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ORIGINAL ARTICLE

Time to hospital arrival among patients with acute myocardial infarction in China: a report from China PEACE prospective study

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Aims Few contemporary studies have reported the time between acute myocardial infarction (AMI) symptoms onset and hospital arrival, associated factors, and patient perceptions of AMI symptoms and care seeking. We sought to study these issues using data from China, where AMI hospitalizations are increasing.

Methods and results We used data from the China PEACE prospective AMI study of 53 hospitals across 21 provinces in China. Patients were interviewed during index hospitalization for information of symptom onset, and perceived barriers to accessing care. Regression analyses were conducted to explore factors associated with the time between symptom onset and hospital arrival. The final sample included 3434 patients (mean age 61 years). The median time from symptom onset to hospital arrival was 4 h (interquartile range 2–7.5 h). While 94% of patients reported chest pain or chest discomfort, only 43% perceived symptoms as heart-related. In multivariable analyses, time to hospital arrival was longer by 14% and 39% for patients failing to recognize symptoms as cardiac and those with rural medical insurance, respectively (both $P < 0.001$). Compared with patients with household income over 100 000 RMB, those with income of 10 000–50 000 RMB, and <10 000 RMB had 16% and 23% longer times, respectively (both $P = 0.03$).

Conclusion We reported an average time to hospital arrival of 4 h for AMI in China, with longer time associated with rural medical insurance, failing to recognize symptoms as cardiac, and low household income. Strategies to improve the timeliness of presentation may be essential to improving outcomes for AMI in China.

Clinical trial registration https://clinicaltrials.gov/ct2/show/NCT01624909.

Keywords Time to hospital arrival • Acute myocardial infarction • Access to care

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Introduction

The benefits of reperfusion therapy for patients with acute myocardial infarction (AMI) depend on timely patient presentation for acute care.[1,2] Prolonged time intervals have been associated with worse outcomes[3,4] and are an international problem. In the United States and other Western countries, the median time from symptoms onset to hospital arrival is 2–3 h [2 h for ST-elevated myocardial infarction (STEMI), 3 h for non ST-elevated myocardial infarction (NSTEMI)],[5,6] yet approximately 10% of patients still arrive at the hospital greater than 12 h after noticing symptoms.[7,8] In countries with limited access to advanced health care, less developed emergency response systems, and limited personal and public financial resources for health care, time intervals to hospital arrival are reportedly worse.[9–11]

Few contemporary studies of delays to hospital arrival incorporate patients' perspectives and perceptions regarding seeking care. Moreover, we know little about whether patient characteristics such as education, medical insurance, income, or psychosocial status are associated with delays. Understanding both the extent of time to hospital arrival and the factors contributing to prolonged time intervals may help identify barriers to timely presentation, and help guide future improvement strategies and interventions. This issue is particularly important in China where rates of AMI are increasing rapidly; by 2030 the country is estimated to have over 23 million AMIs each year, nearly three times as many as those in 2010.[12]

The China Patient-Centered Evaluative Assessment of Cardiac Events Prospective Study of Acute Myocardial Infarction (China PEACE-Prospective AMI Study) was specifically designed to study, among other topics, the time to hospital arrival and factors associated with it, as a means of developing future improvement programs. The study captured details of symptom onset and factors known to be related to health care access for AMI, to examine care seeking delays and associated factors. Specifically, we aim to describe the time from symptom onset to hospital arrival, patient perceptions regarding AMI symptoms and care-seeking, and factors associated with longer time to hospital arrival.

Methods

Study design of China PEACE-prospective AMI study

The design of the China PEACE-Prospective AMI Study has been published previously.[13] In brief, the study consecutively registered patients aged 18 or older and were hospitalized for AMI within 24 h of symptom onset from 53 acute-care hospitals (35 tertiary and 18 secondary hospitals) in 21 Chinese provinces. Eligible patients who provided informed consent were enrolled and interviewed during index hospitalization, and followed up at 1, 6, and 12 months following hospital discharge. The first patient was enrolled in December 2012 and the last patient was enrolled in May 2014.

Data were collected via centralized medical chart abstraction, while interviews and physical examinations were conducted locally by site investigators. Medical chart abstraction quality was monitored by randomly auditing 5% of the medical charts. The chart abstraction achieved an overall accuracy of over 98%. Interviews were completed using tablet computers that employed data entry validation to ensure the accuracy and completeness of data.

The central ethics committee at the NCCD and local internal ethics committees at sites and the Yale University Institutional Review Board approved the China PEACE-Prospective AMI Study. All patients provided written informed consent. The study is registered at www.clinicaltrials.gov (NCT01624909). The funder of the study had no role in the study design, data collection, data analyses, data interpretation, or writing of the report.

Study sample

We limited the study sample to patients with available data of time intervals from symptoms onset to hospital arrival. Patients who were transferred from another hospital were excluded because arrival at study hospitals did not reflect the patient's first contact with acute care.

Study outcomes

The primary outcome was time to hospital arrival, which was defined as the time between symptom onset and hospital arrival in hours. This interval was calculated from the documented timestamp of symptom onset and the documented timestamp of hospital arrival; if timestamps were not available, we used the patient-reported duration from symptom onset to hospital arrival. The timestamps and the patient-reported duration were collected from the patient interview questionnaire.

Patient characteristics

Through the interview, we collected detailed information about symptom onset, patients' perception of symptoms, reasons for patient-reported delays in seeking care; we also collected various demographic, clinical, and psychosocial factors hypothesized to be associated with prolonged time to hospital arrival from medical chart abstraction. We designed a multiple-choice question for AMI symptoms that asked patients to report all acute symptoms including chest pain and chest discomfort, sweating, weakness or fatigue, nausea, shortness of breath, radiating pain, palpitation, dizziness, indigestion or stomach pain/discomfort, confusion, and other symptoms. A distinct question was asked about patient perceptions regarding symptoms, i.e. whether the symptoms were perceived to be heart-related. Patients also reported individual reasons for 'waiting before seeking care', which included lack of time, perception of non-severe symptoms, perception of intermittent symptoms, lack of assistance for a hospital visit, concerns for cost, embarrassment or fear, or none of the above. We also collected data about time of symptom onset—weekdays were defined as Monday through Friday and weekends as Saturday and Sunday. In addition to symptomology, we also collected socio-demographic data (age, gender, marriage status, employment status, level of education, health insurance status, household income), comorbidities and cardiovascular disease risk factors (based on medical history and admission diagnosis), medical history, and AMI type. Each patient was also interviewed during the index hospitalization to assess several patient-reported measures of health status, including generic health-related quality of life measured by the EuroQol five dimensions questionnaire (EQ5D) scale,[14,15] disease-specific quality of life evaluated by the Seattle Angina Questionnaire Angina Frequency (SAQ-AF),[16] depression by the Patient Health Questionnaire Depression (PHQ-8),[17] social support by the ENRICHD Social Support Instrument (ESSI),[18] and stress by the Perceived Stress Scale (PSS).[19] As this study was conducted contemporaneously with acute care, patients responded to interview questions after the initial period of treatment, so that it would not interfere with acute therapy.

Statistical analyses

Categorical variables were expressed as frequencies and percentages and analysed using χ^2 tests; continuous variables were described as

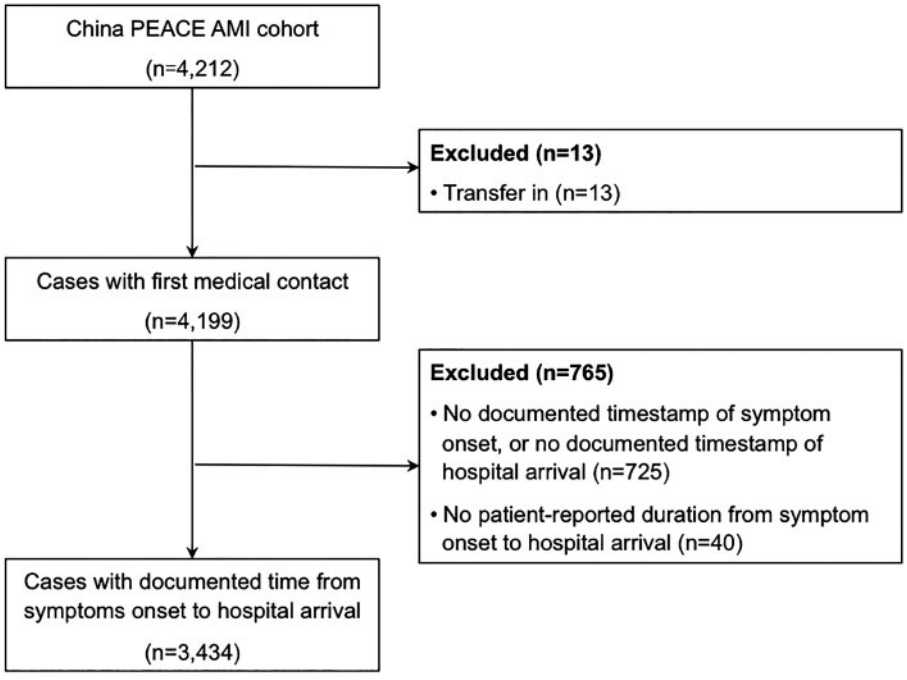

Figure 1 A flowchart of identifying the study sample.

medians and interquartile ranges (IQRs) and analysed by the Kruskal–Wallis test. To characterize the patient characteristics for different time groups, we first examined the distribution of the primary outcome and then classified patients into one of three mutually exclusive categories: (i) less than or equal to 2 h; (ii) 2–6 h; and (iii) greater than 6 h. We chose 2 h and 6 h as cut-offs because these time points were commonly used in previous studies[20,21] as well as in clinical practice; we also defined time to hospital arrival >6 h as 'extreme delay'.

We, subsequently, fit a mixed model to estimate the associations between time to hospital arrival and patient characteristics. Because the distribution of time to hospital arrival was skewed, we applied a log-transformation to normalize its distribution prior to regression analysis. The estimated coefficients represent the percentage change for the time to hospital arrival for each 1-unit change in an independent variable.[7,22] Candidate variables included age, sex, marriage status, work status, education level, household income, medical insurance, diabetes mellitus (DM), hypertension, hypercholesterolaemia, current smoking, medical history (AMI, percutaneous coronary intervention, coronary artery bypass grafting, angina, heart failure, and stroke), time of symptoms onset, onset symptoms, perceiving symptoms as cardiac, EQ5D index score, EuroQol five dimensions questionnaire visual analog scale (EQ5D-VAS), depression, stress level, social support, and SAQ-AF score. Missing data occurred only for time of symptoms onset (7.5%) and was reported as a separate group in the model. The model was fitted with hospital-specific random intercepts to account for within-hospital and between-hospital variations. We also did secondary analysis to identify factors associated with extreme delay using logistic regression; candidate variables included in the logistic model were the same as those in the mixed model. All comparisons were two-tailed, with a $P < 0.05$ considered statistically significant. All statistical analyses were performed using SAS software (version 9.4, SAS Institute, Cary, NC, USA).

Results

Study cohort

The final study sample included 3434 patients (81.5% of the total AMI cohort; *Figure 1*; baseline characteristics of patients included and excluded in this study were shown in Appendix, Table A1), 43% had documented timestamps of both symptom onset and hospital arrival, and 57% reported duration from symptom onset to hospital arrival. Among them, 799 (23%) of patients were female, 2808 (81.8%) were STEMI, and the mean age was 61 years (SD 12 years). Across the cohort, 1435 (42%) were currently employed; 1137(33%) had an education level equal to or greater than high school; 1944 (57%) had household income lower than 50 000 RMB (~7142 USD) per year. Together, medical insurance for urban workers and residents and rural medical insurance accounted for the two major insurance types (56% and 36%, respectively). Cardiovascular risk factors were common: hypertension (56%), DM (23%), current smoking (58%) and hypercholesterolaemia (30%). Two-thirds of the patients had symptom onset during weekdays (*Table 1*).

Time from symptom onset to hospital arrival

The median time to hospital arrival was 4 h (IQR 2–7.5 h). The distribution of time to hospital arrival is shown in *Figure 2*. There were 29% of patients had time from symptom onset to hospital arrival greater than 6 h.

Patient-reported symptoms and reasons for delay in seeking care

Almost all patients (94%) reported typical symptoms of chest pain or chest discomfort (*Table 2*), and 84% also reported other ischaemic

Table 1 Baseline characteristics of study cohort

Characteristics	Number of patients (%)	≤2 h, *n* (%)	2–6 h, *n* (%)	>6 h, *n* (%)	*P*-value
Socio-demographics					
Age	60.7 (11.9)	60.5 (12.0)	60.7 (11.8)	61.0 (11.9)	0.539
Female	799 (23.3)	256 (22.3)	282 (21.8)	261 (26.2)	0.031
Married	3007 (87.6)	1020 (88.9)	1137 (88.1)	850 (85.4)	0.045
Working full or part time	1435 (41.8)	478 (41.6)	541 (41.9)	416 (41.8)	0.991
Education level ≥ high school	1137 (33.1)	450 (39.2)	400 (31.0)	287 (28.8)	<0.001
Health insurance					<0.001
Rural medical insurance	1225 (35.7)	327 (28.5)	470 (36.4)	428 (43.0)	
Household income					<0.001
<10 000 RMB	430 (12.5)	123 (10.7)	145 (11.2)	162 (16.3)	
10 000–50 000 RMB	1514 (44.1)	500 (43.6)	586 (45.4)	428 (43.0)	
50 000–10 000 RMB	501 (14.6)	203 (17.7)	183 (14.2)	115 (11.6)	
>100 000 RMB	215 (6.3)	97 (8.4)	65 (5.0)	53 (5.3)	
Patient unclear or refuse to answer	774 (22.5)	225 (19.6)	312 (24.2)	237 (23.8)	
CVD risk factors					
Diabetes mellitus	798 (23.2)	266 (23.2)	293 (22.7)	239 (24.0)	0.757
Hypertension	1909 (55.6)	652 (56.8)	706 (54.7)	551 (55.4)	0.571
Hypercholesterolaemia	1017 (29.6)	386 (33.6)	374 (29.0)	257 (25.8)	<0.001
Current smoking	2001 (58.3)	680 (59.2)	781 (60.5)	540 (54.3)	0.008
Abnormal waist circumference	1760 (51.3)	603 (52.5)	668 (51.7)	489 (49.1)	0.268
Medical history					
Prior heart failure	232 (6.8)	86 (7.5)	79 (6.1)	67 (6.7)	0.403
Prior stroke	567 (16.5)	197 (17.2)	233 (18.0)	137 (13.8)	0.018
Prior angina	136 (4.0)	41 (3.6)	49 (3.8)	46 (4.6)	0.428
Prior AMI	275 (8.0)	105 (9.1)	115 (8.9)	55 (5.5)	0.003
Prior PCI	238 (6.9)	84 (7.3)	109 (8.4)	45 (4.5)	0.001
Prior CABG	5 (0.1)	2 (0.2)	2 (0.2)	1 (0.1)	0.900
Time of symptoms onset					0.034
Weekday	2287 (66.6)	740 (64.5)	864 (66.9)	683 (68.6)	
Weekend	889 (25.9)	301 (26.2)	334 (25.9)	254 (25.5)	
Unclear	258 (7.5)	107 (9.3)	93 (7.2)	58 (5.8)	
Onset symptoms					
Chest pain or discomfort	3233 (94.1)	1070 (93.2)	1233 (95.5)	930 (93.5)	0.030
Other ischaemic symptoms	2874 (83.7)	952 (82.9)	1093 (84.7)	829 (83.3)	0.475
Symptoms perceived as heart-related problems	1491 (43.4)	533 (46.4)	593 (45.9)	365 (36.7)	<0.001
Psychosocial factors					
Health-related quality of life (EQ5D index score, mean)	0.9 (0.2)	0.9 (0.2)	0.9 (0.2)	0.9 (0.2)	0.210
Health-related quality of life (EQ5D-VAS, mean)	76.1 (16.6)	75.8 (17.4)	76.8 (16.1)	75.6 (16.3)	0.269
Depression (PHQ-8)	212 (6.2)	75 (6.5)	70 (5.4)	67 (6.7)	0.358
Low social support (ESSI)	760 (22.1)	271 (23.6)	275 (21.3)	214 (21.5)	0.335
Stress (PSS-4)	2667 (77.7)	904 (78.7)	1010 (78.2)	753 (75.7)	0.194
SAQ Angina Frequency	87.2 (20.5)	87.5 (20.9)	88.1 (19.7)	85.8 (21.2)	0.009

CVD, cardiovascular disease; AMI, acute myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; EQ5D, EuroQol five dimensions questionnaire; EQ5D-VAS, EuroQol five dimensions questionnaire visual analog scale; PHQ-8, Patient Health Questionnaire depression scale; ESSI, ENRICHD Social Support Instrument; PSS, Perceived Stress Scale; SAQ, Seattle Angina Questionnaire.

symptoms in addition to chest pain/discomfort. However, less than half of patients (43%) perceived the symptoms as heart-related problems. Among all patients, 50% of the cohort reported delays in seeking medical care and a large proportion of prolonged time to acute care could be attributed to 'symptoms did not seem bad enough for emergency care' (27%), and 'symptoms would come and go over time' (24%); these factors were also more pronounced among patients with extreme delay (i.e. greater than 6 h) (*Table 3*).

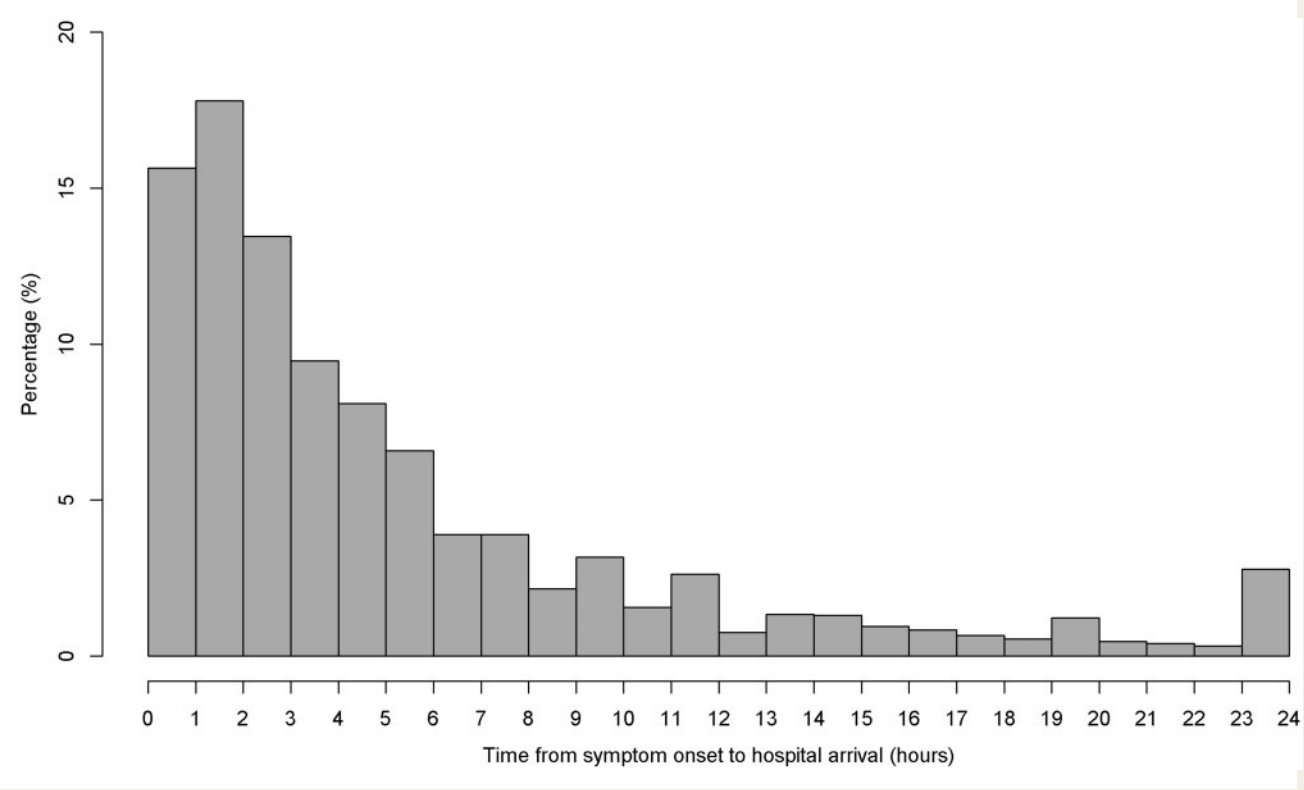

Figure 2 Distribution of time from symptom onset to hospital arrival.

Patient factors associated with prolonged times in care seeking

Several patient-reported perceptions and patient factors were associated with longer time to hospital arrival in unadjusted analyses, as shown in *Table 1*. Results from the log-transformed mixed model are given in *Figure 3A*. Patients who had rural medical insurance had 39% longer times than those with other types of medical insurance (mainly urban medical insurance) ($P < 0.001$). Compared with patients with household income over 100 thousand RMB, those in the 10–50 thousand RMB group and less than 10 thousand RMB group had 16% and 23% longer adjusted times, respectively (both $P = 0.03$). Time to hospital arrival was longer by 14% for patients that failed to recognize symptoms as cardiac ($P < 0.001$). Conversely, patients with a stroke history had 8% shorter times than those without prior stroke ($P = 0.048$).

Similarly, in the secondary analyses assessing factors associated with extreme delay, patients who had rural medical insurance, and those who failed to recognize symptoms as cardiac were more likely to have time to hospital arrival >6 h [odds ratio (OR) 1.7, 95% confidence interval (CI) 1.4–2.1; OR 1.5, 95% CI 1.2–1.8, respectively; both $P < 0.001$] (*Figure 3B*).

Table 2 Patient-reported onset symptoms (multiple choice)

Symptoms	Number of patients (%)
Chest pain or discomfort	3233 (94.2)
Sweating	2308 (67.2)
Weakness of fatigue	1064 (31.0)
Nausea	1053 (30.7)
Shortness of breath	1000 (29.1)
Radiating pain in neck, shoulder, or arms	957 (27.9)
Palpitation	764 (22.3)
Dizziness	562 (16.4)
Indigestion or stomach pain/discomfort	439 (12.8)
Confusion	151 (4.4)
No acute symptoms	6 (0.2)
Unknown	5 (0.2)

Discussion

In this large prospectively enrolled sample of patients with AMI, we found that both patient socio-demographic factors such as rural medical insurance and lower household income, and patient-reported factors, such as failing to recognize symptoms as cardiac, were associated with longer time to hospital arrival. These findings reveal important vulnerabilities in accessing timely acute cardiovascular care. However, the magnitude of effect from each factor was overshadowed by the overall duration of delay in China. Furthermore, we identified significant problem of unawareness of AMI-related symptoms, which were associated with longer times. Our study identifies important opportunities for future improvement initiatives and policy

Table 3 Patient-reported reasons for delays in seeking medical care (among those reported to delay before seeking care)

Self-reported delayed reasons for seeking medical care	Number of patients (%)	≤2 h, *n* (%)	2–6 h, *n* (%)	>6 h, *n* (%)	*P*-value
Didn't have time to go to the doctor	78 (2.3)	18 (1.6)	24 (1.9)	36 (3.6)	0.266
Symptoms did not seem bad enough for emergency care	912 (26.6)	244 (21.2)	310 (24.0)	358 (36.0)	0.182
Symptoms would come and go over time (not persistent)	836 (24.3)	244 (21.2)	297 (23.0)	295 (30.0)	0.065
Transportation-waited for someone to drive me to hospital	181 (5.3)	32 (2.8)	67 (5.2)	82 (8.2)	0.008
A concerns about the cost	49 (1.4)	8 (0.7)	21 (1.6)	20 (2.0)	0.229
Embarrassment or fear	8 (0.2)	4 (0.4)	3 (0.2)	1 (0.1)	0.229
None of above	40 (1.1)	15 (1.3)	16 (1.2)	9 (0.9)	0.111
Other reasons	162 (4.6)	46 (4.0)	50 (3.9)	66 (6.6)	0.392

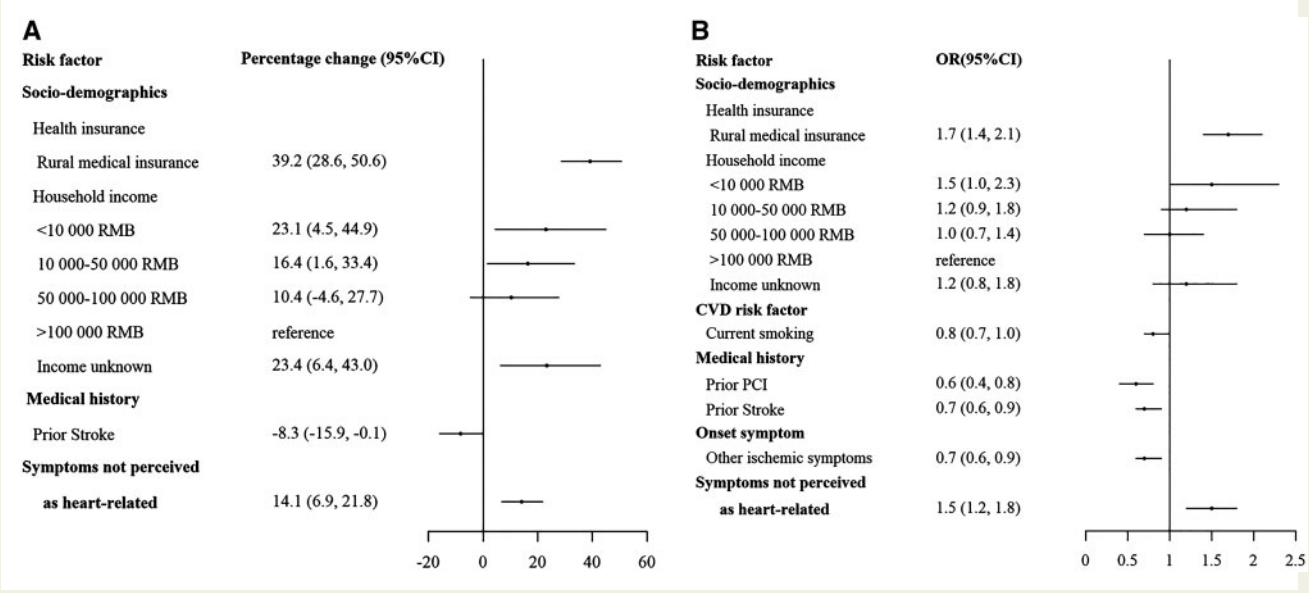

Figure 3 (*A*) Factors associated with time from symptom onset to hospital arrival in log-transformed mixed model. Variables associated with longer or shorter time to hospital arrival among patients with acute myocardial infarction are shown along the vertical axis. The percentage of 0 shows no difference in time from symptoms onset to hospital arrival for different subgroups. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval. (*B*) Factors associated with extreme delay in hospital arrival (greater than 6 h) in multivariable logistic model. Variables associated with extreme delay in hospital arrival (greater than 6 h) among patients with acute myocardial infarction are shown along the vertical axis. The adjusted odds ratio of 1 shows no difference in time from symptoms onset to hospital arrival for different subgroups. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval. CI, confidence interval; CVD, cardiovascular disease; PCI, percutaneous coronary intervention.

efforts to improve timely care seeking, particularly for time-sensitive conditions such as AMI.

Time to hospital arrival in China is longer than what has been reported in both China and Western countries. We describe a median time of 4 h in China; by contrast, the international Global Registry of Acute Coronary Events (GRACE) study reported that in 2006, the median care seeking time ranged between 1.7–2.3 h for STEMI and 1.9–2.7 h for NSTEMI in Western countries.[5] The prolonged time to hospital arrival attenuates the benefit of reperfusion therapy for patients with STEMI, which is particularly important as STEMI accounts for about 80% of patients with AMI in China.[23] The time to hospital arrival is also longer than those previously reported in China.[10,24,25] However, prior studies were usually retrospective, conducted in cities, and were limited to single hospital/region with small sample size (less than 1000 patients). In contrast, our work is the largest and first multi-centre study that includes hospitals in both urban and rural areas, incorporates patients' perspectives from prospective interviews, and therefore, provides a comprehensive assessment of care seeking times for AMI in China. It is no doubt that there are substantial variations in distances to hospital in a huge country like China, which may affect the time to hospital arrival. However, AMI is an acute condition that requires seeking

medical help in the nearest hospital. In China, even in rural areas, patients with AMI could arrive at the nearest county hospital for treatment within a relatively short time period.

We found several patient-level factors that were associated with delayed presentations, such as rural medical insurance. Rural insurance covers 97% of rural residents (rural or urban residents were determined by the *Hukou* policy in China), however, this finding is not easily explained by distance to care. Patients with rural medical insurance live in both rural and urban areas due to China's urbanization, and patients with rural medical insurance in both geographies had longer time to hospital arrival. Out-of-pocket financial concerns may partially explain the result, as household incomes as well as reimbursement rates vary for patients with different types of medical insurance; it is also possible that patients with rural medical insurance had poorer health literacy of AMI than those from urban areas. Lower income is also associated with delayed presentation times independent of insurance type, which indicated that economic status could help to identify vulnerable groups for more educational support. Contrary to our expectations, we did not find associations between psychosocial factors and prolonged time to arrival; it is possible that psychosocial factors play a more important role in long-term prognosis[26,27] rather than acute care-seeking behaviours.

Factors associated with prolonged time to hospital arrival in our study are different from those reported in Western studies. Factors such as older age, DM, female, prior angina, prior AMI, have been commonly reported to be related to delayed presentation in previous Western studies; [5,7–8,28] however, these factors were not associated with delays to hospital arrival in our work. Meanwhile, few previous studies have examined the effect of social and psychosocial factors. It is possible that in China, social factors such as medical insurance and income play a more important role, overshadowing the impact of demographic and clinical factors. Future study is needed to examine our hypothesis and understand the underlying mechanism.

A particularly important insight from this work is the association of patient-reported symptoms and reasons for delaying in seeking care reveal substantial barriers in AMI awareness. Over half of the patients with AMI did not perceive their symptoms as heart-related, although almost all reported typical symptoms of chest pain; nearly half of the patients reporting delays in seeking medical care services also reported lack of awareness of the symptoms' severity. Such findings reveal that many patients may lack the knowledge of AMI symptoms and risks of AMI, which remains a major concern because awareness of AMI symptoms is a prerequisite to shorten time to hospital arrival. To our knowledge, little is known about efforts to narrow patient education gaps in China. Public education campaigns in Western countries designed to reduce time to hospital arrival for patients with AMI have shown mixed results.[29–32] The largest study to date, the Rapid Early Action for Coronary Treatment (REACT) trial,[33] failed to shorten time to hospital arrival in the USA. However, authors of the REACT study noted that this campaign would be more likely to succeed in a context where there are relatively long time to hospital arrival at baseline, a less competitive media environment, and a centrally organized health care system. Due to its central coordinating and planning system, China may have a greater capacity to implement strategies and policies more rapidly and consistently. Moreover, STEMI, which usually presents with more typical symptoms than NSTEMI, is preponderant in China; therefore, it is possible that awareness regarding unrelenting chest pain as a prompt to recognize AMI in the circumstances of education campaign may carry more impact in China.

Our findings suggest several principles for future improvement efforts for patients with AMI in China and perhaps other countries. First, substantial opportunity exists to reduce time to hospital arrival in China, particularly through interventions aimed at improving patient awareness of symptoms and responsiveness to seek care. Given that the overall duration of time to hospital arrival in China is worrying, such interventions should target all patients at risk for AMI, not just those who have individual risk factors for longer delays. Second, a mix of socio-demographic and patient-reported factors should be acknowledged as contributing to longer time to hospital arrival; there should be intensive strategies tailored to these vulnerable groups. Third, novel, multi-dimensional strategies should be developed and tested in order to address the knowledge gaps. The current dramatic growth of electronic media and mobile health applications offer powerful platforms for effective education at a lower cost. By making clear strategies as well as testing these new tools, China may implement effective improvement initiatives to shorten delays to hospital and provide solutions for other countries facing similar challenges of acute care access.

Limitations

Certain limitations should be considered when interpreting our results. First, although a strength of our design is the prospective interview of patients, those enrolled patients may have been subject to recall bias regarding symptom onset time. However, documenting time to hospital arrival by patients' recall has been widely used in other studies, and there is no better way to collect this information. Second, our findings are limited to those who successfully survived through pre-hospital period to hospital arrival, suggesting that the clinical ramifications of our findings may be interpreted as conservative. Third, we are unable to assess time for transportation, and the use of ambulance services; therefore, investigations on transportation delays are warranted in future studies.

Conclusion

We reported a median time of 4 h for time to access care for AMI in China, which was worse than previously reported, especially among patients with rural insurance, low household income, and those failing to recognize symptoms as cardiac. Notably, the poor awareness of AMI symptoms and severity contributed to delays in seeking hospital care for AMI. Future initiatives are needed to improve the responsiveness to seek AMI care.

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Appendix

Table A1 Baseline characteristics of patients included and excluded in the article

Variables	Total	Enrolled	Not enrolled	*P*-value
Socio-demographics				
Age	60.9 (11.8)	60.7 (11.9)	61.6 (11.6)	0.108
Female	995 (23.6)	799 (23.3)	196 (25.2)	0.254
Married	3674 (87.2)	3007 (87.6)	667 (85.7)	0.167
Working full or part time	1727 (41.0)	1435 (41.8)	292 (37.5)	0.029
Education level ≥ high school	1403 (33.3)	1137 (33.1)	266 (34.2)	0.564
Health insurance				
Rural medical insurance	1648 (39.1)	1339 (39.0)	309 (39.7)	0.708
Household income				
<10 000 RMB	537 (12.7)	430 (12.5)	107 (13.8)	0.284
10 000–50 000 RMB	1824 (43.3)	1514 (44.1)	310 (39.8)	
50 000–10 000 RMB	622 (14.8)	501 (14.6)	121 (15.6)	
>100 000 RMB	258 (6.1)	215 (6.3)	43 (5.5)	
Patient unclear or refuse to answer	649 (15.4)	498 (14.5)	151 (19.4)	
CVD risk factors				
Diabetes mellitus	999 (23.7)	798 (23.2)	201 (25.8)	0.124
Hypertension	1840 (43.7)	1477 (43.0)	363 (46.7)	0.064
Hypercholesterolaemia	1114 (26.4)	880 (25.6)	234 (30.1)	0.011
Current smoking	2 (0.0)	1 (0.0)	1 (0.1)	0.25
Abnormal waist circumference	2130 (50.6)	1760 (51.3)	370 (47.6)	0.063
Medical history				
Prior heart failure	323 (7.7)	232 (6.8)	91 (11.7)	<0.001
Prior stroke	675 (16.0)	571 (16.6)	104 (13.4)	0.025
Prior angina	167 (4.0)	136 (4.0)	31 (4.0)	0.975
Prior AMI	328 (7.8)	275 (8.0)	53 (6.8)	0.261
Prior PCI	273 (6.5)	238 (6.9)	35 (4.5)	0.013
Prior CABG	5 (0.1)	5 (0.1)	0 (0.0)	0.287
Time of symptoms onset				
Weekday	2811 (66.7)	2287 (66.6)	524 (67.4)	0.843
Weekend	1089 (25.9)	889 (25.9)	200 (25.7)	
Unclear	312 (7.4)	258 (7.5)	54 (6.9)	
Onset symptoms				
Chest pain or discomfort	3927 (93.2)	3233 (94.1)	694 (89.2)	<0.001
Other ischaemic symptoms	3503 (83.2)	2874 (83.7)	629 (80.8)	0.056
Symptoms perceived as heart-related problems	1818 (43.2)	1491 (43.4)	327 (42.0)	0.48
Psychosocial factors				
Health-related quality of life (EQ5D index score, mean)	0.9 (0.2)	0.9 (0.2)	0.8 (0.2)	0.051
Health-related quality of life (EQ5D-VAS, mean)	76.1 (16.9)	76.1 (16.6)	76.1 (18.2)	0.587
Depression (PHQ-8)	256 (6.1)	212 (6.2)	44 (5.7)	0.585
Low social support (ESSI)	671 (15.9)	525 (15.3)	146 (18.8)	0.009
Stress (PSS-4)	3192 (75.8)	2667 (77.7)	525 (67.5)	<0.001
SAQ Angina Frequency	86.5 (21.3)	87.2 (20.5)	83.4 (24.0)	<0.001

PSS, Perceived Stress ScaleCVD, cardiovascular disease; AMI, acute myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; EQ5D, EuroQol five dimensions questionnaire; EQ5D-VAS, EuroQol five dimensions questionnaire visual analog scale; PHQ-8, Patient Health Questionnaire depression scale; ESSI, ENRICHD Social Support Instrument; SAQ, Seattle Angina Questionnaire.