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Association between COVID-19 incidence and postponement or cancellation of elective surgeries in Japan until September 2020: a cross-sectional, web-based survey

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ABSTRACT

Objectives This study aimed to examine whether and how the COVID-19 pandemic has affected the postponement or cancellation of elective surgeries in Japan.

Design and setting A cross-sectional, web-based, self-administered survey was conducted nationwide from August 25 to September 30 2020. We used data from the Japan 'COVID-19 and Society' Internet Survey collected by a large internet research agency, Rakuten Insight, which had approximately 2.2 million qualified panellists in 2019.

Participants From a volunteer sample of 28 000 participants, we extracted data from 3678 participants with planned elective surgeries on any postponement or cancellation of elective surgeries.

Outcome measures The main outcome measure was any postponement or cancelltion of elective surgeries. In addition, for all respondents, we extracted data on sociodemographic, health-related characteristics, psychological characteristics and prefectural-level residential areas. We used weighted logistic regression approaches to fulfil the study objectives, minimising potential bias relating to web-based surveys.

Results Of the 3678 participants, 431 (11.72%) reported experiencing postponement or cancellation of their elective surgeries. Notably, the participants living in prefectures where the declaration of the state of emergency was made on 7 April 2020 were significantly more likely to experience postponement or cancellation of elective surgeries than those residing in prefectures with the state of emergency beginning on 16 April 2020 (174 (26.02%) vs 153 (12.15%)).

Conclusions The proportion of patients whose elective surgery had been postponed was limited during Japan's first wave of the COVID-19 pandemic, although the declaration of a state of emergency increased the likelihood of postponement. It is imperative to increase awareness of the secondary health effects related to policy intervention in pandemics and other health crises and to use appropriate countermeasures such as standard infectious control measures and triage of surgical patients.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is a large-scale, online survey-based study evaluating postponement and cancellation of elective surgeries in Japan during the early phase of the COVID-19 pandemic in 2020.
⇒ The most important limitation is that we did not collect data on conditions to be treated in elective surgeries.
⇒ It is unclear whether the postponement or cancellation of surgeries increased due to the effects of the COVID-19 pandemic and the declaration of a state of emergency because the data could not be compared with those in normal circumstances.

INTRODUCTION

Timely diagnosis and treatment are crucial for a better prognosis and to improve the quality of life of patients.[1 2] Delay in surgery is particularly concerning as it is directly associated with disease progression and adverse long-term outcomes. Indeed, studies have highlighted that delay in treatment could lead to more aggressive tumours, thus resulting in poorer chances for survival. For example, delayed surgeries have been reported to increase mortality among several types of cancer cases.[1] Similarly, in benign conditions such as cholecystitis, early treatment through surgery is more desirable because it would decrease the complication rate and improve the quality of life of patients.[2] It has been suggested that various patient characteristics and broader extrinsic contexts would affect how swiftly patients can receive surgeries when necessary, following their initial medical consultations with medical institutions.[3 4]

Among many extrinsic factors, crisis situations such as the recent COVID-19 pandemic pose a significant challenge to receiving timely treatment.[5] The current pandemic has starkly jeopardised the healthcare delivery system, which resulted in the postponement or cancellation of elective (non-emergent) surgeries.[6] Approximately 2.3 million surgeries were estimated to have been postponed globally.[7]

In Japan, COVID-19 began to spread in January 2020, and the number of confirmed cases exceeded 2500 by the end of March 2020.[8] Although the numbers of infections and deaths in Japan have been relatively low compared with those in the USA and European countries, under those circumstances, on 16 April 2020, the Japanese government issued an emergency declaration for all prefectures in Japan to contain the spread of the epidemic, and its lengths differed between prefectures depending on the prefectural COVID-19 incidence rates.[9] Consequently, there is anecdotal evidence regarding decreased screening programme uptake and hospital visits among general citizens and patients, as well as the overwhelming pressure of the COVID-19 response efforts in medical institutions. Moreover, the emergency declaration lasted longer for some prefectures reporting higher caseloads, and as a result, people residing in those prefectures might have encountered additional challenges in receiving timely treatment, including surgeries.[10] However, information regarding the extent of elective surgery postponement or cancellation in the country has not been explored yet.

Therefore, in this large-scale online survey-based study, we aimed to find the proportion of participants who experienced postponement or cancellation of elective surgeries in Japan and to evaluate its association with COVID-19 cases per population among 47 prefectures. Additionally, other factors associated with postponement or cancellation of elective surgeries were explored in detail as well.

METHODS

Study design, setting and data sources

We used data from the Japan 'COVID-19 and Society' Internet Survey collected by a large internet research agency, Rakuten Insight, which had approximately 2.2 million qualified panellists in 2019.[11] It was a nationwide cross-sectional, web-based, self-report questionnaire survey administered to 224 389 participants using simple random sampling. This internet research agency was also used in previous studies.[12 13] We extracted the relevant data for the current analysis covering all 47 prefectures and first-tier administrative districts in Japan.

The questionnaire was distributed from 25 August 2020 onward, and the data collection was completed on 30 September 2020, when the target number of 28 000 respondents was met. Individuals who consented to participate in the survey accessed the designated website and responded to the questionnaires. They also had the option not to respond or to discontinue at any point in the survey; in such cases, they were regarded as not having consented to participate in the survey and were not counted as respondents. Among these respondents, we considered 3678 (13.14%) who originally planned to have elective surgeries during the emergency declaration period.

Variables

For all respondents, we extracted data on postponement or cancellation of elective surgeries, sociodemographics, health-related characteristics, psychological characteristics and prefectural-level residential areas. We defined elective surgeries as non-emergent surgeries planned beforehand and used the questionnaire item corresponding to this topic. The sociodemographic factors included age (categorised as 15–39, 40–64 and 65–79 years) and sex, academic attainment (categorised as high school or lower, college/university/graduate), equivalised income level (categorised using the tertiles of household equivalent income (low, <2.5 million JPY; medium, 2.5–4.3 million JPY; and high, >4.3 million JPY), and an indicator for those who refused to respond to this question), household size (number of household members: 1, 2, 3 or above), employment status (unemployment, any type of employment) and marital status (married, never married, widowed or separated). The household equivalised income was calculated as previously described.[14]

Health-related and psychological characteristics included walking disability, fear of COVID-19 score and trust in the information provided by the government (yes or no).[14] To estimate the fear of COVID-19, we used the Japanese version of the Fear of COVID-19 Scale (FCV-19S).[15 16] This scale consists of seven items, and the total score was calculated by adding up each item score (ranging from 7 to 35), with a higher score indicating greater fear of COVID-19. In the present study, FCV-19S scores were categorised into 7–15, 16–20, 21–25 and 26–35, according to the categories used in a previous study.[14]

In Japan, a state of emergency was declared in seven prefectures (Tokyo, Kanagawa, Saitama, Chiba, Osaka, Hyogo and Fukuoka) on 7 April 2020 (hereafter Specific Alert Area A). On 16 April, the declaration was extended to cover all prefectures in Japan. Of these, six prefectures (Hokkaido, Ibaraki, Ishikawa, Gifu, Aichi and Kyoto) (hereafter Specific Alert Area B) were added to the original seven prefectures and were designated as Specific Alert Area to prevent the spread of the disease. Then, on 14 May, the government decided to lift the state of emergency in 39 prefectures, except for 8 prefectures (Hokkaido, Tokyo, Saitama, Chiba, Kanagawa, Osaka, Kyoto and Hyogo).

The state of emergency was lifted in Osaka, Kyoto and Hyogo on 21 May and in Hokkaido, Tokyo, Saitama, Chiba and Kanagawa on 25 May. We accordingly divided the 47 prefectures into 3 groups, namely, Specific Alert Areas A, B and the other, which is illustrated in figure 1.

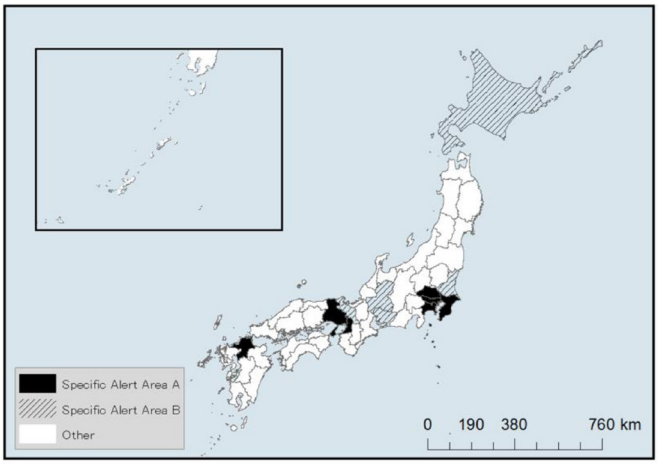

Figure 1 Japanese map of Japan with the categories of the state of emergency during the first wave of the COVID-19 pandemic.

For the sake of sensitivity analysis, we also considered data on prefecture-level COVID-19 incidence (cases per 100 000 residents), retrieved on 16 April 2020, which corresponded to the first day of the declaration of a state of emergency across the country. The rate of surgery postponement or cancellation was calculated by the number of surgery postponements or cancellations divided by the number of surgeries planned in each prefecture. For example, in Hokkaido, 11 out of 173 patients who planned their surgeries postponed them. Therefore, the rate of surgery postponement or cancellation in Hokkaido was calculated to be 6.4%.

Data analysis

First, we conducted a descriptive analysis of the participant characteristics. Second, we examined a potential association between postponement or cancellation of surgeries and the declaration of a state of emergency, constructing a weighted multivariable logistic regression model for COVID-19 postponement or cancellation. We employed this weighted model as done elsewhere[14] to minimise potential bias inherent to web-based surveys and for standardisation with a Japanese representative population. Since we were also interested in how other variables might be associated with the outcome, we also exploratorily considered all variables, including sociodemographic, psychological and health-related characteristics, as covariates of the model. In the model, we made the standard errors clustered at the prefecture level to consider the potential association of the participants within the same prefecture, as done in a previous study.[14] To estimate incidence rates of postponement or cancellation of elective surgeries with adjustment of covariates, we used marginal standardisation, as done previously.[14] For each participant, we estimated the predicted probabilities of the incidence of elective surgery postponement or cancellation averaged over the distribution of prefecture-level COVID-19 incidence and other covariates in our sample.[14] We handled weighted logistic regression analyses, instead of crude data, as the primary findings of the entire study. For sensitivity analyses, we also constructed another regression model using the prefecture-level COVID-19 incidence instead of the declaration of a state of emergency. We conducted visual inspections of the associations between elective surgery postponement or cancellation and prefecture-level COVID-19 incidence, by plotting both variables in the same figure. Stata/IC V.15 (StataCorp, College Station, Texas, USA) was used for all analyses.

Patient and public involvement

None.

RESULTS

Compared with those who did not plan to have elective surgeries, those who originally did were significantly older, predominantly men, more likely to be living with other family members, predominantly employed, married, with college or higher education, with comorbidities and with greater fear of COVID-19 (table 1).

Table 2 shows the demographic characteristics of the participants considered in this analysis. The majority of the participants (39.62%) were in the 40–64year age group, and more than half of the participants (54.73%) were men. Further, 64.36% were married, and 69.17% had completed their university education. Overall, 46.03% of the participants were found to be living with three or more persons, and 57.26% were employed at the time of the survey. In terms of comorbidities, 36.70% of the participants had hypertension, 15.23% had diabetes mellitus and 18.08% had asthma. The fear of COVID-19 was found to be quite high, with 31.27% of the participants scoring 21–25 points (35 being the highest score). Trust in government information was observed in 41.76% of the respondents. Among the 3678 participants with planned surgeries, 223 (6.06%) experienced elective surgery postponement or cancellation. Table 2 shows significant differences in age and income distribution between the group that postponed surgery and the group that did not. In addition, we also found that in the group that cancelled or postponed their surgeries, the proportions of those with any type of employment, those with diabetes, asthma, acute coronary syndrome, stroke, chronic obstructive pulmonary diseases, cancer, psychotic disease, disability, worse self-rated health and those who trust in the information from the central government were larger than those in the group that did not cancel or postpone their surgeries.

Table 3 shows the weighted numbers and proportions of elective surgery postponement or cancellation per the participants' characteristics. After weighing, among 3678 participants with planned elective surgeries, 431 (11.72%) reported having their elective surgeries postponed or cancelled. Notably, the participants living in Specific Alert Area A were significantly more likely to postpone or

Table 1 Participants' characteristics according to elective surgery planning

	Total, N=25 482	Elective surgeries planned, N=3678	Elective surgery not planned, N=21 804	P value*
Age (years)				<0.001
≤39	8192 (32.15)	1025 (27.87)	7167 (32.87)	
40–64	11 138 (43.71)	1461 (39.72)	9677 (44.38)	
≥65	6152 (24.14)	1192 (32.41)	4960 (22.75)	
Sex				<0.001
Male	12 673 (49.73)	2013 (54.73)	10 660 (48.89)	
Female	12 809 (50.27)	1665 (45.27)	11 144 (51.11)	
Number of people in household				<0.001
1	4997 (19.61)	561 (15.25)	4436 (20.34)	
2	8654 (33.96)	1424 (38.72)	7230 (33.16)	
≥3	11 831 (46.43)	1693 (46.03)	10 138 (46.50)	
Employment				<0.001
Unemployed	10 028 (39.35)	1572 (42.74)	8456 (38.78)	
Employed	15 454 (60.65)	2106 (57.26)	13 348 (61.22)	
Income				<0.001
Low	6899 (27.07)	1084 (29.74)	5805 (26.62)	
Moderate	6707 (26.32)	1003 (27.27)	5704 (26.16)	
High	6602 (25.91)	934 (25.39)	5668 (26.0)	
Unknown	5274 (20.70)	647 (17.59)	4627 (21.22)	
Marital status				<0.001
Married	15 230 (59.77)	2367 (64.36)	12 863 (58.99)	
Never married	7806 (30.63)	916 (24.90)	6890 (31.60)	
Widowed or separated	2446 (9.60)	395 (10.74)	2051 (9.41)	
Academic background				0.303
High school or less	7673 (30.11)	1134 (30.83)	6539 (29.99)	
College/university or graduate school	17 809 (69.89)	2544 (69.17)	15 265 (70.01)	
Region				0.09
Other	8811 (34.58)	1330 (36.16)	7481 (34.31)	
Specific Alert Area B (13 April 2020)	11 546 (45.31)	1631 (44.34)	9915 (45.47)	
Specific Alert Area A (7 April 2020)	5125 (20.11)	717 (19.49)	4408 (20.22)	
History of hypertension				<0.001
No	19 518 (76.60)	2328 (63.30)	17 190 (78.84)	
Yes	5964 (23.40)	1350 (36.70)	4614 (21.16)	
History of diabetes mellitus				<0.001
No	23 543 (92.39)	3118 (84.77)	20 425 (93.68)	
Yes	1939 (7.61)	560 (15.23)	1379 (6.32)	
History of asthma				<0.001
No	22 275 (87.41)	3013 (81.92)	19 262 (88.34)	
Yes	3207 (12.59)	665 (18.08)	2542 (11.66)	
History of ACS				<0.001
No	24 540 (96.30)	3363 (91.44)	21 177 (97.12)	
Yes	942 (3.70)	315 (8.56)	627 (2.88)	
History of stroke				<0.001
No	24 866 (97.58)	3462 (94.13)	21 404 (98.17)	
Yes	616 (2.42)	216 (5.87)	400 (1.83)	
History of COPD				<0.001

Continued

Table 1 Continued

	Total, N=25 482	Elective surgeries planned, N=3678	Elective surgery not planned, N=21 804	P value*
No	25 105 (98.52)	3537 (96.17)	21 568 (98.92)	
Yes	377 (1.48)	141 (3.83)	236 (1.08)	
History of cancer				<0.001
No	23 873 (93.69)	3252 (88.42)	20 621 (94.57)	
Yes	1609 (6.31)	426 (11.58)	1183 (5.43)	
History of psychotic diseases				<0.001
No	22 342 (87.68)	3011 (81.87)	19 331 (88.66)	
Yes	3140 (12.32)	667 (18.13)	2473 (11.34)	
Body mass index (kg/m^2)				<0.001
<30	24 608 (96.57)	3497 (95.08)	2111 (96.82)	
≥30	874 (3.43)	181 (4.92)	693 (3.18)	
Disability				<0.001
No	23 085 (90.59)	3053 (83.01)	20 032 (91.87)	
Yes	2397 (9.41)	625 (16.99)	1772 (8.13)	
Self-rated health				<0.001
Other than good	12 471 (48.94)	2076 (56.44)	10 395 (47.67)	
Good	13 011 (51.06)	1602 (43.56)	11 409 (52.33)	
Fear of COVID-19				<0.001
7–15	8038 (31.54)	912 (24.80)	7126 (32.68)	
16–20	7342 (28.81)	1057 (28.74)	6285 (28.82)	
21–25	7305 (28.67)	1150 (31.27)	6155 (28.23)	
26–35	2797 (10.98)	559 (15.20)	2238 (10.26)	
Information from the central government				0.681
Do not trust	14 919 (58.55)	2142 (58.24)	12 777 (58.60)	
Trust	10 563 (41.45)	1536 (41.76)	9027 (41.40)	

Specific Alert Area A (7 April 2020): Tokyo, Kanagawa, Saitama, Chiba, Osaka, Hyogo and Fukuoka; Specific Alert Area B (13 April 2020): Hokkaido, Ibaraki, Ishikawa, Gifu, Aichi, and Kyoto.
*Chi-squared analysis.
ACS, acute coronary syndrome; COPD, chronic obstructive pulmonary disease.

cancel elective surgeries than those in prefectures other than the specific areas.

With regard to the association with other participant characteristics, those who had their elective surgeries postponed or cancelled tended to be older (adjusted OR (95% CI) of 65 or above vs 39 or below: 2.64 (1.81 to 3.86)); be woman (woman vs man: 2.64 (1.40 to 4.99)); live in smaller households (2 vs 1: 0.71 (0.56 to 0.91); 3 or above vs 1: 0.32 (0.22 to 0.47)); be unemployed (any type of employment vs unemployment: 0.69 (0.55 to 0.87)); have higher income (high vs low: 2.09 (1.70 to 2.58)); be widowed or separated (widowed or separated vs married: 0.41 (0.28–0.59)); and have less hypertension (medical history of hypertension vs no medical history of hypertension: 0.15 (0.09 to 0.24)), more stroke (medical history of stroke vs no medical history of stroke: 2.49 (1.48 to 4.21)), less cancer (medical history of cancer vs no medical history of cancer: 0.13 (0.04 to 0.46)) and a higher fear of COVID-19 score (16–20 vs 7–15: 3.40 (2.69 to 4.29); 26–35 vs 7–15: 2.02 (1.05 to 3.85)) (table 3).

Figure 2 shows the elective surgery postponement or cancellation ratio and the number of confirmed COVID-19 cases per 100 000 residents in each prefecture. On visual inspection, there was no clear association between elective surgery postponement or cancellation and prefecture-wise incidence.

DISCUSSION

Our findings based on a cross-sectional online survey involving 28 000 respondents suggest that 11.72% of the surgeries during the emergency declaration of the COVID-19 outbreak between April and May 2020 in Japan were postponed or cancelled. Ikeda *et al* estimated that a decline of major surgical procedures in 2020 compared with 2018 and 2019 was 10%–15%[17] and the observed finding was in line with this study. We also found that living under a state of emergency was associated with postponing or cancelling surgeries.

Table 2 Participants' characteristics according to elective surgery postponement or cancellation

Variable	Total*	Postponement or cancellation†	No postponement or cancellation†	P value‡
Total	3678	223 (6.06)	3455 (93.94)	
Age (years)				0.001
≤39	1025 (27.87)	81 (36.32)	944 (27.32)	
40–64	1369 (39.62)	92 (41.26)	1369 (39.62)	
≥65	1192 (32.41)	50 (22.42)	1142 (33.05)	
Sex				0.776
Male	2013 (54.73)	120 (53.81)	1893 (54.79)	
Female	1665 (45.27)	103 (46.19)	1562 (45.21)	
Number of people in household				0.573
1	561 (15.25)	35 (15.70)	526 (15.22)	
2	1424 (38.72)	79 (35.43)	1345 (38.93)	
≥3	1693 (46.03)	109 (48.88)	1584 (45.85)	
Employment				0.001
Unemployed	1572 (42.74)	71 (31.84)	1501 (43.44)	
Employed	2106 (57.26)	152 (68.16)	1954 (56.56)	
Income				0.007
Low	1094 (29.74)	77 (34.53)	1017 (29.44)	
Moderate	1003 (27.27)	57 (25.56)	946 (27.38)	
High	934 (25.39)	67 (30.04)	867 (25.09)	
Unknown	647 (17.59)	22 (9.87)	625 (18.09)	
Marital status				0.182
Married	2367 (64.36)	138 (61.88)	2229 (64.52)	
Never married	916 (24.90)	66 (29.60)	850 (24.60)	
Widowed or separated	395 (10.74)	19 (8.52)	376 (10.88)	
Academic background				0.389
High school or less	1134 (30.83)	63 (28.25)	1071 (31.00)	
College/university or graduate school	2544 (69.17)	160 (71.75)	2384 (69.00)	
Region				0.908
Other	1330 (36.16)	79 (35.43)	1251 (36.21)	
Specific Alert Area B (13 April 2020)	1631 (44.34)	102 (45.74)	1529 (44.25)	
Specific Alert Area A (7 April 2020)	717 (19.49)	42 (18.83)	675 (19.54)	
History of hypertension				0.326
No	2328 (63.30)	148 (66.37)	2180 (63.10)	
Yes	1350 (36.70)	75 (33.63)	1275 (36.90)	
History of diabetes mellitus				0.001
No	3118 (84.77)	171 (76.68)	2947 (85.30)	
Yes	560 (15.23)	52 (23.32)	508 (14.70)	
History of asthma				<0.001
No	3013 (81.92	153 (68.61)	2860 (82.78)	
Yes	665 (18.08)	70 (31.39)	595 (17.22)	
History of ACS				<0.001
No	3363 (91.44)	178 (79.82)	3185 (92.19)	
Yes	315 (8.56)	45 (20.18)	270 (7.81)	
History of stroke				<0.001
No	3462 (94.13)	187 (83.86)	3275 (94.79)	
Yes	216 (5.87)	36 (16.14)	180 (5.21)	
History of COPD				<0.001
No	3537 (96.17)	192 (86.10)	3345 (96.82)	

Continued

Table 2 Continued

Variable	Total*	Postponement or cancellation†	No postponement or cancellation†	P value‡
Yes	141 (3.83)	31 (13.90)	110 (3.18)	
History of cancer				<0.001
No	3252 (88.42)	181 (81.17)	3071 (88.89)	
Yes	426 (11.58)	42 (18.83)	384 (11.11)	
History of psychotic diseases				<0.001
No	3011 (81.87)	139 (62.33)	2872 (83.13)	
Yes	667 (18.13)	84 (37.67)	583 (16.87)	
Body mass index (kg/m^2)				0.108
<30	3497 (95.08)	207 (92.83)	3290 (95.22)	
≥30	181 (4.92)	16 (7.17)	165 (4.78)	
Disability				<0.001
No	3053 (83.01)	133 (59.64)	2920 (84.52)	
Yes	625 (16.99)	90 (40.36)	535 (15.48)	
Self-rated health				0.017
Other than good	2076 (56.44)	143 (64.13)	1933 (55.95)	
Good	1602 (43.56)	80 (35.87)	1522 (44.05)	
Fear of COVID-19				0.112
7–15	912 (24.80)	55 (24.66)	857 (24.80)	
16–20	1057 (28.74)	65 (29.15)	992 (28.71)	
21–25	1150 (31.27)	58 (26.01)	1092 (31.61)	
26–35	559 (15.20)	45 (20.18)	514 (14.88)	
Information from the central government				0.008
Do not trust	2142 (58.24)	111 (49.78)	2031 (58.78)	
Trust	1536 (41.76)	112 (50.22)	1424 (41.22)	

Specific Alert Area A (7 April 2020): Tokyo, Kanagawa, Saitama, Chiba, Osaka, Hyogo and Fukuoka; Specific Alert Area B (13 April 2020): Hokkaido, Ibaraki, Ishikawa, Gifu, Aichi and Kyoto.
*Proportion was calculated in the column.
†Proportion was calculated in the row.
‡Chi-squared analysis.
ACS, acute coronary syndrome; COPD, chronic obstructive pulmonary disease.

Considering the implications of this rate of surgery postponement or cancellation, the modelling study published by the COVIDSurg Collaborative is insightful. During the peak 12 weeks of the COVID-19 pandemic, 81.7% of elective operations for benign disease, 37.7% of cancer operations and 25.4% of elective caesarean sections were cancelled or postponed.[7] These global estimates suggest that the postponement or cancellation rate of surgeries in Japan could be very low compared with that in other countries in the first wave of the COVID-19 pandemic. There are two potential reasons for this. The most plausible reason is that the COVID-19 epidemic was relatively controlled in Japan compared with other countries, with the first wave occurring from April to May 2020. As of April 16, there were 8582 infected individuals and 136 deaths in Japan. In contrast, in the USA, 637 000 people had been infected, and there had been 36 700 deaths. This situation in Japan may have limited the allocation of human and other medical resources to the care of patients with COVID-19. Further, the fear against the COVID-19 was not a major determinant for postponement or cancellation of elective surgeries. Indeed, an association between the FCV-19S and postponement or cancellation of elective surgeries was not so obvious.

Another potential reason is that the Japanese surgical communities made recommendations not to postpone or cancel surgery for those with cancer. Namely, the Japanese Surgical Association had recommended that the implementation or postponement of elective surgeries should be determined after multifaceted consideration from the medical point of view and the perspective of efficient and effective allocation of limited medical resources, due to the spread of the new coronavirus infection. The recommendations included the following: postponement of non-fatal and non-urgent outpatient surgeries; referring to the American College of Surgeons' triage; postponement of non-fatal but potentially life-threatening or serious diseases requiring hospitalisation (low-grade cancer, etc) as much as possible; and careful surgical intervention with adequate infection control measures for diseases that could be fatal or leave serious disabilities if not operated on within a few days to a few months

Table 3 Weighed associations between participants' characteristics and elective surgery postponement or cancellation

	Weighted sample	Weighted incidence	Adjusted rate % (95% CI)	Adjusted OR (95% CI)*	P value
Total	3678	431 (11.72)			
Age (years)					
≤39	1277	162 (12.70)	9.25 (7.79 to 10.72)	Reference	
40–64	1159	66 (5.72)	8.64 (8.17 to 9.11)	0.89 (0.64 to 12.5)	0.507
≥65	1242	202 (16.27)	16.21 (14.17 to 18.26)	2.64 (1.81 to 3.86)	<0.001
Sex					
Male	2015	193 (9.57)	8.52 (6.84 to 10.21)	Reference	
Female	1663	238 (14.28)	14.80 (12.39 to 17.20)	2.64 (1.40 to 4.99)	0.003
Number of people in household					
1	718	183 (25.54)	15.85 (15.07 to 16.63)	Reference	
2	1219	170 (13.91)	13.02 (11.22 to 14.83)	0.71 (0.56 to 0.91)	0.006
≥3	1742	78 (4.45)	7.86 (6.79 to 8.93)	0.32 (0.22 to 0.47)	<0.001
Employment					
Unemployed	1300	183 (14.04)	13.13 (11.96 to 14.30)	Reference	
Employed	2378	248 (10.42)	10.65 (9.78 to 11.53)	0.69 (0.55 to 0.87)	0.002
Income					
Low	1154	124 (10.74)	12.13 (9.84 to 14.43)	Reference	
Moderate	949	35 (3.68)	6.14 (3.85 to 8.43)	0.35 (0.21 to 0.59)	<0.001
High	932	206 (22.08)	18.40 (15.96 to 20.85)	2.09 (1.70 to 2.58)	<0.001
Unknown	643	66 (10.21)	8.46 (12.33 to 18.16)	0.56 (0.08 to 3.93)	0.56
Marital status					
Married	2115	209 (9.90)	12.12 (11.29 to 12.96)	Reference	
Never married	765	104 (13.54)	14.43 (10.86 to 17.99)	1.37 (0.83 to 2.26)	0.215
Widowed or separated	798	117 (14.71)	7.33 (6.81 to 7.84)	0.41 (0.28 to 0.59)	<0.001
Academic background					
High school or less	1422	94 (6.64)	9.72 (7.27 to 12.18)	Reference	
College/university or graduate school	2256	336 (14.89)	12.77 (11.41 to 14.14)	1.60 (0.80 to 2.26)	0.18
Region					
Other	1753	104 (5.92)	9.57 (7.01 to 12.14)	Reference	
Specific Alert Area, 13 April 2020	1256	153 (12.15)	12.01 (9.62 to 14.39)	1.46 (0.83 to 2.56)	0.192
Specific Alert Area, 7 April 2020	669	174 (26.02)	15.15 (11.74 to 18.57)	2.19 (1.24 to 3.86)	0.007
History of hypertension					
No	2032	234 (11.52)	18.29 (16.77 to 19.82)	Reference	
Yes	1646	196 (11.93)	6.74 (5.22 to 8.26)	0.15 (0.09 to 0.24)	<0.001
History of diabetes mellitus					
No	2805	246 (8.78)	9.91 (7.18 to 12.63)	Reference	
Yes	873	184 (21.07)	18.67 (7.16 to 30.18)	3.02 (0.58 to 15.86)	0.191
History of asthma					
No	2777	275 (9.89)	11.35 (9.94 to 12.76)	Reference	
Yes	901	156 (17.30)	12.88 (8.11 to 17.66)	1.25 (0.54 to 2.92)	0.598
History of ACS					
No	2996	291 (9.71)	10.80 (9.14 to 12.45)	Reference	
Yes	682	139 (20.44)	16.91 (6.92 to 26.90)	2.24 (0.69 to 7.31)	0.181
History of stroke					
No	3223	312 (9.67)	10.98 (10.55 to 11.41)	Reference	
Yes	455	119 (26.10)	18.29 (13.44 to 23.15)	2.49 (1.48 to 4.21)	0.001
History of COPD					
No	3185	313 (9.83)	10.15 (8.88 to 11.42)	Reference	

Continued

Table 3 Continued

	Weighted sample	Weighted incidence	Adjusted rate % (95% CI)	Adjusted OR (95% CI)*	P value
Yes	493	117 (23.82)	28.69 (6.93 to 50.44)	6.85 (0.81 to 58.03)	0.077
History of cancer					
No	3048	408 (13.39)	13.84 (12.27 to 15.40)	Reference	
Yes	630	22 (3.51)	3.69 (2.25 to 5.13)	0.13 (0.04 to 0.46)	0.001
History of psychotic diseases					
No	2754	282 (10.22)	11.98 (11.38 to 12.59)	Reference	
Yes	924	149 (16.11)	10.83 (8.81 to 12.84)	0.83 (0.55 to 1.27)	0.395
Body mass index (kg/m^2)					
<30	3507	421 (12.00)	11.73 (11.48 to 11.98)	Reference	
≥30	171	10 (5.63)	10.80 (8.81 to 12.84)	0.86 (0.27 to 2.76)	0.805
Disability					
No	2507	214 (8.55)	10.97 (9.35 to 12.59)	Reference	
Yes	1171	216 (18.45)	12.92 (10.39 to 15.45)	1.34 (0.78 to 2.29)	0.288
Self-rated health					
Other than good	2371	337 (14.20)	13.13 (10.89 to 15.38)	Reference	
Good	1307	94 (7.17)	8.85 (4.43 to 12.98)	0.51 (0.17 to 1.53)	0.227
Fear of COVID-19					
7–15	817	35 (4.23)	7.80 (6.88 to 8.72)	Reference	
16–20	1182	270 (22.85)	16.73 (14.72 to 18.75)	3.40 (2.69 to 4.29)	<0.001
21–25	1133	51 (4.46)	6.84 (3.37 to 10.31)	0.83 (0.35 to 1.93)	0.66
26–35	545	75 (13.77)	12.28 (8.05 to 16.51)	2.02 (1.05 to 3.85)	0.034
Information from the central government					
Do not trust	1908	253 (13.28)	11.57 (11.24 to 11.91)	Reference	
Trust	1770	177 (10.00)	11.85 (11.46 to 12.24)	1.04 (0.94 to 1.56)	0.42

Specific Alert Area, 7 April 2020: Tokyo, Kanagawa, Saitama, Chiba, Osaka, Hyogo and Fukuoka; Specific Alert Area, 13 April 2020: Hokkaido, Ibaraki, Ishikawa, Gifu, Aichi and Kyoto.
*Adjusted for all variables listed in this table.
ACS, acute coronary syndrome; COPD, chronic obstructive pulmonary disease.

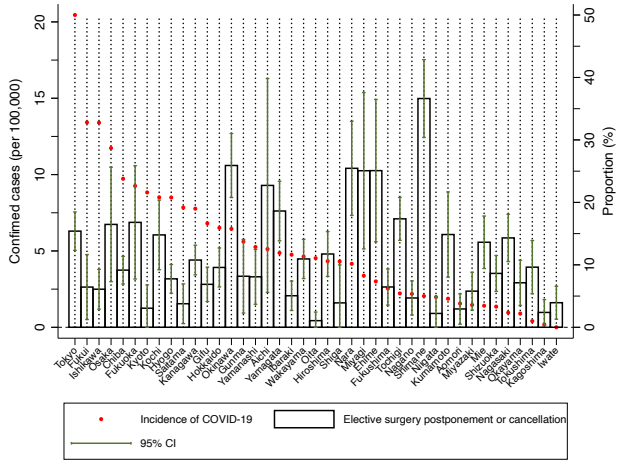

Figure 2 Weighed associations between prefecture-level COVID-19 incidence and elective surgery postponement or cancellation. We constructed the weighted logistic regression model for elective surgery postponement or cancellation, considering all the extracted variables. Using this model, we estimated the prefecture-level rate of postponement or cancellation.

(eg, trauma and cancer).[18] This was also true for other specialties, such as cardiac and respiratory surgery. This may have allowed surgeons to perform cancer surgery without hesitation during the COVID-19 pandemic. Indeed, based on the findings from our weighted multivariate regression analyses, those with cancer had lower odds of experiencing postponement or cancellation of elective surgeries than their counterparts.

Notably, the declaration of a state of emergency had a significant relationship with the postponement or cancellation of surgeries in our analyses. The declaration is determined by weighing the SARS-CoV-2 infection rate and other factors in each province, but other factors are also taken into account. In this context, it is to be noted that there was no clear association between a prefecture-wise incidence of SARS-CoV-2 infection and elective surgery postponement or cancellation, as shown in figure 2. The contrasting findings indicate that the postponement or cancellation rate was more strongly associated with policy-level measures, subsequent behavioural changes and the role of medical institutions, than with the COVID-19 incidence rate.

In addition to the state of emergency and medical history of cancer, we explored whether there were any other individual factors contributing to the cancellation or postponements of surgeries, and the weighted logistic regression analyses revealed multiple individual factors associated with the cancellation or postponement of surgery. While it is intuitively easy to understand the association of cancellation or postponement of the surgery with higher fear of COVID-19 score, older age and medical history of cancer, its association with factors such as female, smaller household number, unemployment, income, being widowed or separated and no medical history of hypertension is difficult to comprehend with the available data. Therefore, further studies are warranted to understand better potential individual factors relating to the cancellation or postponement of surgeries.

Overall, this study suggests that the normal medical care delivery system was maintained to some extent in the early phase of the COVID-19 pandemic in Japan. Past studies have suggested that the health of the vulnerable population is the most susceptible when the provision of medical care is disrupted by disasters.[4 19 20] As of writing (August 2021), the increase in the number of COVID-19 cases significantly interfered with normal healthcare operations, and in such a situation, usual medical care, including surgeries, may be more disrupted than during the early phase of the pandemic in 2020. Therefore, the effects of the COVID-19 pandemic on surgical treatment may change over time, and the study findings may no longer apply.

Implications of the study findings

The prolonged COVID-19 pandemic may indirectly lead to significant delays in scheduled surgeries for patients with benign diseases; that is, when hospitals resume routine care, patients are likely to be prioritised by clinical urgency, resulting in lengthening delays for patients with benign but potentially disabling conditions.[21] To minimise the impact of the COVID-19 pandemic, efforts beyond infection control measures are warranted. Particularly, a triage of patients for surgeries, based on conditions and criticalness, is imperative, as repeatedly shown in other studies.[20] Furthermore, its importance cannot be overemphasised, given that Japan has experienced multiple waves of the COVID-19 pandemic as of writing this work.

Study limitations

Despite the possible explanations presented above, we must cautiously interpret the findings given the various limitations of this study. First, we did not collect data on the conditions to be treated by the cancelled or postponed surgeries. This is the most critical limitation of our study given that it heavily restricts using the findings to predict potential future implications. Second, we were unable to obtain data on surgery postponement or cancellation in ordinary times. As a result, we could not confirm whether the COVID-19 pandemic and the subsequent declaration of a state of emergency increased the postponement or cancellation of surgeries. Third, we did not collect data on the characteristics of hospitals where surgeries were planned. The impact of the COVID-19 pandemic on surgical care may have also differed by hospital characteristics, such as its scale, presence of nosocomial infection and official designation regarding accepting COVID-19 patients. During our study period, only a limited number of hospitals were officially designated as accepting COVID-19 patients, and the participants planning to undergo surgeries in such hospitals may have had to postpone their surgeries. Fourth, findings obtained through internet surveys are limited to people living in Japan with access to the internet and may not be generalizable to the general Japanese population or those in other countries. While we used a weighted model to minimise potential biases caused by this, we may not have fully made it. Fifth, the questionnaire does not distinguish between postponements and cancellations: they are combined. Finally, it is unclear whether the procedures were cancelled or postponed by the physicians or by the patients, and thus it was unclear whether their surgeries were conducted after all.

CONCLUSION

We found that approximately 12% of planned surgeries were postponed or cancelled in Japan during the early phase of the COVID-19 pandemic in 2020, when Japan had relatively controlled the epidemic compared with other countries. The postponement or cancellation appeared to have been affected by the timing of the declaration of a state of emergency, while there appeared to be no association between the incidence of positive SARS-CoV-2 infection and the proportion of the participants who experienced postponement or cancellation of elective surgeries in Japan on visual inspection. It is imperative to increase awareness of the secondary health effects related to policy intervention in pandemics and other crises. At the same time, it is necessary to take appropriate countermeasures such as standard infectious control measures and triage of surgical patients, during and beyond the COVID-19 pandemic.

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