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SHORT COMMUNICATION

Increased risk of acute myocardial infarction during colder periods is independent of the conventional cardiovascular risk factors: Takashima AMI Registry, Japan

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Abstract
We investigated the association of the variability of acute myocardial infarction (AMI) occurrences between warm and colder periods and the conventional cardiovascular risk-factors. For the registered 429 first-ever-AMI event, the odd of suffering an AMI during the colder period was significantly higher (OR 1.47, 95%CI: 1.21–1.78). None of the conventional cardiovascular risk factors explains the excess risk of AMI during the colder period pointing towards the influence of AMI triggering factors in the time preceding onset of AMI irrespective of presence or absence of cardiovascular risk-factors.

Studies in various parts of the world have reported that the hospital admission, incidence and mortality of acute myocardial infarction (AMI) increase in winter and spring and decrease in summer and autumn [1–3]. This categorization of the year into seasons mainly reflects the segregation of warmer and colder periods. Although it is well established

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that AMI incidence is affected by risk factors such as hypertension, diabetes mellitus, dyslipidemia, obesity, cigarette smoking, alcohol consumption [4], the effects of these risk factors on a warmer-colder period variation in AMI incidence have not been clearly addressed. Information about how the AMI incidences difference between warm and cold periods is influenced by conventional AMI risk factors might be helpful in identifying high risk groups and contribute in preventive efforts focused towards the periods of increased AMI risk. We, therefore, used a population based AMI registration system in Japan to investigate whether variability of AMI occurrences between warm and colder periods were associated with conventional cardiovascular risk factors.

Data were obtained from the Takashima AMI Registry, which covers a stable population of approximately 55,000 people in Takashima County in the central part of Japan. Takashima County is located at approximately 35° north and 136° east. The average annual temperature is about 13.5 °C, ranging from 2.5 °C in February to 29.5 °C in August. The registered patients included all residents of Takashima County who suffered from AMI. Details of the case finding, registration process, diagnostic criteria and items registered have been described elsewhere [5,6]. All suspected AMI cases in the population during 1988–2004 were registered on the basis of the medical records from all the relevant hospitals inside and outside the county and the county ambulance records. For possible inclusion in the registry, all suspected AMI events, both hospitalized cases and out-of-hospital cases were identified, evaluated, and confirmed using several sources of information. For hospitalized cases, hospital admission, discharge or death records were routinely collected for suspected AMI events and validated by project criteria. For non-hospitalized cases (deaths in emergency rooms, deaths on/during arrival at hospital, or community deaths) the event information was collected from emergency room records, ambulance records, and death certificates. For information of pre-hospital fatal cases, ambulance records and death certificates at the local government were screened for acute events and validated according to the study criteria [5,6]. AMI diagnostic criteria employed in this study are established by the Monitoring system for Cardiovascular Disease commissioned by Ministry of Health and Welfare, Japan. These criteria are in accord with the WHO-MONICA project. Validation of diagnosis of the registered events was based on information on medical history, clinical symptoms, electrocardiograph (ECG) as well as cardiac enzymes findings. For cases of out of hospital cardiac death, ECG findings and cardiac enzymes levels were often not available. In such cases we had to base registration on the patients' location and symptoms at onset and their history of CHD. Patient's privacy was protected at all times.

The mean monthly temperatures for the study area for the duration of the study period (1988–2004) were obtained from the Japan Meteorological Agency [7]. We dichotomized the year into a warm period (May to October; mean monthly temperatures 16.5–25.9 °C) and a cold period (November to April: mean monthly temperatures 2.8–11.5 °C). Multiple logistic regressions were used to test the associations of age, gender, hypertension, diabetes, dyslipidemia, obesity, previous stroke, presence of other heart disease, current smoking and drinking habit with the occurrence of AMI during the cold period. This study was approved by the Institutional Review Boards of the Shiga University of Medical Science.

We registered 429 first-ever cases of AMI (281 males and 148 females) during the period of 1988–2004. Table 1 shows the characteristics of the patients registered during the warm and cold periods. Out of all registered events, 174 patients suffered AMI during the warm period and 255 during the cold period ($p < 0.001$). The odd of suffering an AMI during the colder period was significantly higher than the warmer period of the year (OR 1.47, 95%CI: 1.21–1.78). The regression analysis results indicate that none of the conventional cardiovascular risk factors explains the excess risk of AMI during the colder periods in reference to the warmer periods of the year (Table 2).

The reasons underlying the increased AMI risk during the colder periods are not well understood. It has been proposed that climatic effects and the resulting variation in biological factors may potentially mediate increases in disease incidence or its outcome. The variation in temperature has been considered to be the most likely influence on AMI incidence [8]. Cold temperature can cause increased cardiac workload, higher coronary and vascular resistance, higher blood pressure, higher serum cholesterol, triglyceride, and some blood components and clotting factor levels such as fibrinogen and activated factor VII levels, all of which are associated with risk of AMI [9,10]. Moreover, seasonal patterns of infection and air pollution may also influence the seasonality of AMI incidence [1,3]. Thus our analysis points towards an influence of internal or external AMI triggering factors in the time preceding onset of AMI. An understanding of the potential determinants and other physiologic mechanisms responsible for the cold period ex-

Table 1 Baseline characteristics of 429 subjects with acute myocardial infarction during warm and cold periods of the year. Takashima AMI Registry 1988–2004.

Characteristics	Warm period ($n = 174$) %	Cold period ($n = 255$) %
Gender		
Males	44.1	55.9
Mean age (SD)	68.2 (13.0)	68.6 (14.4)
Females	33.8	66.2
Mean age (SD)	75.8 (9.8)	74.9 (12.3)
Age-group		
<65 years	39.8	60.2
⩾65 years	40.9	59.1
Risk factors		
Hypertension	40.2	38.4
Diabetes mellitus	29.9	25.5
Dyslipidemia	20.1	23.5
Obesity	8.6	5.5
Other heart disease	17.8	20.4
Past history of stroke	8.1	9.8
Current smoker	19.5	18.0
Current drinker	21.2	13.3

SD, standard deviation.

Table 2 Univariate and multivariate ORs for acute myocardial infarction during the cold period of the year. Takashima AMI Registry 1988–2004.

Variable	Univariate		Multivariate	
	OR	95%CI	OR	95%CI
Age (y)	1.00	0.99–1.02	0.99	0.98–1.01
Male gender	0.65	0.43–0.98	0.69	0.44–1.09
Hypertension	0.93	0.63–1.38	0.84	0.55–1.30
Diabetes mellitus	0.80	0.52–1.23	0.83	0.53–1.31
Dyslipidemia	1.22	0.76–1.96	1.31	0.79–2.17
Obesity	0.62	0.29–1.31	0.56	0.25–1.24
Other heart disease	1.18	0.72–1.94	1.24	0.72–2.13
Past history of stroke	1.24	0.63–2.46	1.23	0.61–2.51
Current smoker	0.91	0.55–1.48	1.28	0.71–2.29
Current drinker	0.57	0.34–0.95	0.56	0.31–1.01

OR, odds ratio.
CI, confidence intervals.

cess AMI occurrences may be useful in AMI treatment and management. The identity of these triggering factors, which may be of significant use in AMI prevention strategies, requires further investigations.

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