Public Health Report

Settings of coronavirus disease 2019 transmission during community outbreak in Tsuchiura, Japan, November 2020

Tsuyoshi OGATA*,2*, Shifuko UJIIE3*, Hideko OGAWA2*, Manami NAGATA4*, Aina SEKI2* and Hideo TANAKA5*

Objectives This study aimed to investigate the settings of coronavirus disease 2019 (COVID-19) transmission in Tsuchiura, in November 2020.

Methods We assessed Tsuchiura City residents diagnosed with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection—as defined by the Tsuchiura Health Center—in November 2020. To establish the setting of each transmission, we defined the first known setting of transmission in each epidemiological link of transmission as the "index setting of transmission."

Results We were able to ascertain the transmission settings in 160 (85%) of the 188 cases with COVID-19, which were as follows: house (38%), restaurant (34%), workplace (12%), care facility for the elderly or disabled patients (7%), another prefecture (6%), and other contact settings (4%). Restaurant was the index setting of transmission in 54% of the cases.

Conclusion Restaurant was found to be the setting of transmission in one third and the index setting of transmission in half of the Tsuchiura residents infected with SARS-CoV-2 in November 2020.

Key words: COVID-19, transmission, restaurant, setting, Japan

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I. INTRODUCTION

Tsuchiura City is located in the southern part of the Ibaraki Prefecture, Japan with only two confirmed cases of coronavirus disease 2019 (COVID-19) in October 2020. However, the number of infected cases increased in November, reaching level 4 by national criteria (30 or more cases of infection per 100,000 population per week), indicating a large-scale COVID-19 outbreak in the region. The Tsuchiura Public Health Center isolated people with active infection by hospitalization or hotel stay, implemented a bidirectional contact tracing, and increased severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing for contacts and communities. The number of cases decreased to almost 20 per 100,000 people per week by the end of the month.

A study using a mathematical model predicted that a small minority of superspreading points of interest account for a large majority of the infections[1]. It is important to clarify the whole picture of the transmission of COVID-19 and elucidate the major setting of transmission in this region. That will also be useful in the development of appropriate intervention measures to prevent community transmission.

The objectives of this report were to clarify the overall picture of a community outbreak and investigate the settings of transmission of a COVID-19 outbreak in Tsuchiura in November 2020.

II. METHODS

This report is an observational study.

The setting of this study was Tsuchiura City, Ibaraki Prefecture (population: 136,000). Tsuchiura City is located about 70 kilometers northeast of Tokyo, and has easy access to Tokyo by railroads and highway.

In Japan, according to the Infectious Diseases Control Law (hereafter referred to as the Law), the public health center must be notified of all COVID-19 infected cases. The relevant public health center implements a law-based bidirectional contact tracing of the patient,

* Itako Public Health Center of Ibaraki Prefectural Government
2* Tsuchiura Public Health Center of Ibaraki Prefectural Government
3* Tsukuba Public Health Center of Ibaraki Prefectural Government
4* Ryuugasaki Public Health Center of Ibaraki Prefectural Government
5* Fujiidera Public Health Center of Osaka Prefectural Government
Corresponding Author: Tsuyoshi Ogata
Itako Public Health Center of Ibaraki Prefectural Government
1446–1 Osu Itako Ibaraki 311–2422, Japan

whether symptomatic or not. In Tsuchiura City, the highest number of COVID-19 infected cases between March 2020 and February 2021 was recorded in November 2020.

The participants in this study included people living in Tsuchiura City with confirmed SARS-CoV-2 infection, as defined by the Tsuchiura Public Health Center in November 2020. In November 2020, the Government of Ibaraki did not refrain the inhabitants from going out or declare any regulations on opening restaurants. SARS-CoV-2 infections were confirmed using polymerase chain reaction (PCR) with a cycle threshold value of 40, loop-mediated isothermal amplification (LAMP) test, antigen quantitative test, or monoclonal antigen qualitative test. If the results of any test other than the PCR test were not definite, we implemented a PCR test. We collected data on the number of tests conducted on Tsuchiura citizens based on the samples collected by both the Tsuchiura Public Health Center and other hospitals and clinics. We calculated that about 4,100 Tsuchiura citizens were tested for SARS-CoV-2 in November 2020.

Through bidirectional contact tracing after SARS-CoV-2 confirmation, physicians and public health nurses of Tsuchiura Public Health Center collected the participants' demographic data, date of symptoms onset, and behaviors prior to testing. They also collected data on the patient's contacts and the setting of the contact of a patient from 14 days before to 10 days after symptom onset or infection confirmation for asymptomatic participants[2]. We assumed that an individual infected with COVID-19 could transmit the SARS-CoV-2 virus from two days before to ten days after the onset of symptoms or the SARS-CoV-2 confirmation for asymptomatic cases[2~4]. Additionally, we also assumed that an individual infected with COVID-19 could have transmitted the SARS-CoV-2 virus within 14 days before the onset of symptoms or the SARS-CoV-2 confirmation for asymptomatic cases, because the incubation period of the COVID-19 cases between infection and symptom onset was generally 1–14 days[2,5].

The presumed settings of transmission were "restaurant," "house," "workplace," "care facility for the elderly or disabled patients," "outside the prefecture," "other contact settings," and "unknown." We defined the "setting of transmission" as "restaurant" when a participant, during the incubation period (14 days) prior to symptom onset or SARS-CoV-2 confirmation for asymptomatic cases, visited a restaurant serving dishes or drinks, where a person with COVID-19 symptoms or one within two days prior to symptom onset was present on the day of the patient's visit and did not have other confirmed settings of transmission. We defined the "setting of transmission" as "another prefecture" when the participant had traveled out of Ibaraki Prefecture during the incubation period (14 days) prior to symptom onset or SARS-CoV-2 confirmation for asymptomatic cases. Some epidemiological links between patients were not detected at first, and later became apparent upon development of the investigation.

We defined the first known setting of transmission in each epidemiological link of transmission as the "index setting of transmission," and other known settings of transmission in each epidemiological link of transmission as the "subsequent setting of transmission." In this study, participant A was a restaurant employee with symptom onset on November 2nd; the setting of transmission was "unknown." Participant B visited the restaurant on that same day and the symptoms began on November 7th; the setting of transmission was "restaurant." Participant C had dinner with participant B in another restaurant on November 6th and had symptom onset on November 10th; the setting of transmission was "restaurant." Participant D lived with participant C and the symptoms began appearing on November 12th; hence, the setting of transmission was "house." We then classified the "index setting of transmission" for participants B, C, and D as "restaurant," and the "subsequent setting of transmission" for participants C and D as "restaurant" and "house," respectively.

We calculated the sex and age distribution for all the participants. We calculated the "setting of transmission," "index setting of transmission," and "subsequent setting of transmission" for participants with known settings of transmission.

The investigation was implemented following the Law. The study was conducted in accordance with the recommendations outlined in the Declaration of Helsinki. The study protocol was approved on February 15, 2021 by the Ibaraki Prefecture Epidemiological Research Joint Ethics Review Committee (protocol number: R2–5). As per the protocol, we collected data from original databases following data anonymization. Moreover, the study plan and the means to opt out of the study were advertised on the homepage of the Ibaraki Prefecture website.

III. RESULTS

Tsuchiura Public Health Center confirmed 188 COVID-19 cases living in Tsuchiura in November 2020. Table 1 shows the number of infected people by sex and age, with 56% being male.

We were able to determine the "setting of transmission" for 160 participants (85%). We excluded the remaining 28 participants (15%) from the analysis.

The estimated settings of transmission were as follows: house (38%), restaurant (34%), workplace (12%), facility for the elderly or disabled (7%), and another prefecture (6%), and other contact settings (4%). "House" was the major setting of transmission for female patients and for those aged ≥60 years,

while "restaurant" was the major setting of transmission for male patients and for those aged ≤59 years. The "house" setting among the female patients was found to be 50%, which was higher than that observed among male patients, and the "workplace" setting among the male patients was found to be 19%, which was higher than that observed among female patients. Among patients aged ≥60 years, the proportion of "house" setting was found to be 60%, which was higher than that observed among patients aged ≤59 years. (Table 2).

The proportion of "restaurant" in the "index setting of transmission" was 54%, which was higher than that observed in the subsequent setting of transmission." The proportion of "house" in the "subsequent setting of transmission" was 58%, which was higher than that observed in the "index setting of transmission" (Table 3).

The proportion of A+B (i.e., total number of participants by the index setting of transmission) was 67% for the "restaurant" setting. This setting was also the highest in terms of the ratio of A+B (total number of participants) to A (number of participants by the index setting of transmission), which was found to be 2.7. Among the "subsequent setting of transmission", "house" was found to be the major setting (Table 4).

Table 1 Number of people with confirmed COVID-19 infection living in Tsuchiura City in November 2020 by sex and age

Age	Male	Female	Total
0–9	2	0	2
10–19	5	10	15
20–29	18	17	35
30–39	10	11	21
40–49	23	18	41
50–59	26	11	37
60–69	12	6	18
70–79	5	6	11
80–89	3	4	7
90+	1	0	1
Total	105	83	188

Table 3 Demographic data and settings of transmission of participants by the "index setting of transmission" and "subsequent setting of transmission" in the epidemiological link

	Index setting of transmission		Subsequent setting of transmission	
	N	% (95%CI)	*N*	% (95%CI)
Sex of participants with known settings of transmission				
Male	38	52.4(40.2–62.4)	52	60.5(52.2–72.2)
Female	36	48.6(36.9–59.2)	34	39.5(32.0–52.4)
Age of participants with known settings of transmission				
≤59	67	91.9(83.0–96.5)	62	72.1(61.7–80.5)
≥60	6	8.1(3.5–17.0)	24	27.9(19.5–38.3)
Setting of transmission				
House	10	13.5(7.4–23.4)	50	58.1(47.6–68.0)
Restaurant	40	54.1(42.8–64.9)	15	17.4(10.8–27.0)
Workplace	3	4.1(1.0–11.8)	16	18.6(11.5–28.3)
Care facility*	9	12.2(6.4–21.8)	2	2.3(0.2–8.7)
Another prefecture	9	12.2(6.4–21.8)	—	—
Others	3	4.1(1.0–11.8)	3	3.5(0.8–10.3)
Total	74	100	86	100

* Care facility for aged or disabled people. CI: confidence interval

Table 2 Settings of transmission by demographics for participants with confirmed COVID-19 infection living in Tsuchiura City in November 2020

	No. of participants with known settings of transmission								
	Sex				Age				Total (%)
	Male		Female		0–59		60+		
Setting of transmission	*N*	% (95%CI)	*N*	% (95%CI)	*N*	% (95%CI)	*N*	% (95%CI)	
House	25	27.8(19.6–37.9)	35	50.0(38.6–61.4)	42	32.3(24.9–41.1)	18	60.0(42.3–75.4)	60(37.5)
Restaurant	33	36.7(27.5–47.0)	22	31.4(21.8–43.1)	50	38.5(30.6–47.1)	5	16.7(7.0–34.2)	55(34.4)
Workplace	17	18.9(12.1–28.3)	2	2.9(0.3–10.6)	16	12.3(7.7–19.2)	3	10.0(2.8–26.6)	19(11.9)
Care facility*	6	6.7(2.9–14.2)	5	7.1(2.8–16.1)	10	7.7(4.1–13.8)	1	3.3(−18.4)	11(6.9)
Another prefecture	5	5.6(2.1–12.8)	4	5.9(1.9–14.3)	9	6.9(3.6–12.9)	0	0.0(−13.8)	9(5.6)
Others	4	4.4(1.4–11.3)	2	2.9(0.3–10.6)	3	2.3(0.5–6.9)	3	10(2.8–26.6)	6(3.8)
Total	90	100	70	100	130	100	30	100	160(100)

* Care facility for aged or disabled people. CI: confidence interval

Table 4 Number of participants with confirmed COVID-19 infection living in Tsuchiura City in November 2020 by the "index setting of transmission" and "subsequent setting of transmission"

Index setting of transmission	Subsequent setting of transmission							Total		
	A†	House	Workplace	Restaurant	Facility	Others	Subtotal B‡	A+B	(%)	(A+B)/A
House	10	1	0	0	0	0	1	11	6.9	1.1
Restaurant	40	33	15	15	2	2	67	107	66.9	2.7
Workplace	3	0	0	0	0	0	0	3	1.9	1.0
Care facility*	9	9	0	0	0	0	9	18	11.3	2.0
Another prefecture	9	6	1	0	0	1	8	17	10.6	1.9
Others	3	1	0	0	0	0	1	4	2.5	1.3
Total	74	50	16	15	2	3	86	160	100	2.2

* Care facility for aged or disabled people

† A is number of participants by index setting of transmission.

‡ B is number of subtotal participants for subsequent setting of transmission by index setting of transmission.

IV. DISCUSSION

In the present study, "house" was found to be the major setting of transmission, followed by "restaurant." Each of these two settings amounted to more than one-third of the total settings of transmission. As for the "index setting of transmission," more than half of the SARS-CoV-2 transmission occurred in restaurants. "Restaurant" was found to be the "index setting of transmission" among two-thirds of all the participants.

Several studies have reported the role of restaurants in the transmission of COVID-19. A study using a mathematical model predicted that full-service restaurants were superspreading points of interest, accounting for a large majority of the infections[1]. A case-control study reported that COVID-19 case-patients were more likely to have reported dining at a restaurant prior to illness onset[6]. In Japan, the National Institute of Infectious Diseases reported that the proportion of the employees of restaurants and bars was relatively large at the beginning of the second wave (week 26, 2020), although the proportion of the settings of transmission was not reported[7].

The characteristics of the present study are that we almost clarified the overall picture of the transmission link in the region through contact tracing, and estimated the settings of transmission for most participants. However, the present study described the situation at the stage when the COVID-19 outbreak had just begun, and when the number of infected people was rapidly increasing. The results cannot necessarily be applied externally to the situation where the increase in infection has been steady for a long time[8]. In the present study, although "restaurant" was an important for the "index setting of transmission," the "house" setting was found to be the major "subsequent setting of transmission."

In restaurants, customers and employees are prone to both droplet and aerosol transmission, because customers may speak without wearing masks and the restaurants may have poor ventilation[9]. A study showed the association between allowing on-premises restaurant dining and the increase in COVID-19 case growth rates[10]. The Government did not implement any regulations on opening restaurants in Tsuchiura in November 2020. Interventions such as regulations for the opening of restaurants, thorough contact tracing of COVID-19 outbreaks in restaurants, and rapid diagnosis of symptomatic patients with a history of restaurant visits might be useful[2,10,11]. Further studies are necessary to investigate the impact of restaurant dining on the transmission of COVID-19, and the effects of interventions to prevent the COVID-19 infection in restaurants.

The staff for contact tracing and testing worked until midnight every night in November, and we managed understaffing challenges through outsourcing to businesses inside and outside the Public Health Center. For example, we utilized private institutions other than the Prefectural Health Research Institute to increase the number of tests conducted.

This study has several limitations. Firstly, it is an observational study, and no causal relationship can be proved. Secondly, we collected most of the epidemiological survey data from interviews with participants and did not necessarily have supporting evidence. Thirdly, the estimation of the setting or route of transmission was not necessarily objectively proven.

In conclusion, restaurant was found to be the setting of transmission in one third, and the index setting of transmission in half of the patients with SARS-CoV-2 infection living in Tsuchiura, Japan in November 2020.

The authors declare that they have no competing in-

terests.

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TO designed the study, collected, and analyzed the data, and was involved in the initial draft preparation and preparation of tables and figures. HO, MN, and AS were involved in the collection of data. SU and HT contributed to the interpretation of the data, and were involved in revising the manuscript. All the authors have read and approved the final manuscript.

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