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Importance of Acute Coronary Syndrome Knowledge to Improve Early Detection and Reduce Prehospital Delay in Patient with Acute Coronary Syndrome: A Systematic Review

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Abstract

BACKGROUND: Acute coronary syndrome (ACS) is still a global cause of mortality and morbidity. Early detection of ACS is crucial management in preventing the high mortality rate. Several research results show that the perception of the severity of the symptoms is also one of the factors that prompt them to immediately seek help at the hospital. The higher the knowledge of the patient at risk of recognizing the signs and symptoms of ACS, the faster the time required for early detection will trigger a shorter time to seek help.

AIM: This study will focus on the effect of knowledge about ACS on early detection and pre-hospital delay.

METHODS: A systematic literature search was conducted in the following databases: PubMed, ProQuest, and Science Direct. Keywords used for the search included "knowledge," "education," "early detection," "prehospital delay," and "acute coronary syndrome" to identify studies published between 2018 and 2022. 709 citations of journal articles written between 2018 and 2020 have been reviewed and 20 studies were meet all of the inclusion criteria.

RESULTS: The result shows that knowledge about ACS symptom and the risk factor is important to improve early detection with decreased misinterpretation and misdiagnosis, this condition will lead reduce prehospital delay because increase the need for treatment-seeking as soon as possible.

CONCLUSION: Knowledge about ACS symptom and the risk factor is important to improve early detection with decreased misinterpretation and misdiagnosis, this condition will lead reduce prehospital delay because increase the need for treatment-seeking as soon as possible.

Introduction

Acute coronary syndrome (ACS) is still a global cause of mortality and morbidity. The latest data from the Global Burden of Disease in 2017 reported that ACS has impacted around million individuals globally (1.655/100,000), which is estimated to be 1.72% of the world's population. ACS is also one of the cardiovascular diseases that cause the most deaths at 43% [1]. ACS is usually characterized by chest, arm, jaw, neck, back, or abdominal pain accompanied by shortness of breath [2].

Early detection of ACS is crucial management in preventing the high mortality rate. Because the longer the prehospital delay, the worsening outcome and increased mortality [2], [3]. One of the factors causing prehospital delay is the lack of knowledge regarding the symptoms of ACS [4]. Patients will assume the symptoms that arise are ordinary illnesses that do not require immediate referral to the hospital so that when they arrive at the hospital, the patient's condition has worsened.

Cognitive factors are important in the assessment of perceived symptoms. Several research results show that the perception of the severity of the symptoms is also one of the factors that prompt them to immediately seek help at the hospital. Good knowledge about the symptoms of ACS will be a factor driving behavior to seek help as soon as possible so that the outcome in handling ACS will be better [2], [3], [4].

Prehospital delay consists of two components, patient decision delay, and health services delay. Patient decision delay refers to the length of time the patient takes for early detection or making a decision to seek help. The longer the patient recognizes the symptoms of ACS, the longer it will take the patient to seek help [2], [5]. Meanwhile, health services delay refers to the length of time required for health services to assist, such as the distance to access health services and the time required for an ambulance to make a referral. The longer the early detection required is linear the longer the prehospital delay [2], [3], [4].

The above conditions show the importance of patient knowledge of ACS symptoms to speed up the process of seeking help. The higher the knowledge

of the patient at risk of recognizing the signs and symptoms of ACS, the faster the time required for early detection will trigger a shorter time to seek help [2], [6]. Knowledge of ACS is influenced by many factors, ranging from education level, exposure to information, and experience with symptoms, to knowledge related to risk factors. All of the above components will affect a person's assessment of the perceived ACS symptoms so that it will affect the time needed for early detection [2], [3], [6].

This study will focus on the effect of knowledge about ACS on early detection and pre-hospital delay. Prehospital delay in this study focuses more on the length of time the decision is needed to seek help or patient decision delay. This study will also investigate related knowledge of ACS symptoms, risk factors, and perceptions of disease severity in influencing early detection and prehospital delay.

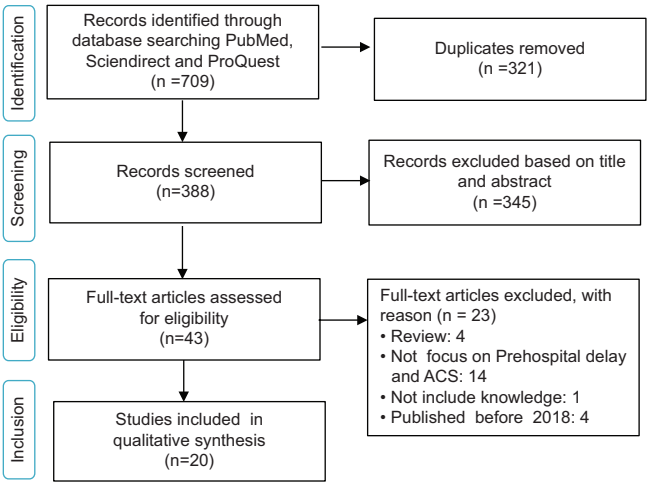

Figure 1: PRISMA diagram

Methods

Study selection: Search strategy, data sources, and screening

A systematical literature search was conducted in the following databases: PubMed, ProQuest and ScienceDirect. Keywords used for the search included "knowledge," "education," "early detection," "prehospital delay," and "acute coronary syndrome" to identify studies published between 2018 and 2022.

Study eligibility criteria

Inclusion/exclusion criteria

All studies selected for inclusion were English-language publications, which reported original empirical findings and were published in a peer-reviewed journal, between 2018 and 2022. Studies were required to have used an experimental design and focused on effect knowledge or education in early detection and prehospital delay in patients with the ACS. The researchers excluded trials with case studies, outpatient studies, theses, or dissertations.

Screening

As displayed in Figure 1 (PRISMA flow diagram), the initial first search yielded 709 citations of journal articles written between 2018 and 2022. 321 citations were discarded after identifying they were duplicates, and 345 discarded after reviewing the abstract. The researchers reviewed the remaining 43 in more detail and excluded 23 because they did not meet all the inclusion criteria. The final eligible for the review 20 studies were meet all of inclusion criteria. These studies are described in detail in Table 1.

Data extraction

The following data were extracted from the included studies: Author, journal, country, research purpose and questions, design, setting, subjects, sampling method, measurements instruments, reliability and validity, analysis, outcomes, and significant and non-significant results.

Results

A total of 20 publications were eligible according to the criteria. 2 studies were prospective multi-center studies; 6 studies were cross-sectional studies; 1 study was a retrospective study, 2 studies were a single group pre-test post-test design, 3 studies were randomized control trials, 1 study was cross-sectional retrospective design, 1 study was a quasi-experimental design, 3 studies were prospective cohort, and 1 study was a qualitative design. All the studies include 6.341 participants overall. 18 studies (90%) included patients with both STEMI (i.e., ST-elevation myocardial infarction) and non-STEMI and 2 studies (10%) included patients with STEMI only. Six studies (30%) give interventions to increase knowledge about ACS to reduce prehospital delay or improve early detection of ACS, and 14 studies (70%) analyzed the effect of knowledge and other variables on prehospital delay or early detection. Based from location research, 5 studies (25%) were conducted in America, 4 studies (20%) in Australia, 8 studies (40%) in Asia, 1 studies (5%) in Africa, and 2 (10%) in Europe.

In all studies, the endpoint was the occurrence of prehospital delay. The starting point for prehospital delay came from knowledge about severity of symptoms (4 studies), lack of knowledge regarding symptoms

Table 1: Summary of the reviewed studies (n = 20)

Number	Study	Aim	Study design	Sample	Intervention/data collection	Main result
1	Hee-Sook Kim, PhD, a, b Sang Jun Eun, MD, PhD, c Jin Yong Hwang, MD, PhD, d Kun-Sei Lee, MD, PhD, e and Sung-il Cho, MD, ScDb,* (2018)	Identify symptom clusters among Korean patients with STEMI; examine the relationship between symptom clusters and patient-related variables, and to investigate the influence of symptom clusters on treatment time delay ([DT], [OTB])	A prospective multicenter study with a descriptive design that used face-to-face interviews	342 patients who survived and those with a final diagnosis of STEMI who underwent PCI, hospitalization within 72 h after the onset of symptoms, hemodynamic stability, Korean speaking and without cognitive impairment between July 2014 and June 2015	Questionnaire was developed by the investigator in collaboration with 4 cardiologists. Data on the following variables were collected using the questionnaire through the interview method: Sociodemographic characteristics (gender, age, height, weight, education level, occupation, living alone or not and residence area); risk factors (smoking, drinking, obesity and family history of cardiovascular disease); clinical characteristics (hypertension, diabetes, dyslipidemia, medical history of angina or MI); transport-related items {mode of transport to the study hospital in the case of direct admission or to the first hospital in the case of interhospital transfer for AMI: 119 (the national emergency telephone number in Korea and EMS), private vehicle and other); and symptoms experienced during the acute phase of STEMI (multiple choice)	Three symptom clusters were identified: Cluster 1 (classic MI; characterized by chest pain); cluster 2 (stress symptoms; sweating and chest pain); and cluster 3 (multiple symptoms; dizziness, sweating, chest pain, weakness, and dyspnea). Compared with patients in clusters 2 and 3, those in cluster 1 were more likely to have diabetes or prior MI. Patients in clusters 2 and 3, who predominantly showed other symptoms in addition to chest pain, had a significantly shorter DT and OTB than those in cluster 1. In conclusion, to decrease treatment time delay, it seems important that patients and clinicians recognize symptom clusters, rather than relying on chest pain alone. Further research is necessary to translate our findings into clinical practice and to improve patient education and public education campaigns
2	Syed F. Mujtaba, Hina Sohail, Jaghat Ram, Muhammad Waqas, Muhammad Hassan, Jawaid A. Sial, Khalid Naseeb, Tahir Saghir, Musa Karim (2021)	Assess the duration of prehospital delay among STEMI patients and its contributing factors	A cross-sectional study design	A total of 240 patients fulfilling the inclusion criteria were enrolled in this study after obtaining written informed consent. The inclusion criteria were patients of either gender between the ages of 20 and 60 years presenting with acute STEMI. In contrast, all patients with prior cardiac-related surgery, CKD and congenital heart disease were excluded from the study	Data were collected using a structured questionnaire covering demographic characteristics, predisposing risk factors, care-seeking behavior of the patients from symptom onset to hospital, reasons for delay presentation, and procedural. STEMI is defined as chest pain along with ST-segment elevation in two contagious leads on an ECG	The observed prehospital time was 120 minutes; 229 (median; IQR). It was found that 33.3% of patients arrived within 1 h of the symptom onset, while 20.4% of patients delayed hospital arrival for more than 6 h. The delay rate was highest among patients aged 41–65 years. Moreover, delayed admissions were more common among females as compared to males ($p = 0.008$). Among the causes of delay in hospital arrival were misinterpretation, misdiagnosis and transportation and financial issues. Of these, misdiagnosis significantly influenced the delay rate, that is, more than 50% of the misdiagnosed patients arrived hospital after 6 h of symptom onset ($p < 0.05$)
3	Kathryn Eastwood, Stuart Howell, Ziad Nehme, Judith Finn, Karen Smith, Peter Cameron, Dion Stub, Janet E Bray (2021)	Examined the impact of this campaign on ED presentations and EMS use in Victoria, Australia	Retrospective, observational study	This retrospective, observational study used data between 2003 and 2015 from the VEMD provided by the Victorian department of health and human services Over the study period, the population of Victoria increased from 4.9 million to 5.9 million	The Victorian department of health and human services provided data for adult Victorian patients presenting to public hospitals with an ED diagnosis of ACS or U-CP. We modelled changes in the incidence of ED presentations, and the association between the campaign period and (1) EMS arrival and (2) referred to ED by a GP	Between 2003 and 2015, there were 124 632 eligible ED presentations with ACS and 536 148 with U-CP. In patients with ACS, the campaign period was associated with an increase in ED presentations (incidence rate ratio: 1.11; 95% CI 1.07–1.15), a decrease in presentations via a GP (AOR: 0.77; 95% CI 0.70–0.86) and an increase in EMS use (AOR: 1.10; 95% CI 1.05–1.17). The Warning Signs Campaign was associated with improvements in treatment seeking in patients with ACS, including increased EMS use. The increase in ACS ED presentations corresponds with a decrease in out-of-hospital cardiac arrest over this time. Future education needs to focus on improving EMS use in ACS patient groups where use remains low
4	Davis, L. L., and McCoy, T. P. (2019)	Evaluate the feasibility and acceptability of a nurse-delivered education and skill-building intervention designed to improve symptom recognition and interpretation in women with recurrent ACS symptoms	A single group pre-posttest design	Study was conducted on 12 women age 35 years and older who had been hospitalized with a definitive diagnosis of ACS were eligible for the study. Diagnosis of ACS was determined through having symptoms of cardiac ischemia combined with one or more of test	Women hospitalized for an ACS event received an individualized education and skill building intervention that was conceptually framed by the investigator's prior research. Three in-person sessions were followed by 2 phone sessions for reinforcement. Outcomes and acceptability were evaluated at close-out (approximately 2 months after the index event)	Mean knowledge scores increased by 7.4% measured by the ACS response index. Attitudes towards symptom recognition and help-seeking increased by 2.4, while beliefs towards expectations and actions increased by 3.2. The nurse-delivered intervention was feasible and acceptable to women in the study
5	Xia, W., Liu, T., and Lei, J. (2021)	Assess the efficacy of a short one-on-one nursing intervention in people with CHD	Randomized, intervention -controlled study	A total of 70 patients participating in this study are randomly divided into control group and nursing group, with 35 patients in	Patients are given information about typical symptoms, emotional responses to ACS symptoms and social factors. The intervention is delivered in an individualized,	Enhancing knowledge must be considered an essential first step to promoting appropriate patient behavior in responding to ACS symptoms. Currently, few interventions have used

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Table 1: ***(Continued)***

Number	Study	Aim	Study design	Sample	Intervention/data collection	Main result
				each group. Patients are eligible for the study if they have a diagnosis of CHD, confirmed by their physician and lived independently	one-on-one session of approximately 40 minutes with the patient. Using a script, an experienced cardiovascular nurse uses a flipchart with the main points listed and pictures illustrating the process of coronary occlusion and how reperfusion therapies restore blood flow to the myocardium. Patients are asked to place it in a prominent place in the home	one-on-one delivery of the information and few investigators have evaluated intermediate outcomes that potentially influence patient treatment-seeking behavior in response to ACS symptoms
6	Lemlem Demisse *et al*. (2022)	Examine the knowledge, attitudes and beliefs among ACS patients	Cross-sectional design	300 patients with a diagnosis of ACS from November 2019 to December 2020 and met eligibility criteria were recruited. The eligibility criteria were: (a) 18 years or older, (b) ability to understand and speak Amharic or English, (c) a confirmed diagnosis of ACS documented in medical records, (d) ability to recall the time symptoms started and events prior to hospital admission and (e) hemodynamically stable as confirmed by stable vital signs, free of chest pain or discomfort at the time of data collection	The modified ACSRI were used to measure knowledge, attitudes, and beliefs about ACS. Knowledge was measured using a dichotomous scale from a list of 15 preset questions. Additional six distractor symptoms were also included to determine if participants could identify symptoms that were non-ACS related. Attitudes and beliefs were measured using a 4-point Likert scale. The attitudes scale had five items, which documented the patient's attitudes on their ability to recognize symptoms and initiate appropriate help-seeking behavior. The belief subscale has 5 items that assess the participants beliefs and identifies actions for future ACS symptoms	Half of the study participants have inadequate knowledge (n = 147, 44.6%), unfavorable attitudes (n = 152, 46%) and belief (n = 153, 46.4%) about ACS symptoms even after being diagnosed and treated in the EU. The study findings a need to provide health awareness campaigns using different media outlet with special attention to the uneducated and unemployed groups. Furthermore, most participants were less likely to utilize EMS, which should be further investigated and addressed
7	Dunia Garrido *et al*. (2020)	Investigated for the first time whether knowledge about cardiovascular risk factors is related to decision delay in patients experiencing an ACS	A cross-sectional retrospective study	120 ACS patients admitted to the cardiology department of the University Hospital Virgen de las Nieves (Granada, Spain) who underwent a PCI as part of the management of ACS between March 2017 and April 2019. The study was completed on average 4.67 days (95% CI 4.24–5.09) after the cardiac event	Participants completed a survey that started with assessment of standard data for studies in ACS patients (demographics, family history of cardiovascular disease, anthropometric data and healthy habits). Participants then completed the measures described below, including knowledge of ACS symptoms, knowledge of CV risk factors, prehospital delay and part of the modified response to symptoms questionnaire	Among patients with relatively high knowledge of risk factors, only 5% waited >1 h to seek help, compared to 22% among patients with relatively low knowledge. These results suggest that knowledge of the factors that increase the risk of developing cardiovascular disease could play a role in patient decision making during an acute cardiac event
8	Arrebola-Moreno *et al*. (2020)	Identify psychosocial markers of prehospital decision delay and psychological distress patients with ACS	A cross-sectional study	102 patients with ACS admitted to the cardiology service of the University Hospital Virgen de las Nieves in Granada, Spain, who agreed to participate. The inclusion criteria were as follows: (1) having high cardiac markers (i.e., troponin I) and symptoms or ECG abnormalities suggestive of ischemia, and (2) being fluent in Spanish	Participants completed a survey that consisted of two parts on average 5 days (95% CI 4.49–6.34) after the cardiac event. Participants completed a questionnaire measuring prehospital decision delay, psychological distress and several known psychosocial factors related to cardiovascular health: Type D personality, resilience, social support and concerns during the cardiac event. Multiple linear regression and mediation analyses were conducted	Type D personality may be a risk factor for more delayed help-seeking for an ACS and higher psychological distress after the cardiac event. Resilience, in contrast, emerged as a potential protective factor of patient's mental health after the cardiac event. Prehospital decision delay was related to thinking about serious consequences (e.g., complications, protecting one's family) but not about social concerns (e.g., wasting other people's time) during the cardiac episode
9	Allana, Saleema; Moser, Dr. Debra K.; Ali, Dr. Tazeen Saeed; Khan, Dr. Aamir Hameed (2018)	Explore gender differences in acute symptoms of ACS, knowledge about the symptoms, their attribution, and perception of urgency, among Pakistani ACS patients	Comparative, cross-sectional study design	249 ACS patients admitted to two tertiary care hospitals in Karachi, Pakistan and meet all inclusion criteria	Participant fill questionnaire about demographic and clinical characteristics; symptoms experienced, knowledge about the symptoms, symptom attribution and perception of urgency for treatment seeking during ACS event	The most commonly reported symptoms were ghabrahat (fidgetiness), chest pain and chest heaviness. Most atypical symptoms were experienced more by women, such as nausea/vomiting ($p < 0.001$), backache ($p < 0.001$), palpitations ($p = 0.004$) and epigastric pain ($p = 0.005$). Chest pain and palpitations were the symptoms most commonly attributed to cardiac causes, whereas epigastric pain was most commonly attributed to noncardiac causes by both men and women. Significantly more women than men perceived dyspnea ($p = 0.026$), nausea/vomiting ($p = 0.027$), sweating ($p = 0.014$) and palpitations ($p = 0.01$) as symptoms not at all urgent for treatment. Gender disparity in symptom experience along with the women's perception of nonurgency for their symptoms, could lead to delayed care seeking

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Table 1: ***(Continued)***

Number	Study	Aim	Study design	Sample	Intervention/data collection	Main result
10	Darsin Singh, Sukhbeer K; Ahmad, Aini; Rahmat, Norsiah; Hmwe, Nant Thin Thin (2018)	Evaluate the effectiveness of a nurse-led health education program on knowledge, attitude and beliefs of coronary patients towards the responses to ACS and the association with patient's characteristics	A single-group quasi-experimental design	60 patients with CHD were recruited to this study. The inclusion criteria for the selected respondents were adult patients aged 18 years old and above with a diagnosis of ACS or CHD as confirmed by the physician	Data collection procedures involved three phases; (1) pretest conducted before giving the education programme, (2) intervention phase when the nurse-led education program was carried out and (3) Posttest carried out 1 month after providing the education. Initially, potential participants were directly approached by the investigator and chosen according to the inclusion criteria	Knowledge, attitude and beliefs about ACS increased significantly from baseline to 1 month after intervention. Level of attitude was associated with gender, educationallevel and employment status. The findings of this study suggest that an education program conducted by a nurse improved patient's level of knowledge, attitudes and beliefs in response to ACS symptoms at 1 month compared to baseline, but whether they are sustained for a longer period is unclear. Improving the responses towards ACS might reduce decision delay in symptom interpretation and seeking early treatment
11	Hossein Habibzadeh, Aynaz Bagherzadi, Alireza Didarloo and Hamidreza Khalkhali (2021)	Determine the effect of patient education based on the health belief model on readmission preventive behaviors and readmission rate in patients with a primary diagnosis of ACS	A quasi-experimental study	70 patients with a primary diagnosis of ACS who were discharging from Seyed Al-Shohada Hospital, Urmia, Iran. All sample were recruited using convenience sampling and then randomly assigned to two groups of intervention and control (n = 35 in each group)	A total of 7 face-to-face group training sessions were held with the participation of the patients and one of their family members during 14 days after hospital discharge. These sessions were conducted along with concentration on the structures of the health belief model. Data were collected at three time points of immediately before, 1 month and 3 months after the intervention using a demographic questionnaire, a researcher-made questionnaire of readmission preventive behaviors in cardiovascular diseases and a checklist of hospital readmission. Data were analyzed using SPSS Statistics for Windows, version 17.0	The results showed that there was a statistically significant difference in the mean score of preventive behaviors between the two groups at time points of 1 month and 3 months after the intervention ($p < 0.05$). However, there was no statistically significant difference in the readmission rate between the two groups after the intervention ($p > 0.05$)
12	Stolic, Snezana; Lin, Frances; Mitchell, Marion (2019)	Evaluate the effectiveness of symptom management patient education on the knowledge of sublingual nitroglycerin for people with ACS	A randomized controlled trial	169 sample were admitted with a diagnosis of ACS and were older than 18 years, were able to read and understand English, were prescribed the sublingual nitroglycerin medication on an "as needed" basis, and were available to be interviewed by telephone at 4–6 weeks after discharge	All participants completed the pretest survey, which included 2 components: Demographic information and the Sublingual Nitroglycerine Interview Schedule. Following randomization, the intervention group participants received the 3-resource patient education in a plastic folder and were instructed to expect a follow-up telephone call in approximately 4–6 weeks following their discharge from hospital. During the follow-up telephone call, the participants were asked to complete the posttest	The results of this study suggest that people who received symptom management patient education, which included 3 resources-an information leaflet, a refrigerator magnet and a digital video disc-had improved knowledge of sublingual nitroglycerin compared with people who did not receive the education. This study provides cautious evidence supporting the use of the patient education to improve knowledge of sublingual nitroglycerin for people with ACS. The symptom management patient education could be implemented into usual practice as part of the discharge education process. Further longer term studies are needed to evaluate the sustainability of individual's knowledge of sublingual nitroglycerin and its impact on people's symptom self-management behavior
13	Tongpeth, Jintana; Yun, Hui; Barry, Tracey; Clark, Robyn A (2019)	Evaluate the effectiveness of an Avatar application for educating people with ACS (heart attack)	A single-center, nonblinded, pragmatic randomized controlled trial	70 ACS patients were randomly assigned to the intervention (Avatar application) or usual care groups	Participants were followed up at 0, 1 and 6 months. Tobit Growth Curve Model was used to analyse the primary outcome-symptom knowledge; and the secondary outcomes-attitudes and beliefs. Heart attack action plan implementation, health care use were analyzed using Chi-square and Mann–Whitney *U*-test	Between group differences on ACS response index scores were statistically significant at 1-month and 6-month follow-ups ($p < 0.01$). The intervention group had a significant improvement in symptom knowledge, attitudes and beliefs over the 6-month period ($p < 0.001$, $P = 0.009$, $P < 0.001$ respectively); and no significant improvement in the usual care group participants ($p = 0.152$, $P = 0.068$, $P = 0.228$). For healthcare use, at follow-up, there was a significant difference in ambulance use, between the intervention group and the usual care group (33.33% vs. 18.18%, $P = 0.008$; cardiac: 88.89% vs. 42.86%; $P = 0.049$); 85.14% of participants
14	Coventry, Linda L.; Bremner, Alexandra P.; van Schalkwyk, Johanna W.; Hegney, Desley; Thompson, Peter L. (2018)	Assesses the impact of the Australian National Heart Foundation media campaign and identifies patient characteristics and presenting	Prospective cohort study	255 patients admitted to a perth metropolitan tertiary metropolitan tertiary hospital with a diagnosis of MI between July 2013 and January 75 2014	Patients were interviewed and responses were categorized to determine their reasons for delaying treatment and the impact of mass media campaigns. Delay times were analyzed using multivariable linear regression models for the whole cohort (all	While almost two thirds of the cohort was aware of media campaigns, awareness was not associated with decreased prehospital delay. Median delay was 3.9 h for the whole cohort and 3.5 h for the direct admission cohort. Delay was associated with being widowed, symptom onset on

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Table 1: ***(Continued)***

Number	Study	Aim	Study design	Sample	Intervention/data collection	Main result
		symptoms that may contribute to delay			patients admitted to the tertiary hospital, including patients from rural and peripheral hospitals	a weekday compared with weekend, past medical history of MI and coronary artery bypass graft, private compared with ambulance transport to hospital, and lack of symptoms of sweating and weakness. In addition, for the direct admission cohort, age and income were also associated with delay
15	MartaViana *et al* (2020)	Asses patient and system delays according to diagnosis and risk profile and to identify predictors of prolonged delay	A cohort study	939 patients consecutively admitted to the cardiology department of two hospitals, one in the metropolitan area of Porto and one in the north-east region of Portugal, between August 2013 and December 2014	Data were collected through structured interviews and review of medical records. Staff nurses or physicians collected data on clinical presentation and health-care seeking behaviors within 48 h of admission. Chest pain intensity was measured on a visual analog scale (from 0 to 10)	The proportion of patients with time from symptom onset to FMC ≥ 120 min was highest among high-risk NSTE-ACS (57.7%), followed by intermediate-risk NSTE-ACS (52.1%) and STEMI (43.3%). Regardless of diagnosis and risk stratification, use of own transportation and inability to interpret cardiac symptoms correctly were associated with prolonged delays. Regarding system delays, we found that 78.0% of patients with STEMI and 65.8% of patients with high-risk NSTE-ACS were treated in a timeframe exceeding the recommended limits. Admission to a non-PCT-capable hospital, admission on weekends and complications at admission were associated with prolonged delays to treatment
16	Frisch, Stephanie O.; Faramand, Ziad; Li, Hongjin; Abu-Jaradeh, Omar; Martin-Gill, Christian; Callaway, Clifton; Al-Zaiti, Salah (2019)	Evaluate the prevalence and predictors of delay in seeking care in high-risk chest pain patients with or without ACS	A secondary analysis of an observational cohort study	743 patients transported by EMS for a chief complaint of chest pain	Prehospital and in-hospital electronic health records were manually examined by independent reviewers to extract pertinent clinical data. Baseline demographics and clinical characteristics for each patient (i.e., age, sex, race, income, medical history and medications) were collected from charts as per a predefined data coding scheme that has been described in detail previously	Overall, 24% presented > 12 h from onset of symptoms. Among those with ACS (*n* = 115), 14% presented > 12 h after onset of symptoms. Race, smoking, diabetes and related symptoms were associated with delayed seeking behavior. In multivariate analysis, non-Caucasian race (black or others) was the only independent predictor of > 12 h delay in seeking care (OR: 1.4; 95% CI: 1.0–1.9). One in four patients with chest pain, including 14% of those with ACS, wait more than 12 h before seeking care. Compared to nonblacks, black patients are 40% more likely to delay seeking care > 12 h
17	Lourance A. Al Hadid *et al* (2020)	Explored factors associated with prehospital delay among men and women experiencing ACS for the first time in Jordan	A qualitative design using face-to-face, semi-structured interviews	35 men and 33 women with ACS admitted and treated at the coronary and post-coronary care units that met inclusion criteria in February 2019 and June 2019	The delay time in this study was defined as the time between the beginning of chest pain feeling and asking for help, whether professional through phone or asking a family member to call for a professional medical help. All data concerning the delay were taken directly from the patients. Interview questions were adopted from the published international literature	Prehospital delay is common among first-timer ACS patients from both sexes and thus, increasing awareness about ACS among the public from all age groups is necessary. Availability of specialized health care centers and equity in health-care services are vital to improve public confidence in these health-care settings and health outcomes
18	Sahereh Mirzaei, Alana Steffen, Karen Vuckovic, Catherine Ryan, Ulf G Bronas, Jessica Zegre-Hemsey, Holli A DeVon (2020)	Determine if there was an association between gradual versus abrupt symptom onset and prehospital delay for patients with ACS and to examine the relationship between activities at symptom onset and gradual versus abrupt symptom onset	A secondary analysis of a large prospective multi-center study	474 patients presenting to the ED with symptoms of ACS were included in the study	Symptom characteristics, activity at symptom onset and prehospital delay were measured with the ACS patient questionnaire	Patients should be counseled that a gradual onset of symptoms for potential ACS is an emergency and that they should call 911. Men with ischemic heart disease or with multiple risk factors should be cautioned that symptom onset following exertion may represent ACS
19	Chau, Pui Hing; Moe, Gordon; Lee, Siu Yin; Woo, Jean; Leung, Angela Y M; Chow, Chi-Ming; Kong, Cecilia; Lo, Wing Tung; Yuen, Ming Hay; Zerwic, Julie (2018)	Assess the level of knowledge of AMI symptoms and expected treatment-seeking behaviour among older Chinese in Hong Kong	A cross-sectional population-based survey	1804 people aged 65 years and above at the elderly health centers in Hong Kong from March to September 2016	Faceto-face interviews were conducted with a structured questionnaire based on previous studies and local adaptations	Regarding the expected treatment seeking behavior, seeking nonemergent medical care was the most popular action when AMI symptoms emerged during the day, without chest pain or with lower discomfort intensity, whereas calling an ambulance was the most common option when AMI symptoms emerged at night or with high discomfort intensity. To minimize delays in seeking treatment, future health education should focus on increasing the public knowledge of AMI symptoms and the need to call an ambulance during an emergency

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Table 1: ***(Continued)***

Number	Study	Aim	Study design	Sample	Intervention/data collection	Main result
20	Prashant Panda *et al*. (2021)	Evaluate the factors responsible for prehospital delay in ACS patients	A descriptive cross-sectional study	130 patients (males = 93, females = 37) with ACS patients who reported to the tertiary care medical centre in North India	A standardized tool was used to record the demographic data, socioeconomic status and clinical presentation of patients. All factors which led to prehospital delay were noted and the appropriate statistical tests were used for analysis	Our study concludes that socioeconomic status, rural residence, misinterpretation of symptoms, delay in getting transport and having local dispensary as FMC lead to a significant prehospital delay in ACS patients. This calls for increased public awareness about ACS symptoms, improved health care and public transportation systems and continuous medical education of all medical practitioners to avoid prehospital delays of ACS patients

STEMI: ST-elevation MI, DT: Decision time, OTB: Onset-to-balloon time, ED: Emergency department, EMS: Emergency medical services, ACS: Acute coronary syndromes, CHD: Coronary heart disease, PCI: Percutaneous coronary intervention, CKD: Chronic kidney diseases, VEMD: Victorian Emergency Minimum Dataset, CI: Confidence interval, MI: myocardial infarction, AMI: Acute MI, ECG: Electrocardiogram, U-CP: Unspecified chest pain, GP: General practitioner, ACSRI: ACS response index questionnaires, CV: Cardio vascular, SPSS: Statistical package for the social sciences, IQR: Interquartile range, AOR: Adjusted odds ratio, EU: European union, FMC: First medical contact, NSTE-ACS: Non-ST elevation ACS.

Table 2: The starting point for prehospital delay (n = 20)

Categories	Number of references	Conclusion
Knowledge about severity of symptoms	[1], [5], [8], [10]	Better the knowledge of the severity of the symptoms, faster decision of seeking help
Knowledge regarding symptoms	[2], [3], [4], [5], [6], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18]	Better the knowledge of ACS symptoms, reduce time decision making
Knowledge regarding risk factors	[7]	Better the knowledge of risk factor, reduce delay of seeking help
Knowledge regarding the impact of delay	[3], [5], [10]	Better knowledge regarding the impact of delay, faster decision of seeking help
Knowledge regarding response to symptoms	[3], [4], [5], [6], [9], [11], [12], [15], [16], [17]	Better knowledge regarding response to symptoms, reduce delay of seeking help

ACS: Acute coronary syndromes.

(17 studies), lack of knowledge regarding risk factors (1 study), lack of knowledge regarding the impact of delay (3 studies), and lack of knowledge regarding response to symptoms (12 studies). Table 2 describes the findings divided into knowledge about severity of symptoms, regarding symptoms, regarding risk factors, regarding the impact of delay and regarding response to symptoms.

Discussion

Knowledge about severity of symptoms

The severity of the symptoms felt is one of the driving factors in seeking help. The severity of ACS symptoms can be in the form of high-intensity chest pain or shortness of breath that is felt. In addition, frequency also affects the perception of severity, patients who feel symptoms for a longer time or more often will feel a more serious threat. The number of symptoms experienced also affects the perception of the severity of ACS. Patients who feel more than 1 symptom such as chest pain, dyspnea, sweating, and dizziness will feel the urgency to seek help immediately [3], [5], [7].

The above conditions show the importance of knowledge regarding the severity of symptoms in ACS so that patients do not need to wait for symptoms to worsen until they decide to seek help. Mild ACS symptoms will make patients misrecognize the disease it will prolong the early detection of ACS. This condition will certainly cause delays in seeking help and will worsen the outcome of ACS patients when they arrive at the hospital. This is in accordance with the research of Kim *et al*. (2018) that patients who experience symptoms of chest pain on average arrive at the hospital 180 min after onset compared to patients who experience multiple symptoms who will arrive at the hospital on average <1 h after symptom onset [3], [7], [8], [9].

Knowledge regarding symptom

Knowledge of the symptoms of ACS is very important in reducing prehospital delay. Good knowledge of ACS symptoms will increase public awareness and make it easier for them to recognize the perceived ACS symptoms. With increased knowledge, patients do not need to wait for symptoms to worsen; they can already recognize that the symptoms they feel require immediate action to get treatment at the hospital [3], [7], [10], [11].

Increasing knowledge related to ACS symptoms is important because from the results of the study there are still many patient failures in recognizing the perceived ACS symptoms. Demisse *et al*. study (2022) reported that 81% of 720 participants failed to recognize symptoms and only 6% were able to identify one or more symptoms of ACS. The level of public knowledge of ACS symptoms also varies greatly, influenced by various factors such as education level and socioeconomic status. This is supported by several studies that knowledge of ACS symptoms in developing countries is lower than in developed countries due to the above factors. The level of knowledge of ACS symptoms also differs between urban and rural areas, lower ACS knowledge in rural areas coupled with transportation problems cause delays in early detection and increases prehospital delay [3], [4], [12], [13].

Several studies that provide interventions to increase knowledge related to ACS symptoms show positive results. With increased knowledge related

to ACS symptoms, the time needed for patients to recognize and seek help is getting shorter. Research conducted by David *et al*. (2020) shows that education related to ACS symptoms can increase the speed of recognizing and seeking help. Habibzadeh's research (2021) also shows an increase in preventive measures and accelerated efforts to seek help after providing education regarding ACS symptoms. This improves the outcome of patient readmission [3], [4], [12], [13].

The various studies above show that it is very important for interventions to increase patient knowledge regarding ACS symptoms so that patients are able to recognize the ACS symptoms as early as possible. This condition will shorten the patient's decision-making time so that it can speed up the time needed to seek help. All of these components will certainly reduce the prehospital delay in handling ACS (Allana *et al*., 2018; Davis and McCoy, 2019; Kim *et al*., 2018; Stolic *et al*., 2019).

Knowledge regarding risk factor

Knowledge of ACS risk factors has an important role in increasing the ability to recognize ACS symptoms or early diagnosis and reducing prehospital delay. A person who already knows that he has risk factors for ACS will be more aware when mild ACS symptoms appear. This condition will trigger the patient to be faster in the early detection process and draw conclusions to seek help. The time interval required for the decision-making process will also be shorter. This will make the patient faster in contacting EMS or asking for help to get treatment at the hospital [2], [3], [10], [14].

Various studies have shown that recognizing risk factors for ACS will increase patient awareness of the severity of symptoms. Research by Garrido *et al*. (2020) showed that only 5% of patients who had good knowledge of risk factors waited more than 1 h for treatment after onset. Meanwhile, for patients who have a low level of knowledge related to risk factors, 22% just arrived at the hospital after 1 h. This shows that knowledge related to risk factors has an important role in increasing early detection and reducing prehospital delay [2], [13], [14], [15], [16].

Providing knowledge related to risk factors that have a direct effect on accelerating early detection and decreasing prehospital delay also has an impact on increasing skills related to ACS prevention. Patients will be more aware of the various managements that must be done to prevent ACS or re-attack. This will improve the quality of life of patients at risk of ACS and improve the ability to prevent a recurrence. This condition will also have an impact on decreasing the readmission of ACS patients. According to Habibzadeh's research (2021), education related to ACS risk factors can increase understanding and attitudes related to ACS prevention, so that ACS prevention behavior increases. This shows that knowledge-enhancing interventions will have an impact on changes in health behavior which will have the effect of not only reducing prehospital delay but also improving quality of life and optimizing output in ACS patients [8], [10], [11], [17].

Knowledge regarding impact of delay

Knowledge related to the consequences that will occur due to delays in handling also affects the decision-making process. When the patient knows the impact caused when there is a delay in handling it will make the process of seeking help faster. This knowledge is mainly owned by patients who have had a previous history of ACS. A history of outcomes experienced during treatment will increase knowledge regarding the consequences that can occur when there is a delay in treatment. Research related to readmission shows that although education does not reduce readmission rates, it does improve outcomes due to accelerated decision-making and decreased prehospital delay in patients [6], [8], [9], [10], [18].

In addition, psychological factors also affect awareness of these consequences. The D personality type, who tends to be easily anxious and stressed, will feel more afraid than other personality types when symptoms appear. This will cause them not to focus on management or the actions they have to take. This will trigger a decrease in the urgency to seek help because they fear they feel becomes a biased factor that makes them focus more on problems rather than problem-solving [2], [9], [19].

Resilience is related to knowledge related to the impact that arises due to delay. The high resilience of ACS survivors will increase the protective effect and decrease distress. The experience related to suffering ACS can be traumatic so that they are able to change their health behavior for the better. Resilience will increase cognitive abilities to improve self-ability to take preventive action or increase speed in early diagnosis abilities because of the experience they have. This condition will trigger a faster time interval for patients to seek appropriate help and maximize post-treatment ACS outcomes [9], [12], [20], [21].

Knowledge regarding response to symptoms

Knowledge related to the response or action that must be taken after feeling the symptoms is also one of the factors that increase the speed of seeking help. This is no less important because even though the patient knows about the symptoms of ACS but does not understand what to do, it will also have an impact on the length of time it takes to make a decision. So that the

prehospital delay will still occur due to the lengthening of the decision-making time in seeking help. This makes it important to increase knowledge regarding appropriate actions when experiencing ACS [9], [11], [13], [20], [21].

Changes in knowledge related to appropriate action in dealing with ACS have been shown to reduce prehospital delay and increase the success of ACS therapy. Research by Eastwood *et al*. (2021) shows that education through mass media related to ACS warning signs (including recognition of symptoms and actions to be taken) can improve ACS emergency response, thereby reducing the rate of cardiac arrest outside the hospital. This study provides evidence that increasing knowledge is important to increase the effectiveness of prehospital management, thereby saving many lives [18], [22].

Increased knowledge related to ACS management is not only needed by patients who have never experienced it but also in post-ACS patients. Post-ACS patients require increased skills related to knowledge of proper ACS care and management so that they can cope better when relapse occurs. The research of Davis *et al*. (2019) showed an increase in the ACS response index after the provision of education and skills related to ACS. This condition does not reduce the readmission rate but can reduce the number of complications caused by taking appropriate action in response to ACS symptoms [4], [11], [15].

Conclusion

Knowledge about ACS symptom and the risk factor is important to improve early detection with decreased misinterpretation and misdiagnosis, this condition will lead reduce prehospital delay because increase the need for treatment-seeking as soon as possible. Knowledge is important which has a direct impact on improving decision-making abilities and early detection of ACS. Increasing knowledge regarding symptoms, severity, risk factors, impact, and appropriate action can increase the patient's ability to respond quickly to ACS and reduce prehospital delay.

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