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COVID-19–Related Factors Delaying Dental Visits of Workers in Japan

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ABSTRACT

Background: The aim of this research was to investigate the factors associated with postponing dental attendance amongst Japanese workers during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: We conducted an internet-based survey in Japan from November 24 to 29, 2021. The participants were selected from people registered with an online research company. The inclusion criteria for this study were full-time or part-time workers aged 20 to 69 years. Participants filled out a questionnaire about their oral health, behaviour, and working conditions.

Results: A total of 1840 participants were included in the analysis. Three hundred ninety-eight participants (21.5%) answered that they postponed dental attendance due to COVID-19. Multiple logistic regression showed that women were more likely to postpone dental attendance (odds ratio [OR], 1.74; 95% confidence interval, 1.33–2.26). Moreover, employment status, household income, changes in income, working at home, interdental cleaning device use, regular dental attendance, awareness of untreated teeth, and dental pain were also associated with postponing dental attendance. The results of decision tree analysis showed that regular dental attenders with dental pain were the most likely to postpone dental attendance.

Conclusions: The characteristics of postponed dental visits for Japanese workers differ depending on whether one is a regular dental attender or not. Amongst regular dental attenders, worsening oral health due to interruptions in dental attendance is concerning. Meanwhile, untreated teeth might be neglected amongst nonregular dental attenders. Preventing patients from refraining from dental attendance, regardless of whether or not they are regular dental attenders, is important during the COVID-19 pandemic.

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic has had a tremendous impact on society around the world. In the United States, dentists were advised to halt elective dental services and treat only patients requiring emergency dental

procedures.¹ On August 3, 2020, the World Health Organisation (WHO) released interim guidance for oral health services. In this interim guidance, it was advised that routine non-urgent oral health care be delayed until there was a sufficient reduction in COVID-19 transmission rates.² In response to this guidance, despite the World Dental Federation releasing a statement for oral health services to continue under official recommendations,³ there is concern that the number of people who postponed dental attendance based on this information may have increased during the COVID-19 pandemic.

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Dental attendance is an important factor in maintaining good oral health.⁴ Pre-COVID-19 pandemic conditions, several factors, including sex,⁵⁻⁸ socioeconomic status (SES),⁵⁻⁸ dental insurance status,^{7,8} lifestyle-related factors,⁵ and oral symptoms,⁹ were reported to be associated with dental attendance. Particularly, SES is one of the main factors determining dental attendance.^{10,11} Low SES has been reported to be associated with difficulties in dental attendance.¹⁰ Moreover, a systematic review indicated that free dental checkups might be an important factor to promote regular dental attendance.¹² Meanwhile, COVID-19 significantly affected SES around the world.¹³ There are several studies investigating the impact of COVID-19 on health care use.¹⁴⁻¹⁶ In Taiwan, medical and dental visits from January to March 2020 decreased by 6.8% and 5.1% compared with the same period in 2019, respectively.¹⁶ It has been reported that preventive care, including cancer screening, significantly decreased.¹⁴ These results indicate that preventive care or non-emergency procedures might be postponed due to the COVID-19 pandemic. Several studies reported the status of dental attendance during the COVID-19 pandemic.¹⁷⁻¹⁹ One of these studies indicated that low SES was related to disruption of regular dental attendance in Japan.¹⁹

It is reasonable to assume that workers have experienced significant changes in their working environments due to the COVID-19 pandemic. Investigating the relationships between the factors associated with postponing dental attendance can facilitate planning of a dental care approach during the COVID-19 pandemic. This study aimed to investigate the factors associated with postponing dental attendance and the interactive relationships amongst Japanese workers during the COVID-19 pandemic.

Methods

Participants

This cross-sectional study was conducted in Japan from November 24 to 29, 2021. The participants were selected from people registered with an online research company called Macromill. Macromill has approximately 1.3 million registered people living in Japan and is used in several studies.^{19,20} The survey was outsourced to Macromill. The inclusion criteria for this study were full-time or part-time workers aged 20 to 69 years. The number of participants was designed to be the same for each sex and age group. Moreover, the regional numbers of participants were based on statistics from the National Population Census of the Ministry of Internal Affairs and Communications.²¹

The sample size was set to perform multiple logistic regression analysis for 15 independent variables. Events per variable of 10 is widely used as the lower limit for developing prediction models.²² Therefore, we assumed that at least 150 events were required for the analysis. Moreover, we hypothesised that 20% of participants would have postponed dental attendance based on a previous study.²³ Considering these results and budget limitations, the sample size was set to approximately 2000.

In the first screening process, 40,000 candidates were selected from the online research company database by the quota sampling method (men in their 20s: 3233 candidates; 30s: 3711 candidates; 40s: 4804 candidates; 50s: 4321 candidates; 60s: 3989 candidates; women in their 20s: 3115 candidates; 30s: 3609 candidates; 40s: 4717 candidates; 50s: 4333 candidates; 60s: 4176 candidates). Next, questionnaires were sent to all candidates at once. The survey was closed when the default number of participants was reached ($n = 1840$). The participants completed the questionnaire after informed consent was obtained from them in a survey via a website. If a question item was missing or the answer was an abnormal value, the answer could not be terminated. All respondents were included in the analysis. This study was carried out in accordance with the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of Tokyo Dental College (approval number 1082).

Postponing dental attendance

Postponing dental attendance was defined by the following question: "Have there been any changes in your behaviour regarding visits to dental clinics since the first declaration of a state of emergency (April 16, 2021) until now?" The answers were as follows: changed clinics; less frequent dental attendance; more frequent dental attendance; I wanted to attend a dental clinic, but I held back; there was no change in behaviour regarding dental attendance; and others. Participants who answered "less frequent dental attendance" or "I wanted to attend a dental clinic, but I held back" were defined as postponing dental attendance.

Variables

Participants were requested to provide the following demographic variables: sex, age, residential region, employment status, household income, and educational attainment. We assessed changes in workload and income and working at home as labour-related factors affected by COVID-19. Changes in workload were assessed using the following question: "Has there been any change in your workload due to COVID-19?" The answer was categorised as unchanged, increased, or decreased. Changes in income were assessed using the following question: "Has there been any change in your income due to COVID-19?" The answer was categorised as unchanged, increased, or decreased. Working at home was assessed using the following question: "Did you have to work from home due to COVID-19?" The answer was categorised as yes or no. We assessed the frequency of toothbrushing, interdental cleaning device use, regular dental attendance, number of teeth, untreated teeth, and dental pain as factors associated with oral health. The frequency of toothbrushing was assessed using the following question: "How many times do you brush your teeth?" The answer was categorised as <2 or ≥ 2 times per day. Interdental cleaning device use was assessed using the following question: "Do you use an interdental brush or floss?" The answer was categorised as yes or no. Regular dental attendance was assessed using the following question: "How often do you visit your dentist for regular dental checkups?" The answers were once a month, once in 2

–3 months, once in 6 months, once a year, once in 2 years, once in 3 years, interrupted, and never. Those answers were categorised as yes or no. The number of teeth was assessed using the following question: “How many teeth do you have?” The validity of a self-reported number of teeth has been shown.²⁴ The answer was categorised as <20 or ≥20. Awareness of untreated teeth was assessed using the following question: “Do you currently have a tooth that has a hole or a filling that has been left untreated?” This question was based on a question used in a previous study of untreated teeth.²⁵ Dental pain was assessed using the following question: “Do you have pain in your mouth?” The answer was categorised as yes or no.

Statistical analysis

A chi-squared or Fisher exact test was used to compare the characteristics between participants who did or did not postpone dental attendance by each variable. Multiple logistic regression analysis was performed, with postponing dental attendance as the dependent variable. We tested four models to evaluate the association between postponing dental attendance and each variable. Model 1 included sex, age, and residential region. Model 2 included employment status, household income, and educational attainment, in addition to model 1. Model 3 included labour-related factors affected by COVID-19, in addition to model 2. Model 4 included factors associated with oral health, in addition to model 3. Moreover, it was reasonable to assume that the characteristics of postponing dental attendance would be different by regular dental attendance.¹⁹ Subgroup analysis using multiple logistic regression analysis was performed to compare the differences in the factors associated with postponing dental attendance between regular and nonregular dental attenders.

Decision tree analysis was performed to identify the interaction between the factors associated with postponing dental attendance. This analysis was used to examine interactions between variables.²⁶ The Chi-Squared Automatic Interaction Detection (CHAID) algorithm was used.²⁷ The significance level for splitting nodes was set at $P < .05$, and the Bonferroni method was used to obtain the significant values of adjustment. The data were analysed using the computerised statistical package SPSS, version 26.0 (IBM Corp.), and the significance level was set at 5%.

Results

A total of 1840 participants responded to the questionnaire (men: 49.8%, women: 50.2%). The mean and standard deviation of the participants' ages were 44.9 and 13.8 years, respectively.

In total, 398 participants (21.5%) answered that they postponed dental attendance due to COVID-19 (Table 1). As for the COVID-19 impact, changes in workload, income, and working at home were significantly associated with postponing dental attendance; 452 participants (24.6%) reported that their income was reduced due to COVID-19.

Several factors were significantly associated with postponing dental attendance during the COVID-19 pandemic (Table 2). In model 1, sex was significantly associated with postponing dental attendance (odds ratio [OR], 2.15; 95% confidence interval [CI], 1.70–2.71). However, this association was weakened in model 4. In model 2, a part-time worker was more likely to postpone a dental visit compared to a full-time employee (OR, 1.65; 95% CI, 1.27–2.15). In model 4, this association was stronger. In addition, participants with a household income of 4,000–9,999 JPY were more likely to postpone dental attendance compared to those with <3,999 JPY (OR, 1.54; 95% CI, 1.15–2.05). This association was also observed in model 4. Moreover, participants with the educational attainment of college graduate or higher were more likely to postpone dental attendance compared to those with high school or lower (OR, 1.36; 95% CI, 1.01–1.84). However, this association was not observed in the other models. In model 3, changes in workload and income and working at home were significantly associated with postponing dental attendance. However, income reduction (OR, 1.44; 95% CI, 1.06–1.95) and working at home (OR, 1.73; 95% CI, 1.31–2.26) were only associated in model 4. In model 4, interdental cleaning device use, regular dental attendance, awareness of untreated teeth, and dental pain were significantly associated with postponing dental attendance.

Decision tree analysis for the factors associated with postponing dental attendance showed the difference between regular and nonregular dental attenders (Figure). Amongst participants with regular dental attendance, postponing dental attendance was greater amongst those with dental pain (41.1%). Amongst participants without regular dental attendance, women were more likely to postpone dental attendance than men (7.4% vs 20.3%). Moreover, postponing dental attendance was greater amongst participants with interdental cleaning device use in both sexes.

Similar results were obtained from subgroup analysis (Table 3). Although household income, changes in income, working at home, and dental pain were associated with postponed dental attendance amongst regular dental attenders, changes in workload, interdental cleaning device use, and awareness of untreated teeth were associated with postponed dental attendance amongst nonregular dental attenders.

Discussion

Overall, 21.5% of the participants postponed dental attendance due to COVID-19. Similar figures were reported in an online survey conducted in Germany (22%),²³ Spain (24.5%),²⁸ and Japan¹⁹ (28.5%). Although dentists were advised to limit their dental practice to urgent care in some countries,¹ no strong recommendations were made to limit dental practice in Japan.²⁹

Regular dental attendance was strongly associated with postponing dental attendance. It was also reported that individuals with regular dental attendance were the most likely to postpone their dental visits during the COVID-19 pandemic.²³ We believe that the WHO interim guidance on the postponement of non-urgent regular dental visits might be

Table 1 – Characteristics of the participants (n = 1840).

| | | Postponing dental attendance | | | | P value |
|-------------------------------------|----------------------------|------------------------------|-------|-----|-------|---------|
| | | No | | Yes | | |
| | | n | % | n | % | |
| Sex | Men | 776 | 84.6% | 141 | 15.4% | <.001 |
| | Women | 668 | 72.4% | 255 | 27.6% | |
| Age (y) | 20–29 | 284 | 77.4% | 83 | 22.6% | .592 |
| | 30–39 | 296 | 80.7% | 71 | 19.3% | |
| | 40–49 | 283 | 78.0% | 80 | 22.0% | |
| | 50–59 | 296 | 80.0% | 74 | 20.0% | |
| | 60–69 | 285 | 76.4% | 88 | 23.6% | |
| Residential region | Hokkaido | 82 | 81.2% | 19 | 18.8% | .763 |
| | Tohoku | 69 | 73.4% | 25 | 26.6% | |
| | Kanto | 562 | 78.2% | 157 | 21.8% | |
| | Chubu | 240 | 78.2% | 67 | 21.8% | |
| | Kinki | 260 | 79.8% | 66 | 20.2% | |
| | Chugoku | 63 | 75.9% | 20 | 24.1% | |
| | Shikoku | 33 | 86.8% | 5 | 13.2% | |
| | Kyushu/Okinawa | 135 | 78.5% | 37 | 21.5% | |
| | | | | | | |
| Employment status | Full-time employee | 751 | 80.8% | 179 | 19.2% | <.001 |
| | Contract employee | 172 | 83.5% | 34 | 16.5% | |
| | Part-time worker | 428 | 73.2% | 157 | 26.8% | |
| | Dispatch employee | 93 | 78.2% | 26 | 21.8% | |
| Household income (JPY) | ≥10,000 | 126 | 74.6% | 43 | 25.4% | .026 |
| | 4,000–9,999 | 636 | 76.2% | 199 | 23.8% | |
| | <3,999 | 448 | 82.2% | 97 | 17.8% | |
| | Unknown | 234 | 80.4% | 57 | 19.6% | |
| Educational attainment | College graduate or higher | 602 | 78.5% | 165 | 21.5% | .093 |
| | High school or lower | 450 | 81.5% | 102 | 18.5% | |
| | Others | 377 | 75.1% | 125 | 24.9% | |
| | Do not want to answer | 15 | 78.9% | 4 | 21.1% | |
| Changes in workload | Increased | 145 | 76.3% | 45 | 23.7% | .004 |
| | Unchanged | 955 | 80.8% | 227 | 19.2% | |
| | Decreased | 344 | 73.5% | 124 | 26.5% | |
| Changes in income | Increased | 26 | 61.9% | 16 | 38.1% | <.001 |
| | Unchanged | 1087 | 80.8% | 259 | 19.2% | |
| | Decreased | 331 | 73.2% | 121 | 26.8% | |
| Working at home | No | 1044 | 81.1% | 243 | 18.9% | <.001 |
| | Yes | 400 | 72.3% | 153 | 27.7% | |
| Frequency of toothbrushing, times/d | <2 | 305 | 85.7% | 51 | 14.3% | <.001 |
| | ≥2 | 1139 | 76.8% | 345 | 23.2% | |
| Interdental cleaning device use | No | 685 | 85.2% | 119 | 14.8% | <.001 |
| | Yes | 759 | 73.3% | 277 | 26.7% | |
| Regular dental attendance | No | 638 | 87.6% | 90 | 12.4% | <.001 |
| | Yes | 806 | 72.5% | 306 | 27.5% | |
| Number of teeth | <20 | 89 | 73.6% | 32 | 26.4% | .173 |
| | ≥20 | 1355 | 78.8% | 364 | 21.2% | |
| Awareness of untreated teeth | No | 1262 | 79.4% | 327 | 20.6% | .013 |
| | Yes | 182 | 72.5% | 69 | 27.5% | |
| Dental pain | No | 1268 | 79.9% | 319 | 20.1% | <.001 |
| | Yes | 176 | 69.6% | 77 | 30.4% | |

one of the reasons for changed dental attendance behaviour amongst regular dental attenders.

Employment status, household income, and changes in income were also associated with postponing dental attendance. SES has been reported to be associated with dental attendance.⁵⁻⁸ Moreover, it has been reported that worsened SES was associated with poor oral health, and postponing dental visits was related to household income reduction during the COVID-19 pandemic.³⁰ Therefore, changes in socioeconomic factors might affect dental attendance behaviour.

Interestingly, working at home has been significantly associated with postponing dental attendance. In Japan, self-restraining behaviours, including working at home, were requested by the government.³¹ Moreover, working at home has been reported to be associated with becoming inactive during the COVID-19 pandemic.³² Changes in the work environment might have influenced dental attendance behaviour.

The decision tree analysis and subgroup analysis showed that the factors associated with postponing dental attendance differed according to regular dental attendance.

Table 2 – Factors associated with postponing dental attendance during COVID-19 using multiple logistic regressions.

| | | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|--------------------------------------|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Sex | Men | Reference | | Reference | | Reference | | Reference | |
| | Women | 2.15 | 1.70–2.71 | 2.06 | 1.61–2.63 | 2.07 | 1.62–2.66 | 1.74 | 1.33–2.26 |
| Age (y) | 20–29 | Reference | | Reference | | Reference | | Reference | |
| | 30–39 | 0.80 | 0.56–1.15 | 0.76 | 0.53–1.10 | 0.82 | 0.56–1.18 | 0.86 | 0.59–1.26 |
| | 40–49 | 0.96 | 0.68–1.37 | 0.95 | 0.66–1.60 | 1.02 | 0.71–1.47 | 1.05 | 0.72–1.53 |
| | 50–59 | 0.86 | 0.60–1.23 | 0.86 | 0.60–1.24 | 0.94 | 0.64–1.36 | 0.96 | 0.65–1.42 |
| | 60–69 | 1.05 | 0.74–1.50 | 1.06 | 0.74–1.51 | 1.20 | 0.84–1.73 | 1.10 | 0.76–1.60 |
| Residential region | Hokkaido | Reference | | Reference | | Reference | | Reference | |
| | Tohoku | 1.69 | 0.85–3.36 | 1.74 | 0.87–3.48 | 1.61 | 0.80–3.25 | 1.62 | 0.78–3.35 |
| | Kanto | 1.36 | 0.80–2.33 | 1.33 | 0.77–2.29 | 1.15 | 0.66–2.00 | 1.02 | 0.58–1.80 |
| | Chubu | 1.31 | 0.74–2.33 | 1.32 | 0.74–2.36 | 1.34 | 0.75–2.41 | 1.25 | 0.69–2.27 |
| | Kinki | 1.18 | 0.67–2.10 | 1.14 | 0.63–2.03 | 1.04 | 0.58–1.87 | 0.92 | 0.51–1.68 |
| | Chugoku | 1.46 | 0.71–2.99 | 1.44 | 0.70–2.98 | 1.50 | 0.72–3.12 | 1.44 | 0.68–3.07 |
| | Shikoku | 0.62 | 0.21–1.82 | 0.69 | 0.23–2.04 | 0.77 | 0.26–2.28 | 0.70 | 0.23–2.13 |
| | Kyushu/Okinawa | 1.20 | 0.64–2.23 | 1.19 | 0.63–2.24 | 1.19 | 0.63–2.24 | 1.13 | 0.59–2.16 |
| Employment status | Full-time employee | | | Reference | | Reference | | Reference | |
| | Contract employee | | | 1.04 | 0.68–1.57 | 1.02 | 0.67–1.55 | 1.11 | 0.72–1.71 |
| | Part-time Worker | | | 1.65 | 1.27–2.15 | 1.79 | 1.37–2.35 | 1.90 | 1.44–2.51 |
| | Dispatch employee | | | 1.48 | 0.91–2.40 | 1.42 | 0.87–2.32 | 1.52 | 0.91–2.52 |
| Household income (JPY) | <3,999 | | | Reference | | Reference | | Reference | |
| | 4,000–9,999 | | | 1.54 | 1.15–2.05 | 1.57 | 1.17–2.11 | 1.47 | 1.09–1.99 |
| | ≥10,000 | | | 1.59 | 1.03–2.50 | 1.45 | 0.92–2.26 | 1.39 | 0.87–2.20 |
| | Do not know | | | 1.08 | 0.75–1.57 | 1.19 | 0.81–1.74 | 1.25 | 0.85–1.85 |
| Educational attainment | High school or lower | | | Reference | | Reference | | Reference | |
| | College graduate or higher | | | 1.36 | 1.01–1.84 | 1.27 | 0.94–1.73 | 1.22 | 0.89–1.67 |
| | Others | | | 1.24 | 0.91–1.69 | 1.23 | 0.90–1.68 | 1.18 | 0.85–1.63 |
| | Do not want to answer | | | 1.38 | 0.43–4.38 | 1.19 | 0.36–4.01 | 1.39 | 0.39–4.97 |
| Changes in workload | Unchanged | | | | | Reference | | Reference | |
| | Increased | | | | | 1.18 | 0.80–1.74 | 1.17 | 0.78–1.74 |
| | Decreased | | | | | 1.24 | 0.92–1.67 | 1.18 | 0.87–1.60 |
| Changes in income | Unchanged | | | | | Reference | | Reference | |
| | Increased | | | | | 2.26 | 1.15–4.45 | 1.88 | 0.93–3.81 |
| | Decreased | | | | | 1.45 | 1.08–1.96 | 1.44 | 1.06–1.95 |
| Working at home | No | | | | | Reference | | | |
| | Yes | | | | | 1.81 | 1.39–2.36 | 1.73 | 1.31–2.26 |
| Frequency of tooth-brushing, times/d | <2 | | | | | | | Reference | |
| | ≥2 | | | | | | | 1.29 | 0.91–1.84 |
| Interdental cleaning device use | No | | | | | | | Reference | |
| | Yes | | | | | | | 1.57 | 1.21–2.03 |
| Regular dental attendance | No | | | | | | | Reference | |
| | Yes | | | | | | | 2.30 | 1.74–3.05 |
| Number of teeth | <20 | | | | | | | Reference | |
| | ≥20 | | | | | | | 0.83 | 0.51–1.33 |
| Awareness of untreated teeth | No | | | | | | | Reference | |
| | Yes | | | | | | | 1.54 | 1.09–2.18 |
| Dental pain | No | | | | | | | Reference | |
| | Yes | | | | | | | 1.64 | 1.18–2.28 |

OR, odds ratio; CI, confidence interval.

Model 1: Sex, age, and residential region.

Model 2: Model 1 + employment status, household income, and educational attainment.

Model 3: Model 2 + labour-related factors affected by COVID-19.

Model 4: Model 3 + factors associated with oral health.

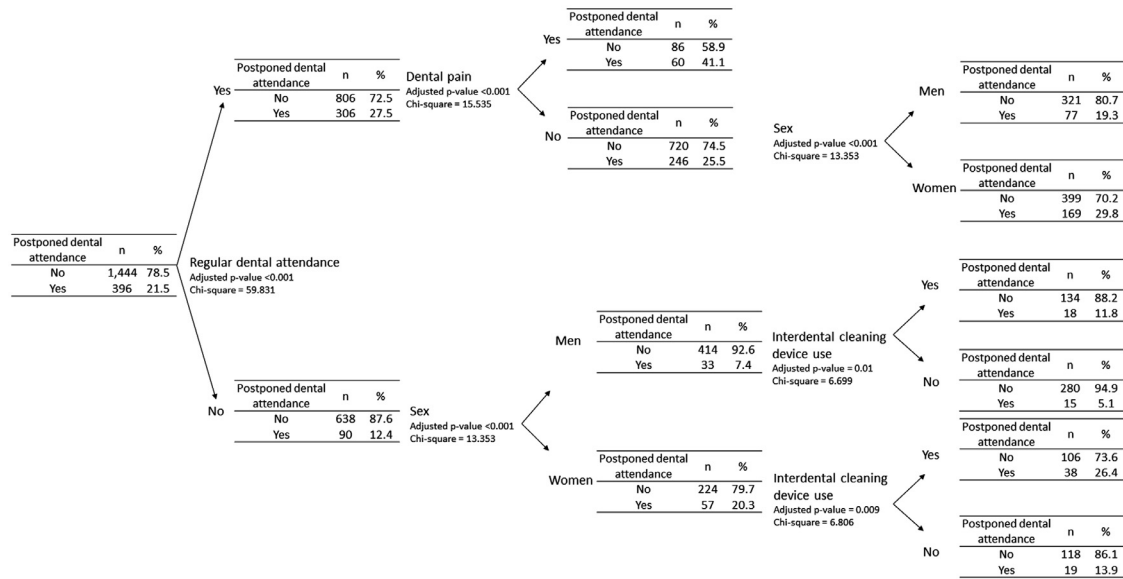


Fig – Decision tree analysis for the factors associated with postponed dental attendance.

Amongst participants with regular dental attendance, dental pain was associated with postponing dental attendance in the decision tree analysis results. Approximately 10% of individuals reported having postponed dental attendance even though they had dental pain.²³ The results of this study suggest that people who had regular dental attendance might be experiencing dental pain because they refrained from visiting a dentist. Amongst participants without dental pain, women were more likely to postpone dental attendance. Similar to this study, Hajek et al reported that postponed dental attendance during the COVID-19 pandemic was more frequent amongst women compared to men (24.7% vs 19.1%).²³ In addition, it has been reported that fear of COVID-19 infection was greater amongst women than amongst men.²⁸ There might be sex-based differences in postponing health care visits. Moreover, the results of subgroup analysis showed that SES was also associated with postponing dental attendance amongst regular dental attenders. Although participants with a household income of 4,000–9,999 JPY were more likely to postpone dental attendance compared with those with a household income of <3,999 JPY, this association was not observed amongst nonregular dental attenders. It is reasonable to assume that people with a higher SES more likely had regular dental attendance before the COVID-19 pandemic. Therefore, they might be more likely to postpone regular dental attendance. However, we did not have information on dental attendance patterns before the COVID-19 pandemic due to the limitation of the number of questions.

Amongst nonregular dental attenders, sex and interdental cleaning device use were associated with postponing dental attendance. The Japan Dental Association recommended practicing oral health care to prevent infection during the COVID-19 pandemic.³³ Moreover, it has been reported that fear of COVID-19 infection was significantly associated with not visiting a dentist.²⁸ We hypothesise that people using interdental cleaning devices might be more

likely to have a fear of COVID-19 transmission. However, we had no data to prove this hypothesis in this study. Moreover, the results of subgroup analysis showed that changes in workload and awareness of untreated teeth were associated with postponing dental attendance. Although it is important to recognise that untreated teeth might be neglected amongst nonregular dental attenders, the reasons for this could not be determined from this study due to lack of information. However, it is meaningful to mention that changes in workload were also associated with postponing dental attendance. Therefore, changes in workload due to COVID-19 might affect dental attendance behaviour amongst nonregular dental attenders.

This study had some limitations. First, the target of this survey was limited to full-time or part-time workers aged 20 to 69 years. Therefore, people who had lost their jobs during the COVID-19 pandemic or who were unemployed were not included. Although the number of participants was designed to be the same for each sex and age group, the participants in this survey may not be representative of the Japanese population. However, the distribution of the participants in this study by region was similar to that of the population census in Japan.²¹ Therefore, we assumed that the participants in this study reflected the population of Japan to some extent. Moreover, response rates were not obtained because the responses were registered in order of arrival until the default number of responses was reached. Possible bias due to this effect could not be estimated. Second, self-reported information was used and may be biased; we did not have information on changes in behaviour during the COVID-19 pandemic. For example, regular dental attendance was obtained at the survey time. Therefore, we could not determine whether they had regular dental attendance before the COVID-19 pandemic. There was uncertainty in the accuracy of responses because this study used a self-administered survey. Moreover, we did not differentiate dental attendance for curative

Table 3 – Comparing the factors associated with postponing dental attendance between regular and nonregular dental attenders.

| | | Regular dental attenders | | Nonregular dental attenders | |
|-------------------------------------|----------------------------|--------------------------|-----------|-----------------------------|------------|
| | | OR | 95% CI | OR | 95% CI |
| Sex | Men | Reference | | Reference | |
| | Women | 1.43 | 1.05–1.95 | 3.20 | 1.86–5.50 |
| Age (y) | 20–29 | Reference | | Reference | |
| | 30–39 | 0.88 | 0.56–1.37 | 0.78 | 0.35–1.75 |
| | 40–49 | 1.05 | 0.67–1.64 | 1.26 | 0.59–2.71 |
| | 50–59 | 0.92 | 0.58–1.45 | 1.14 | 0.51–2.52 |
| | 60–69 | 1.00 | 0.65–1.54 | 1.63 | 0.72–3.70 |
| Residential region | Hokkaido | Reference | | Reference | |
| | Tohoku | 1.12 | 0.47–2.71 | 4.07 | 0.90–16.43 |
| | Kanto | 0.86 | 0.45–1.64 | 2.12 | 0.56–7.99 |
| | Chubu | 1.00 | 0.50–2.00 | 2.72 | 0.68–10.87 |
| | Kinki | 0.82 | 0.42–1.63 | 1.35 | 0.32–5.61 |
| | Chugoku | 1.23 | 0.50–3.00 | 2.47 | 0.49–12.36 |
| | Shikoku | 0.57 | 0.16–2.00 | 1.74 | 0.15–20.02 |
| | Kyushu/Okinawa | 0.84 | 0.39–1.79 | 2.72 | 0.65–11.44 |
| Employment status | Full-time employee | Reference | | Reference | |
| | Contract employee | 1.05 | 0.62–1.76 | 1.65 | 0.72–3.77 |
| | Part-time Worker | 1.79 | 1.29–2.48 | 2.84 | 1.57–5.15 |
| | Dispatch employee | 1.76 | 0.97–3.20 | 1.17 | 0.39–3.58 |
| Household income (JPY) | <3,999 | Reference | | Reference | |
| | 4,000–9,999 | 1.58 | 1.11–2.25 | 1.61 | 0.87–2.98 |
| | ≥10,000 | 1.38 | 0.81–2.33 | 2.11 | 0.77–5.82 |
| | Do not know | 1.38 | 0.86–2.24 | 1.12 | 0.55–2.28 |
| Educational attainment | High school or lower | Reference | | Reference | |
| | College graduate or higher | 1.24 | 0.85–1.79 | 1.24 | 0.66–2.32 |
| | Others | 1.36 | 0.93–1.99 | 0.68 | 0.35–1.31 |
| | Do not want to answer | 0.51 | 0.05–5.14 | 2.97 | 0.59–14.93 |
| Changes in workload | Unchanged | Reference | | Reference | |
| | Increased | 0.91 | 0.56–1.50 | 2.24 | 1.08–4.65 |
| | Decreased | 1.02 | 0.71–1.46 | 2.01 | 1.07–3.78 |
| Changes in income | Unchanged | Reference | | Reference | |
| | Increased | 1.98 | 0.89–4.38 | 1.26 | 0.24–6.61 |
| | Decreased | 1.45 | 1.01–2.09 | 1.34 | 0.74–2.42 |
| Working at home | No | Reference | | Reference | |
| | Yes | 1.71 | 1.25–2.35 | 1.69 | 0.96–2.97 |
| Frequency of toothbrushing, times/d | <2 | Reference | | Reference | |
| | ≥2 | 1.35 | 0.86–2.10 | 1.02 | 0.56–1.88 |
| Interdental cleaning device use | No | Reference | | Reference | |
| | Yes | 1.34 | 0.99–1.82 | 2.49 | 1.50–4.14 |
| Number of teeth | <20 | Reference | | Reference | |
| | ≥20 | 0.89 | 0.51–1.56 | 0.66 | 0.25–1.73 |
| Awareness of untreated teeth | No | Reference | | Reference | |
| | Yes | 1.33 | 0.85–2.08 | 1.89 | 1.05–3.41 |
| Dental pain | No | Reference | | Reference | |
| | Yes | 1.89 | 1.28–2.80 | 1.00 | 0.51–1.98 |

OR, odds ratio; CI, 95% confidence interval.

care and preventive purposes. Therefore, it was not possible to clarify the purpose for which dental attendance were postponed. Third, the factors associated with postponing dental attendance in the decision tree analysis were determined in a hierarchical manner and were only assessed in certain subgroups. Therefore, caution should be taken when applying these results to the general population. Forth, Japan has universal health coverage for dentistry³⁴; therefore, the external validity of this study is limited to countries with universal health coverage. Finally, this study was a cross-sectional study; thus, further research is required to demonstrate causal relationships between the factors.

Conclusions

The results of this study suggest that the characteristics of postponed dental attendance differ depending on the presence or absence of regular dental attendance. Amongst regular dental attenders, worsening oral health due to interruptions in dental attendance is concerning and SES might affect dental attendance behaviour. Meanwhile, untreated teeth might be neglected amongst nonregular dental attenders. It is necessary to take actions to prevent patients from refraining from dental attendance, regardless of whether or not they have regular dental attendance.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interest

None disclosed.

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