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Article

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Research Article

The impact of the “COVID-19 life” on the Tokyo metropolitan area households with primary school-aged children: A study based on spatial characteristics

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ABSTRACT

This study aims to elucidate the effects that staying home due to COVID-19 has had on households with primary school-age children living in the central area. To determine the differences in states of mind between people in the central area and people in other areas, we investigated the changes in their “daily lives” including matters related to school; playing outside; associating with other children; “communication” including communication with family and friends; and the “use of information technologies” that secure communication. Moreover, we explored households that are satisfied even when they are unable to go out and clarified how children and their parents who live in the central area perceive the current situation. The study results indicate that the risks of COVID-19 in large cities have spatial characteristics and increase the burden on households raising children. Particularly in the central area, which has a high population density, the changes children experience are striking. Furthermore, due to the inadequate amount of open space, a strong awareness of the “new normal (avoiding the ‘Three Cs’ (closed spaces, crowded places, and close-contact settings))” is required.

1. Introduction

1.1. Research background

The COVID-19 pandemic has affected countries worldwide, and the situation appears to be deteriorating. According to the World Health Organization (2021), as of January 14, 2021, the number of active cases had increased to 90,335,008 with over 1,950,000 deaths worldwide, while in Japan the figures were 307,159 active cases with 4314 deaths. While Japan’s figures may appear low when compared to other regions, the number of cases are rapidly increasing, especially in Tokyo (Ministry of Health, Labor, and Welfare 2020).

In April 2020, the Japanese government declared a state of emergency and called on citizens to avoid the “Three Cs: closed spaces, crowded places, and close-contact settings” (Prime Minister’s Office of Japan, 2020). In May 2020, the state of emergency was temporarily lifted; however, citizens were directed to “stay home.” Particularly in Tokyo, which has a high population, people have been urged to adopt a preventative lifestyle. This has brought sudden changes to people’s lives.

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In this context, we must consider how children are coping with the pandemic. Although conditions vary across countries, the suspension of schools and the implementation of distance learning to maintain social distancing have been gaining ground worldwide. Thus, COVID-19 has had extensive impact on children.

Studies from China, Japan, and Korea have highlighted that although the pandemic has affected the entire world, its impact and the status of infections vary by region (Shaw et al., 2020). Children's lifestyles are expected to significantly change in each region with measures such as the implementation of online education. The proportion of infected children is negligible compared to that of adults and the elderly; however, reports have affirmed the effectiveness of suspending schools given the risk of infection spreading with their reopening. (Cluver, L. et al., 2020) Accordingly, the temporary closure of schools and public facilities is expected to continue.

Faced with this unforeseeable event, children have been displaying various stress reactions. Therefore, it is important to cultivate resilience in children (Lyu et al., 2020). Since depression and stress levels have increased due to COVID-19, it is imperative to provide mental health care and support to children and students to combat the stress caused by long-term isolation and online learning (Rajkumar, 2020). More than 20% of university students experience anxiety, with stress levels increasing further due to factors such as family members or acquaintances becoming infected, the economic situation, and the delay in schoolwork. However, considering that the psychology underlying anxiety differs between university and primary school students, Cao et al. (2020) have highlighted that the same countermeasures should not be adopted across the board; instead, students' specific characteristics must be considered. For university students, these include a diverse range of factors that contribute to anxiety and are associated with depression, whereas primary school students tend to become deeply anxious about risks to life and health. Shengyi et al. (2020) reported that primary school students are dependent on the information and attitudes of their parents and that the roles that parents play are therefore important.

It is also difficult to keep children in a healthy and secure state within the home. Cluver, L et al. (2020) found that these issues are further aggravated in low-income, high-density households; the violence and vulnerability experienced by children have increased during the school closure period and parents and children are susceptible to stress as well as information and sensational reporting by the media that increase their fears of COVID-19.

Under these circumstances, UNICEF (2020) has published "coronavirus (COVID-19) parenting tips," which offer advice on dealing with the problems arising from children remaining at home. Another issue is how to maintain the quality of primary school education (World Health Organization, 2020). However, considering the gravity of the infection in major cities, such as New York, the number of cases in regions primarily comprising low-income households has increased greatly, and the occurrence of child abuse and other related problems has become increasingly severe (Donnelly, 2020; Paybarah et al., 2020). Correspondingly, the risk of COVID-19 in major cities has spatial characteristics, increasing the burden borne by households with children. Although there are few reports of children being infected, they are being forced to accept changes to their lifestyles due to the pandemic.

1.2. Review of previous surveys on COVID-19 and Japanese children

Public interest corporation "Save The Children Japan" is an international NGO that specializes in supporting children. In March 2020, the organization distributed an emergency child questionnaire, targeting children from Grade 1 age to 18 years old, in response to the increase in COVID-19 infections. Subsequently, Save The Children Japan (2020) published an overall report summarizing the 1422 responses collected from 41 prefectures nationwide. Comments confirmed COVID-19's significant effect on Japanese children, such as "I want to/cannot meet with other people" and "I cannot live my daily life/I want to leave the house." At approximately 50%, this was most relevant for primary school children (in lower grades) who were surveyed through afterschool childcare.

Furthermore, Aiko et al. (2020) studied with the Association for Children's Environment/Association for Research on the Children's Environment, Hokkaido, conducting a survey targeting children aged up to 12 to examine how they were coping with school closures and staying at home without playing outdoors, following COVID-19. They confirmed that staying at home increased the amount of time spent watching television, videos, being on the Internet, and playing video games. However, it decreased the opportunities to play outdoors and spend time with friends, and caused confusion for many parents with respect to leaving the house, going for walks, or playing in nearby parks, home gardens, or lawns.

1.3. Research objectives and questions

Based on this background, this study references the above-mentioned existing surveys and establishes three viewpoints. The first comprises the spatial features of the effects on children of staying at home, through a comparison of the central area with other areas. The second clarifies the differences between children and parents in terms of their concerns. The third underlines that it is possible to be satisfied with staying indoors, and considers the risks and benefits of living spaces in the central area.

Primary schools in Tokyo closed in early March 2020.¹ Since the academic year commences in April under the Japanese primary school system, children were unable to participate in the graduation ceremonies at the end of March and the opening ceremonies in early April. In various countries, the academic year begins in September; however, Japanese children were forced to "stay home" during these momentous events. Thus, they could not participate in special occasions such as the graduation and opening ceremonies.

This study examines whether the risks of COVID-19 have spatial characteristics and whether the anxieties experienced by households with children vary based on their area of residence. Children that live in cities are exposed to risks due to population. Our research

¹ On February 27, 2020, at the Novel Coronavirus Response Headquarters, Prime Minister Shinzo Abe announced a call for temporary closures of elementary, middle, high, and special support schools nationwide from March 2, 2020 until spring vacation.

Table 1
Outline of the questionnaire survey.

Distribution period	April 20, 2020–April 22, 2020		
Survey form	Internet web survey	Number of responses	310
Survey subjects	Households with children in Grades 4–6 living in the 23 wards of Tokyo		
Respondents	Children in Grades 4–6 and their parents		
Survey items	Questions about raising children in the current living environment [Answered by parents]		
	Questions about raising children in the current living environment [Answered by children]		
	Questions about current life status and living environment [Answered by parents]		

questions are as follows:

- 1 What are the difficulties in daily life and communication experienced by families raising children under the difficult circumstances caused by COVID-19? Do these difficult situations differ between children and parents?
2. What are parents satisfied with in life under COVID-19? What are the trends by region?

The answers to these questions may provide useful knowledge on how the living environment in the central area should be reconstructed during the post-COVID-19 period. Correspondingly, this study aims to elucidate the effects that staying home due to COVID-19 has had on households with primary school-age children living in the central area. To determine the differences in the state of mind between people in the central and other areas (the Eastern and Western areas), we investigated the “daily life” changes, including matters related to school; playing outside; associating with other children; “communication” with family and friends; and the “use of information and communication technologies (ICT)” that secure communication. We also examined households that are content even when they are unable to go out, and aimed to clarify how children and their parents who live in the central area perceive the current situation.

2. Research methods

2.1. Overview of questionnaire survey

We conducted a questionnaire survey on households with children attending grades four to six, living in one of Tokyo’s 23 wards (Tables 1 and 2). We conducted the questionnaire survey from April 20–22, 2020 (Table 1). The survey comprised an Internet web survey, which garnered 310 responses. We conducted the survey online, without coming into direct contact with the participants. It targeted households with children in Grades 4–6 living in the 23 wards of Tokyo. The main survey questions, which were only answered by the parents, concerned the care of their children in the current living environment under COVID-19. The children answered questions concerning their condition in the current living environment.

To elucidate the differences between the opinions of children and their parents, parents and children were required to respond separately to the survey.

2.2. Method of identifying spatial trends

To identify spatial trends, we categorized the survey participants into three different residence areas: the central, Eastern, and Western areas. The “central area” comprises a total of seven wards and is where the majority of the 23 wards’ political, economic, and cultural functions are concentrated (Statistics of Tokyo Metropolitan Government, 2018), while the subcentral area features scattered capital city functions (Shinjuku, Shibuya, Toshima, and Bunkyo).² The remaining areas were divided in two, as the Eastern and Western areas (Figs. 1 and 2). The regional classification used in this study was determined by the following criteria and characteristics.

● Spatial characteristics related to urban functions and residence

- > **Population density (daytime population density)³ and birth rate⁴** The average daytime population density (person/km²) is 25,499.2 in the 23 wards of Tokyo, while it is 45,703.1 in the central area of Tokyo. The highest intermediate population density is in Chiyoda (73161.9 persons/km²), followed by Chuo (59608.5 persons/km²) and Chuo (46184.8 persons/km²). These three

² The central and subcentral areas comprise the core areas where many capital functions are concentrated, such as governmental, legal, and administrative agencies as well as the headquarters and flagship stores of large companies. There are around 207,000 offices within the area, or approximately 31% of the total number in Tokyo. There is a conspicuous concentration of offices related to telecommunications, the service industry, academic and research functions, finance, and medicine, as well as foreign companies. For further information, see the Tokyo Metropolitan Industrial Location Support Center, <https://ilsc.tokyo/region/toshin.html>.

³ Population density: Statistics of Tokyo Metropolitan Government (Daytime population of Tokyo according to the national census), 2018 <https://www.toukei.metro.tokyo.lg.jp/tyukanj/2015/tj-15index.htm>.

⁴ Fertility rate: Bureau of Social Welfare and Public Health, 2019 Tokyo Metropolitan Government, Annual Trends (by ward, city, town and village), 2019 https://www.fukushihoken.metro.tokyo.lg.jp/smph/kiban/chosa_tokei/jinkodotaitokei/kushityosonbetsu.html.

Table 2
Attributes of respondents.

Items	Contents
Gender	136 men (44%), 174 women (56%)
Age group	27 people aged 30–35 (9%), 56 people 35–40 (18%), 110 people 40–45 (35%), 90 people 45–50 (29%), 27 people older than 50 (9%)
Areas of residence	The central area: 68 people (22%) The other areas: Eastern area, 62 people (20%); and Western area, 180 people (58%)
Housing type	Home-owner (single-family): 135 people (44%) Home-owner (condominium): 81 people (26%) Tenant (single-family): 11 people (4%) Tenant (apartment building): 75 people (24%) Dormitory or company housing: 6 people (2%) Other: 2 people (less than 1%)



Fig. 1. The wards of Tokyo.

wards show a particular increase in the birth rate among the 23 wards. The average fertility rate per 1000 population in the 23 wards is 7.6, while the fertility rate in the 7 wards is 8.9.

- **Administrative services**⁵ If the revenue per capita is large, it is easy to enhance the administrative services that each resident can receive; the average revenue per capita in the 23 wards is 460,700 yen, while the average revenue per capita in the 7 central wards is 611,000 yen. In addition, we compared the ratio of self-financing by the government, which is important in considering stable finances. The average self-financing rate of the 23 wards is 29.3%, while that of the 7 central wards is a high 36.8%.

● **Spatial characteristics related to the lives of families with small children**

- **Total amount of park space**⁶ In the seven central wards of Tokyo, there are many green parks. The average area of parks per capita in the 7 central wards of Tokyo is 7.01 m², compared to the average of 4.3 m² in the 23 wards. The average area of parks per resident is 7.01 m², compared to 4.3 m² in the 23 wards.
- **Hospitals and clinics** Comparing the number of general hospitals per 10,000 population, the average number of hospitals in the 7 wards of central Tokyo is 0.25 times higher than that in the 23 wards (0.54 in the 23 wards, 0.79 in the 7 wards of central Tokyo). The average number of clinics per 10,000 people in the 7 wards of central Tokyo is almost double that of the 23 wards (31.7 clinics per 10,000 people compared to 15.8 clinics per 10,000 people in the 23 wards).

⁵ Revenue and self-financing ratio Quoted from each municipality's website Chiyoda, Chuo, Minato, Shinjuku, Bunkyo, Taito, Sumida, Koto, Shinagawa, Meguro, Ota, Setagaya, Shibuya, Nakano, Suginami, Toshima, Kita, Arakawa, Itabashi, Nerima, Adachi, Katsushika, Edogawa Wards.

⁶ Parks: Tokyo Metropolitan Government, "Table of Urban Parks by District, Municipality, Area and Population Ratio" https://www.kensetsu.metro.tokyo.lg.jp/jigyo/park/kouenannai/kouen_menseki.html.



Fig. 2. The central area and the other areas (Western and Eastern).

2.3. Text mining

In this study, text mining analysis with open-ended responses was used to examine the details of residential satisfaction. This analysis explores satisfaction while having to stay at home and its relationship with area of residence. The analysis method involved text-matching on free description responses to the question, “Please describe the aspects with which you are most satisfied in your current life.” Text-matching analysis is also commonly used in research on administrative planning (Yamashita, 2012) and the state of affairs of community development (Oda et al., 2017). KH Coder3 software was used to process data in text form (Higuchi, 2014). After morphological analysis, frequently appearing words were extracted and shown in a co-occurrence network. Moreover, the relationship between frequently appearing words and area of residence was considered through a correspondence analysis between “satisfaction with current life” and “area of residence.” Thus, we clarified how parents living in the central area perceived their current situation.

3. Results

3.1. The effects of staying home on children’s living environments

The brief attributes of respondents are shown in Table 2. Most parents were in the age groups 35–40 (18%) and 40–45 (35%). Approximately half of the survey respondents lived in their own homes. There were 68 responses (22%) from the central area, 62 responses (20%) from the Eastern area, and 180 responses (58%) from the Western area.

In this section, the changes in life due to COVID-19 were divided into three aspects, and the changes of each child and parent were tabulated. The three aspects were: things in daily life, communication with others, and the use of ICT technology. Specifically, we grasped things related to life in general in “normal life,” and then we grasped “communication with others,” which has the most impact when it comes to maintaining social distance. Finally, we investigated the use of ICT technology that can supplement those changes.

3.1.1. Changes in daily life

We compared the changes to children’s daily lives from the perspective of parents and children by area of residence. The question to the parents was, “How has your child’s daily life changed under COVID-19?”. The parents selected five answer options: “increased,” “did not change,” “decreased,” “did not exist to begin with,” or “I don’t know.” And the question to the children was, “How has your daily life changed under COVID-19?”. The children selected four answer options: “increased,” “did not change,” “decreased,” or “did not exist to begin with.” In this way, we prepared questions on “daily life changes,” “communication,” and “use of information and communication technologies (ICT).”

We asked parents and children to fill out questionnaires separately. Figs. 3–5 exclude “don’t know” responses.

Many children believed that affinity toward schools, time spent playing outdoors, and interactions with other children had decreased, while home activities, chores, and reading time had increased. The opinions of parents largely concurred with these beliefs, particularly regarding the changes in playing outdoors (Fig. 3).

Looking solely at children’s opinions, we examined whether the hypothesized spatial characteristics existed. We conducted a Fisher’s exact probability test using JMP pro, regarding the independence of the central and other areas (the Eastern and Western areas). The survey results showed that the percentage of respondents who reported that “relations with school” “decreased” was significantly higher



Fig. 3. Life changes.

for other areas than for the central area (Table 3).

3.1.2. Changes in communication

The question to the parents was, “How has your child’s communication changed under COVID-19?” The parents selected five answer options: “increased,” “did not change,” “decreased,” “did not exist to begin with,” or “I don’t know.” And the question to the children was, “How has your communication changed under COVID-19?” The children selected four answer options: “increased,” “did not change,” “decreased,” or “did not exist to begin with.”

Regarding children’s communication, “time spent together with family” and “time spent talking with family” increased, while “time spent together with friends” and “time spent talking with friends” decreased. Particularly in the central area, “opportunities to talk with family about worries and inexplicable concerns” increased (Fig. 4).

Fisher’s exact probability test revealed significant differences between the central area and other areas for all survey items, except for “opportunities to talk with friends about worries and concerns.” “Time spent together with family” and “time spent talking with family” either “decreased” or “did not exist to begin with” for a section of children in the central area. In comparison, it “increased” in the other areas. Furthermore, when compared to the large percentage of children in the central area, who responded that “opportunities to talk with family about worries and inexplicable concerns” “increased,” in the other areas, a large percentage of children responded that the situation “did not change.” In contrast to children from the central area who often responded that “time spent with friends outside of school” and “time spent talking with friends” increased or “did not change,” children in other areas responded that it “decreased”



Fig. 4. Changes in communication.

(Table 4).

3.1.3. Changes in the use of ICT

The question to the parents was, “How has your child’s use of information and communication technologies (ICT) changed under COVID-19?” The parents selected five answer options: “increased,” “did not change,” “decreased,” “did not exist to begin with,” or “I don’t know.” And the question to the children was, “How has your use of ICT changed under COVID-19?” The children selected four answer options: “increased,” “did not change,” “decreased,” or “did not exist to begin with.”

In the central area, the frequency of interactions with friends on social networking services such as LINE approximately doubled compared to that in the other areas. Moreover, in the central area, time spent playing online games and using the Internet on personal computers increased. As schools closed, and children were compelled to learn at home, their opportunities to come in contact with information systems may have increased. Furthermore, they may have been affected by opportunities to use information technologies as an alternative means to compensate for the lack of communication (Fig. 5).

Fisher’s exact probability test revealed significant differences in the “frequency of interactions with friends on social media networks such as LINE,” “frequency of online gaming,” and “frequency of using the Internet from a personal computer.” In contrast to a high percentage of children in the downtown area who reported that these activities “increased,” children from the other areas responded that these activities were “not common to begin with” (Fig. 5).



Fig. 5. Changes in the use of information technologies.

3.2. Concerns regarding COVID-19

3.2.1. Differences between the concerns of parents and children

The question “What are your problems, worries, or concerns that bother you under COVID-19?” elicited five levels of response ranging from “Applies to me” to “Does not apply to me.” Approximately 40% of parents responded to all the questions with “Applies to me” (Fig. 6). The most pressing problem was “worry and anxiety about the increasing rate of infections,” to which 65.2% of parents responded “Applies to me.” Other highly concerning items were “lack of exercise and loss of strength for children,” “losing out on special experiences,” “not being able to lead a normal life (having to stay at home),” and “concerns about studying, such as children falling behind in their studies.” In contrast, “my own job and family life” and “not being able to meet up with people” were not considered serious problems. Children were concerned about “not being able to live a normal life (having to stay at home),” “losing out on special experiences,” and “not being able to meet up with people.” However, they were unconcerned about their “parents’ jobs and family life” and “disruptions to lifestyle” (Fig. 6, Table 5).

3.2.2. Regional comparison

Fig. 7 shows a distribution of the problem items faced by children, with the rate of responses that were “most applicable” of the five

Table 3

Fisher's exact probability test regarding life changes (children's opinions).

			Increased	Did not change	Decreased	Do not exist to begin with	Fisher's exact probability test	
Relations with school	City center	Number of answers	5	5	53	5	0.0024	**
		%	7.35	7.35	77.94	7.35		
	Western area & Eastern area	Number of answers	2	17	218	5	0.5210	n.s.
		%	0.83	7.02	90.08	2.07		
Time to play with children of different age	City center	Number of answers	5	9	40	14	0.2027	n.s.
		%	7.35	13.24	58.82	20.59		
	Western area & Eastern area	Number of answers	20	36	154	32	0.5300	n.s.
		%	8.26	14.88	63.64	13.22		
Time to play outside	City center	Number of answers	7	5	50	6	0.5603	n.s.
		%	10.29	7.35	73.53	8.82		
	Western area & Eastern area	Number of answers	13	18	200	11	0.5300	n.s.
		%	5.37	7.44	82.64	4.55		
Time to help our house	City center	Number of answers	27	30	5	6	0.5603	n.s.
		%	39.71	44.12	7.35	8.82		
	Western area & Eastern area	Number of answers	117	96	15	14	0.5603	n.s.
		%	48.35	39.67	6.20	5.79		
Time to read a book	City center	Number of answers	31	25	8	4	0.5603	n.s.
		%	45.59	36.76	11.76	5.88		
	Western area & Eastern area	Number of answers	94	97	25	26	0.5603	n.s.
		%	38.84	40.08	10.33	10.74		

* p<5%, **p<1%, n.s.

levels on the Y-axis, and the difference between children and parents' responses on the X-axis. Matters of concern are categorized into two groups, the upper area being the highly concerned group and the lower area being the least concerned. Overall, parents were more worried than children in most cases, whereas children were worried about "not being able to meet up with people." In the Eastern and Western areas, the difference between parents and children was significant in comparison to that in the central area. Parents living in the central area were particularly concerned about "losing out on special experiences" and "disruptions to lifestyle."

3.3. Relationship between satisfaction with current life and area of residence

3.3.1. Overview of result

A portion of the "free descriptions" in response to the question "Please describe the aspects with which you are most satisfied in your current life" were excerpted, as shown in Table 6. The words with the highest frequency were "family (51 times)" and "children (51 times)," followed by "health (28 times)" and "convenience (20 times)" (Table 7).

Fig. 8 shows the results of a co-occurrence network targeting the top 45 most frequently appearing words. The co-occurrence network shows the relationship between pairs of words, and circle sizes indicate the frequencies of appearance. Words with a deep color indicate a high degree of association with other words. Fig. 8 shows that "satisfaction with current life" is composed in such a way that it can be largely categorized into two networks.

The first network focuses on words like "shopping," "convenience," and "medical treatment," and indicates an awareness of daily convenience, the availability of medical facilities, and so on. Words such as "close," "transport," and "replete" are derived from these words. That is, the convenience of the transportation environment and the surrounding facilities are some of the necessities of Tokyo residents. Specifically, this corresponds to comments such as "Transport is convenient," "There are plenty of medical facilities, and transport is easy, so it's not hard to take the children out to play," "Schools, medical facilities, child welfare facilities, and so on are available," and "Shopping places are close to train stations, so you can walk to them."

The second network highlights words such as "spend [time]" and "stress." Words such as "child," "family," "home," and so on are derived from these words. Respondents reported that they gain satisfaction from time spent with children and the family. Specifically, this network corresponds to comments such as "spending time with my happy and healthy family every day" and "a healthy family spending stress-free time together."

Moreover, focusing on the phrase "COVID-19" revealed comments such as "I feel that once the situation eases, I won't have the opportunity to spend time with my family like I do now" and "I have more time to spend with the children. The virus concerns me, but I

Table 4

Fisher's exact probability test regarding communication changes (children's opinions).

			Increased	Did not change	Decreased	Do not exist to begin with	Fisher's exact probability test
In a day, time spent together with family	City center	Number of answers	55	6	4	3	0.0251 *
		%	80.9	8.8	5.9	4.4	
	Western area & Eastern area	Number of answers	213	24	3	2	
		%	88.02	9.92	1.24	0.83	
In a day, time spent talking with family	City center	Number of answers	50	12	6	0	0.0147 *
		%	73.53	17.65	8.82	0.00	
	Western area & Eastern area	Number of answers	199	38	3	2	
		%	82.23	15.70	1.24	0.83	
Opportunities to talk with family about worries and concerns	City center	Number of answers	29	26	1	12	0.0130 *
		%	42.65	38.24	1.47	17.65	
	Western area & Eastern area	Number of answers	59	139	8	36	
		%	24.38	57.44	3.31	14.88	
In a day, time spent with friends outside of school	City center	Number of answers	9	10	44	5	0.0487 *
		%	13.24	14.71	64.71	7.35	
	Western area & Eastern area	Number of answers	14	19	188	21	
		%	5.79	7.85	77.69	8.68	
In a day, time spent talking with friends	City center	Number of answers	9	9	48	2	0.0167 *
		%	13.24	13.24	70.59	2.94	
	Western area & Eastern area	Number of answers	9	21	202	10	
		%	3.72	8.68	83.47	4.13	
Opportunities to talk with friends about worries and concerns	City center	Number of answers	6	8	34	20	0.0543 n.s.
		%	8.82	11.76	50.00	29.41	
	Western area & Eastern area	Number of answers	8	57	109	68	
		%	3.31	23.55	45.04	28.10	

* p<5%, **p<1%, n.s.

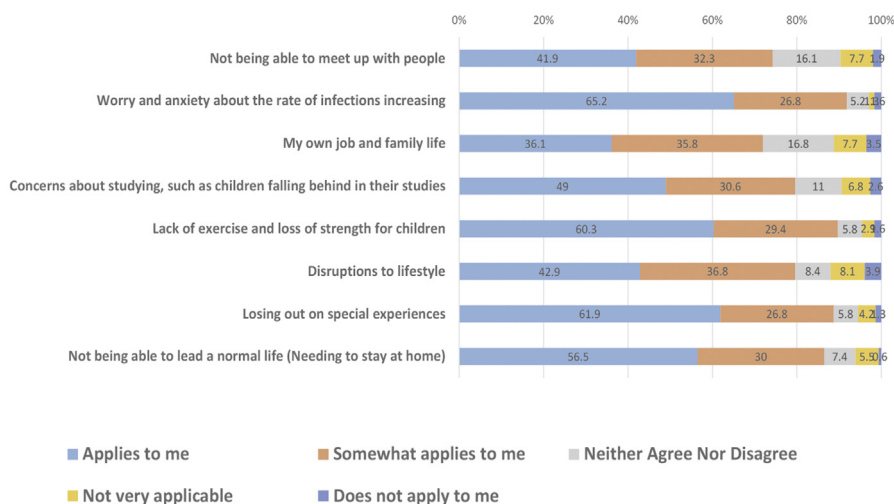
like having more quality time.” In a survey conducted on city residents by the Department of Life and Culture of the [Tokyo Metropolitan Government \(2018\)](#), when asked “What are the reasons that you are satisfied with your current life? (multiple choice),” “being healthy” and “having a full life together with my family” were chosen by 68% and 56% of respondents, respectively. This indicates that, even before the rise in COVID-19 infections, residents were relatively satisfied with their home life and the health of their families. However, although residents feel concerned about their family's health and the infection itself along with the rise in COVID-19 infections, we can observe that they also experience satisfaction and happiness regarding the increase in the amount of time they can spend with their families.

3.3.2. Correspondence analysis between satisfaction with current life and area of residence

The correspondence analysis between “satisfaction with current lifestyle” and “area of residence” ([Fig. 9](#)) revealed that words with no characteristics clustered in the area around the origin, while words with characteristics clustered away from the origin. The five words with the least characteristics are clustered around the origin and are not displayed in the figure.

Words such as “convenient” and “public safety” are clustered around the “central area,” indicating satisfaction with the convenience of transport and the quality of public safety. In contrast, words such as “park” and “job” are clustered on the opposite end of the figure, indicating a weak relationship. Specifically, this area corresponds to comments such as “It's much easier to get around, and I don't have to spend time commuting anymore. I'm quite pleased with the increased convenience everywhere I go” and “It's safe, and the educational environment is well organized.”

What are your problems, worries, or concerns that bother you under COVID-19 (Guardians)



What are your problems, worries, or concerns that bother you under COVID-19 (Children)

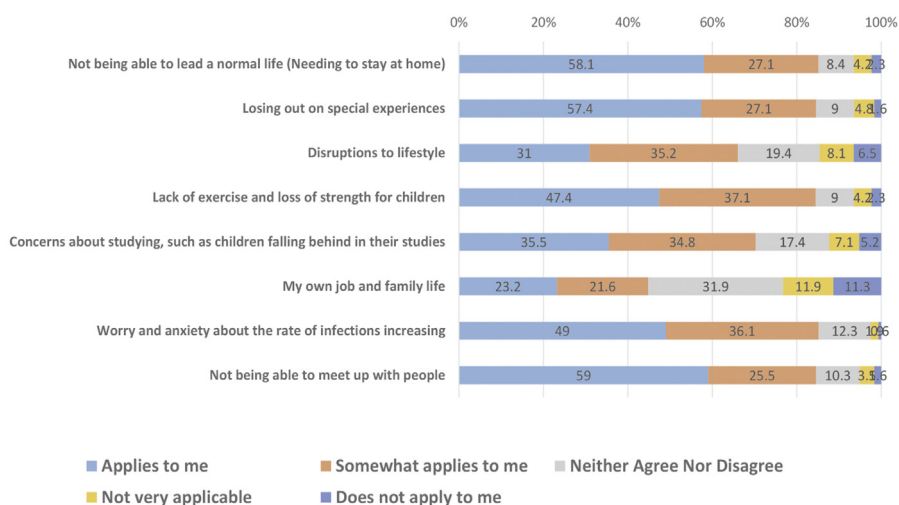


Fig. 6. Comparison of problems for children and parents (upper: parents, lower: children).

Words such as “shopping” and “together” are clustered around the “Eastern area.” While satisfaction with the convenience of shopping and spending time with family are high, words such as “commuting” and “central area” are clustered on the opposite end of the figure, indicating a weak relationship. Specifically, this area corresponds to comments such as “convenience due to nearby shopping and medical institutions” and “I can be together with my family.”

Many words are clustered near the “Western area,” and this group is close to the origin. This may be because there are many parameters for the “Western area” in comparison to the other groups. Words such as “parks” and “job” are clustered here, indicating that one trait of the group is satisfaction with the circumstances surrounding parks and jobs. Specifically, this area corresponds to comments such as “There are many large parks, making this neighborhood a good place to live for people raising families, and the elderly” and “My family is safe, and I have a job.”

Table 5

Fisher's exact probability test regarding changes in the use of information technologies (children's opinions).

			Increased	Did not change	Decreased	Do not exist to begin with	Fisher's exact probability test	
Frequency of watching TV news programs	City center	Number of answers	43	15	4	6	0.5198	n.s.
		%	63.24	22.06	5.88	8.82		
	Western area & Eastern area	Number of answers	150	59	6	27		
		%	61.98	24.38	2.48	11.16		
Frequency of interactions with friends on social media networks	City center	Number of answers	20	15	4	29	0.0121	*
		%	29.41	22.06	5.88	42.65		
	Western area & Eastern area	Number of answers	37	39	13	153		
		%	15.29	16.12	5.37	63.22		
Frequency of online gaming	City center	Number of answers	37	11	4	16	0.0259	*
		%	54.41	16.18	5.88	23.53		
	Western area & Eastern area	Number of answers	95	45	6	96		
		%	39.26	18.60	2.48	39.67		
Frequency of using the internet from a cellular telephone	City center	Number of answers	32	11	3	22	0.2841	n.s.
		%	47.06	16.18	4.41	32.35		
	Western area & Eastern area	Number of answers	89	46	6	101		
		%	36.78	19.01	2.48	41.74		
Frequency of using the internet from a personal computer	City center	Number of answers	38	13	1	16	0.0068	**
		%	55.88	19.12	1.47	23.53		
	Western area & Eastern area	Number of answers	87	43	4	108		
		%	35.95	17.77	1.65	44.63		

* $p < 5\%$, ** $p < 1\%$, n.s.

4. Discussion and conclusion

This study examined the difficulties faced by families raising children under the difficult circumstances caused by COVID-19. It also explores the changes faced by children and parents living in central Tokyo, where density and risk of infection are particularly high, in terms of daily life, communication life, and satisfaction levels in COVID-19.

This study elucidated how staying indoors due to COVID-19 has impacted households with primary school-age children, living in the central area. Accordingly, we conducted an online survey to understand the changes to the respondents' daily lives, their concerns due to the increasing number of infections, and their satisfaction with their current lives.

We conducted Fisher's exact probability tests using JMP pro regarding the independence of the central and other areas (the Eastern and Western areas). The results confirmed significant differences for several items. Many children believed that while relations with school, playing outside, and associating with other children were negatively impacted, home activities and chores, as well as reading time, increased. In the central area, "opportunities to talk with my family about worries and inexplicable concerns" increased compared to that in the Western and Eastern areas. Furthermore, in the central area, children's use of information technologies rose in comparison to that in the Western and Eastern areas. Parents expressed several concerns, while the primary concern for children was "not being able to meet up with people."

Moreover, the results of text mining on free description responses to the question "Please describe the things you are most satisfied with in your current life" showed the centrality of the word "spend [time]" that was related to "family" and "children." While children and parents are worried about many issues due to the increase in COVID-19 infections, parents feel satisfied concerning their life situation at home and their family's health. Children living in high-density cities may be at high risk of COVID-19 infection; however, their parents' comments confirm that many parents are thankful for the chance to prioritize family time and good health.

Land prices are high in the central area, even within the 23 wards of Tokyo, and residents have high incomes (Tokyo Metropolitan Government Bureau of Finance, 2020). Moreover, parents spend long hours working, and the proportion of homes in which both parents work is high. As staying at home means that it is necessary to work and study at home, affluent central area residents may adapt more easily to these lifestyle changes.

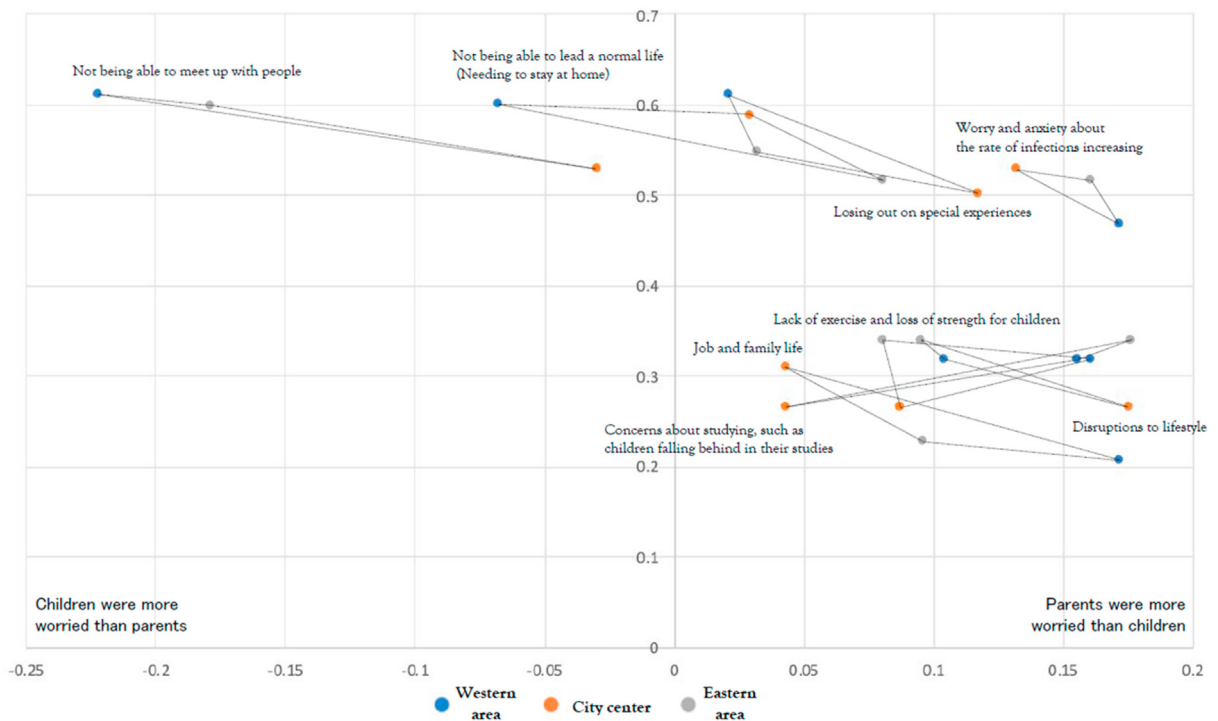


Fig. 7. Comparison considering areas.

Table 6

Free description responses (partially excerpted).

44-year-old woman (living in the Arakawa Ward)	Having a supermarket right in front of my eyes, having several more supermarkets in the neighborhood, both children and parents having good friends
49-year-old man (living in the Kita Ward)	Having all members of the family living happily in good health.
37-year-old man (living in the Edogawa Ward)	I live every day in fear of COVID-19 and am continuously inside of our home. My daily stress levels have risen, but I also feel the happiness of being in the same space with my family for long periods. I'm very fortunate not to be alone. There is a mountain of worries, but I also feel that once the situation eases, I won't have the opportunity to spend time with my family like I do now, so I have to make every moment of this time count.
34-year-old woman (living in the Setagaya Ward)	I'm glad that the kids can go and have fun at school. Other than that, I don't have many problems, so I'm satisfied.
51-year-old man (living in the Minato Ward)	It's much easier to get around, and I don't have to spend time commuting anymore. I'm quite pleased with the increased convenience everywhere I go.
34-year-old woman (living in the Shibuya Ward)	It's a tough situation, but I'm happy to have more time to spend with my family.
43-year-old man (living in the Minato Ward)	Everything is more convenient now, and I don't have to waste time.
44-year-old man (living in the Itabashi Ward)	Due to the effects of COVID-19, I wind up my job earlier than usual. I'm very happy to have more time to spend with my wife and son.
48-year-old man (living in the Ota Ward)	I'm glad that I have a job where my income hasn't decreased, even during this calamitous situation.
49-year-old woman (living in the Nerima Ward)	I have more time to spend with the children. The pandemic concerns me, but I like having more quality time.
41-year-old woman (living in the Nakano Ward)	I bought my house when the market was low (15 years ago), and this month I'll pay it off completely after 15 years. That's the most satisfying thing for me in life under the current situation.

Significant changes observed in the central area may change the living environments of parents who have the economic potential to set up Internet connections easily and who spent only short periods of time at home prior to the changes in lifestyle caused by COVID-19. Compared to other areas, the central area has specific features such as high-quality educational institutions and a very convenient transportation network. These elements may encourage resident satisfaction for households raising children in the area. The benefits and risks of living spaces in the central area could be understood by clarifying what it is that makes households raising children in the central area feel satisfied with their lives during periods when they are compelled to stay at home.

This survey has allowed us to understand that the risks of COVID-19 in large cities have spatial characteristics and that they increase

Table 7

Frequently appearing words (15 times or more).

1. family (51 times), 2. children (51 times), 3. health (28 times), 4. convenience (20 times), 5. spend [time] (19 times), 6. life (18 times), 7. transportation (16 times), 8. lots (16 times), 9. good (16 times)

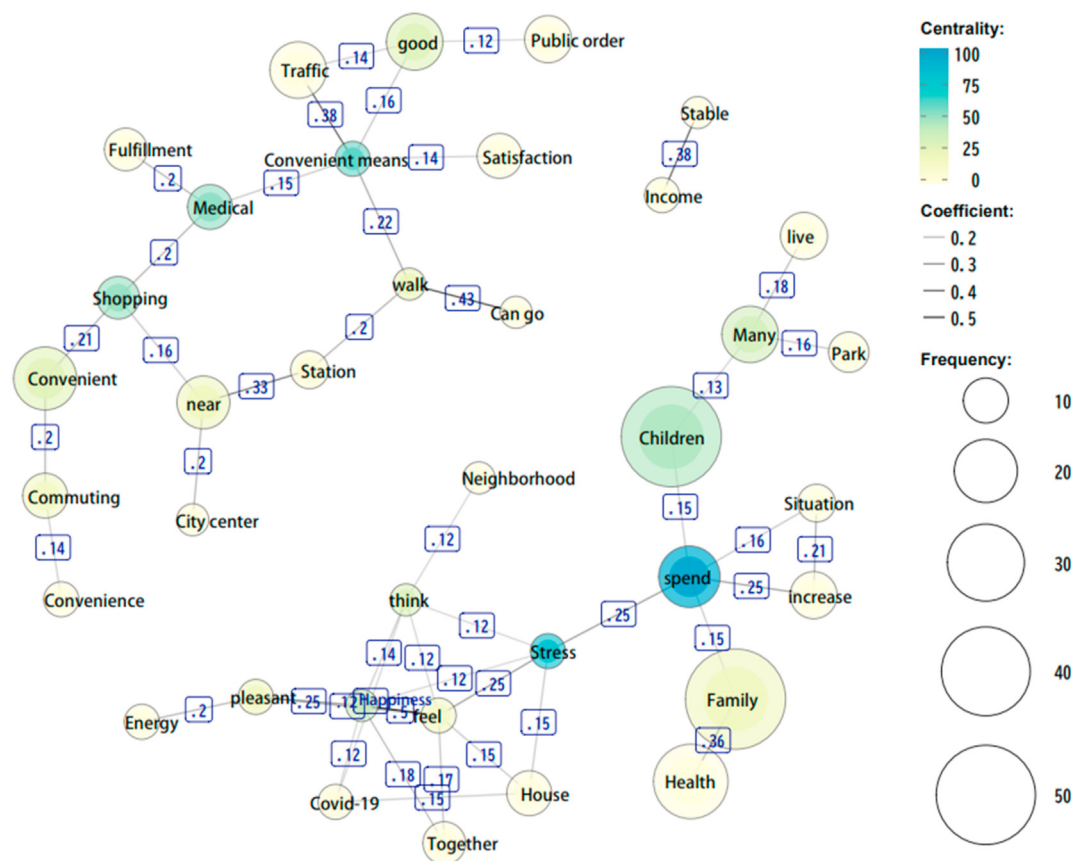


Fig. 8. Co-occurrence network (centrality (intermediary)) (top 45 words).

the burden on households raising children. Particularly in the central area that has high population density, the changes experienced by children are striking. Furthermore, since the number of open spaces is not sufficient in the central area, a strong awareness of the “new normal”⁷—avoiding the “Three Cs” (closed spaces, crowded places, and close-contact settings)—is required.

Based on the “new lifestyle,” the Ministry of Education, Culture, Sports, Science and Technology presented the “Hygiene Management Manual for New Coronavirus Infections in Schools: A New Lifestyle for Schools” to set standards of behavior for schools. Not only in school life, behavioral restrictions have been imposed for days, such as not being able to interact with friends or relaxing in public spaces, and their continuation is likely to increase stress, an effect not limited to children. An increase in children’s stress levels necessitates the provision of mental care by their parents. The Ministry of Health, Labor and Welfare has published “10 points to reduce human contact by 80%” and urges people to avoid the “three densities” in daily life. As can be inferred from this study, even within the 23 wards, the impact and changes due to COVID-19 have different characteristics depending on the space, socio-economic features, and lifestyle. On the other hand, there is a limit to the number of measures taken by wide-area local governments based on a general view of the region. Furthermore, the burden on the child-rearing generation has not been taken into account at all. Future policies will need to consider aspects of inclusive planning.

While an increase in communication within the home may be a benefit of these restrictions, the need to suppress interactions among people in high-density areas is a burden. To prevent secondary problems, the population must be both spatially and temporally spread to

⁷ In schools too, a “new lifestyle” has been introduced that involves avoiding the “Three Cs” and continuing to take basic infection countermeasures such as “wearing masks” and “hand sanitation such as hand washing.” Schools are offering a “Health Management Manual Regarding Novel Coronavirus Infection in Schools—A New Lifestyle for Schools,” as it is necessary to reduce the risk of infection and spread of the virus as much as possible while allowing educational activity to continue, to ensure that children are able to study in good health.

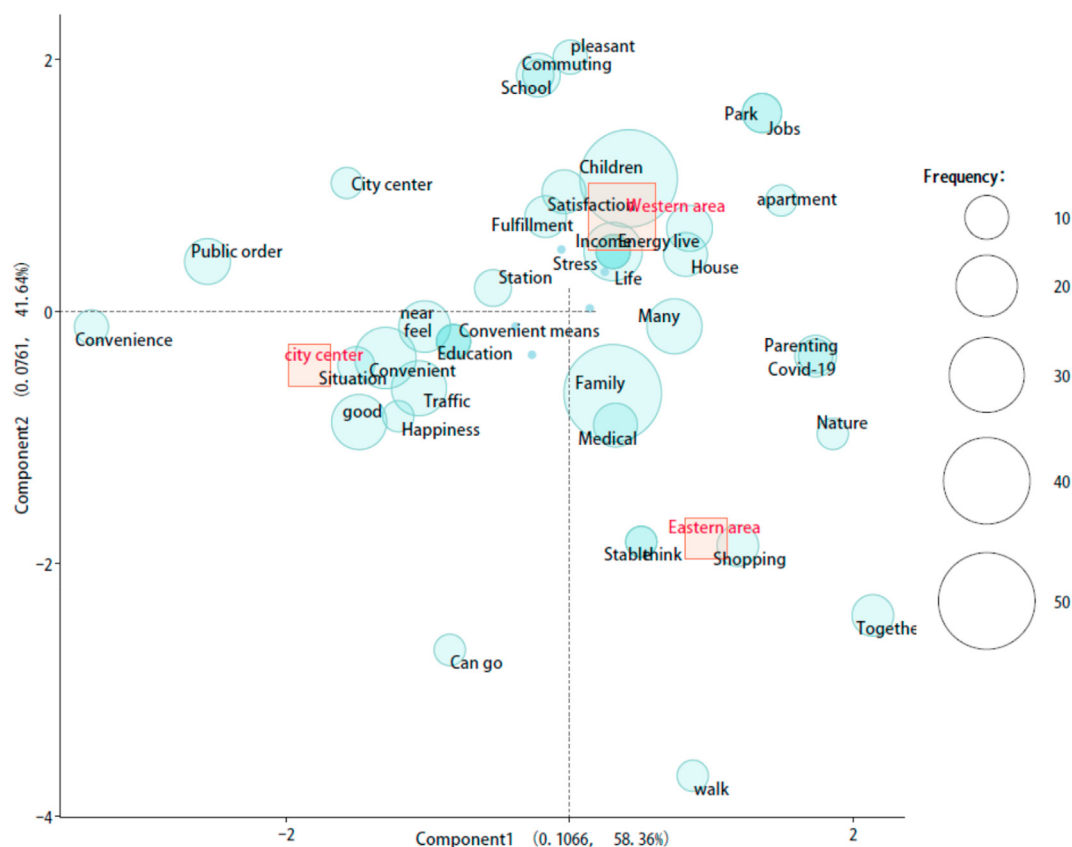


Fig. 9. Correspondence analysis between word frequency and area of residence.

minimize such stress. In the high-density central area, it may also be necessary to create mechanisms by which open spaces, which help reduce stress, can be experienced without crowds.

The increase in COVID-19 infections has forced us to consider how spaces are being built and used. The new normal as we adapt to COVID-19 is an opportunity to confront the risks (or disadvantages) that cities represent concerning pandemics, terrorism, and large-scale natural disasters. Urban structure and functions should be considered to avoid focusing on the benefits of concentrated urban functions that are typical of the status quo.

Declaration of competing interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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