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Full Length Research Paper

Onset epidemiology of new H1N1 influenza in Central Japan - Social morphologic approach

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The swine influenza A (H1N1) virus had spread rapidly throughout the world in 2009. Japan's Ministry of Health Labor and Welfare collected detailed data for each patient at the beginning of the outbreak in Japan. We described the characteristics of H1N1 infections in three big cities in Japan and examined the correlation between factors using multiple correspondence analysis method. We obtained patients data from governmental published data through internet from May 8 to June 30, 2009. We collected patients' socio-economical background and categorized most likely source of infection into three groups. We used multiple correspondence analysis method. The collected data showed that 57.9% of 908 patients were of age 11 to 20. Based on the numerical data, we made multiple correspondence analysis map. This map showed each area's patients characteristics simultaneously. This article extended the sociological thinking into the field of emerging infectious diseases. We had many H1N1 patient data. Each data showed a few meanings, but each data's correlation was sometimes complicated and hard to understand. The multiple correspondence analysis maps were strong tool for understanding the relationship factors of diseases.

Key words: Epidemiology, swine influenza A(H1N1), Japan.

INTRODUCTION

On April 17, 2009, United States' Centers for Disease Control and Prevention (CDC) confirmed 2 cases of swine influenza A(H1N1) (CDC, 2009). Earlier, the Mexico's had reported many cases of Influenza-like illness (ILI) from March 18, 2009. 18 cases of Mexican ILI were confirmed as swine influenza A/H1N1 (WHO, 2009). Following CDC's reports of the virus, on April 24, Japan enacted the New Influenza Prevention Law (NIPL) extensive measures to prevent introduction of the virus into the country. Given concerns that the novel virus could produce life-threatening disease, strict quarantines were instituted at international airports with, quarantine personnel checking each passenger from North America. Despite the quarantine, the first Japanese domestic case was reported on May 16, 2009 in Kobe, signaling the start of the H1N1 influenza epidemic in Japan (Shimada et al., 2009).

Japan's Ministry of Health, Labor and Welfare (MHLW) collected detailed data for each patient at the beginning of the outbreak in Japan. Under NIPL, doctors were required to report new influenza patients to the regional health center, and each health center reported the patient data to the Ministry of Health Labor and Welfare (MHLW). MHLW and each prefecture's health service bureau opened these patients' data for everyone. Throughout

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July, the number of patients increased dramatically, but no fatalities occurred until August 15. MHLW ceased mandatory collection of detailed patient data after July 25.

This study examines the data from the earliest H1N1 infections in the Osaka/Kansai, Tokyo metropolitan and Nagoya/Chubu areas. These areas are all located in central Japan and are major economic and political centers. We described the characteristics H1N1 infections in those 3 areas and examined the correlation between factors using multiple correspondence analysis method, applying a Social Morphological approach to Public health epidemiology. Through popular in social science statistics (Bourdieu, 1984; Greenacre et al., 1994), this method is less common in public health research. Applying this new approach to clarify correlation of factors can improve our understanding of how H1N1 is disseminated in central Japan and may yield useful insights into the anticipated next wave of influenza.

METHODOLOGY

Collecting data

We obtained the patients data from MHLW as well as local government published data through internet. Each reported patient was diagnosed in clinics or hospitals as A/H1N1positive using RT-PCR test. We collected patients' age, gender, occupation, residential address, recent overseas travel history, and suspected cause of infection. We categorized the most likely source of infection into three groups: overseas travel; contact with an infected person through school, office, family and/or friends; and unknown. Individuals who had more than one suspected source of infection were excluded from analysis. This analysis utilizes the data from May 8, the date of first Japanese case was reported, to June 30, 2009. Starting in July, some local governments stopped reporting detailed patient data due to the overwhelming increase in patient numbers in those areas. Therefore, an outer limit of June 30 was selected, to create a dataset with consistently reported details. The daily data was categorized into weekly data, and each week was numbered as Calendar order. For example, May 8th was belonged to Week 18, this meant Week 1 started from January 1st, 2009. The three geographic areas of analysis comprised approximately half of the total Japanese population and are shown in detail in Figure 1. Osaka/Kansai area includes; Osaka prefecture, Hyogo prefecture, Kyoto prefecture, Wakayama prefecture, Nara prefecture, and Shiga prefecture. Tokyo area includes; Tokyo metropolis, Kanagawa prefecture, Chiba prefecture, and Saitama prefecture. Nagoya/Chubu area includes; Aichi prefecture, Shizuoka prefecture, Gifu prefecture, and Mie prefecture.

Data analysis

We used multiple correspondence analysis method. Following Bourdieu's seminal studies of the morphology of social spaces, we analyzed the merged database by means of multiple correspondence analyses (Factor et al., 2010). Multiple correspondence analysis is a general model of correspondence analysis, in which several categories of variables with similar status are analyzed simultaneously (Veenstra, 2007). We made morphological maps using PASW 18.0®. We found that two dimensional depiction was sufficient to explain the majority of the variance (Greenacre et al., 1994; Higgs, 1990). Following Veenstra (2007), we interpreted the social morphology method as follows; identified the space structure and interpreted its main axes, plotted the distribution of each category (age, gender, living place, occupation, cause of infection, and onset week), and identified clusters of variables that were closely of each area plot. Finally, we found the relationship with each category of each area and reported these characteristics.

RESULTS

Our results displayed that 57.9% of patients were of age 11 to 20. Approximately 70% of the patient was under 20 years old and most of them were students, (65.1%) (Table 1). The probable cause of infection in 46.9 and 16.2% of the patients infection was contact with infected person from school or office or family or friends and overseas visiting, respectively. The diagnosed date is categorized into weeks. But at the beginning, the patient number is few (only 3 people in May 8th), so first 12 days are combined into one week (week 20).

The multiple correspondence analysis map is presented in Figure 2. And discrimination measures are shown in Table 2. As can be seen from the bottom of Table 2, the first dimension explains 44.1% and the second dimension 26.7% of the total variance. Table 2 suggests that the first dimension is influenced primarily by age (with a discrimination measure of 0.614), gender (0.481), occupation (0.631), probable cause (0.415), and diagnosed date (by week) (0.531). Figure 2 presents the distribution of these categories in social space. The vertical axis is characterized primarily by the patients living area. The horizontal axis is characterized primarily by other factors (age, gender, occupation, probable cause, and onset date). We integrated into 3 areas (as circle in Figure 2), each category in the circle characterize each area patients. As shown in Figure 2, the circle which is located left side of the middle shows as Osaka/Kansai areas patient characteristics. It includes men, student, the age is from 11 to 20, probable cause of infection was contact the patients from school or office or family or friends, and the infected date was week 20 and 21. The circle which is located at lower right shows Tokyo areas patient characteristics. And the upper right circle shows Nagoya/Chubu areas patient characteristics.

DISCUSSION

This article extends the sociological thinking into the field of emerging infectious diseases. We had a lot of H1N1 patient data from each hospital, local government and MHLW. Each data showed a few meanings, but each data's correlation was sometimes complicated and hard to understand. The multiple correspondence analysis maps are strong tool for understanding the relationship factors of diseases. Compare with normal graphs or charts, the map was very simple and clear for multiple

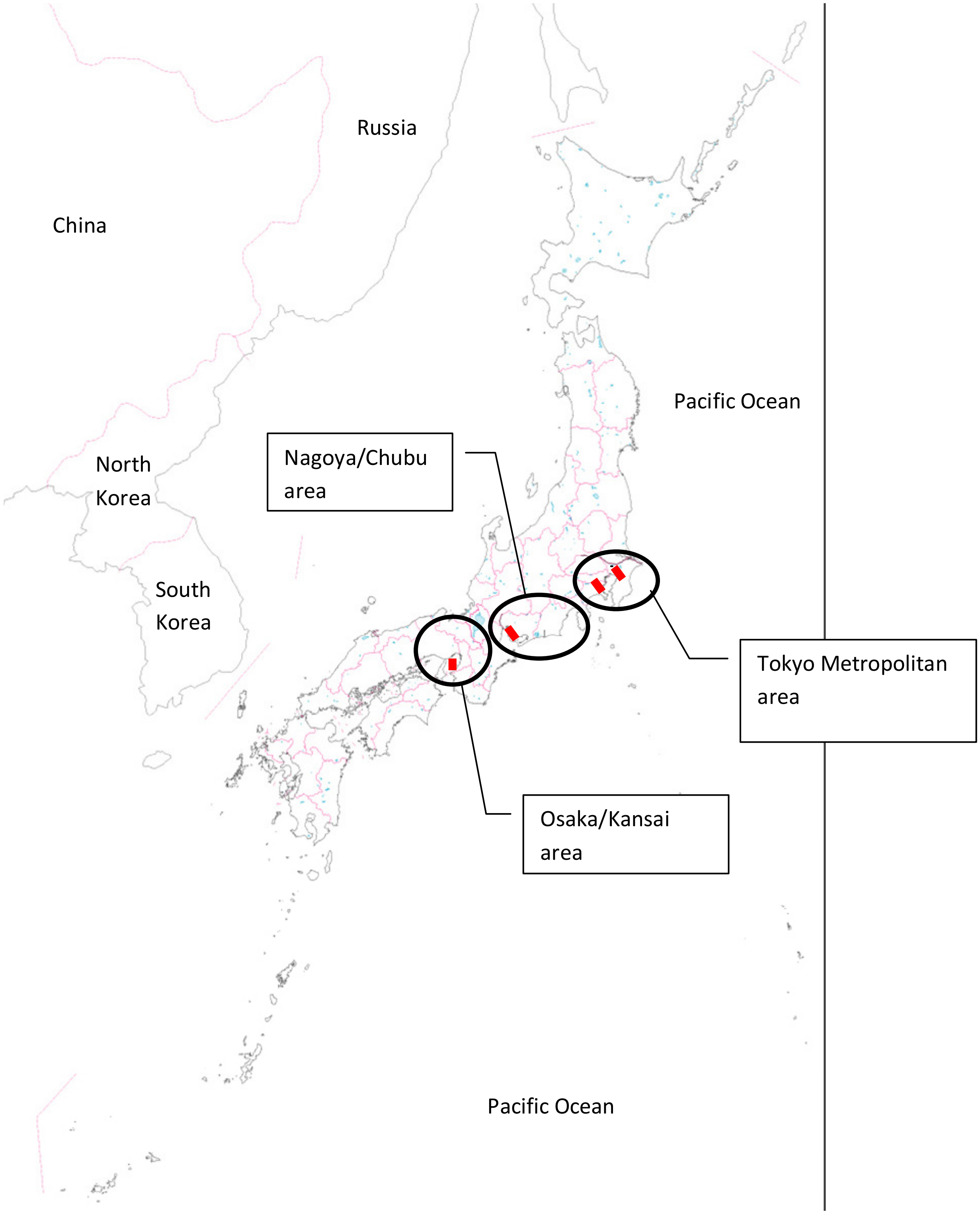

Figure 1. The map of Japan. (Red mark shows the location of International airport in these three areas.)

factors of each area's characteristics. We verified the accuracy of the multiple correspondence analysis map with some statistical data (Shimada et al., 2009; Nishiura et al., 2009; Wada et al., 2010; IDSC/NIID, 2009; Tokyo Metropolitan Infectious Diseases information center, 2009), the characteristics of Osaka area was the same at

Table 1. Attributes of new H1N1 patient in Central Japan during May- June, 2009.

Variable	Category	N	%
Age	Under 10 (a0-10)	101	11.1
	11 to 20 (a11-20)	526	57.9
	21 to 30 (a21-30)	135	14.9
	31 to 40 (a31-40)	60	6.6
	41 to 50 (a41-50)	46	5.1
	Over 51 (a51-60)	40	4.4
Gender	Men	521	57.4
	Women	387	42.6
Occupation	Student	591	65.1
	Office worker	104	11.4
	Doctor or Nurse	3	0.3
	Teacher	15	1.7
	Airport worker	16	1.8
	Non-Japanese visitors (tourist)*	7	0.8
	Others/Unknown (others-occ)	172	18.9
Living place	Osaka	396	43.6
	Tokyo	350	38.6
	Nagoya	162	17.8
Cause of infection	Overseas travel (overseas)	147	16.2
	Contact with an infected person from school/office/family in Japan	426	46.9
	Unknown	335	36.9
Onset date	Before May 20th (20)	220	24.2
	May 21st-May 27th (21)	92	10.1
	May 28th-Jun 3rd (22)	34	3.7
	Jun 4th-Jun 10th (23)	49	5.4
	Jun 11th-Jun 17th (24)	98	10.8
	Jun 18th-Jun 24th (25)	178	19.6
	Jun 25th-Jun 30th (26)	237	26.1

*Non Japanese visitors are living in their own countries, but we categorized that their living place area is case reported area. Therefore total living place number is not different.

the point of age distribution, occupation, disease affected week, and probable cause of infection. Tokyo area's characteristics had the same tendencies about cause of infection and time duration. Nagoya area's characteristics were the same as cause of infection, time duration and age distribution. Other factors were not published until now, therefore we could not compare. But as our available data were known, the multiple correspondence analysis map is an accurate reflection of disease characteristics.

This type of analysis was quite rare in the field of medicine (Caceres et al., 2010). Many diseases, especially non-communicable diseases such as hypertension, cancer, myocardial infarction, cerebrovascular diseases were considered multiple causes. The multiple correspondence analysis used multiple causes simultaneously. Therefore we can evaluate inter causes interaction.

Our study limitations are as follows; a part of the data is patient self-reported data, for protection of the privacy, some local government did not all disclose the patient detail data, we did not trace the patient who did not go to hospital/clinics, and the research period is only the first one month and a half.

Conclusion

It can be concluded that the H1N1 onset epidemiology of

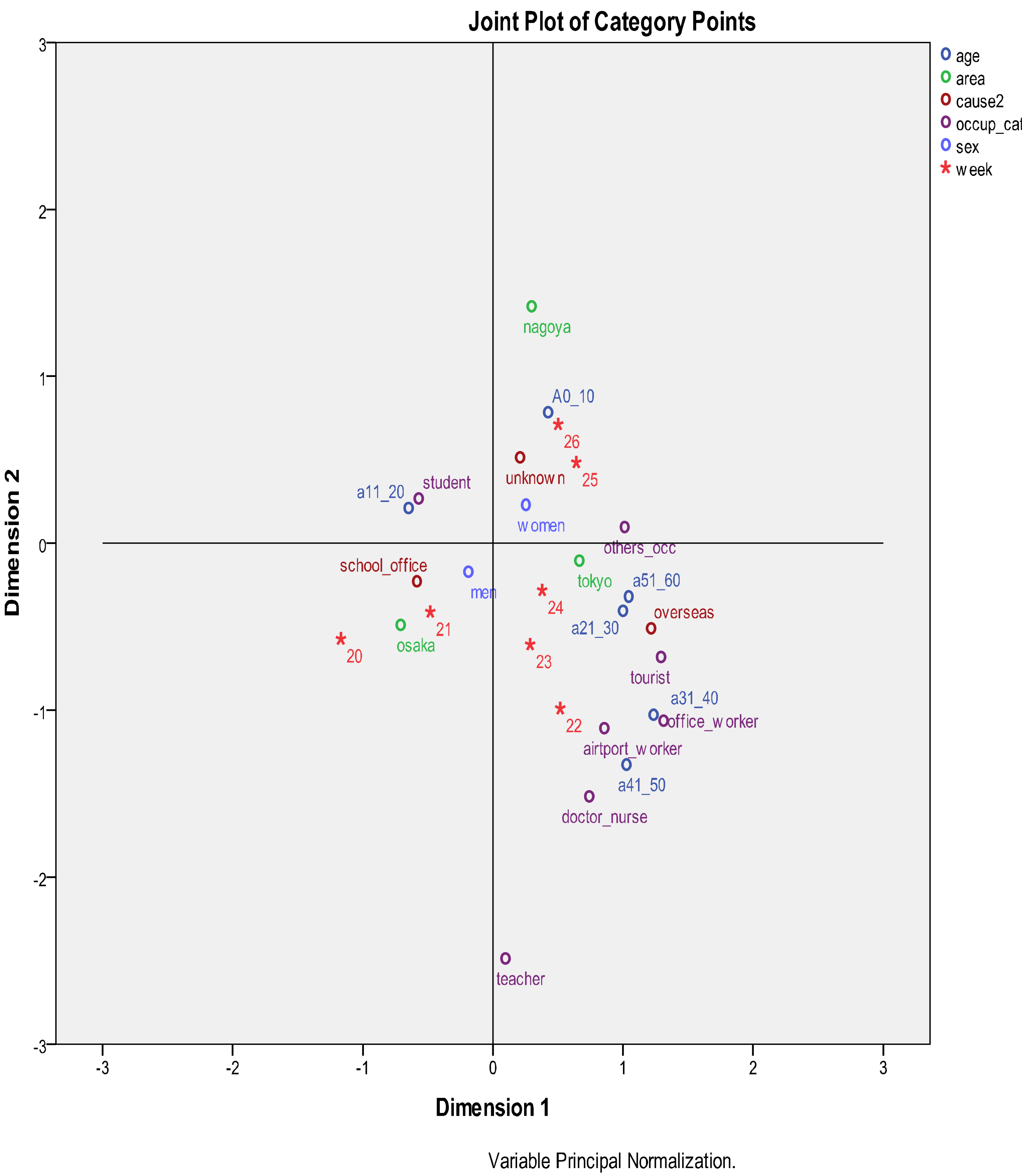

Figure 2. Multiple correspondence analysis map.

Osaka/Kansai area is characterized as 'student' diseases and Tokyo area as 'overseas travel diseases'. As mentioned previously, Japanese government decided to apply very severe quarantines for people coming from North American continents at the beginning of the disease outbreak. But they did not continue the severe quarantine, and changed their policy from quarantine to school closure. It is important to change their policy,

Table 2. Multiple correspondence analysis discrimination measures.

Items	Discrimination measures		
	Dimension		
	1	2	Mean
Age	0.614	0.282	0.448
Gender	0.048	0.039	0.044
Occupation	0.631	0.313	0.472
Living place	0.406	0.468	0.437
Probable cause	0.415	0.164	0.290
Onset date	0.531	0.340	0.435
Active total	2.645	1.606	2.125
% of variance	44.081	26.764	35.423

however, each area have their own characteristics, so they should apply the area's suitable prevention way.

According to our study, area of Osaka/Kansai is reasonable to apply school closure, but it is not effective for Tokyo metropolitan area. Our visible map is easily to point out the characteristics, so it will be a powerful tool to understand the cause of diseases.

Moreover, this analysis method is applicable to the next novel influenza or new type of communicable diseases. For example, avian influenza (H5N1) is now considerable for next pandemic influenza in human (Eyanoer et al., 2011). We can collect many human cases of H5N1 influenza in some countries (WHO, 2011). Our analysis method will help to evaluate patient's characteristics easily. Not only H5N1 influenza, but also many kinds of diseases can be evaluated by using multiple correspondence analysis. Therefore we strongly recommend using this analysis to understand disease characteristics.

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