Clusters of COVID-19 in long-term care hospitals and facilities in Japan from 16 January to 9 May 2020

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Introduction

Long-term care (LTC) hospitals and facilities with a majority of high-risk residents are particularly vulnerable places for the spread of coronavirus disease 2019 (COVID-19). Large cluster outbreaks with deaths in LTC hospitals/facilities have been reported around the world,1-6 including the USA,1-4 Canada5 and Korea.6 Among these, 27% of total deaths as a result of COVID-19 occurred in LTC facilities in the USA,4 and nearly half of Canada’s COVID-19 deaths were linked to LTC facilities.5 Japan experienced sporadic cases of SARS-CoV-2 from 16 January 2020. The Cluster Response Team of the government used a strategy of minimizing the spread of infection by preventing one cluster of patients from creating another cluster, by following up all patients and their close contacts. In counter-cluster measures, the government also asked people to avoid places where the “3Cs” (crowded conditions of people, closed spaces with insufficient ventilation and conversations at short distance) overlap, and to maintain social distancing based on the recommendations of The Expert Committee.7 The Japan Geriatric Society has also promoted attention to the prevention of COVID-19 in day-care and day-service centers,8 and in nursing homes.9 Japan further experienced the first large spike of infection after a 3-day holiday in late March (Fig. 1). To prevent an infection explosion, the government declared a state of emergency on 7 April 2020, and asked the public to stay at home and refrain from going out unnecessarily, to reduce contact with others by at least 70% and by as much as 80%. The government also recommended suspending or restricting temporary use of LTC facilities in areas where infection was prevalent. An infection explosion has thus far not been observed, and mortality has been kept low in Japan. However, many clusters have been reported, especially in medical and welfare facilities, during the period.

This study aimed to clarify the characteristics of clusters of COVID-19 by comparing those in LTC hospitals/facilities, in general medical/welfare facilities and in non-medical/welfare facilities. Cluster numbers in general medical/welfare facilities and in non-medical/welfare facilities were significantly smaller compared with those in the other two groups, the cluster size in LTC hospitals/facilities was significantly larger than that in non-medical/welfare facilities. Cluster numbers in general medical/welfare facilities and in non-medical/welfare facilities were significantly positively correlated with morbidity (105), indicating relatively early identification of clusters in these facilities. Unlike in these facilities, cluster size in LTC hospitals/facilities was significantly positively correlated with morbidity, indicating that clusters in LTC hospitals/facilities were finally identified after already having grown to a large size in areas where infection was prevalent. Multivariate logistic regression analysis showed that both cluster number and cluster size only in LTC hospitals/facilities were independently associated with higher mortality (median 0.64/105 subjects) after adjustment.

Conclusions: Preventive efforts against COVID-19 outbreaks even at the early phase of the epidemic are critically important in LTC hospitals/facilities, as both the larger number and size of clusters only in LTC hospitals/facilities were independently linked to higher mortality in prefectures in Japan. Geriatr Gerontol Int 2020; 20: 715–719.

Keywords: cluster, COVID-19, long-term care facility, morbidity, mortality.

Aim: To clarify the association of cluster number and size of coronavirus disease 2019 (COVID-19) in long-term care (LTC) hospitals/facilities, general medical/welfare facilities and non-medical/welfare facilities with morbidity and mortality in 47 prefectures during 16 January to 9 May 2020 in Japan.

Methods: Information on COVID-19 clusters (n ≥2), and morbidity and mortality of COVID-19 was collected.

Results: A total of 381 clusters with 3786 infected cases were collected, accounting for 23.9% of 15,852 cumulated cases on 9 May 2020. Although the cluster number (107 subjects) in LTC hospitals/facilities was significantly smaller compared with those in the other two groups, the cluster size in LTC hospitals/facilities was significantly larger than that in non-medical/welfare facilities. Cluster numbers in general medical/welfare facilities and in non-medical/welfare facilities were significantly positively correlated with morbidity (105), indicating relatively early identification of clusters in these facilities. Unlike in these facilities, cluster size in LTC hospitals/facilities was significantly positively correlated with morbidity, indicating that clusters in LTC hospitals/facilities were finally identified after already having grown to a large size in areas where infection was prevalent. Multivariate logistic regression analysis showed that both cluster number and cluster size only in LTC hospitals/facilities were independently associated with higher mortality (median 0.64/105 subjects) after adjustment.

Methods

Cluster collection

Clusters (case number ≥2) of COVID-19 were collected from media websites and prefectures’ home pages in Japan. The morbidity and mortality of COVID-19 in 47 prefectures were

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in Japan on 9 May 2020. Of these, 176 clusters (46.2% of total clusters) with 2833 cases (74.8% of cluster cases) occurred in medical welfare facilities, consisting of 66 clusters (17.3% of total clusters) with 1038 cases (27.4% of cluster cases) in LTC hospitals/facilities, and 110 clusters (28.9% of total clusters) with 1795 cases (47.4% of cluster cases) in general medical/welfare facilities, including acute care hospitals, mental hospitals, clinics and welfare facilities. The remaining 205 clusters (53.8% of total clusters) with 953 cases (25.2% of cluster cases) occurred in non-medical/welfare facilities, including schools and nurseries, amusement facilities, public facilities, markets, and other offices.

Cluster number and morbidity/mortality of COVID-19

Cluster numbers (/10^7 subjects) in LTC hospitals/facilities (9.4 ± 3.8) were significantly smaller (P < 0.001) than those in general medical/welfare facilities (14.5 ± 5.4) and in non-medical/welfare facilities (29.0 ± 17.5; Table 1). The association of cluster number (/10^7 subjects) with morbidity (case number/10^5 subjects) and mortality (death number/10^5 subjects) in prefectures is shown in Figure 2. Higher morbidity (/10^5 subjects) of COVID-19 in prefectures was significantly positively correlated with larger cluster number (/10^7 subjects) in general medical/welfare facilities (Spearman: \( \rho = 0.679, P < 0.001 \)) and in non-medical/welfare facilities (\( \rho = 0.583, P < 0.001 \)), but not in LTC hospitals/facilities (\( \rho = 0.138 \), \( P = 0.280 \); Fig. 2a). Subsequently, larger cluster numbers (/10^7 subjects) were significantly positively correlated with higher mortality (/10^5 subjects) in general medical/welfare facilities (\( \rho = 0.720, P < 0.001 \)) and in non-medical/welfare facilities (\( \rho = 0.490, P < 0.001 \)), but not in LTC hospitals/facilities (\( \rho = 0.214, P = 0.092 \); Fig. 2b).

Cluster size and morbidity/mortality of COVID-19

Cluster sizes (case number in cluster) in LTC hospitals/facilities (15.7 ± 20.0, range 2–74) and that in general medical/welfare facilities (16.3 ± 28.4, 2–213) were significantly larger (P < 0.001) than that in non-medical/welfare facilities (4.6 ± 4.7, range 2–48; Table 1). Larger cluster sizes in LTC hospitals/facilities were significantly positively associated with higher morbidity (/10^5 subjects; Spearman: \( \rho = 0.336, P = 0.006 \)) and higher mortality (/10^5 subjects; \( \rho = 0.317, P = 0.009 \)) in prefectures (Fig. 3). In contrast, smaller cluster sizes in non-medical/welfare facilities were significantly associated with higher morbidity (/10^5 subjects; \( \rho = -0.155, P = 0.045 \)) and higher mortality (/10^5 subjects; \( \rho = -0.017, P = 0.015 \)) in prefectures (Fig. 3).

Factors associated with higher mortality of COVID-19

Univariate logistic regression analysis showed that morbidity (/10^5 subjects; OR 1.850, 95% CI 1.561–2.192; \( P < 0.001 \)), cluster number (/10^7 subjects; OR 1.056, 95% CI 1.038–1.074; \( P < 0.001 \)) and cluster size (case number in cluster; OR 1.022, 95% CI 1.006–1.039; \( P = 0.007 \)) were significantly associated with higher mortality (median among clusters: 0.64 deaths/10^5 subjects) in total groups (crude in Table 2). Multivariate logistic regression analysis showed that both larger cluster number and larger cluster size were significantly associated with higher mortality only in LTC hospitals/facilities, after adjustment for morbidity (model 1 in Table 2), and with morbidity, cluster number and cluster size (model 2 in Table 2), although morbidity itself was constantly independently associated with mortality in these logistic regression analyses (data not shown).
Table 1  Clusters of COVID-19 in Japan

| Total | Medical welfare facilities | Non-medical/welfare facilities |
|-------|---------------------------|-------------------------------|
| Cluster (n) | 381 | 176 | 205 |
| n (10^7) subjects | 21.4 ± 15.6 | 12.6 ± 5.4 | 29.0 ± 17.5***, ### |
| Cluster size (No. cases) | 21.4 ± 15.6 | 12.6 ± 5.4 | 29.0 ± 17.5***, ### |
| Mean ± SD | 9.9 ± 18.6 | 4.6 ± 4.7***, ### |
| Range | 2–213 | 2–213 | 2–48 |
| Total cases (n) | 3786 | 2833 | 953 |

| LTC hospital/facility | General medical/welfare facilities |
|-----------------------|-------------------------------|
| Cluster (n) | 66 | 110 |
| n (10^7) subjects | 9.4 ± 3.8 | 14.5 ± 5.4*** |
| Cluster size (No. cases) | 21.4 ± 15.6 | 12.6 ± 5.4 | 29.0 ± 17.5***, ### |
| Mean ± SD | 15.7 ± 20.0 | 16.3 ± 28.4 |
| Range | 2–74 | 2–213 |
| Total cases (n) | 1038 | 1795 |

| LTC hospital | LTC facility | Acute care hospital | Mental hospital | Clinic | Welfare facility | School, nursery | Amusement facility | Public facility | Market | Other office |
|--------------|--------------|---------------------|----------------|--------|-----------------|----------------|-------------------|----------------|--------|-------------|
| Cluster (n) | 29 | 37 | 97 | 4 | 6 | 20 | 22 | 39 | 7 | 117 |
| n (10^7) subjects | 9.3 ± 3.5 | 9.6 ± 4.0 | 14.8 ± 5.2 | 10.5 ± 4.8 | 11.3 ± 5.6 | 13.8 ± 8.5 | 24.8 ± 13.8 | 25.5 ± 10.3 | 29.3 ± 13.1 | 16.8 ± 7.7 | 31.4 ± 20.1 |
| Cluster size (No. cases) | 21.4 ± 15.6 | 12.6 ± 5.4 | 29.0 ± 17.5***, ### |
| Mean ± SD | 15.0 ± 23.4 | 15.8 ± 17.3 | 15.9 ± 28.5 | 7.5 ± 4.8 | 5.3 ± 2.5 | 34.8 ± 38.1 | 5.1 ± 3.2 | 8.5 ± 9.2 | 3.8 ± 3.1 | 2.4 ± 0.5 | 4.3 ± 3.9 |
| Range | 2–74 | 2–70 | 2–213 | 3–14 | 3–8 | 5–100 | 2–13 | 2–48 | 2–12 | 2–8 | 2–19 |
| Total cases (n) | 453 | 585 | 1541 | 30 | 15 | 209 | 109 | 181 | 148 | 17 | 498 |

***P < 0.001 compared with long-term care (LTC) hospital/facility.
###P < 0.001 compared with general medical/welfare facility, by Mann–Whitney U-test.
welfare facilities; blue triangles, clusters in non-medical/hospitals/facilities; green squares, clusters in general medical/prefectures in Japan. Red circles, clusters in long-term care facilities. (a) morbidity (/10^5 subjects) and (b) mortality (/10^5 subjects) in 718 prefectures in Japan. Red circles, clusters in long-term care hospitals/facilities; green squares, clusters in general medical/welfare facilities; blue triangles, clusters in non-medical/welfare facilities.

Discussion

The results of the present study showed a crucial link of clusters in LTC hospitals/facilities with increased mortality in prefectures in Japan, being partly comparable with the reports in the USA and Canada. COVID-19 is more likely to affect older adults, particularly those with serious comorbidities, with a higher risk of severe morbidity and mortality. The highest fatality rate was reported in older adults aged ≥85 years, being from 10.4 to 27.3%, followed by 4.3 to 10.5% in those aged 75–84 years. LTC hospitals/facilities were originally high-risk settings for cluster formation of COVID-19, with high-risk older adults with systemic comorbidities. Furthermore, LTC hospitals/facilities are places with “3Cs” (crowded conditions of people, closed spaces with insufficient ventilation and conversations at short distance). Securement of space for quarantine of any suspected cases among residents and staff members, appropriate ventilation, limitation of visitors except narrowly defined conditions, closure of common dining rooms and cancellation of group activities were recommended for LTC hospitals/facilities in areas where infection was prevalent.

The present study newly revealed that both the number and size of clusters only in LTC hospitals/facilities played independent, critical roles in increased mortality in prefectures in Japan. Cluster numbers in general medical/welfare facilities and in non-medical/welfare facilities increased under the direct influence of morbidity in prefectures (Fig. 2a), probably because of relatively early identification of infected cases under utmost caution in these facilities. However, the cluster number in LTC hospitals/facilities increased without a direct link to current morbidity in prefectures (Fig. 2a). Clusters in LTC hospitals/facilities were finally identified after they grew to large-sized clusters in these facilities in areas where infection was prevalent (Fig. 3a). These findings might indicate that many COVID-19 outbreaks in LTC hospitals/facilities occurred even at the early phase of the epidemic, like in other groups of facilities, and were finally identified as already enlarged clusters, without awareness of the infection, because of delayed diagnosis or misdiagnosis. Once COVID-19 outbreaks occurred in LTC hospitals/facilities, the number, as well as the size of clusters, was significantly and independently linked to higher mortality in prefectures, even after adjustment for morbidity itself (Table 2). Residents of LTC hospitals/facilities might fail to communicate COVID-19 symptoms, as the majority have dementia, a history of stroke or other chronic diseases that make it difficult to complain of symptoms. Although typical symptoms of COVID-19 in younger patients are persistent fever ≥37.5°C, cough and dyspnea; symptoms in frail older patients, such as malaise, muscle pains and low-grade fever, differ from the symptoms in younger patients. Furthermore, the majority of residents and staff identified with COVID-19 were asymptomatic or pre-symptomatic in a long-term care skilled nursing facility in Los Angeles, USA, where universal serial polymerase chain reaction testing was carried out for all residents and staff members after identification of two COVID-19 cases. These findings could explain the potential delay in detection of COVID-19 infection and large-scale cluster formation in LTC hospitals/facilities. In fact, it is recommended that any suspected residents in LTC hospitals/facilities, as well as healthcare workers who worked while symptomatic (with fever or signs/symptoms of lower respiratory illness, such as cough or shortness of breath) in acute care facilities and in LTC facilities should be tested. In addition, LTC hospital/facility staff would be relatively unfamiliar with infection control and prevention, and personal protective equipment compared with those in acute care hospitals. Conservation and allocation of personal protective equipment, and use of appropriate personal protective equipment in COVID-19 cases, as well as suspected cases, are strongly recommended for LTC hospitals/facilities, even in the early phase of the epidemic.

A major limitation of the present study was the lack of linkage of each cluster case with demographic data, including age and sex, and with consequences, such as death, as all these epidemiological data were collected from media websites and prefectures’ home pages. Precise analysis including these data should be carried out in the future.

In conclusion, the present study showed that both the number and size of clusters in LTC hospitals/facilities are independently linked to higher mortality in prefectures. Preventive measures, including quarantining suspected cases among residents and care-
COVID-19 clusters in LTC facilities

**Table 2** Association between higher mortality (≥median 0.64/10^5) and variables in 42 out of 47 prefectures in Japan based on logistic regression analyses

|                        | Crude OR (95% CI) | P     | Model 1 OR (95% CI) | P     | Model 2 OR (95% CI) | P     |
|------------------------|-------------------|-------|---------------------|-------|---------------------|-------|
| **Morbidity (case number/10^5)** |                    |       |                     |       |                     |       |
| Total                  | 1.1288 (1.076-1.196) | <0.001 | 1.1280 (0.957-1.314) | 0.082 | 1.0750 (0.845-1.360) | 0.546 |
| Total medical welfare  | 1.1288 (1.076-1.196) | <0.001 | 1.0970 (0.934-1.264) | 0.224 | 1.0470 (0.853-1.277) | 0.606 |
| LTC hospitals/facilities | 1.1288 (1.076-1.196) | <0.001 | 1.0970 (0.855-1.390) | 0.450 | 1.0470 (0.813-1.345) | 0.508 |
| General medical/welfare | 1.1288 (1.076-1.196) | <0.001 | 1.0970 (0.855-1.390) | 0.450 | 1.0470 (0.813-1.345) | 0.508 |
| Non-medical/welfare    | 1.1288 (1.076-1.196) | <0.001 | 1.0970 (0.855-1.390) | 0.450 | 1.0470 (0.813-1.345) | 0.508 |
| **Cluster size (case number in cluster)** |                    |       |                     |       |                     |       |
| Total                  | 1.0220 (1.006-1.036) | 0.007 | 1.0220 (0.996-1.058) | 0.087 | 1.0220 (0.997-1.063) | 0.080 |
| Total medical welfare  | 1.0220 (1.006-1.036) | 0.007 | 1.0220 (0.996-1.058) | 0.087 | 1.0220 (0.997-1.063) | 0.080 |
| LTC hospitals/facilities | 1.0220 (1.006-1.036) | 0.007 | 1.0220 (0.996-1.058) | 0.087 | 1.0220 (0.997-1.063) | 0.080 |
| General medical/welfare | 1.0220 (1.006-1.036) | 0.007 | 1.0220 (0.996-1.058) | 0.087 | 1.0220 (0.997-1.063) | 0.080 |
| Non-medical/welfare    | 0.9800 (0.923-1.041) | 0.519 | 0.9900 (0.847-1.158) | 0.904 | 0.9910 (0.849-1.157) | 0.906 |

Crude: univariate logistic regression analysis was used. Model 1: adjusted for respective morbidity (case number/10^5) in each prefecture. Model 2: adjusted for respective morbidity (case number/10^5), cluster number (/107) and cluster size in each prefecture. CI, confidential interval; OR, odds ratio.

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Disclosure statement

The authors declare no conflict of interest.

References

1. McMichael TM, Currie DW, Clark S et al. Epidemiology of Covid-19 in a long-term care facility in King County, Washington. N Engl J Med 2020; 382: 2005–2011.
2. Kamp J, Mathews AW. Coronavirus outbreaks spreading in nursing homes. Wall Street Journal. Available from: https://www.wsj.com/articles/coronavirus-outbreaks-spread-in-nursing-homes-11584628291
3. Georgia Department of Community Health. Long-term care facility COVID-19 report. Available from: https://dch.georgia.gov/announcements/2020-04-28/long-term-care-facility-covid19-report.
4. Chidambaram P. State reporting of cases and deaths due to COVID-19 in long-term care facilities. Available from URL: https://www.kff.org/medicaid/issue-brief/state-reporting-of-cases-and-deaths-due-to-covid-19-in-long-term-care-facilities/
5. Bensadoun, E (2020). “Nearly half of Canada’s COVID-19 deaths linked to long-term care facilities: Tam”. Available from URL: https://globalnews.ca/news/6811726/coronavirus-long-term-care-deaths-canada/
6. Kim T. Improving preparedness for and response to Coronavirus Disease 19 (COVID-19) in long-term care hospitals in the Korea. Infect Chemother 2020. Online ahead of print. PMID: 32406211.
7. Minister of Health, Labour and Welfare, Japan. About Coronavirus Disease 2019 (COVID-19). Available from URL: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/newpage_00032.html
8. The Japan Geriatrics Society. Home service (out-of-town, short-term admission) users/family related information regarding new coronavirus [monograph on the Internet]. Available from URL: https://www.jpn-geriat-soc.or.jp/citizen/pdf/for_tsunmo.pdf
9. The Japan Geriatrics Society. Infection disease prevention in nursing homes [monograph on the Internet]. Available from URL: https://www.jpn-geriat-soc.or.jp/citizen/pdf/for_short_stay.pdf
10. The Japan Broadcasting Corporation (NHK). Special site for SARS-CoV-2. [Japanese]. Available from URL: https://www3.nhk.or.jp/news/special/coronavirus/
11. Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China [Chinese]. Chin Center Dis Control Prevent Week 2020; 41: 145–151.
12. CDC COVID-19 Response Team. Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, February 12–March 16. MMWR Morb Mortal Wkly Rpt 2020; 69: 343–346.
13. The Centers for Medicare & Medicaid Services. COVID-19 long-term care facility guidance. Available from URL: https://www.cms.gov/files/document/4220-covid-19-long-term-carefacility-guidance.pdf
14. D’Adamo H, Yoshikawa T, Ouslander JG. Coronavirus disease 2019 in geriatrics and long-term care; the ABCDs of COVID-19. J Am Geriatr Soc 2020; 68: 912–917. https://doi.org/10.1111/jgs.16445.
15. Dora, AV, Winnett A, Jatt LP, et al. Universal and serial laboratory testing for SARS-CoV-2 at a long-term care skilled nursing facility for veterans - Los Angeles, California, 2020. Available from URL: https://www.cdc.gov/mmwr/volumes/69/wr/mm6921e1.htm

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