



Original Article

Snowfall reduces the risk of chronic subdural hematoma onset: Analysis of an administrative database in Japan

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ABSTRACT

Background: Chronic subdural hematoma (CSDH) is a frequently observed disease in neurosurgical practice. Although first snowfall has been considered to increase the onset of CSDH, few reports have assessed the relationship between snowfall and CSDH. In this study, we aimed to investigate the relationship between CSDH onset and first snowfall events.

Methods: This retrospective study was based on the Japanese Diagnosis Procedure Combination inpatient database from July 1, 2010, to March 31, 2016, and on the global observation of snowfall events in Japan obtained from the Japan Meteorological Agency. We used a binomial approximation to evaluate the average number of CSDH patients after first snowfall events compared with that before first snowfall events. We calculated the odds ratio of CSDH onset on the first snowfall.

Results: We identified 8526 CSDH patients from the database. A total of 5573 (65.4%) were observed before first snowfall events, and 2953 (34.6%) after first snowfall events. The first snowfall of winter was significantly associated with a reduction in the occurrence of CSDH (odds ratio, 0.53; 95% confidence interval; 0.51–0.55). In subgroup analysis, only the first snowfall in October was not associated with reduction in the occurrence of CSDH.

Conclusion: First snowfall events did not affect the onset of CSDH in Japan.

Keywords: Chronic subdural hematoma, Epidemiology, Neurosurgery, Snowfall, Trauma

INTRODUCTION

Chronic subdural hematoma (CSDH) is defined as a collection of encapsulated liquefied hematoma in the subdural space after head trauma and may result in brain compression and subsequent neurological deficits.^[5] The overall incidence of CSDH has been reported to be 7.35/100,000/year after 70 years of age in Helsinki, whereas the annual incidence in contemporary Japan is reported to be 20.6/100,000/year.^[2,6] Risk factors for CSDH have been widely discussed and are not only limited to a previous history of head trauma and the older age of the patient but also include hypertension diabetes mellitus, hypercholesterolemia, and the use of anticoagulant or antiplatelet agents.^[7,8,18]

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Snowfall has long been considered to be associated with CSDH onset. A previous small sample-size and single region study reported that snowfalls could be a risk factor for CSDH recurrence, although the study was not able to show the relationship between snowfall and CSDH occurrence.^[9] It remains unclear whether snowfall increases the occurrence of CSDH.

The aim of the present study was to investigate whether first snowfall increases the onset of CSDH using a Japanese nationwide administrative database.

MATERIALS AND METHODS

Data sources

Relevant data about CSDH were obtained from the Diagnosis Procedure Combination database. The database includes discharge abstracts and administrative claims from more than 1200 acute-care hospitals in Japan,^[16,19] covering more than 80% of all tertiary-care emergency hospitals in Japan. The database includes the following data for each patient: Zip code; date of admission; age; sex; diagnoses, comorbidities at admission, and complications after admission, recorded using the International Classification of Diseases, Tenth Revision (ICD-10) codes with text data entered in Japanese; procedures; drugs and devices used; length of hospital stay; and discharge status (discharge to home, discharge to other facility, or in-hospital death). A previous study examined the validity of the recorded diagnoses and procedures.^[17] The specificity of recorded diagnoses was found to exceed 96%, whereas the sensitivity was 50–80%. The specificity and sensitivity of recorded procedures were found to exceed 90%.

Meteorological analysis

The data for the global observation of snowfall events in Japan were obtained from the Japan Meteorological Agency.^[14] We extracted the 1st day of each snowfall event from more than 200 meteorological observatories in Japan.

Patient selection

We included patients who were diagnosed with traumatic subdural hematoma (ICD-10 codes: S65.0) or non-traumatic subdural hematoma (I62.0) from July 1, 2010 to March 31, 2016, and who were admitted between 2 weeks and 2 months before or after the 1st day of each snowfall event, because the time from head trauma to the onset of CSDH is typically more than 2 weeks.^[10] We excluded patients who were diagnosed with stroke, intracerebral hemorrhage, and subarachnoid hemorrhage as the main diagnosis (I60.9, I61.9, and I63.9). We classified patients into two groups: (I) CSDH patients admitted between 2 weeks and 2 months before the 1st day of snowfall (the before snowfall group), and (II) CSDH patients

admitted between 2 weeks and 2 months after the 1st day of snowfall (the after snowfall group).

Patient characteristics and outcomes

Patient characteristics included sex, age, recurrence, hypertension, hypercholesterolemia, diabetes mellitus, residence in a heavy snowfall area, latitude of residence, and month of CSDH onset. Patients were divided into the following groups based on age: 40–59 years, 60–69, 70–79, 80–89, and 90 years and older. Recurrence was defined as re-admission with the same ICD-10 codes. Heavy snowfall areas were identified in certain prefectures as defined by the Japanese law, and specifically the Act on Special Measures concerning Countermeasures for Heavy Snowfall Areas (Act No. 73 of 1962).^[15]

Patients' settlement areas were divided based on the north latitude: lower than 34°, 34–35, 35–37, 37–41, and higher than 41°. The months of the 1st day of snowfall events were from October to February each year.

Ethical statement

The present study was approved by the Institutional Review Board of The University of Tokyo. Because of the anonymous nature of the data, the requirement for informed consent was waived.

Patient and public involvement

No real patient involved in this study.

Statistical analysis

We used a binomial approximation to evaluate the average number of cases in the before snowfall and after snowfall groups. This is essentially equivalent to examining the deviations of each group from a common ratio, since the patient database was large and odds ratio can be estimated by the ratio in each group. The main advantage of this approach is that it is simple to program, easy to repeat, and readily generates odds ratio measures of relative risk along with 95% confidence intervals (CI). The binomial approximation is sufficiently simple that it can be checked with a hand-held calculator.^[11] Subgroup analysis was conducted to account for CSDH risk factors and meteorological factors. All *P* values were two-tailed; with relative risk estimates calculated using the exact 95% CI. All statistical analyses were performed using STATA/MP version 15.0 software (STATA Corp., College Station, TX, USA).

RESULTS

From July 1, 2010 to March 31, 2016, a total of 8,526 patients satisfied our selection criteria. Of them, 5573 (65.4%) were

observed before snowfall events, and 2953 (34.6%) after snowfall events. [Table 1] shows the baseline characteristics of patients with CSDH before and after the 1st day of snowfall. Patients in the before snowfall group had more hypercholesterolemia, and lived in heavier snowfall areas, compared with those in the after snowfall group. Age, north latitude of residence, and month of first snowfall were imbalanced. The first snowfall was significantly associated with a reduction in the occurrence of CSDH [odds ratio, 0.53; 95% CI, 0.51–0.55; Table 2]. In the subgroup analysis, the first snowfall significantly reduced the occurrence of CSDH in all subgroups, except the first snowfall in October [Table 2 and Figure 1].

DISCUSSION

This study investigated the effect of first snowfall on the onset of CSDH. We hypothesized that first snowfall events will increase CSDH onset; however, the results showed that first snowfall events were significantly associated with a reduction in the onset of CSDH.

This study aimed to examine whether snowfall could be a risk factor for the development of CSDH, and compared before and after the 1st day of snowfall during the snowfall season to

eliminate confounding factors such as temperature, climate, and barometric pressure.

A previous study found that snowfall could be a risk factor for CSDH recurrence.^[9] This small sample-size study analyzed aggregated data, whereas the present study analyzed individual data. Moreover, the previous study compared data across different years, while the current study compared data between the first snowfall events in the same year.

A potential reason for CSDH onset not increasing at first snowfall events may be that patients tended to stay at home because snowfall affects traffic safety by causing changes in roadway surfaces and visibility, thus resulting in more frequent crashes, spinouts, and breakdowns.^[1,13] Therefore, head traumas and consequently CSDH would be reduced. Another potential reason may be that patients died before the onset of CSDH. Several papers have reported the associations between snowfall and several potentially fatal conditions, such as major fractures or acute myocardial infarction.^[3,4] Patients may have died because of acute diseases before CSDH developed.

Subgroup analysis revealed that the first snowfall significantly reduced the occurrence of CSDH, except in October. These results may be explained by the fact that people did not tend to stay home because of milder temperatures in October.

Table 1: Baseline characteristics.

Variables	Total n (%)	Before snowfall n (%)	After snowfall n (%)	P-value
Total number	8526 (100)	5573 (65.4)	2953 (34.6)	
Sex, male	5640 (66.2)	3665 (65.8)	1975 (66.9)	0.300
Age in years				
40–59	471 (5.5)	320 (5.7)	151 (5.1)	<0.001
60–69	1171 (13.7)	820 (14.7)	351 (11.9)	
70–79	2631 (30.9)	1769 (31.7)	862 (29.2)	
80–89	3368 (39.5)	2131 (38.2)	1237 (41.9)	
90–	885(10.4)	533 (9.6)	352 (11.9)	
Recurrence	252 (3.0)	147 (2.6)	105 (3.6)	0.017
Medical history				
Hypertension	2770 (32.5)	1778 (31.9)	992 (33.6)	0.110
Hypercholesterolemia	810 (9.5)	501 (9.0)	309 (10.5)	0.027
Diabetes mellitus	1197 (14.0)	790 (14.2)	407 (13.8)	0.620
Geographic factor				
Heavy snowfall area	3641 (42.7)	2316 (41.6)	1325 (44.9)	0.003
Latitude of residence				
More than 41	580 (6.8)	320 (5.7)	260 (8.8)	<0.001
37–41	1041 (12.2)	636 (11.4)	405 (13.7)	
35–37	1248 (14.6)	856 (15.4)	392 (13.3)	
34–35	4442 (52.0)	2994 (53.7)	1448 (49.0)	
Less than 34	1215 (14.3)	767 (13.8)	448 (15.2)	
Month of snowfall				
October	115 (1.3)	65 (1.2)	50 (1.7)	<0.001
November	1832 (21.5)	1130 (20.3)	702 (23.8)	
December	4129 (48.4)	2688 (48.2)	1441 (48.8)	
January	2251 (26.4)	1491 (26.8)	760 (25.7)	
February	199 (2.3)	199 (3.5)	0(0)	

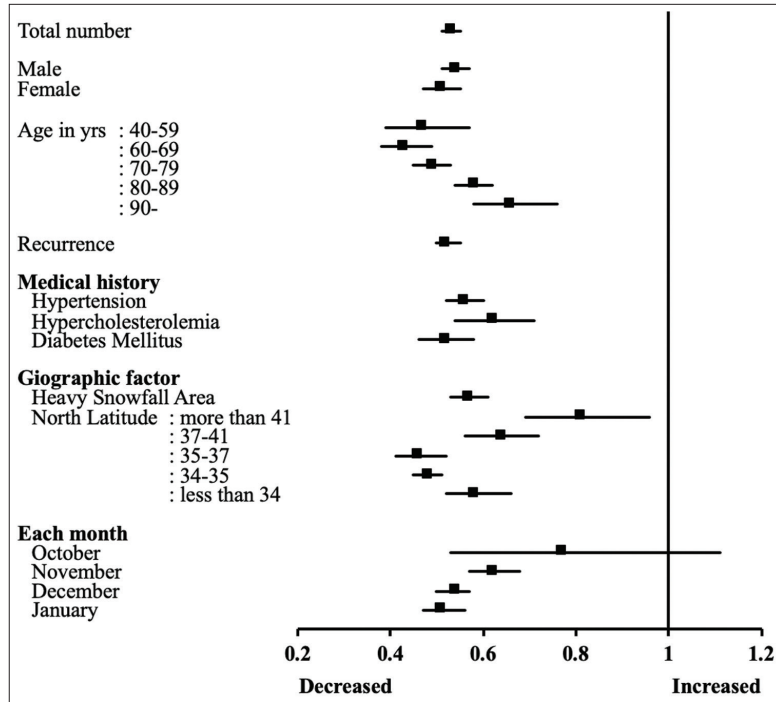


Figure 1: Association between occurrence of chronic subdural hematoma and snowfall by baseline characteristics.

Table 2: Relationship between onset of chronic subdural hematoma and snowfall by baseline characteristics.

Variables	Odds ratio	95% CI
Total number	0.53	0.51–0.55
Male	0.54	0.51–0.57
Female	0.51	0.47–0.55
Age in years		
40–59	0.47	0.39–0.57
60–69	0.43	0.38–0.49
70–79	0.49	0.45–0.53
80–89	0.58	0.54–0.62
90–	0.66	0.58–0.76
Recurrence	0.52	0.50–0.55
Medical history		
Hypertension	0.56	0.52–0.60
Hypercholesterolemia	0.62	0.54–0.71
Diabetes mellitus	0.52	0.46–0.58
Geographic factor		
Heavy snowfall area	0.57	0.53–0.61
Latitude of residence		
More than 41	0.81	0.69–0.96
37–41	0.64	0.56–0.72
35–37	0.46	0.41–0.52
34–35	0.48	0.45–0.51
Less than 34	0.58	0.52–0.66
Month of snowfall		
October	0.77	0.53–1.11
November	0.62	0.57–0.68
December	0.54	0.50–0.57
January	0.51	0.47–0.56

CI: Confidence interval

Although our study represents a large-scale analysis of CSDH in Japan, a number of limitations deserve attention. First, the database does not include detailed clinical information such as symptoms, vital signs, laboratory data, and medication history before admission. The previous studies have suggested that anticoagulant and antiplatelet agents are associated with the onset of CSDH.^[8,12] Second, because the onset of CSDH is not acute, confounding factors occurring between the first snowfall and the onset of CSDH may exist. Because the databases did not include information about events occurring between snowfall and CSDH presentation, we were not able to take such possible confounders into account.

CONCLUSION

The present study, using a national inpatient database in Japan, did not find that CSDH onset was significantly higher after first snowfall events.

Declaration of patient consent

Patient’s consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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