Gender Differences in Factors Related to Prehospital Delay in Patients with ST-Segment Elevation Myocardial Infarction

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Purpose: The aim of our study was to investigate gender differences in factors related to prehospital delay and identify whether the knowledge of acute myocardial infarction symptoms affects this delay in Korean patients with ST-elevation myocardial infarction (STEMI).

Materials and Methods: A total of 350 patients (286 men, 64 women) with confirmed STEMI were interviewed to investigate socio-demographics, history of disease, symptom onset time, and factors that contributed to delayed decision time in seeking treatment and hospital arrival time from symptom onset. Factors associated with prehospital delay were examined separately by gender using univariate and multivariate analyses.

Results: Female patients had higher proportions of ≥60-minute decision time and ≥120-minute arrival time compared to male patients (33.9% vs. 23.1%, 60.9% vs. 52.1%, respectively). However, the difference was not statistically significant (p=0.093 and 0.214, respectively). Previous cardiovascular disease (CVD) was associated with increased decision time in men, whereas, in women, lower educational status caused a greater delay in decision time. Factors associated with hospital arrival time excluding delayed decision time were referral from another hospital, previous CVD, and percutaneous coronary intervention in men, and referral from another hospital in women.

Conclusion: Gender differences exist in factors related to prehospital delay. Therefore, public education to reduce prehospital delay should be conducted according to gender with a focus on the pertinent factors.

Key Words: Acute coronary syndrome, healthcare timeout, sex differences

INTRODUCTION

Prompt reperfusion therapy, including percutaneous coronary intervention (PCI) and fibrinolytic therapy in patients with ST-segment elevation myocardial infarction (STEMI) is very important. Because prompt salvaging of the critical myocardium as much as possible improves patient survival rates or outcomes,[1-3] effort is expended to reduce symptom onset-to-hospital arrival time (prehospital time) and door to needle time (hospital time, i.e., from presentation to treatment).

There are many factors affecting prehospital delay, which comprised of patient delay (decision time) and transport delay. Identification of factors influencing the delays may help reduce the time to receive treatment. Numerous studies on the factors related to prehospital delay in patients with acute myocardial infarction (AMI) have been conducted in many countries.[4-9] However, few studies involving Korean patients with AMI have been conducted.[10,11]

Previous studies identified several major categories that might predict prehospital delay, such as socio-demographic factors, context at symptom onset, and clinical, cognitive, and behavioral factors.[12-14] Among these factors, a significant cognitive factor known to be related to decision time delay is knowledge or recognition of AMI symptoms. Symptoms are a core element of a patient's decision to seek help, and have a decisive effect on the correct triage, thus affecting the decisions regarding additional early medical intervention.[15] Moreover, there may be gender differences regarding time to seek medical care. Several studies have reported that women are more likely to experience longer delays than men.[4,16,17] However, other studies have suggested that there are no gender differences in prehospital time delay.[18,19] Thus, the relationship between gender and prehospital delay times in AMI is currently unclear, partially because of the differences in design and methodology in the studies.

Outcomes in women such as early death occur more frequently than in men; additionally, in-hospital and overall mortality after AMI is higher in women than in men.[20] Thus, we believe that the reason for the higher mortality in women is a difference in prehospital delay, and it is important to identify the gender-related factors related to prehospital delay.

Consequently, the objective of this study was to investigate gender differences in factors related to prehospital delay, and to identify whether knowledge of AMI symptoms affects the delay in Korean patients with STEMI.

MATERIALS AND METHODS

Study participants
The participants were patients hospitalized with STEMI at 6 PCI-capable tertiary hospitals in various regions of Korea from July 2014 to June 2015.

Inclusion criteria for the present study were: 1) final diagnosis of STEMI, 2) hospitalization within 72 hours after the onset of symptoms, 3) hemodynamic stability (stable blood pressure and consistent blood flow), 4) Korean native speaker, and 5) mental alertness (information communicated through conversation). Among 359 patients with STEMI who were consecutively admitted during the data collection period, 350 (286 men and 64 women) were finally included in this study. Participants were selected using an electronic medical recoding system and then interviewed face-to-face after obtaining consent and agreeing to be in the study. The interview was conducted in the education room of the cardiac ward, and took less than 20 minutes. The survey was completed within 3 days after admission to the hospital.

At each hospital, the study design and protocol were approved by the Institutional Review Board (IRB) before data collection, and the IRB of Seoul National University approved the present study.

Questionnaire and data collection
The investigator developed a special questionnaire for this study in collaboration with several cardiologists, which was pre-tested on patients with STEMI and subsequently modified. The final questionnaire comprised 5 domains including: 1) sociodemographic characteristics, 2) history of disease, 3) symptoms and awareness of AMI, 4) patient decision time, and 5) transport-related items.

More detailed items on the questionnaire, which were collected by interview after admission, were as follows: sociodemographic characteristics such as age (categorized as <60 and ≥60 years when analysis), gender, education level (categorized as ≤middle school and ≥high school), medical insurance status (national health insurance and Medicaid), residence (urban and rural), whether the patient lived alone or not, and health behavior (smoking status, alcohol use, and obesity).

Moreover, data regarding disease history [family history of cardiovascular diseases (CVD) and personal history of hypertension, diabetes mellitus, dyslipidemia, CVD, PCI, or stroke] were collected.

Information on symptoms and quality of symptoms included the chief complaint, accompanying symptoms, and onset time during the acute phase of STEMI. Patients were questioned on the 10 symptoms using a Yes/No format. These symptoms included the following: 1) chest pain, 2) radiating pain, 3) dyspnea, 4) sweating, 5) weakness, 6) indigestion, 7) nausea or vomiting, 8) dizziness, 9) palpitations, and 10) other (an option to write in the symptom). During analysis, these symptoms were categorized into two groups such as "chest pain" and "other symptoms" as a major symptom. Awareness of AMI symptoms was asked using the following question: "Did you usually know the AMI disease" and "Did you usually know the early symptoms of AMI"; patients answered "Yes" or "No" to these questions. Additionally, patients who answered "Yes"

Table 1. Socio-Demographic, Clinical History and Knowledge Characteristics of Participants between Male and Female

Variables	Male (n=286)	Female (n=64)	*p* value
Age, mean (±SD)	59.2 (±11.9)	71.1 (±11.5)	<0.001
<60 yr	152 (53.1)	12 (18.8)	<0.001
≥60 yr	134 (46.9)	52 (81.2)	
Education level, n (%)			<0.001
<Middle school	83 (30.2)	42 (79.2)	
≥Middle school	192 (69.8)	11 (20.8)	
Medical insurance status, n (%)			0.746
National Health Insurance	272 (95.1)	62 (96.9)	
Medicaid	14 (4.9)	2 (3.1)	
Residency region, n (%)			0.849
Urban	243 (85.0)	54 (84.4)	
Rural	43 (15.0)	10 (15.6)	
Living with others, n (%)			0.023
Alone	31 (10.9)	14 (21.9)	
With family	254 (89.1)	50 (78.1)	
Smoking status, n (%)			<0.001
Non-smoker	49 (17.1)	63 (98.4)	
Current or past smoker	237 (82.9)	1 (1.6)	
Alcohol use status, n (%)			<0.001
Non-drinker	83 (29.0)	42 (65.6)	
Current drinker	203 (71.0)	22 (34.4)	
Body mass index, n (%)			0.003
<25.0 kg/m^2	165 (57.7)	50 (78.1)	
≥25.0 kg/m^2	121 (42.3)	14 (21.9)	
Family history of CVD, n (%)	134 (46.9)	17 (26.6)	0.003
Hypertension, n (%)	104 (36.4)	38 (59.4)	0.001
Diabetes mellitus, n (%)	71 (24.8)	19 (29.7)	0.431
Dyslipidemia, n (%)	35 (12.2)	11 (17.2)	0.307
Previous CVD, n (%)	46 (16.1)	18 (28.1)	0.031
Previous PCI, n (%)	23 (8.0)	7 (10.9)	0.460
Previous stroke, n (%)	13 (4.6)	5 (7.8)	0.343
Symptoms onset time, n (%)			0.256
Weekday and day (8 am–6 pm)	106 (37.1)	29 (45.3)	
Weekend or night (6 pm–8 am)	180 (62.9)	35 (54.7)	
Knowledge of disease for AMI, n (%)			0.049
Did not known	84 (33.7)	28 (48.3)	
Known	165 (66.3)	30 (51.7)	
Knowledge of symptoms for AMI, n (%)			<0.001
Did not known	170 (67.5)	53 (89.8)	
Known	82 (32.5)	6 (10.2)	
Major symptom, chest pain, n (%)			1.000
Chest pain	246 (86.0)	55 (85.9)	
Other symptoms	40 (14.0)	9 (14.1)	
Use of EMS, n (%)			0.886
Did not used	175 (61.8)	40 (63.5)	
Used	108 (38.2)	23 (36.5)	
Referral hospital, n (%)			0.324
Did not referred	120 (42.0)	22 (34.4)	
Referred	166 (58.0)	42 (65.6)	

Table 1. Socio-Demographic, Clinical History and Knowledge Characteristics of Participants between Male and Female (Continued)

Variables	Male (n=286)	Female (n=64)	p value
Decision time,* minute			0.712
Mean (±SD)	49.4 (±85.2)	59.2 (±95.6)	
Median (Min–Max)	25.0 (5.0–720.0)	20.0 (10.0–480.0)	
Arrival time,† minute			0.041
Mean (±SD)	251.6 (±435.2)	438.7 (±706.2)	
Median (Min–Max)	124.5 (10.0–3138)	171.0 (17.0–1814)	

SD, standard deviation; CVD, cardiovascular disease; PCI, percutaneous coronary intervention; AMI, acute myocardial infarction; EMS, emergency medical service.
*Decision time: the time of symptom onset to decision seek help, †Arrival time: the time of symptom onset to emergency room visiting.

were asked about the following symptoms, consisting of 5 dichotomous Yes/No items: chest pain, radiating pain, dyspnea, sweating, and weakness/dizziness. When patients answered more than 3 symptoms correctly, we determined that the patient had knowledge of AMI symptoms.

Transport-related items comprised the use of emergency medical service (EMS) and whether the patient arrived directly at the hospital. These items were investigated using the medical record systems.

Prehospital delay was divided into patient decision time and arrival time. Patient decision time is the elapsed time from symptom onset to the decision to seek medical care or call EMS. We obtained the symptom onset time and decision time to seek medical care via interview. We then calculated the decision time and categorized the times as <60 minutes and ≥60 minutes during analysis. The arrival time is the elapsed time from symptom onset to arrival at the emergency room (ER). We investigated arrival time at the ER through the hospital medical record system. Based on this time, we calculated the time from symptom onset to ER arrival and categorized it to <120 minutes and ≥120 minutes.

Statistical analysis

Fisher's exact test was performed to compare the difference between male and female patients based on socio-demographic characteristics, clinical history, knowledge of AMI, decision time, and arrival to ER time.

In men and women, separate univariate logistic regression analyses were performed to calculate the odds ratio (OR) and to confirm factors related to the decision time (<60 minutes vs. ≥60 minutes). After that, by gender, multivariate logistic regression analyses were performed to confirm factors related to the decision time after adjustment. For the selection of variables for adjustment, when the p value was less than 0.20 in the univariate logistic regression analysis, the variables were included for the adjustment. Additionally, we included the known risk factors (age, education level, medical insurance, living with others, history of hypertension, diabetes mellitus, previous CVD and PCI, symptoms onset time, knowledge of disease and symptoms for AMI, and major symptoms) and considered the affected decision time and arrival time for the adjustment in multivariate logistic model. Using modeling in the multivariate logistic analysis, the multicollinearity between risk factors was confirmed by correlation coefficient between the risk factors. If the correlation coefficient was more than 0.8, we omitted the risk factor in the model. We conducted the same analysis to confirm the factors related to arrival in ER time (<120 and ≥120 minutes) in both genders. All analyses were performed using IBM SPSS Statistics for Window version 20 (IBM Corp., Armonk, NY, USA). The statistical significance level (α) was set at 0.05.

RESULTS

Characteristics of men and women

Among patients with STEMI, 286 (81.7%) were men and 64 (18.3%) were women. Patient characteristics are shown in Table 1. Many differences in socio-demographic, clinical history, and knowledge of disease characteristics between genders were seen.

The mean age of male patients was 59.2 years, which was less than the 71.1 years of the female patients (p<0.001). Additionally, the proportion of men with greater than middle school education was higher than that of women. Moreover, the proportion of men who lived with family was greater than that of women. The proportion of patients with body mass index (BMI) >25.0 kg/m² , family history of CVD, hypertension, and previous CVD was greater in male than in female patients (all has statistically significant level).

Differences in prehospital delay between men and women

A total of 23.1% of the male patients and 33.9% of the female patients decided to seek medical assistance at a hospital ≥60 minutes after symptom onset. Moreover, it took more than 120 minutes for 52.1% and 60.9% of the male and female patients, respectively, to arrive at the ER after symptom onset. Although both percentages were lower in male patients, no statistically significant difference was observed between the two genders (p=0.093 and 0.214, respectively) (Fig. 1).

Factors associated with a prolonged delay in deciding to seek medical assistance at a hospital
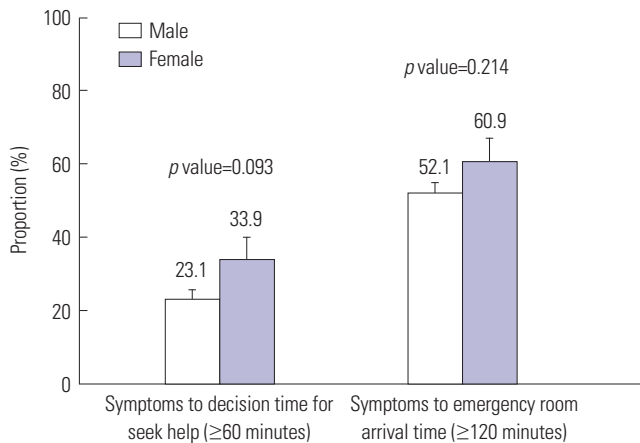Factors that led to the decision to seek medical assistance at a

Fig. 1. Proportion for patients of the ≥60 minutes of symptoms to decision seek help time and the ≥120 minutes of symptoms to emergency room arrival time between male and female. Error bars on the bar chart is standard error.

hospital were separately analyzed for male and female patients using univariate and multivariate logistic regression. In univariate logistic regression for male patients, the OR for a delay ≥60 minutes in deciding to seek medical assistance at a hospital was higher in those with dyslipidemia and those with a history of CVD {2.24 [95% confidence interval (CI), 1.03–4.90] and 2.66 [95% CI, 1.00–7.09], respectively}. A multivariate logistic regression was subsequently conducted with these and other variables (age, educational level, medical insurance, living with others, smoking status, hypertension, diabetes mellitus, dyslipidemia, previous CVD and PCI, symptom onset time, knowledge of disease and symptoms for AMI, and major symptoms) showing a high significance, albeit not statistical significance, as covariates. The OR for a delay ≥60 minutes in deciding to seek medical assistance at a hospital was high [4.86 (95% CI, 1.13–28.74)] in patients with a history of CVD (Table 2).

In the univariate analysis for female patients, the OR for a delay ≥60 minutes in deciding to seek medical assistance at a hospital was very high [9.44 (95% CI, 1.09–81.88)] in those with low education. Moreover, after adjustment by the other variables (age, living with others, hypertension, diabetes mellitus, previ-

Table 2. Related Factors on Time from Symptom Onset to Seek Medical Care in Male and Female by Univariate and Multivariate Logistic Regression Analysis

Variables	Male				Female			
	Crude OR	p value	Adjusted OR	p value	Crude OR	p value	Adjusted OR	p value
Age, more than 60 yr	1.10 (0.62–1.95)	0.744	0.89 (0.43–1.87)	0.766	0.65 (0.18–2.42)	0.525	4.40 (0.60–48.07)	0.123
Education level, ≤middle school	1.62 (0.88–3.01)	0.124	0.79 (0.37–1.72)	0.555	9.44 (1.09–81.88)	0.042	33.28 (3.78–293.04)	0.011
Medical insurance, Medicaid	1.69 (0.36–7.84)	0.503	0.73 (0.13–4.10)	0.718	-	-	-	-
Residency region, rural	1.47 (0.70–3.09)	0.310	-	-	1.65 (0.30–9.06)	0.567	-	-
Living with others, alone	0.89 (0.34–2.31)	0.815	0.75 (0.22–2.62)	0.656	0.73 (0.18–2.96)	0.655	0.83 (0.10–7.22)	0.867
Smoking status, current/past smoker	1.89 (0.80–4.47)	0.146	2.18 (0.83–5.68)	0.113	-	-	-	-
Alcohol use status, current drinker	1.07 (0.58–2.01)	0.821	-	-	0.76 (0.23–2.45)	0.644	-	-
Body mass index, ≥25.0 kg/m²	0.74 (0.41–1.33)	0.313	-	-	0.83 (0.22–3.15)	0.784	-	-
Family history of CVD, yes	0.91 (0.51–1.61)	0.745	-	-	1.25 (0.37–4.18)	0.721	-	-
Hypertension, yes	1.18 (0.65–2.13)	0.594	0.90 (0.42–1.93)	0.795	0.49 (0.16–1.50)	0.211	0.10 (0.01–0.83)	0.033
Diabetes mellitus, yes	1.84 (0.99–3.44)	0.055	2.05 (0.93–4.54)	0.076	0.84 (0.24–2.92)	0.789	3.39 (0.41–27.80)	0.256
Dyslipidemia, yes	2.24 (1.03–4.90)	0.043	1.73 (0.70–4.26)	0.232	1.14 (0.29–4.52)	0.849	-	-
Previous CVD, yes	2.66 (1.00–7.09)	0.050	4.86 (1.13–28.74)	0.032	1.18 (0.34–4.10)	0.789	1.01 (0.07–13.55)	0.996
Previous PCI, yes	0.29 (0.07–1.29)	0.105	1.27 (0.10–16.50)	0.854	0.75 (0.13–4.30)	0.750	17.96 (0.20–165.02)	0.211
Previous stroke, yes	0.97 (0.20–4.78)	0.966	-	-	0.63 (0.06–6.50)	0.698	-	-
Symptoms onset time, weekend and night time	1.59 (0.86–2.94)	0.143	1.68 (0.83–3.42)	0.151	0.85 (0.28–2.57)	0.769	0.31 (0.05–2.12)	0.232
Knowledge of disease for AMI, did not known	1.12 (0.59–2.14)	0.731	1.08 (0.46–2.50)	0.866	1.56 (0.50–4.88)	0.442	0.69 (0.11–4.21)	0.685
Knowledge of symptoms for AMI, did not known	0.97 (0.52–1.84)	0.937	0.76 (0.34–1.69)	0.501	2.12 (0.22–20.55)	0.515	5.76 (0.65–512.54)	0.770
Major symptom, chest pain	1.02 (0.44–2.37)	0.970	0.73 (0.27–1.99)	0.538	2.81 (0.30–25.98)	0.362	0.26 (0.01–5.73)	0.393

OR, odds ratio; CVD, cardiovascular disease; PCI, percutaneous coronary intervention; AMI, acute myocardial infarction.

ous CVD and PCI, symptoms onset time, knowledge of disease and symptoms for AMI, and major symptoms), the OR for a delay ≥60 minutes in deciding to seek medical assistance at a hospital increased to 33.28 (95% CI, 3.78–293.04) in female patients with low education (Table 2). However, patients with hypertension had a shorter decision time [0.10 (95% CI, 0.01–0.83)].

Factors associated with a prolonged delay in arrival at ER

Regarding the factors that influenced the delay in arrival at the ER ('arrival time'), the use of EMS and visits to other hospitals were included as variables, and the data for both genders were analyzed separately. In univariate analysis for male patients, those with a history of CVD, those who did not use EMS, those who visited other hospitals, and those who decided to seek medical assistance late at a hospital presented at the ER later. A multivariate analysis was conducted with these variables, age, education level, medical insurance, place of residence, living with others, drinking status, hypertension, diabetes mellitus, previous history of PCI, symptom onset time, knowledge of disease and symptoms for AMI, and major symptoms as covariates. The OR of arriving at the ER ≥120 minutes after symp-

tom onset was 7.25 (95% CI, 1.69–31.12) in those with history of CVD, 7.25 (95% CI, 1.17–44.97) in those with a history of PCI, 4.02 (95% CI, 1.89–8.56) in those who visited other hospitals, and 74.82 (95% CI, 17.98–311.38) in those who made late decisions (Table 3).

According to the univariate analysis conducted for female patients, factors that exerted statistically significant influences on arrival time included age, education level, place of residence, living with others, drinking status, hypertension, diabetes mellitus, history of CVD and PCI, symptoms onset time, knowledge of disease and symptoms for AMI, and major symptoms. The OR for late arrival was 5.65 (95% CI, 0.99–23.69) for patients with low education, 17.0 (95% CI, 4.70–61.49) for those who visited other hospitals, and 18.9 (95% CI, 3.85–92.68) for those who made late decisions. Those who drank alcohol arrived at the ER earlier (Table 3).

DISCUSSION

Timely reperfusion is very important for patients with myocardial infarction. Therefore, patients should arrive at the hos-

Table 3. Related Factors on Time form Symptom Onset to Emergency Room Arrival in Male and Female by Univariate and Multivariate Logistic Regression Analysis

Variables	Male				Female			
	Crude OR	p value	Adjusted OR	p value	Crude OR	p value	Adjusted OR	p value
Age, more than 60 yr	1.27 (0.79–2.02)	0.321	2.04 (0.94–4.45)	0.073	4.12 (1.09–15.61)	0.037	2.88 (0.80–10.43)	0.107
Education level, ≤middle school	1.22 (0.73–2.04)	0.455	0.98 (0.45–2.13)	0.958	8.53 (1.89–38.43)	0.005	5.65 (0.99–23.69)	0.062
Medical insurance, Medicaid	1.70 (0.55–5.20)	0.354	2.71 (0.48–15.36)	0.259	-	-	-	-
Residency region, rural	1.67 (0.86–3.26)	0.130	1.87 (0.74–4.76)	0.188	2.97 (0.58–15.31)	0.194	2.97 (0.58–15.31)	0.194
Living with others, alone	1.51 (0.70–3.24)	0.290	1.63 (0.52–5.10)	0.403	1.20 (0.35–4.11)	0.772	0.83 (0.24–2.85)	0.772
Smoking status, current/past smoker	0.86 (0.47–1.60)	0.644	-	-	-	-	-	-
Alcohol use status, current drinker	1.43 (0.86–2.39)	0.173	1.84 (0.86–3.96)	0.116	0.37 (0.13–1.08)	0.070	0.26 (0.09 –0.78)	0.016
Body mass index, ≥25.0 kg/m²	0.84 (0.53–1.34)	0.467	-	-	0.82 (0.25–2.72)	0.742	-	-
Family history of CVD, yes	0.96 (0.60–1.52)	0.847	-	-	0.64 (0.21–1.96)	0.432	-	-
Hypertension, yes	1.26 (0.78–2.05)	0.348	0.70 (0.33–1.52)	0.371	0.73 (0.26–2.05)	0.547	1.01 (0.37–2.77)	0.987
Diabetes mellitus, yes	1.46 (0.85–2.52)	0.171	1.49 (0.62–3.58)	0.377	1.14 (0.38–3.46)	0.813	1.37 (0.46–4.13)	0.574
Dyslipidemia, yes	0.97 (0.48–1.97)	0.933	-	-	0.47 (0.13–1.73)	0.254	-	-
Previous CVD, yes	2.61 (1.34–5.09)	0.005	7.25 (1.69–31.12)	0.008	1.87 (0.62–5.66)	0.265	1.19 (0.39–3.68)	0.758
Previous PCI, yes	0.69 (0.29–1.62)	0.390	7.25 (1.17–44.97)	0.033	0.44 (0.09–2.15)	0.308	0.83 (0.17–4.07)	0.822
Previous stroke, yes	2.12 (0.64–7.05)	0.220	-	-	0.96 (0.15–6.18)	0.964	-	-
Symptoms onset time, weekend and night time	0.80 (0.49–1.29)	0.355	0.58 (0.29–1.19)	0.137	0.70 (0.25–1.94)	0.495	1.24 (0.46–3.35)	0.665
Knowledge of disease for AMI, did not known	1.25 (0.74–2.13)	0.400	0.89 (0.37–2.09)	0.782	3.92 (1.28–12.02)	0.017	1.72 (0.57–5.18)	0.335
Knowledge of symptoms for AMI, did not known	1.15 (0.68–1.95)	0.603	0.99 (0.43–2.26)	0.979	3.30 (0.55–19.69)	0.190	0.72 (0.19–2.69)	0.634
Major symptom, chest pain	0.69 (0.35–1.36)	0.283	0.57 (0.20–1.67)	0.308	2.19 (0.53–9.09)	0.282	0.52 (0.12–2.16)	0.365
Use of EMS, did not used	1.96 (1.20–3.18)	0.007	1.28 (0.61–2.68)	0.509	20.40 (5.47–76.15)	0.000	2.48 (0.72–8.58)	0.152
Referral hospital, referred	3.79 (2.31–6.23)	0.000	4.02 (1.89–8.56)	<0.001	14.45 (4.10–50.94)	0.000	17.0 (4.70–61.49)	<0.001
Make decision, late decision	32.31 (9.78–106.71)	0.000	74.82 (17.98–311.38)	<0.001	13.96 (2.79–69.77)	0.001	18.9 (3.85–92.68)	0.003

OR, odds ratio; CVD, cardiovascular disease; PCI, percutaneous coronary intervention; AMI, acute myocardial infarction; EMS, emergency medical service.

pital and receive treatment as soon as possible after symptom onset. The American College of Cardiology Foundation/American Heart Association guidelines recommend that patients receive treatment within 120 minutes.[21] Thus, a 120-minute "symptom onset-to-door time" duration is considered the gold standard for preventing cardiac muscle necrosis.[6] However, delays in prehospital time remain common in many patients. In the present study, the time from symptom onset to the decision to seek medical assistance at a hospital exceeded 60 minutes in 23.1% of male patients and 33.9% of female patients. Moreover, the arrival time exceeded 120 minutes for 52.1% of male patients and 60.9% of female patients. Therefore, there is a need to investigate the factors influencing the time at which patients decide to seek medical assistance and arrival time at a hospital in patients with myocardial infarction. Furthermore, basic data are required to establish national policies to decrease delays. In particular, the characteristics (age at onset, symptoms, medical history, and prognosis) of AMI differ greatly between men and women,[22-25] and differences in decision time or symptom onset to arrival time were also observed in certain studies;[12,17,26-29] thus, separate investigations are necessary for male and female patients.

In the present study, 286 of 350 patients with myocardial infarction (81.7%) were men, while 18.3% were women. Differences were observed in socioeconomic characteristics, clinical characteristics, and knowledge of AMI. The mean age was lower and educational level was higher in male patients. The proportions of smokers and alcohol consumers, those living with family and those with a BMI ≥25 kg/m² were also higher in male patients. Moreover, more male patients had a family history of CVD and appropriate knowledge of AMI and its symptoms. The proportion of female patients with history of CVD was high. The present study did not differ considerably from previous studies in terms of patient characteristics. In most studies,[16,17,30,31] the mean age and proportions of CVD history of the male patients were lower than that of female patients, while the mean education level was lower for female than for male patients.

In the present analysis, the proportion of persons who decided to seek medical assistance at a hospital ≥60 minutes after symptom onset was 10.8% higher in female than in male patients (33.9% in female patients and 23.1% in male patients). Moreover, the proportion of those who arrived at the ER ≥120 minutes after symptom onset was 8.8% higher in female than in male patients (60.9% in female patients and 52.1% in male patients). However, these differences were not statistically significant. Currently, studies have reached inconsistent conclusions regarding the time spent deciding to seek medical assistance at a hospital, arrival time, or prehospital time. Some studies concluded that there was no difference between male and female patients;[19,32-34] whereas other studies concluded that female patients had longer delays[12,26-28,35,36] or that the prehospital time was longer in male patients. In our study, the

10.8% and 8.8% differences in proportions between male and female patients may have been non-significant due to the small sample size. In other words, the notion that female patients tended to arrive later at hospitals appears rational.

When factors influencing the time spent deciding to seek medical assistance at a hospital in male and female patients were analyzed, male patients with a history of CVD made later decisions (OR, 4.86; decision delay ≥60 minutes). Moreover, although the differences were not statistically significant ($p>0.05$), male patients with diabetes and dyslipidemia tended to make decisions to seek medical assistance at a hospital later. Such findings are similar to those of the randomized clinical trial conducted by Mooney, et al.[37] They divided 1944 patients who were treated for acute coronary syndrome into an intervention group receiving education and a control group (n=972 patients in each group). In the control group, the arrival time was more prolonged for recurrent episodes of acute coronary syndrome than for the initial episode. Considering the results of our study and those of the study by Mooney, et al.,[37] patients who appear to be less interested in their health seem to have worse health-related behaviors. Accordingly, these people would be more susceptible to chronic diseases and myocardial infarction. In addition, these people would arrive at hospitals later when myocardial infarction symptoms appear, since they appear uninterested in their symptoms or consider them trivial. Because a recurrent infarction in patients with previous CVD may be associated with different symptoms and more tolerable pain compared to first infarction,[38] education on prevention and recurrence would be necessary in male patients with chronic diseases or a history of AMI.

Among the female patients, the time spent deciding to seek medical assistance at a hospital was more prolonged in those with low education. Up to the present, studies in female patients have investigated prehospital delay times according to education level only. Moser, et al.[17] found no differences by education level. However, some studies[39-41] that did not assess male and female participants separately reported that education level exerted significant influences on the decision time to seek medical assistance at a hospital, and, as in the present study, the delay in these studies could have been further prolonged in female patients. Late decisions in poorly educated female patients may be due to aging and lack of knowledge of symptoms for AMI. In fact, in our data, poorly educated female patients were older and did not have knowledge of symptoms for AMI compared to highly educated female patients. Therefore, preventive measures and education for females should be customized appropriately for their education level.

The present study also analyzed factors influencing arrival time with some predictable outcomes. The OR for an arrival time delay ≥120 minutes was 74.82 for men who made late decisions to seek medical assistance at hospitals. Moreover, the arrival time was also prolonged when patients visited other hospitals. This is consistent with the findings of several pre-

vious studies,[7,10,27,36,42] which reported that the arrival and treatment delay times are prolonged when patients visit other hospitals that are unable to treat their conditions. In contrast, the use of EMS did not exert any significant influence on arrival time (OR 1.28). This finding contradicts the findings of some previous studies,[12,43] but is consistent with those of other studies.[37] Since the use of EMS requires additional time to call the EMS and travel, it would not have exerted any significant influence. Particularly for those living in urban areas where the distance to hospitals is often short, the arrival time would not have been different considerably according to EMS use. Other factors that influenced arrival time included a history of CVD and PCI. These factors also influenced the time spent deciding to seek medical assistance at a hospital; in other words, they are effective modifiers of arrival time. Patients with disease histories made decisions late to seek medical assistance at a hospital, which prolongs the arrival time.

Similarly, the time spent deciding to seek medical assistance at a hospital was a factor that influenced the arrival time of female patients; late decisions resulted in late arrival at the ER. Moreover, patients arrived at the ER later when they visited other hospitals. As in male patients, arrival time was not influenced by use of the EMS. Those that consumed alcohol arrived at the hospital earlier; however, due to the small number of female patients who consumed alcohol, this finding is unreliable. Furthermore, in univariate analysis, the arrival time was prolonged in those with low education; however, in multivariate analysis, education level did not lead to any significant differences in arrival time. Since this finding is inconsistent with those of other previous studies,[39-41] an analysis of more patients would be required to assess arrival time by education level. Nonetheless, since those with low education made decisions late to seek medical assistance at a hospital, these late decisions would have led to ER arrival delays.

Limitations

The present study has several limitations. First, symptom onset and the time spent deciding whether to seek medical assistance at a hospital, which are important variables in the present study, were recalled based on the patients' memories. Although the investigation was conducted by a professional nurse, recall bias could have been present. Second, patients who died on arrival and those who could not be interviewed because of their severity of condition were not investigated. Such fundamental limitations must be considered in the interpretation of our results. Third, a smaller number of female patients was included, considering the whole patient could have led to limited reliability. In fact, the CIs in female patients were often very wide. Furthermore, even OR values that were deemed clinically significant had no statistical significance because of the small sample size. This necessitated the interpretation of the absolute OR and CI values.

Conclusion

Despite the limitations due to the study design, the present study is significant as it addresses the need to separately analyze the decision times to seek medical assistance at a hospital and arrival times for each gender among patients with myocardial infarction. This is because myocardial infarction presents different characteristics in men and women. Moreover, since few studies have investigated Korean patients, our study's findings are even more significant and may be used to prepare national policies. Factors that influenced the time spent deciding to seek medical assistance at a hospital included CVD history in men and a lower education level in women. Visits to other hospitals influenced the arrival time for both men and women. In addition, the arrival time in men was delayed when the patients had a previous history of CVD or PCI.

These findings suggest the need to prepare appropriate education programs on preventing cardio-cerebrovascular diseases for men and women. For men, education about symptoms and the risks of complications would be required for those with chronic diseases or CVD. For women, customized education for individuals with different educational backgrounds would be required. Furthermore, for symptomatic patients to arrive as early as possible at a hospital for treatment, the contents of educational programs for the general public and emergency medical technicians should to be reinforced.

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