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Factors Influencing Pre-Hospital Delay in Acute Coronary Syndrome Patients

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ABSTRACT

Background: Acute Coronary Syndrome (ACS) is a major cause of morbidity and mortality worldwide, with delayed hospital presentation contributing to poor outcomes. Pre-hospital delay, defined as the time from symptom onset to seeking definitive care, is influenced by patient, symptom, and system-related factors. Evidence from Indonesia on determinants of such delays remains limited.

Purpose: This study aimed to analyze factors associated with pre-hospital delay among ACS patients in the Emergency Department of Dr. Wahidin Sudiro Husodo Regional Hospital, Mojokerto City.

Methods: An observational, analytic, cross-sectional study was conducted in 2024, with 70 adult ACS patients recruited through consecutive sampling. Data were collected via standardized questionnaires and medical record review, including demographic, clinical, transportation, attack type, symptom onset timing, health insurance, and ACS knowledge. Bivariate and multivariate logistic regression analyses were performed to identify predictors of pre-hospital delay.

Results: The mean age of respondents was 61.67 years, with 60% male and 61.4% lacking knowledge of ACS. Most arrived by private vehicle (87.1%) and experienced a new attack (77.1%). Pre-hospital delay occurred in 77.1% of respondents. Multivariate analysis showed that the type of attack had the highest odds ratio (OR = 5.55) for pre-hospital delay, although not statistically significant (p = 0.115). Transportation, time of onset, and ACS knowledge did not demonstrate significant associations but suggested potential confounding effects.

Conclusion: Pre-hospital delay is highly prevalent among ACS patients in this setting. No significant predictors were identified, suggesting delays reflect complex behavioral and system factors. Given the limited sample size, the findings should be interpreted with caution. Improving public awareness and emergency access remains essential.

Keywords: Acute Coronary Syndrome, Emergency Department, Pre-hospital Delay

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BACKGROUND

Acute Coronary Syndrome (ACS) remains a major global health problem due to its high morbidity and mortality, especially when treatment is delayed. Prompt medical intervention is critical, as early reperfusion significantly improves outcomes; however, many patients still arrive late at healthcare facilities (AL Ahmadi et al., 2020; Mirzaei et al., 2020). Pre-hospital delay, defined as the time from symptom onset to seeking definitive care, is influenced by patient, system, and symptom-related factors. Reducing these delays remains a major challenge, particularly in low- and middle-income countries (Caltabellotta et al., 2021).

Factors such as symptom identification, transportation method, awareness of acute coronary syndrome (ACS), and onset features significantly influence the promptness with which patients seek medical attention. (Mirzaei et al., 2020). Cardiovascular disease, particularly acute coronary syndrome, is the primary cause of mortality worldwide, resulting in 17.9 million deaths each year (WHO, 2023), with 254 million individuals affected by ischemic heart disease (Hu et al., 2022; Mirzaei et al., 2020). The prevalence of cardiac disease in Indonesia is approximately 1.5%, resulting in roughly 245,000 fatalities per year (Rosjidi, 2020). The data underscore the pressing need to understand patient behavior to ensure timely therapy, especially in the Indonesian context, where evidence remains scarce (AL Ahmadi et al., 2020; Bauer et al., 2023).

Several studies suggest that early errors in home decision-making, insufficient first reactions, and a lack of awareness lead to extended pre-hospital delays (Kontsevaya et al., 2019; Rosjidi, 2020). Furthermore, no research in Indonesia has thoroughly investigated, using a multivariate approach, factors such as transportation, attack type, health insurance, ACS knowledge, and symptom onset timing. This disparity is significant, as differences in healthcare accessibility, cultural attitudes, and insurance provisions may influence patient trajectories differently than in other nations (Hu et al., 2022; Mujtaba et al., 2021; Ogushi et al., 2022). This study aims to examine factors contributing to pre-hospital delays among patients with ACS. The study integrates clinical, behavioral, and environmental characteristics into a multivariate model, offering insights pertinent to the Indonesian context and facilitating strategic public health planning, patient education, and enhanced emergency response (Anggraini et al., 2023; Petrova et al., 2024). The results are anticipated to enhance early identification and decrease preventable mortality from ACS.

OBJECTIVE

To analyze the factors influencing pre-hospital delay among patients with Acute Coronary Syndrome in the Emergency Department of Dr. Wahidin Sudiro Husodo Regional Hospital, Mojokerto City.

METHODS

This study employed an observational, cross-sectional design to identify factors associated with pre-hospital delays among patients with Acute Coronary Syndrome (ACS). The study was performed at the Emergency Department of Dr. Wahidin Sudiro Husodo Regional Hospital in Mojokerto, Indonesia, in 2024. The target population comprised adult patients diagnosed with acute coronary syndrome who were admitted to the hospital during the study period. Ethical approval for this study was obtained from the Institutional Review Board of Bina Sehat PPNI University, and written informed consent was obtained from all participants before data collection commenced.

Seventy respondents were recruited by a successive sampling procedure, inviting all eligible patients who met the inclusion criteria until the target sample size was attained.

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Inclusion criteria were patients aged ≥18 years with acute coronary syndrome (ACS) who consented to participate, whereas those with cognitive disabilities or communication obstacles were excluded. A standardized questionnaire and a review of medical records were used to gather data. The assessment of ACS knowledge was conducted using the ACS Symptom Response Index, which was derived and validated by Rofi'ah (2018). The questionnaire included demographic factors, clinical variables, method of transportation, type of attack, timing of symptom onset, health insurance status, and ACS knowledge scores.

Data were entered, and descriptive statistics were used to summarize respondent characteristics. Bivariate analysis was performed to find potential variables for the multivariate model utilizing the chi-square test. Variables with p-values < 0.25 were included in a multivariate logistic regression analysis to identify independent predictors of pre-hospital delay. Odds ratios (ORs) with 95% confidence intervals (CIs) were presented, with statistical significance set at $p < 0.05$.

RESULTS

Table 1. Average Age of Respondents with Acute Coronary Syndrome in the Emergency Department of Dr. Wahidin Sudiro Husodo Regional Hospital, Mojokerto City

Variable	Mean	Median	SD	Min-Max	95% CI
Age*	61.67	60.00	9.87	40.00-82.00	59.32-64.02

*Data was normally distributed

Based on Table 1, the mean age of the respondents was 61.67 years, with a standard deviation of 9.87 years. The 95% confidence interval ranged from 59.32 to 64.02 years, indicating that the true average age of the population fell within this range.

Table 2. Distribution of Respondents by Gender, Education Level, Transportation to Hospital, Type of Attack, Time of Onset, Health Insurance, ACS Knowledge, and Pre-Hospital Delay

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	42	60.0
	Female	28	40.0
	Total	**70**	**100.0**
Education Level	Elementary School	27	38.6
	Junior High School	11	15.7
	Senior High School	19	27.1
	Academy/University	13	18.6
	Total	**70**	**100.0**
Transportation to Hospital	Private Vehicle	61	87.1
	Public Transport	1	1.4
	Assisted Ambulance	8	11.4
	Total	**70**	**100.0**
Type of Attack	New Attack	54	77.1
	Recurrent Attack	16	22.9
	Total	**70**	**100.0**
Time of Onset	Morning (03:00–10:00)	17	24.3
	Midday (10:00–15:00)	21	30.0
	Afternoon (15:00–18:00)	13	18.6
	Evening (18:00–19:00)	13	18.6

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	Night (19:00–03:00)	6	8.6
	Total	**70**	**100.0**
Health Insurance	General (Self-Pay)	4	5.7
	National Health Insurance (BPJS)	65	92.9
	Private Insurance	1	1.4
	Total	**70**	**100.0**
ACS Knowledge	Not Knowledgeable	43	61.4
	Knowledgeable	27	38.6
	Total	**70**	**100.0**
Pre-Hospital Delay	No Delay	16	22.9
	Delay	54	77.1
	Total	**70**	**100.0**

Based on Table 2, the majority of respondents were male (60.0%). In terms of education level, most respondents had completed elementary school (38.6%). Most of them arrived at the hospital using private vehicles (87.1%). The majority experienced a new attack of Acute Coronary Syndrome (77.1%). The highest proportion of symptom onset occurred at midday between 10:00 and 15:00 (30.0%). Most respondents were covered by the National Health Insurance (BPJS), representing 92.9% of the sample. In addition, the majority were not knowledgeable about Acute Coronary Syndrome (61.4%). Furthermore, most respondents experienced pre-hospital delay (77.1%).

Table 3. Candidate Variable Selection for Logistic Regression Modeling

Variable	Chi-square	df	Sig.	Decision*
Transportation	3.509	2	0.173	Not eligible
Type of Attack	3.964	1	0.046	**Eligible**
Time of Onset	4.839	4	0.304	Not eligible
Health Insurance	2.707	2	0.258	Not eligible
ACS Knowledge	0.232	1	0.630	Not eligible

*Eligibility criterion commonly used: p-value (Sig.) ≤ 0.25 enters candidate model for multivariate testing.

Based on the Omnibus Test of Model Coefficients, only the attack variable met the statistical eligibility criterion for inclusion in the multivariate logistic regression model (p = 0.046). The remaining variables, transportation, time of onset, health insurance, and ACS knowledge, showed p-values greater than 0.25 and were therefore not statistically significant. However, these four variables were still included in the modeling process because they were considered substantively important and theoretically relevant to the outcome, thus warranting their inclusion despite not meeting the statistical threshold.

Table 4. Initial Multivariate Model

Variable	OR (Exp B)	95% CI for OR	p-value
Transportation	1.19	0.19-7.38	0.852
Type of Attack	5.97	0.71-50.14	0.100
Time of Onset	0.51	0.15-1.75	0.287
Health Insurance	0.00	0.00-∞	0.999
ACS Knowledge	0.74	0.23-2.46	0.628

Based on the initial multivariate model, none of the variables showed a statistically significant association with the outcome (p > 0.05). Transportation (OR = 1.19; 95% CI: 0.19–7.38) and ACS knowledge (OR = 0.74; 95% CI: 0.23–2.46) did not demonstrate meaningful effects. The type of attack had the largest odds ratio (OR = 5.97; 95% CI: 0.71–50.14), but the association was not statistically significant. Time of onset (OR = 0.51; 95% CI: 0.15–1.75) also showed no significant relationship. Health insurance produced an unstable estimate (OR = 0.00), indicating complete separation in the model. Overall, none of the variables reached the significance threshold; therefore, further model refinement was required.

Table 5. Multivariate Model After Excluding Health Insurance

Variable	OR Lama	OR Baru	Perubahan OR (%)	95% CI for OR	p-value
Transportation	1.19	1.36	**14.3**	0.23-7.96	0.734
Type of Attack	5.97	5.55	**7.0**	0.66-46.78	0.115
Time of Onset	0.51	0.42	**17.9**	0.13-1.40	0.159
ACS Knowledge	0.74	0.82	**10.2**	0.25-2.68	0.743

Based on Table 5, after removing the health insurance variable, several variables showed odds ratios (ORs) that increased by more than 10%, including Transportation (14.3%), Time of Onset (17.9%), and ACS Knowledge (10.2%). According to the ≥10% change-in-estimate criterion, these variables may confound and should therefore be retained in the multivariate model regardless of their p-values. Only the variable Type of Attack showed a relatively small OR change (7.0%), suggesting a lower likelihood of confounding. Among all variables, ACS Knowledge had the highest p-value (p = 0.743), indicating a weak statistical association; however, because its OR changed by more than 10%, it may still confound and should not be immediately excluded. Overall, the evaluation suggests that variables with OR changes of 10% or more should be reintroduced or retained in the final model to ensure more accurate and unbiased estimates of associations.

Table 6. Multivariate Model After the Health Insurance Variable Was Reinserted Into the Modeling

Variable	OR (Exp B)	95% CI for OR	p-value
Transportation	1.189	0.19-7.38	0.852
Type of Attack	5.972	0.71-50.14	0.100
Time of Onset	0.514	0.15-1.75	0.287
Health Insurance	0.000	0.00-∞	0.999
ACS Knowledge	0.744	0.23-2.46	0.628

Based on Table 6, after the health insurance variable was reintroduced into the multivariate logistic regression model, none of the variables showed a significant association with the outcome (all p > 0.05), and the resulting ORs and confidence intervals did not improve the model's accuracy or stability. The type of attack continued to have the largest OR, while the time of onset showed an OR < 1, but both remained non-significant with very wide confidence intervals. The transportation and ACS knowledge variables also showed no meaningful associations. Most notably, the health insurance variable again produced an OR of 0.000 with an undefined upper confidence limit, indicating complete or quasi-complete separation, which prevented valid estimation of its coefficient. Because reintroducing this variable reintroduced instability into the model, the decision to exclude it from the final model

was further supported to ensure more stable and interpretable regression results.

Table 7. Final Multivariate Model

Variable*	OR (Exp B)	95% CI for OR	p-value
Transportation	1.359	0.232-7.958	0.734
Type of Attack	5.552	0.659-46.781	0.115
Time of Onset	0.422	0.127-1.403	0.159
ACS Knowledge	0.820	0.251-2.682	0.743

*There was no interaction between variables in the model (interaction test p-value > 0.05)

The final multivariate logistic regression model showed that none of the included variables were significantly associated with the outcome. Transportation, type of attack, time of onset, and ACS knowledge did not have statistically significant effects on the model (p-values > 0.05). The interaction test also revealed no interaction between the variables, as all interaction terms had p-values > 0.05.

DISCUSSION

This study investigated factors associated with pre-hospital delay among patients with Acute Coronary Syndrome (ACS) in an Indonesian hospital setting. The average age of respondents was 61.67 years, consistent with global research demonstrating that older adults face an elevated risk of acute coronary syndrome (ACS) and are more prone to delayed hospital presentation due to comorbidities, atypical symptomatology, or mobility constraints (Hu et al., 2022; Mirzaei et al., 2020). The predominant participant demographic was male (60.0%), consistent with other epidemiological research indicating a greater prevalence of ACS in men. Regarding education, the majority of respondents had completed only elementary school (38.6%), indicating that lower educational levels may hinder understanding of ACS symptoms and appropriate responses, a feature frequently linked to delayed care (Chowdhury et al., 2021; Jaskiewicz & Zielinska, 2019; Khaled et al., 2022).

Several variables were investigated in this study as factors of interest associated with pre-hospital delay in patients with Acute Coronary Syndrome (ACS). These variables included transportation mode, type of attack, time of symptom onset, health insurance status, and ACS knowledge. The type of assault was the only one that met the eligibility criterion ($p \leq 0.25$) for inclusion in the multivariate model, suggesting a potential association with delay behavior. In contrast to patients who experienced recurrent episodes, patients who experienced their first (new) attack tended to delay seeking care. This delay was likely due to limited recognition of symptoms and ambiguity in interpreting cardiac warning signs, as supported by previous studies (Chowdhury et al., 2021; Khaled et al., 2022). Nevertheless, the final multivariate analysis did not yield any statistically significant variables ($p > 0.05$), indicating that no independent predictors were identified in this sample. In spite of this, the type of assault showed the highest odds ratio (OR = 5.552), suggesting a potentially significant clinical effect that may not have reached statistical significance due to the limited sample size.

Additionally, transportation, time of onset, and ACS knowledge showed odds ratio changes exceeding 10% during model refinement, suggesting they were potential confounding factors to be retained in the final model. These variables can also be interpreted as contextual or supporting factors that influence pre-hospital delay. A cultural and systemic dependence on non-emergency transport is evident in the predominance of private vehicle use (87.1%), which may delay access to definitive care (AL Ahmadi et al., 2020; Eckle et al., 2021). Furthermore, the substantial proportion of patients (61.4%) with inadequate knowledge of ACS underscores an ongoing deficiency in public awareness, which is consistently associated with delayed

treatment-seeking (Anggraini et al., 2023; Mujtaba et al., 2021). Although symptom onset peaked at midday, consistent with circadian variations in cardiovascular events, this did not substantially influence the delay (Mirzaei et al., 2020). In general, the results did not identify any statistically significant predictors; however, they underscore the significance of behavioral, knowledge-related, and system-level influences. This suggests the need for more extensive research that incorporates psychosocial variables to more effectively elucidate pre-hospital delay among ACS patients.

The incidence of pre-hospital delay was notably elevated at 77.1%, highlighting global apprehensions over delayed presentation for acute coronary syndrome, especially in low- and middle-income nations (AL Ahmadi et al., 2020; Bauer et al., 2023). Logistic regression analysis indicated that assault type (new vs. recurrent) had the highest odds ratio (OR = 5.55), although it did not reach statistical significance (p = 0.115). This data shows that individuals experiencing recurring attacks may recognize symptoms faster and seek care sooner. However, new attacks may be overestimated or misinterpreted, similar to prior reports that symptom recognition influences delay (Ananchaisarp et al., 2023). Despite the lack of statistical significance for variables such as transportation, time of onset, health insurance, and ACS knowledge, odds ratios exceeding 10% suggested possible confounding effects, underscoring their clinical and theoretical importance (Petrova et al., 2024; Sundermeyer et al., 2025).

According to the findings, the type of attack was the sole variable that met the statistical criteria for inclusion in the multivariate logistic regression model, indicating a significant association with pre-hospital delay at the bivariate level. Patients who are experiencing their first episode of Acute Coronary Syndrome are more likely to underestimate the severity of their condition and have limited symptom recognition, which can result in delays in seeking care compared to those who have prior experience. This finding is clinically plausible, as evidenced by previous studies (Chowdhury et al., 2021; Khaled et al., 2022; Kontsevaya et al., 2019). Although they did not meet the strict criteria for statistical eligibility, several other variables, including transportation and health insurance, had values that approached the widely accepted threshold, suggesting potential relevance. The retention of these variables in the multivariate analysis is still justified from a methodological perspective, particularly when supported by theoretical and empirical considerations, to account for potential confounding effects (Ananchaisarp et al., 2023; Ogushi et al., 2022). Overall, the primary candidate variable is the type of attack; however, the inclusion of other clinically meaningful factors demonstrates a comprehensive and methodologically sound analytical approach, which is consistent with prior literature that emphasizes the multifactorial nature of pre-hospital delay in Acute Coronary Syndrome (AL Ahmadi et al., 2020; Mujtaba et al., 2021).

From the researcher's perspective, the high prevalence of pre-hospital delay identified in this study suggests a multifaceted interplay among patient awareness, symptom recognition, and systemic obstacles, rather than a single cause. Although statistical significance was not achieved for most variables, the trends indicate that targeted interventions such as educational initiatives to enhance ACS awareness, community involvement to encourage early symptom recognition, and facilitating emergency transport could significantly reduce delays. It is essential to address these complex elements in the Indonesian setting, where cultural, logistical, and health system challenges converge, potentially leading to improved patient outcomes and reduced preventable mortality from ACS.

CONCLUSION

Pre-hospital delay remains highly prevalent among patients with Acute Coronary Syndrome (ACS) in this setting. No statistically significant factors were identified in the multivariate analysis, although the type of attack showed a potential association at the bivariate

level. These findings suggest that delays are influenced by multifactorial behavioral, knowledge-related, and system-level factors not fully captured in this study. Efforts to reduce delay should focus on improving public awareness, early symptom recognition, and access to emergency services. Further studies with larger sample sizes and the inclusion of psychosocial variables are recommended.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest related to this study. The research was conducted independently, and no financial, personal, or professional relationships influenced the study objectives, design, data collection, analysis, interpretation, or reporting of the results.

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