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A Home-Visiting Clinic Decreased the Emergency Transportation in Rural Japan: A Quasi-Experimental Approach

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This study examined whether a home-visiting clinic decreased emergency transportations in the region, using a quasi-experimental approach derived from private practice. This study employed a retrospective observational design and was conducted in suburban Tome City, Miyagi Prefecture, with a population of approximately 80,000 and an aging population rate of 35.5% in 2020. Information on ambulance services and the age distribution in Tome City was obtained as confidential data from Tome City. Data on ambulance services and age distribution across Japan was obtained from a publicly accessible dataset. We calculated the standardized emergency transportations due to sudden illness ratio (SER), based on the standardized mortality ratio. This ratio represents the relative incidence of emergency transportations due to sudden illnesses in Tome City compared to all of Japan (with 100 for Japan), adjusted for the age distribution in Tome City through an indirect method. The SER increased to 88.2% in 2011, remained high at 89.6% in 2012, and declined from 85.6% in 2013, the year the home-visit clinic was established, to 86.7%, 83.0%, 80.5%, and 78.1%. The findings suggest that home medical care is an effective means of providing medical assistance to homebound patients and may reduce the necessity for hospitalization and ambulance services.

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Introduction

The population of older adults in Organisation for Economic Co-operation and Development (OECD) countries is rapidly increasing (OECD 2023). Consequently, a surge in medical requirements is expected both now and in the future, challenging the existing healthcare supplies due to their insufficient capacity to meet the demands. Japan, with the highest aging rate worldwide, is experiencing a rapid increase in healthcare needs (Nakatani 2019). The increasing number of emergency medical transports, inpatient beds, and medical personnel has become critical (Hagihara et al. 2013). Once admitted to emergency medical services (EMS) and hospitalized, older people may require longer stays (Iwata et al. 2020). In response, the Japanese government has incentivized the establishment of home-visiting clinics by setting high reimbursement rates (Ministry of Health Labour and Welfare 2007), resulting in a significant increase in such clinics (Ohta 2015).

Home-visiting clinics provide planned, regular medical care and emergency care to patients who have difficulty accessing hospitals or clinics (Ministry of Health Labour and Welfare 2007). They offer necessary diagnoses and treatments for both chronic and acute health conditions, as well as palliative care, including end-of-life care, to patients at home or in nursing facilities (Ministry of Health Labour

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and Welfare 2007; Ohta 2015). Without adequate advance care planning by medical professionals, older patients with deteriorating chronic health conditions are likely to be transported to emergency departments and given life-saving interventions such as chest compressions and mechanical ventilation. Before home medical care became widespread in Japan, it was common for family members and nursing staff to use EMS once a patient stopped breathing, even if there was an agreement to allow the patient to die naturally at an advanced age. This response was problematic from a human rights perspective, but the situation has not been fundamentally resolved because laws requiring life-saving measures by life-saving teams have not been revised (Akiyama et al. 2018; Turnbull et al. 2019). It is hypothesized that offering home healthcare services may reduce unnecessary or undesired emergency transportations among the older population. However, to the best of our knowledge, no studies have validated the effectiveness of this approach.

To test our hypothesis that the establishment of home-visiting clinics decreases the number of emergency transportations, a quasi-natural experiment was done by establishing a home-visiting clinic in a suburban area (Craig et al. 2012). Herein, home medical care and emergency transportation data were analyzed, and their impact on emergency transportation rates in the region was examined.

Materials and Methods

Study design

This study used a retrospective observational design. Data was analyzed using statistical methods to investigate the relationship between home medical care and emergency transportations.

Setting

This research was conducted in Tome City, Miyagi Prefecture, which had a population of approximately 80,000 residents and an aging population rate of 35.5% in 2020. In this region, it takes over an hour to drive to a major hospital, and there has historically been a scarcity of healthcare resources; the number of doctors per capita has been less than half the national average. The nearby Tome Municipal Hospital serves the area, but when life-saving measures are "necessary," patients are transported to Ishinomaki Red Cross Hospital or Osaki Municipal Hospital, which takes over an hour. Until 2012, there were no clinics providing home-visiting services in this area. One clinic specializing in home-visiting services was established in 2013. Since then, the number of patients served by the clinic steadily increased, reaching about 500 patients by 2015, and has remained steady since then (Fig. 1).

Data source

Data on ambulance services and the age distribution in Tome City, Miyagi Prefecture, were obtained as confidential data from Tome City. Similarly, data regarding ambulance services and the age distribution across Japan were procured from a publicly accessible dataset: data for ambulance services (Fire and Disaster Management Agency: Current status of emergency rescue 2006-2021, https://www.fdma.go.jp/publication/rescue/post-4.html) and data for the age distribution across Japan (Bureau Statistics: Portal Site of Official Statistics of Japan 2006-2021, https://www.stat.go.jp/english/data/kokusei/index.html). The data from January 1, 2005 to December 31, 2020 were analyzed. This study also obtained data from the clinic specializing in home medical care established in April 2013, which recorded the number of regular visits during the observation

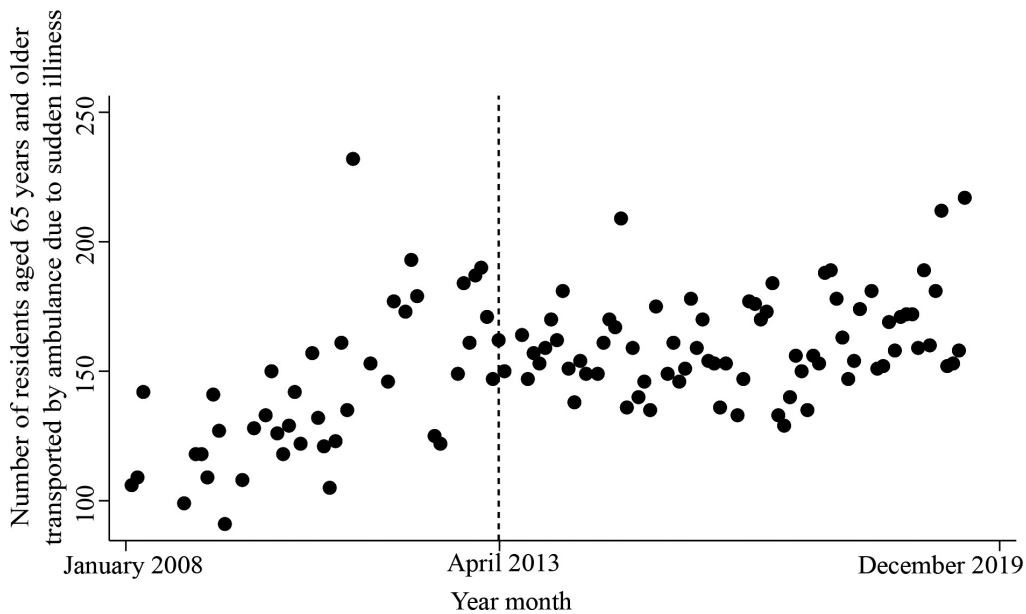

Fig. 1. The trend in the number of emergency transportations due to sudden illnesses among older people in Tome City over time.

period. The current study focused on emergency transportations for cases of sudden illness in the older population (65 years and older).

Standardized emergency transportations due to sudden illness ratio (SER)

SER, originally developed based on a standardized mortality ratio (Litton et al. 2020), represents the ratio of actual emergency transport cases in Tome City to the expected number, calculated by assuming that the incidence rate of emergency transport cases due to sudden illnesses occurs in Tome City at the same proportion as that of the entire age class in Japan.

Thus, SER can be described as follows:

$$SER = \frac{Observed\ number\ of\ Emergency\ transport}{Expected\ \ number\ of\ Emergency\ transport} \times 100$$

The observed number of emergency transports in Tome City refers to the annual aggregate count, while the expected number of transports is estimated based on the assumption that the incidence rate of transports in the entire Japanese population would apply to the population in Tome City. Thus, the expected number of emergency transport (ENET) is calculated as follows:

$$\mathrm{ENET} = \sum_{age\ group} (\text{population by age group in Tome city} \times \text{Japan's overall transportrate by age})$$

The number of emergency transports due to sudden illness was reported by the following age categories (Fire and Disaster Management Agency: Current status of emergency rescue 2006-2021, https://www.fdma.go.jp/publication/rescue/post-4.html): < 7 years, ≥ 7 years and < 18 years, ≥ 18 years and < 65 years, and ≥ 65 years. Therefore, we used this categorization to calcu late ENET.

The SER represents the relative incidence of emergency transportations due to sudden illnesses in Tome City compared to all of Japan (with 100 for the whole of Japan), adjusted for the age distribution of the population in Tome City through an indirect method similar to the standardized mortality ratio. A value of 100 for the SER signifies that the age-adjusted frequency of emergency transportations in Tome City is equal to that of all of Japan, indicating that the level of emergency transportations due to illnesses in Tome City is comparable to that of Japan. Conversely, a value greater than 100 implies a higher frequency of emergency transportations in comparison to all of Japan, while a value lower than 100 indicates a lower frequency of transportations.

Ethical approval

This study was approved by the ethics committee of Yamagata University (approval no. 2021-306). The anonymity of all records was ensured, and protected the personal information on the documents provided by Tome City was protected.

Results

Fig. 1 shows the trend in the number of transportations due to sudden illnesses among older people (aged ≥ 65 years) in Tome City over time. There was a seasonal difference in the expected monthly transportation, with increases noted during winter. Furthermore, in 2011, a massive earthquake occurred in this region, resulting in a sharp increase in emergency transportations. The number of emergency transportations in the region increased from 2008 to 2013, but the increase appears to have leveled off after 2013.

The calculated annual SER for those aged ≥ 65 years is shown in Fig. 2. Before 2011, the SER increased every year from 61.8 in 2005 to 73.2 in 2010. In 2011, a massive earthquake resulted in a sharp increase in emergency transportations. The SER sharply rose in 2011, remained at a

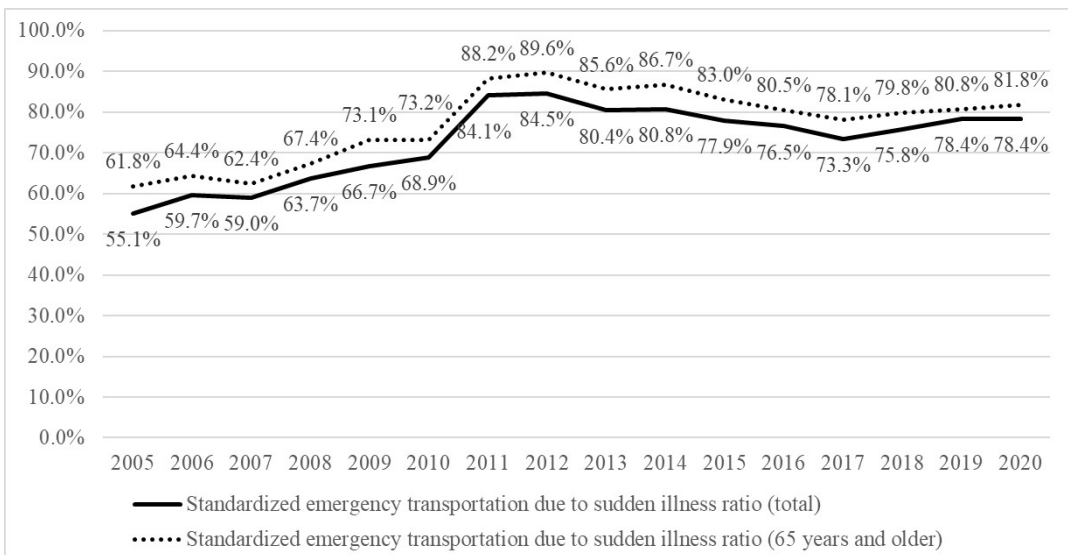

Fig. 2. Standardized emergency transportations due to sudden illness ratio over 15 years in Tome City.

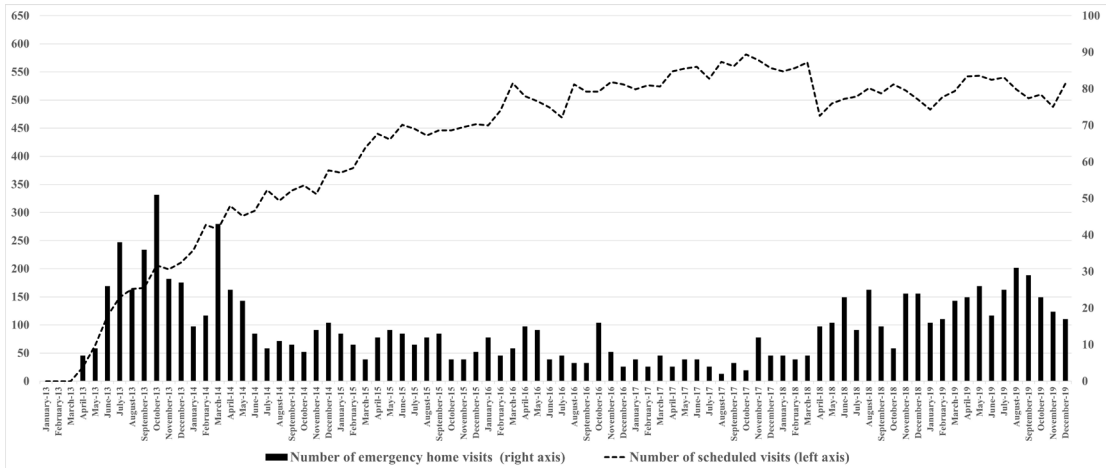

Fig. 3. Number of emergency home visits and number of scheduled visits of Yamato Home Clinic Tome over time.

high level of 89.6% in 2012, and then gradually declined from 2013 to 2017 (Fig. 2). After 2017, there was a slight increase in the SER (Fig. 2).

The monthly number of scheduled visits (dotted line) and emergent visits (bar graph) is shown in Fig. 3. When the home-visiting clinic was established in April 2013, the number of visits for the month was only 25, gradually increasing to 312 in April 2014, and 440 in April 2015. The following year, the number of patients increased to around 500, remained stable at about 520 to 530 until April 2018, and has since stayed around 500 (Fig. 3).

Discussion

The results of this study showed that home medical care was associated with a decrease in emergency transportations in the study region. This suggests that home medical care is an effective way to provide medical care to patients who are unable to leave their homes and could reduce calls for ambulance services.

One possible explanation for the decrease in emergency transportations associated with home medical care is that patients are more likely to receive appropriate care in their homes, reducing the need for hospitalization. Home medical care allows patients to receive medical care in a familiar and comfortable environment, which may make them more comfortable and less likely to require hospitalization (Kuroda et al. 2021). Furthermore, home medical care fosters continuity of care by allowing patients to receive consistent healthcare from the same provider over time, which may result in improved management of chronic conditions (Perry et al. 2016).

Another possible explanation is that home medical care may proactively prevent the exacerbation of patients' conditions, thereby averting the need for hospitalization or emergency transportations (Ministry of Health Labour and Welfare 2007; Behm et al. 2013). By providing regular medical check-ups and monitoring patients' conditions, home medical care may help to identify and address potential health issues before they become severe (Behm et al. 2013; Rose et al. 2019).

In addition, since home-visit services also provide end-of-life care, the widespread use of home-visit treatment has reduced the number of emergency transportations due to respiratory arrest. In Japan, without regular home-visit services, it is difficult to confirm a death at home. Family members or nursing home staff who find someone who has stopped breathing have no choice but to call an ambulance. Then, the patient is taken by ambulance to the hospital, where doctors confirm the death. With the introduction of home-visit services, the family or staff will be informed in advance by the visiting physician that the patient is close to death, so they can prepare themselves and call the physician when the patient stops breathing, rather than calling an ambulance. This is now happening more and more in both urban and rural areas across Japan.

In numerous Western countries, the utilization of EMS entails a considerable financial burden, whereas in Japan, such services are provided entirely free of charge (Godfredson 2018). Consequently, in Japan, there exists a propensity for more casual and frequent emergency transportations. Despite recurrent discussions concerning the potential introduction of fees, EMS services in Japan remain free of charge. Comparatively, the out-of-pocket expenses for hospitalization in Japan are significantly lower than those in the United States, creating a system where medical expenses do not lead to personal bankruptcy. Moreover, the criteria for hospital admission are notably lenient, allowing patients to remain in the hospital with a fairly low co-pay even when the physician explains that hospitalization is no longer necessary. Throughout the research period, EMS services have been free, and the co-payment system has not undergone significant changes, suggesting a negligible impact on the volume of emergency transportations.

The sharp increase in SER in 2011 and 2012 is attributable to the impact of the Great East Japan Earthquake in 2011, which affected the Miyagi Prefecture, including Tome City. Many evacuees from the coastal areas fled to Tome

City, facing extremely challenging circumstances and losing their previous healthcare connections. This led to numerous health deteriorations and a subsequent surge in emergency transportations.

The implications of this study are important for healthcare providers, policymakers, and the general public. The results highlight the potential benefits of integrating home medical care into healthcare systems, especially for patients with limited mobility or chronic conditions (Perry et al. 2016; Fraze et al. 2019). By reducing the demand for EMS and hospitalization, this approach could help alleviate the strain on healthcare resources, including ambulance services and hospital facilities (Jones 2020). Reducing the burden on emergency services and hospitals is expected not only to increase the life-saving rate for patients but also to improve the working conditions of staff, thus enhancing the system's sustainability.

Furthermore, the findings underscore the importance of promoting continuity of care and preventive measures through regular home visits, which can ultimately lead to improved patient outcomes (Behm et al. 2013; Rose et al. 2019). The study also suggested that emergency ambulance usage decreased due to emergency home visits by physicians. However, physician visits can be costly, and replacing these with telemedicine should be considered. Lapointe-Shaw et al. (2023) reported that replacing in-person consultations with telemedicine is equally effective, and verification of this effect is awaited.

Some limitations should be mentioned. First, as this is an observational study, rigorous proof of causality is difficult. However, the aging rate has been steadily increasing during the study period, and the number of emergency transportations would have increased if no measures had been taken. Data from all over Japan show that the number of emergency transportations is increasing. In contrast, the increase was suppressed in this region, suggesting that the home-visiting clinic contributed to this effect. Another limitation is that this study is a validation of one region, and we do not know if the same can be proven for other areas. However, the population and aging rates of the cities analyzed in this study are typical of many rural areas in Japan, and we believe that similar trends may be observed in similar areas.

Conclusion

This study provided important insights into the relationship between home medical care and emergency transportations. The findings suggest that home medical care is effective in providing medical care to patients who are unable to leave their homes and may reduce the need for hospitalization and emergency transportations. Further research is needed to confirm these findings and to understand the underlying mechanisms that explain the observed associations, especially the development of more efficient methods combined with telemedicine.

Conflict of Interest

Drs. Tsuboya and Sugiyama are employees of Yamato Home Clinic Tome, and Dr. Tanoue is the director of Yamato Home Clinic Tome.

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