variables of length of service and marital status did not significantly affect work stress in the bivariate test. The results of the multivariate analysis showed that the variables of length of service (negative value) and mental workload significantly affected work stress. Efforts that can be made by related agencies are to implement routine occupational health programs, such as weekly exercise or other fitness activities, so that workers remain physically fit and are able to reduce work stress. In addition, conducting regular medical check-ups (MCU) and strengthening two-way communication between supervisors and workers so that needs in the field can be immediately addressed. The task for future researchers is to investigate other factors that may influence work stress, such as the physical

work environment or others.

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