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Latent class cluster analysis of knowledge on acute myocardial infarction in community residents: a cross-sectional study in Tianjin, China

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ABSTRACT

Objective Public knowledge of early onset symptoms and risk factors (RF) of acute myocardial infarction (AMI) is very important for prevention, recurrence and guide medical seeking behaviours. This study aimed to identify clusters of knowledge on symptoms and RFs of AMI, compare characteristics and the awareness of the need for prompt treatment.

Design Multistage stratified sampling was used in this cross-sectional study. Latent GOLD Statistical Package was used to identify and classify the respondent subtypes of the knowledge on AMI symptoms or modifiable RFs. Multivariable logistic regression was performed to identify factors that predicted high knowledge membership.

Participants A structured questionnaire was used to interview 4200 community residents aged over 35 in China. 4122 valid questionnaires were recovered.

Results For AMI symptoms and RFs, the knowledge levels were classified into two or three distinct clusters, respectively. 62.7% (Symptom High Knowledge Cluster) and 39.5% (RF High Knowledge Cluster) of the respondents were able to identify most of the symptoms and modifiable RFs. Respondents who were highly educated, had higher monthly household income, were insured, had regular physical examinations, had a disease history of AMI RFs, had AMI history in immediate family member or acquaintance or had received public education on AMI were observed to have higher probability of knowledge on symptoms and RFs. There was significant difference in awareness of the prompt treatment in case of AMI occurs among different clusters. 'Calling an ambulance' was the most popular option in response of seeing others presenting symptoms of AMI.

Conclusions A moderate or relatively low knowledge on AMI symptoms and modifiable RFs was observed in our study. Identification of Knowledge Clusters could be a way to detect specific targeted groups with low knowledge of AMI, which may facilitate health education, further reduce the prehospital delay in China and improve patient outcomes.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Multistage stratified sampling was used to cover 4200 community residents aged over 35, in China, which was proportionally distributed by age.
- ⇒ Latent Cluster Analysis was used to identify latent knowledge clusters through software analysis.
- ⇒ Each unique cluster has a predictive knowledge probability of each symptom or risk factor of acute myocardial infarction (AMI).
- ⇒ It should be noted that other atypical onset symptoms or modifiable risk factors of AMI are not investigated.

INTRODUCTION

It is estimated that 55 million deaths occurred in the world in 2017, of which 17.7 million were from cardiovascular disease (CVD).[1] In 2015, CVD accounted for 40% of all deaths in China.[2] It is reported that about 1 in 10 persons had high CVD risk among the 1.7 million Chinese participants in a national CVD screening project[3]. In view of China's high prevalence of hypertension, diabetes, hyperlipidaemia, obesity and tobacco use, poor knowledge of CVD occurs in a developing country where the burden of risk factors is considerable, and sufficient attention should be paid.

During the onset of acute myocardial infarction (AMI), being able to rapidly and accurately recognise the onset symptoms could mean getting quick and appropriate medical care and further imply the differences between favourable or adverse outcomes. Studies have proved that high awareness of AMI symptoms could significantly reduce patients' prehospital delay time,[4] which results in better MI outcomes.[4 5] Studies have indicated that over 70% of CVD cases can be attributed to a small and common cluster of modifiable risk factors.[3 6] The metabolic risk factors (ie, lipids, blood pressure, diabetes, obesity) were the predominant individual-level risk factors, with hypertension being the largest, accounting for 22.3% of the population-attributable fraction, while the behavioural risk factors (ie, tobacco use, alcohol, diet, physical activity and sodium intake) contributed most to deaths.[6] The INTERHEART study showed that nine potentially modifiable risk factors (smoking, alcohol, hypertension, diabetes, abnormal lipids, abdominal obesity, psychosocial factors, regular physical activity, consumption of fruits and vegetables) account for most of the risk of an initial AMI worldwide (over 90%).[7] Knowledge about modifiable risk factors of AMI is a vital prerequisite to change the individuals' health attitudes, behaviours and lifestyle practices. The grasp of these health knowledge will enable individuals to take a proactive attitude and actively avoiding exposure to risks, therefore to reduce their lifetime risk.[8] In long-term practical sense, adequate knowledge of symptoms and modifiable risk factors of AMI may be a precondition for successful implement of prevention and control strategies.

Knowledge of AMI, its symptoms and risk factors have been studied worldwide in various populations, whether in patients or in the general population.[9–13] However, the studied specific symptom and risk factor of different surveys varies, the number of surveyed symptom and risk factor varies and the criteria for judging good/high knowledge or bad/low knowledge are different (group classification criteria include the number, the percentages or the scores),[14 15] which makes the results difficult to compare. Therefore, in this study, we use Latent Cluster Analysis to identify latent knowledge clusters through software analysis. Each unique cluster has a predictive knowledge probability of each symptom or risk factor. In this way, we compare the socioeconomic and other characteristics, along with their medical seeking behaviours in cope of AMI occurs among different clusters. We believe the interpretation of the study may guide the development of targeted strategies for health promotion and education for community residents on AMI in the future.

METHODS

Study design

Multistage stratified sampling was used in this cross-sectional study. In the first stage, two districts were selected from each of the urban and rural districts in Tianjin. In the second stage, 3–10 community health service centres were randomly selected in each district. In the third stage, residents over 35 managed by the community health service centre were proportionally selected for interview. The sample was proportionally distributed by age according to the Sixth National Census data (2010). The sex ratio was 1:1. The calculated sample size was based on the significance level of 0.05, the allowable error of 0.1 and the estimated excellent symptom knowledge level of 10%. Considering the non-response rate of 20%, the final sample size was adjusted to 4200.

This study complied with the 1975 Declaration of Helsinki. The study was approved by the Ethics Committee of Tianjin Chest Hospital, China (2018KY-010-01). All participants gave written informed consent before the investigation.

Data collection

The investigation period was from April to December, 2019. The respondents were face-to-face interviewed by trained clinical physicians. The items of early onset symptoms of AMI listed include sudden pain or discomfort in the jaw, neck, or back; sudden weakness or dizziness; sudden pain or discomfort in the chest; sudden pain or discomfort in the arms or shoulders and sudden difficulty breathing. The section of the questionnaire on early symptoms of AMI was based on parts of the Behavioural Risk Factor Surveillance System (BRFSS).[16] The AMI risk factors were selected through an extensive review of the literature. The seven modifiable AMI risk factors include behavioural factors (tobacco use, alcohol use and lack of physical activity) and metabolic factors (obesity, hypertension, diabetes and hyperlipidaemia). Respondents responded yes or no to whether a particular symptom or risk factor was associated with AMI.

The socioeconomic characteristics were also investigated, including gender, age, education level, monthly household income, insurance, marital and living status. Other factors included smoking and drinking status, regular physical examinations, disease history (hypertension, diabetes mellitus, dyslipidaemia, stroke, AMI), received AMI-related public health education and received instructions by a physician on AMI. Respondents were asked whether they would choose to go to the hospital within 30 min when chest pain first attacks and whether they would call an ambulance to go to the hospital. The medical seeking behaviours were also investigated in case of AMI occurs. Specifically, for seeing others presenting symptoms of AMI, the respondent was asked to choose one answer among 'take him/her to hospital', 'call an ambulance', 'contact family', 'contact a community doctor for advice', 'take aspirin and wait for the symptoms to disappear' or 'I do not know'.

Statistical analysis

The EpiData V.3.1 software was used for the database set up, dual input and consistency check. Latent class cluster analysis, using the Latent GOLD Statistical Package,[17] was used to identify and classify the respondent subtypes (latent classes) of the knowledge on AMI early onset symptoms or modifiable risk factors. An individual's class membership probabilities are computed from the estimated model parameters and the observed scores. SPSS software (V.22.0, Chicago, IL, USA) was used for the following statistical analysis. When indicated, the values are expressed as percentages (%) or mean±SD. The comparison of the differences among symptom or risk factor clusters based on sociodemographic and other characteristics was performed using the χ^2 test. Quantitative data were analysed using t test or analysis of variance. The cluster membership of clusters was conversed

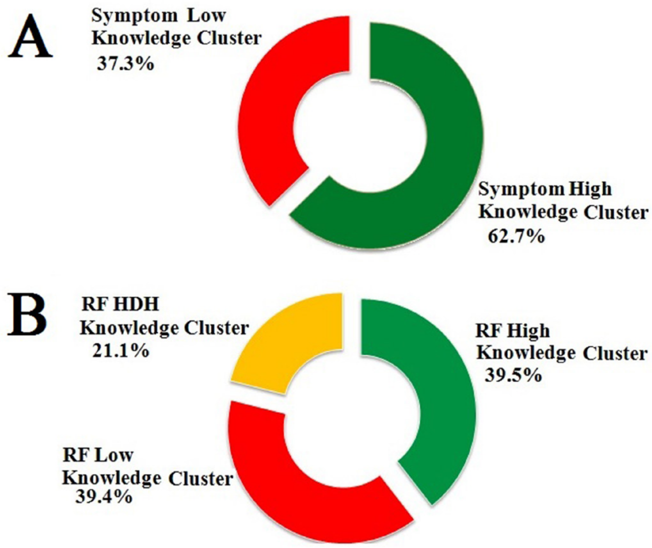

Figure 1 Cluster category chart: the proportion of respondents assigned to different symptom/risk factor knowledge clusters. (A) Symptom Knowledge Cluster and (B) Risk Factor Knowledge Cluster.

to an SPSS data set to identify the membership and associated factors. The multivariable logistic regression was performed in order to identify factors that predicted High knowledge membership. The ORs and 95% CIs were provided. A statistically significant difference was defined as p<0.05.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Baseline characteristics of the respondents

The average age of the respondents was 52.5±11.3 years old (rang from 35 to 97). The proportion of male was 48.5%; 94.7% of the respondents reported living together with companions (spouse, parents or children) and 34.0% had education background of college graduate or higher. There were 71.6% of the respondents who had regular physical examinations and those with insurance accounted for 97.5%.

Overall, the respondents identified 2.97 of the 5 AMI early onset symptoms (with SD=1.79; median=3 with an IQR of 1–5). The top three AMI symptoms recognised by community residents were ‘pain or discomfort in the chest’ (71.3%), ‘difficulty breathing’ (65.1%) and ‘pain or discomfort in the jaw, neck or back’ (60.9%); 28.3% of the respondents could recognise all five AMI early onset symptoms and 15.0% could not recognise any of the symptoms.

As for the seven modifiable AMI risk factors, the respondents could identify 3.81 risk factors (with SD=2.29; median=3 with an IQR of 2–6). The proportion of respondents who recognised all 7 RF and 0 RF were 21.8% and 8.5%, respectively. Approximately 43.4% of the respondents had at least one self-reported RF for AMI. The residents’ knowledge levels of RFs were as follows: tobacco use (55.2%), alcohol use (54.1%), lack of physical activity (40.4%), obesity (48.8%), hypertension (69.8%), diabetes (54.4%) and hyperlipidaemia (58.3%).

In case of the need for prompt treatment for AMI, 79.6% of the respondents chose to go to the hospital within 30 min when chest pain first attacks, and 79.3% chose to call an ambulance to go to the hospital. Meanwhile, 85.0% of the respondents chose to call an ambulance as their first response when witness others having a heart attack.

Symptom knowledge clusters and risk factor knowledge clusters identified by latent class cluster analysis

In the latent class cluster analysis, the responses to all five early onset symptoms and seven modifiable risk factors of AMI items were included separately in two model estimations. For AMI symptoms and risk factors, the knowledge levels were classified into two and three clusters, respectively.

For the symptom knowledge clusters, the cluster 1S (Symptom High Knowledge Cluster) and cluster 2S (Symptom Low Knowledge Cluster) counted for 62.7% and 37.3% of the respondents, respectively (figure 1A). Respondents in cluster 1S had much higher knowledge of the five early onset symptoms with a median of 4 (P25=3; P75=5) than respondents in cluster 2S (median=1; P25=0; P75=2). The respondents in cluster 1S were more likely to be younger, had higher education level, be insured and had regular physical examinations, than those in cluster 2S. The proportions of tobacco and alcohol use were also higher in cluster 1S. As for the disease history, the respondents in cluster 1S were more likely to have disease history of hypertension, dyslipidaemia and AMI, and to have immediate family member or acquaintance been diagnosed of AMI (table 1). Higher proportion of respondents in cluster 1S stated that they had received AMI-related public health education and had received instructions by a physician on AMI (table 2). Furthermore, the respondents in cluster 1S were more likely to be aware of the need for prompt treatment for AMI than those in cluster 2S (go to the hospital within 30 min when chest pain first attacks: 86.9% vs 67.4%; call an ambulance to go to the hospital when chest pain occurs: 85.3% vs 69.1%) (table 2). Figure 2A presents the prevalence of each Latent Symptom Knowledge Cluster and the predicted probability that respondents assigned to a Symptom Knowledge Cluster would know a certain symptom.

As for the knowledge levels of the seven modifiable AMI risk factors, three distinct clusters were identified by Latent Class Cluster Analysis. The cluster 1RF (RF High Knowledge Cluster, 39.5%) were more likely than cluster 2RF (RF Low Knowledge Cluster, 39.4%) (figure 1B) to be younger, had higher education level, with higher monthly

Table 1 Characteristics of respondents among different symptom/risk factor knowledge clusters

	Symptom knowledge cluster n (%)			Risk factor knowledge cluster n (%)			
Characteristics	Cluster 1S (high)	Cluster 2S (low)	P value	Cluster 1RF (high)	Cluster 2RF (low)	Cluster 3RF (HDH)	P value
Total	2586 (62.7)	1536 (37.3)		1629 (39.5)	1624 (39.4)	869 (21.1)	
Gender			0.129				0.348
Male	1277 (49.4)	721 (46.9)		808 (49.6)	765 (47.1)	425 (48.9)	
Female	1309 (50.6)	815 (53.1)		821 (50.4)	859 (52.9)	444 (51.1)	
Age group, years			0.000				0.000
35–45	842 (32.6)	386 (25.1)		516 (31.7)	430 (26.5)	282 (32.5)	
45–55	761 (29.4)	474 (30.9)		464 (28.5)	477 (29.4)	294 (33.8)	
55–65	525 (20.3)	403 (26.2)		362 (22.2)	424 (26.1)	142 (16.3)	
≥65	458 (17.7)	273 (17.8)		287 (17.6)	293 (18.0)	151 (17.4)	
Age range, years (mean±SD)	51.8±11.4	53.8±11.1	0.000	51.90±11.49	53.25±11.21	52.12±11.12	0.002
Education			0.000				0.000
Less than primary school	228 (8.8)	171 (11.1)		142 (8.7)	209 (12.9)	48 (5.5)	
Middle/high school	1319 (51.0)	1003 (65.3)		842 (51.7)	1006 (61.9)	474 (54.5)	
College graduate or higher	1039 (40.2)	362 (23.6)		645 (39.6)	409 (25.2)	347 (39.9)	
Monthly household income per capita, RMB			0.000				0.000
<4000	1033 (39.9)	904 (58.9)		699 (42.9)	885 (54.5)	353 (40.6)	
4000–8000	1424 (55.1)	559 (36.4)		817 (50.2)	660 (40.6)	506 (58.2)	
≥8000	129 (5.0)	73 (4.8)		113 (6.9)	79 (4.9)	10 (1.2)	
Insured	2561 (99.0)	1460 (95.1)	0.000	1612 (99.0)	1550 (95.4)	859 (98.8)	0.000
Regular physical examinations	2031 (78.5)	922 (60.0)	0.000	1264 (77.6)	1114 (68.6)	575 (66.2)	0.000
Married	2412 (93.3)	1442 (93.9)	0.443	1521 (93.4)	1515 (93.3)	818 (94.1)	0.693
Living status			0.817				0.090
Living with companion (spouse, parents or children)	2447 (94.6)	1456 (94.8)		1546 (94.9)	1524 (93.8)	833 (95.9)	
Living alone	139 (5.4)	80 (5.2)		83 (5.1)	100 (6.2)	36 (4.1)	
Smoking (yes or quit)	735 (28.4)	388 (25.3)	0.027	479 (29.4)	445 (27.4)	199 (22.9)	0.002
Drinking (yes or quit)	695 (26.9)	350 (22.8)	0.004	491 (30.1)	370 (22.8)	184 (21.2)	0.000
Hypertension	790 (30.5)	419 (27.3)	0.026	553 (33.9)	437 (26.9)	219 (25.2)	0.000
Diabetes mellitus	335 (13.0)	204 (13.3)	0.763	229 (14.1)	202 (12.4)	108 (12.4)	0.319
Dyslipidaemia	348 (13.5)	161 (10.5)	0.005	233 (14.3)	173 (10.7)	103 (11.9)	0.006
Stroke	31 (1.2)	18 (1.2)	0.939	26 (1.6)	13 (0.8)	10 (1.2)	0.111
History of AMI							
Respondent	44 (1.7)	9 (0.6)	0.002	23 (1.4)	17 (1.0)	13 (1.5)	0.539
Immediate family	124 (4.8)	31 (2.0)	0.000	86 (5.3)	35 (2.2)	34 (3.9)	0.000
Relative, acquaintance or neighbour	878 (34.0)	387 (25.2)	0.000	620 (38.1)	429 (26.4)	216 (24.9)	0.000

AMI, acute myocardial infarction.

Table 2 AMI-related education and knowledge of the need for prompt treatment for AMI in different symptom/risk factor knowledge clusters

Characteristics	Symptom knowledge cluster n (%)			Risk factor knowledge cluster n (%)			
	Cluster 1S (high)	Cluster 2S (low)	P value	Cluster 1RF (high)	Cluster 2RF (low)	Cluster 3RF (HDH)	P value
Received AMI-related public health education	1569 (60.7)	680 (44.3)	0.000	971 (59.6)	753 (46.4)	525 (60.4)	0.000
Received instructions by a physician on AMI	1409 (54.5)	683 (44.5)	0.000	903 (55.4)	725 (44.6)	464 (53.4)	0.000
Go to the hospital within 30 min when chest pain first attacks	2247 (86.9)	1035 (67.4)	0.000	1390 (85.3)	1155 (71.1)	737 (84.8)	0.000
Call an ambulance to go to the hospital when chest pain occurs	2205 (85.3)	1062 (69.1)	0.000	1391 (85.4)	1149 (70.8)	727 (83.7)	0.000

AMI, acute myocardial infarction.

household income, be insured, had regular physical examinations, had more tobacco and alcohol use, had disease history of hypertension and dyslipidaemia, had AMI history in immediate family members and relatives, had received AMI-related public health education and had received instructions by a physician on AMI (tables 1 and 2). Cluster 3RF (RF HDH Knowledge Cluster) was dominated by higher knowledge level of hypertension/diabetes/hyperlipidaemia (21.1%) (figure 2B), which tended to have relatively higher education level, less proportion of regular physical examinations, with less tobacco and alcohol use, have relatively low proportion of history of hypertension and have higher proportions of received AMI-related public health education and physicians' advise (tables 1 and 2). Respondents in cluster 1RF and cluster 3RF had the similar high awareness levels of prompt treatment in case of AMI occurs, which were both higher than those in cluster 2RF (table 2). The respondents could identify 6.25±0.94, 1.82±1.33 and 2.97±0.71 modifiable risk factors in clusters 1RF, 2RF and 3RF, respectively. Figure 2B presents the predicted probability that respondents assigned to a RF Knowledge Cluster would know a certain RF.

Multivariable logistic regression analysis of the estimated probability to assigned to a symptom/RF knowledge cluster

A number of common differences were observed with respect to higher probability of having high knowledge on symptoms and RFs, which was mostly better among those with higher education level and higher monthly

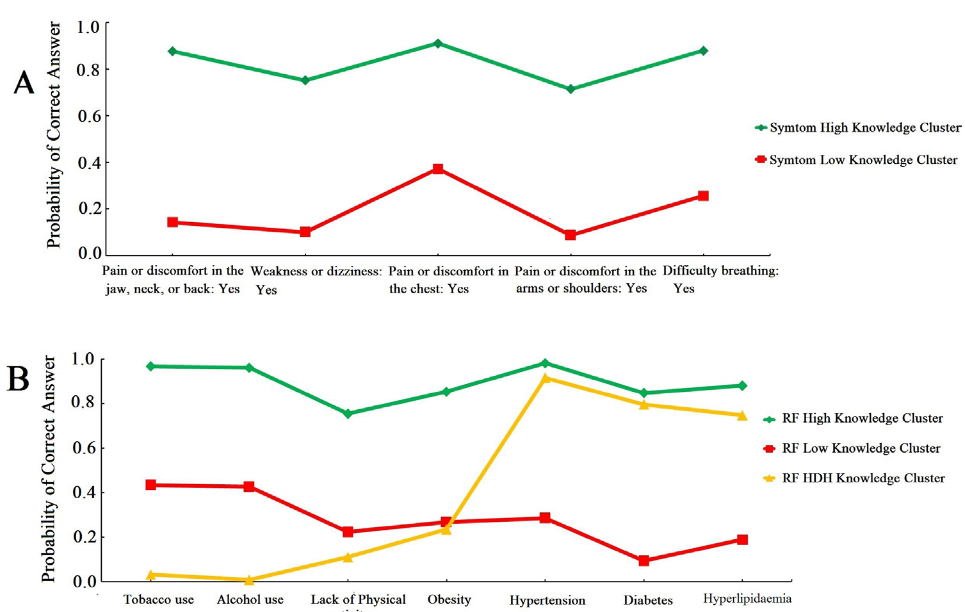

Figure 2 Profile plot for the 2/3-class LC model. On the x-axis are the indicators with respondents' response categories (symptoms or risk factors). On the y-axis, the conditional probabilities are put in the Latent Class Cluster Analysis, with each of the two/three latent classes being represented by a zigzag line. (A) Symptom Knowledge Cluster and (B) Risk Factor Knowledge Cluster.

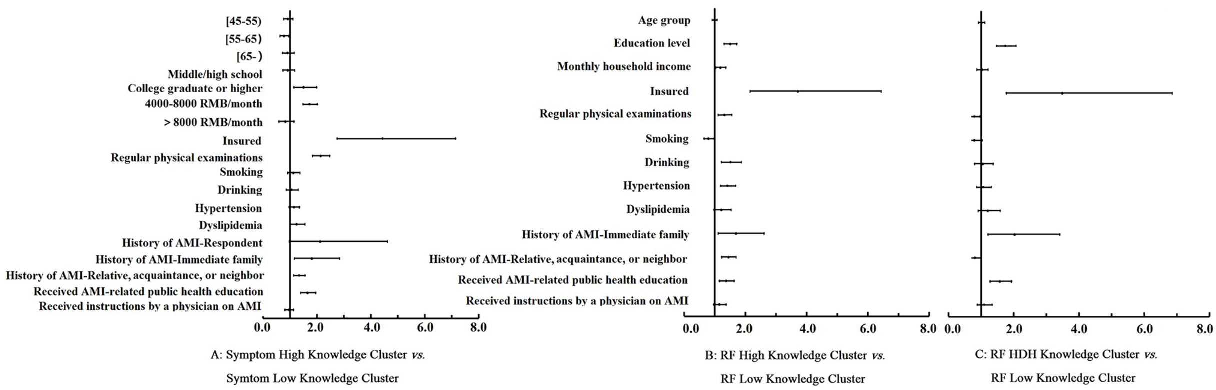

Figure 3 Multivariable logistic regression analysis-factors related to the estimated probability to assigned to a symptom/RF knowledge cluster. The multivariable logistic regression analysis was performed in order to identify demographic (eg, age, education level), medical characteristics (eg, history of hypertension and diabetes), education on AMI and other factors that predicted probability of presenting high knowledge of AMI. A statistically significant difference was defined at p<0.05. (A) Symptom High Knowledge Cluster vs Symptom Low Knowledge Cluster; (B) RF High Knowledge Cluster vs RF Low Knowledge Cluster; (C) RF HDH Knowledge Cluster vs RF Low Knowledge Cluster. AMI, acute myocardial infarction.

household income, be insured, had regular physical examinations, had disease history of possible AMI risk factors, had AMI history in immediate family member or acquaintance and had received AMI-related public health education (figure 3).

Emergency responses in case of AMI occurs in different clusters

Figure 4 shows the proportion of respondents' responses in case of seeing others presenting symptoms of AMI. 'Calling an ambulance' was the most popular option, while there were still differences among symptom/RF clusters.

DISCUSSION

In this large scaled community-based study from Tianjin, a municipality in North China, we found that public knowledge of AMI symptoms was at a moderate level, while knowledge on modifiable risk factors of AMI was relatively low. When latent class cluster analysis was used, the respondents were divided into two and three clusters in terms of their knowledge on AMI symptoms and risk factors. The data from our study showed that 62.7% and 39.5% of the respondents were able to identify most AMI early onset symptoms and modifiable risk factors.

Overall, the recognition of AMI symptoms was at a moderate level comparing with otherrelated studies.[18 19] Respondents in Symptom High Knowledge Cluster had significantly higher knowledge of AMI symptoms and had a greater than 70% probability of identifying four out of the five early onset symptoms. Unfortunately, 37.3% of the respondents were assigned into the Symptom Low Knowledge Cluster. Chest pain is a widely recognised symptom reported in related study,[11 19 20] however, the recognition probability of 'Chest pain and discomfort' in Symptom Low Knowledge Cluster was quite low (37.25%), let alone the other four symptoms (<25%). It has been reported that the knowledge level of AMI symptoms may affect the respondent's medical seeking behaviour, which may be a common reason for delays in seeking care in case of AMI.[21] This has also been verified in our study, that is, respondents in Symptom Low Knowledge Cluster had

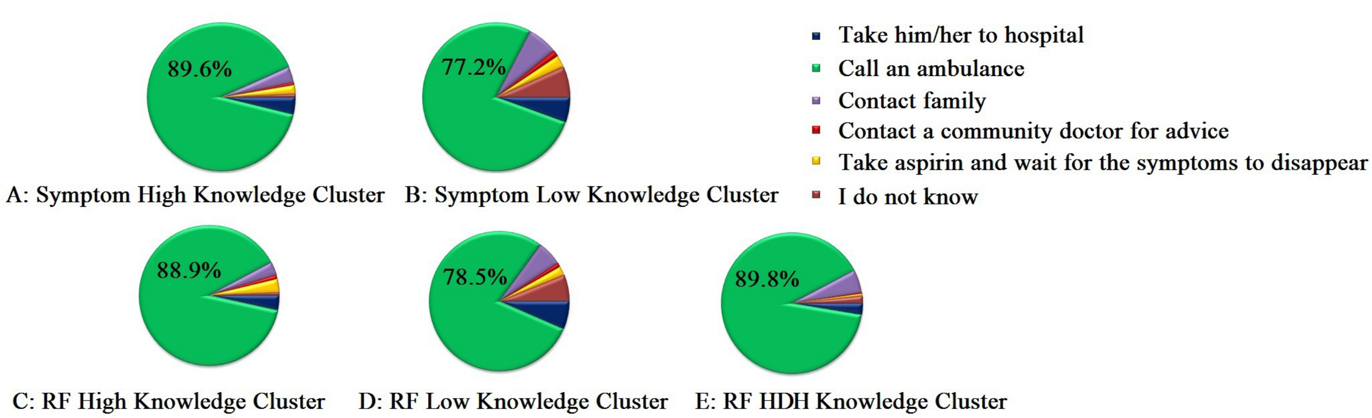

Figure 4 The distribution of respondents' choice in case of seeing others presenting symptoms of AMI. (A and B) Symptom Knowledge Clusters; (C–E) RF Knowledge Clusters.

significantly poorer cognition for prompt treatment of AMI, and the proportion of emergency system usage for AMI rescue was significantly low. Thus, targeted education focusing on specific population is imminent.

In terms of knowledge of AMI modifiable risk factors, the most identified were hypertension (69.8%), dyslipidaemia (58.3%) and tobacco use (55.2%). In present study, although in the RF High Knowledge Cluster, there was basically more than 75.43% probability that six out of seven AMI risk factors could be identified, the knowledge probabilities of lack of activity and diabetes were still the lowest in RF High Knowledge Cluster, which was 75.43% and 84.78%, respectively. Respondents in the RF Low Knowledge Cluster had a relatively low probability to identify lack of activity (22.19%), dyslipidaemia (18.82%) and diabetes (9.17%). Interestingly, in the RF HDH Knowledge Cluster, despite the high probability of knowledge of hypertension, dyslipidaemia and diabetes, the knowledge probabilities of other four risk factors were significantly low (tobacco use 3.05%; alcohol use 0.63%). The knowledge level of hypertension (69.8%) and diabetes (54.4%) we observed were higher than those reported in a national CVD screening project (43.1%, 30.6%) carried in China.[3] However, when comparing our findings with other studies examining knowledge of CVD/AMI risk factors, a lack of knowledge on risk factors in our studied community residents should be noted. Knowledge of hypertension and diabetes we observed was quite similar to findings from Beijing, Shanghai[12] and Kuwait,[15] which was lower than that in Cameroon.[14] Survey results from Northeast China showed that the awareness of diabetes in 1854 Chinese Adult was 64.1%, which was higher than that in our study.[22] Knowledge of dyslipidaemia was lower than that in Kuwait (69.7%),[15] and higher than that in Northeast China (14.4%).[23] Knowledge of other key risk factors such as obesity, physical inactivity, tobacco and alcohol use was far below that documented in other recent studies.[14 15 24] Unfortunately, the knowledge levels of AMI risk factors we observed in Tianjin were quite similar to those in Beijing and Shanghai,[12] which were at the same level as reported in the USA and Canada 20 years ago.[25 26]

Higher education levels were associated with a higher knowledge of AMI, which echoed the findings of previous studies that a relationship between higher education, higher income, insurance status and better overall understanding of health-related knowledge.[12 14 15 27 28] Education affects multiple conditions from childhood onwards, including contacts with community level factors (such as living or working in healthier environments) and better access to health and social resources. One possible explanation for that higher knowledge were seen in people with disease history of hypertension, dyslipidaemia and AMI was that they may have more interactions with the health system and may have more opportunity to receive public education and be instructed by a physician.[14 20 22 28 29] Respondents who had a history of AMI among immediate family members have a better knowledge, which was consistent with the Australian and Kuwait research.[15 30]

This study poses a challenge to healthcare providers: how to utilise the symptom and risk factor knowledge cluster to identify knowledge patterns and to develop wide-spread and effective educational strategies that may facilitate rapid identification of AMI onset symptoms and guide medical seeking behaviour. These included provision of educational materials, screening and monitoring of blood pressure, blood glucose and blood lipids and interventions in lifestyle modification (diet and weight management, regular exercise, smoking and drinking cessation).

Limitation

It should be noted that some other atypical onset symptoms of AMI, such as fatigue, indigestion, sweating and vomit, were not explored in present study. Similarly, other modifiable risk factors, such as stress and unhealthy diet, which had received more and more attentions recently, were not investigated. These would be further improved and investigated in future research.

CONCLUSIONS AND PRACTICE IMPLICATIONS

A moderate or relatively low levels of knowledge on AMI symptoms and modifiable risk factors was observed in our currently study, inferring an overall suboptimal knowledge on AMI, which could turn into insufficient preventative behaviours and suboptimal patient outcomes.

Identification of symptom/risk factor knowledge clusters can be a way to detect specific demographic groups that are most likely to possess higher or lower knowledge of AMI, with readily identifiable characteristics. This study should enable healthcare providers to educate targeted population at risk for low knowledge of AMI, which may further reduce the prehospital delay in China and improve patient outcomes.

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Contributors YL, JM and JG developed the overall methodology. YL, JM, NZ, JX, JW (Ji-xiang Wang) and JG contributed to the study design. JM, NZ, JX, JW (Ji-xiang Wang), XL, JW (Jing Wang), YZ, MG, XZ, YW, JW (Jing-xian Wang) and SX collected primary data. YL, JM, NZ and JG had access to the data and contributed to the data analysis. YL and JM drafted this manuscript and revised the manuscript. All coauthors critically reviewed this manuscript. All authors read and approved the final manuscript. JG acts as the guarantor, accepting full responsibility for the finished work and/or the conduct of the study, had access to the data and controlled the decision to publish.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants. The study was approved by the Ethics Committee of Tianjin Chest Hospital, China (2018KY-010-01). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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