

# Gender-dependent associations between occupational status and untreated caries in Japanese adults

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**Abstract:** The aim of this study was to examine whether the presence of untreated caries is different across occupational status among Japanese adults. This was a cross-sectional survey of 1,342 individuals (990 males and 352 females) aged 40–64 yr who underwent medical and dental checkups at a healthcare center in 2011. Oral examination was performed by a dentist and the presence of untreated caries was defined as having at least one untreated decayed tooth. Data regarding current occupational status were obtained using a self-administered questionnaire; the participants were classified into five groups: professionals and managers, clerical and related workers, service and salespersons, agricultural, forestry, and fishery workers, and homemakers and unemployed. Gender-specific odds ratios (ORs) and 95% confidence intervals (CIs) of occupational status for the presence of untreated caries were estimated using logistic regression. After adjusting for potential confounders, female professionals and managers (OR=3.51, 95% CI=1.04–11.87) and service and salespersons (OR=5.29, 95% CI=1.39–20.11) had greater risks of the presence of untreated caries than female homemakers and unemployed. However, this tendency was not observed among males. In conclusion, there was a significant difference in risk of the presence of untreated caries by occupational status among females.

**Key words:** Decayed teeth, Gender difference, Job, Social inequality, Socioeconomic status

## Introduction

Oral disease is the fourth most expensive disease to treat

according to the World Health Organization<sup>1</sup>). Particularly, untreated caries in permanent teeth is the most prevalent condition worldwide according to the Global Burden of Disease 2010 study<sup>2</sup>). In other words, untreated caries affects 2.4 billion people, which is 35% of the world's population<sup>2</sup>). In addition, untreated caries can cause serious pain<sup>3</sup>) and, eventually, can lead to tooth loss. Recently, tooth loss is known to be a risk indicator for onset of dementia, functional decline, and all-cause mortality<sup>4–7</sup>).

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Therefore, untreated caries remains a major public health concern worldwide.

The cause of oral disease, including untreated caries, involves various lifestyle factors, such as lack of daily tooth brushing and exposure to tobacco smoke<sup>8, 9</sup>. These poor health behaviors are more common in individuals with lower socioeconomic status (SES) than those with higher SES<sup>10</sup>. Occupational status, one component of SES, is hypothesized to be related to oral disease because it defines access to health resources and choice to health behaviors. In recent years, there has been a focus on the link between occupational status and oral disease<sup>11–17</sup>. A previous study reported a social inequality in periodontal disease according to occupational status among Japanese males, indicating that skilled workers, sales persons, and drivers had higher risk of developing periodontal disease compared with professionals<sup>14</sup>. Another recent study also showed that the subjects in the manufacturing industry and the transport industry were more likely to have tooth loss compared to those in the education and learning support industry<sup>15</sup>. However, few studies have focused on the association occupational status and untreated caries. Therefore, the present study investigated whether the presence of untreated caries is different across occupational status among Japanese adults.

## Subjects and Methods

### *Study participants*

This cross-sectional study is based on the existing data from the health check-ups at the Japanese Red Cross Kumamoto Healthcare Center, Kumamoto, Japan. In 2011, 1,549 individuals aged 40–64 yr underwent medical and dental check-ups. Of these, participants who had no teeth ( $n=3$ ), did not provide information regarding their current occupation ( $n=201$ ), and did not provide information regarding their habit of eating sweets/drinking sweet drinks ( $n=3$ ) were excluded from this study. Overall, the remaining 1,342 (990 males and 352 females; mean age,  $56.1 \pm 4.8$  yr) participants were included in the final analysis. A written informed consent was obtained from all participants. The study was approved by the Kyushu University Institutional Review Board for Clinical Research (22-71).

### *Oral examination*

Oral examination was conducted at the dental office room and performed by a trained dentist according to the criteria of the WHO oral health assessment form for adults<sup>18</sup>. During the examination, subjects were seated

on the dental chair with the examiner seated behind the subject's head. The numbers of present, decayed, and filled teeth in each participant were recorded. The primary outcome measure was the presence of untreated caries, defined as the presence of one or more untreated decayed teeth. Number of decayed and filled teeth were dichotomized as  $<10$  or  $\geq 10$ .

### *Occupational status*

Data about the participants' current occupational status was obtained using a self-administered questionnaire. The participants were classified into four groups according to the Japanese Standard Classification of Occupations<sup>19</sup>: professionals and managers, clerical and related workers, service and salespersons, agricultural, forestry, and fishery workers. We also categorized females who did not belong to the above occupational categories as homemakers and unemployed.

### *Covariates*

We included a wide range of independent variables in the analyses as covariates based on prior literature<sup>11, 20–22</sup>. Data regarding the participants' gender, age, smoking status, and habit of eating sweets/drinking sweet drinks were also obtained using the questionnaire. Age was categorized into three groups: 40–49 yr, 50–59 yr, and 60–64 yr. Smoking status was dichotomized as current smoker and non-current smoker. Habit of eating sweets/drinking sweet drinks was measured using the question statements “I seldom eat something sweet” and “I seldom drink something sweet” and classified into four categories: “no eating/no drinking,” “eating,” “drinking,” and “eating/drinking.” The participants' body height and weight were measured, and their body mass index (BMI) was calculated and dichotomized as  $<25$  or  $\geq 25$ .

### *Statistical analysis*

In this study, all analyses were stratified by gender as career decisions and working environment usually differ according to gender, which could influence the association of occupational status with the presence of untreated caries. The  $\chi^2$  test was used to describe the characteristics of participants based on the presence or absence of untreated caries. To evaluate the association between occupational status and the presence of untreated caries, the odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated using a multivariable binary logistic regression model. In the logistic regression models, the presence of untreated caries was included as a dichotomized variable

**Table 1. Comparison of the participants' characteristics based on sex**

	Males (n=990)	Females (n=352)	<i>p</i> -value
Age (%)			0.008
40–49 yr	12.8	10.5	
50–59 yr	62.1	56.0	
60–64 yr	25.1	33.5	
Occupational status (%)			<0.001
Professionals and managers	33.5	23.3	
Clerical and related workers	47.0	26.4	
Service and salespersons	11.4	11.1	
Agricultural, forestry, and fishery workers	8.1	8.0	
Homemakers and unemployed	0	31.3	
Number of untreated caries (%)			0.208
0	87.7	90.3	
≥1	12.3	9.7	
Number of decayed and filled teeth (%)			<0.001
<10	32.2	15.9	
≥10	67.8	84.1	
Smoking status (%)			<0.001
Current smoker	23.9	3.1	
Non-current smoker	76.1	96.9	
Habit of eating sweets/drinking sweet drinks (%)			<0.001
No eating/No drinking	27.1	13.4	
Eating	30.0	52.8	
Drinking	7.0	2.8	
Eating/Drinking	36.0	31.0	
Body mass index (%)			0.002
<25	68.1	77.0	
≥25	31.9	23.0	

(1=one or more untreated caries, 0=no untreated caries). The multivariate models included known risk factors that might be associated with untreated caries as covariates. The models were initially adjusted for age (Model 1) and then for the number of decayed and filled teeth, smoking status, BMI, and habit of eating sweets/drinking sweet drinks (Model 2). All statistical analyses were carried out using SPSS for Windows software (version 24.0; IBM SPSS, Tokyo, Japan), and the level of significance was set at 5% on all cases. We followed the STROBE guidelines for the analysis of the observational data.

## Results

The differences in the characteristics of the participants (n=1,342; average age=55.6 ± 4.1 yr for males and 56.6 ± 4.9 yr for females) based on sex are shown in Table 1. A total of 122 (12.3%) males and 34 (9.7%) females had untreated caries. Around half of the males were clerical and related workers, but there were no male homemakers

and unemployed. On the other hand, around a third of the females were homemakers and unemployed. The distributions of age, occupational status, number of decayed and filled teeth, smoking status, habit of eating sweets/drinking sweet drinks, and BMI were significantly different between male and female participants. In contrast, the distribution of number of untreated caries was not significantly different between male and female participants.

The results of the logistic regression analyses regarding the association between occupational status and the presence of untreated caries are shown in Table 2. The occupational status of male participants was not significantly associated with the presence of untreated caries based on the age-adjusted model. After adjusting for all potential confounders, the association remained unchanged. In contrast, female professionals and managers and service and salespersons had significantly higher ORs for the presence of untreated caries than that of female homemakers and unemployed based on the age-adjusted model (professionals and managers: OR=3.72, 95% CI=1.13–12.32; service

**Table 2. Association of occupational status with the presence of untreated caries among males determined using a logistic regression model**

	Males ( n=990 )				
	Untreated caries ≥1 (%)	Model 1*		Model 2**	
		OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value
Occupational status					
Professionals and managers	12.0	0.93 (0.59–1.46)	0.756	0.99 (0.63–1.58)	0.994
Clerical and related workers	11.8	Ref		Ref	
Service and salespersons	9.7	0.80 (0.41–1.59)	0.53	0.76 (0.38–1.52)	0.438
Agricultural, forestry, and fishery workers	20.0	1.64 (0.86–3.11)	0.133	1.73 (0.90–3.35)	0.101

\*Adjusted for age.

\*\*Adjusted for age, number of decayed and filled teeth, smoking status, habit of eating sweets/drinking sweet drinks, and body mass index.

**Table 3. Association of occupational status with the presence of untreated caries among females determined using a logistic regression model**

	Females (n=352)				
	Untreated caries ≥1 (%)	Model 1*		Model 2**	
		OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value
Occupational status					
Professionals and managers	14.6	3.72 (1.13–12.32)	0.031	3.51 (1.04–11.87)	0.043
Clerical and related workers	6.5	1.44 (0.38–5.43)	0.593	1.38 (0.36–5.28)	0.635
Service and salespersons	20.5	5.41 (1.48–19.78)	0.011	5.29 (1.39–20.11)	0.014
Agricultural, forestry, and fishery workers	14.3	4.07 (0.94–17.26)	0.056	3.71 (0.82–16.79)	0.089
Homemakers and unemployed	3.6	Ref		Ref	

\*Adjusted for age.

\*\*Adjusted for age, number of decayed and filled teeth, smoking status, habit of eating sweets/drinking sweet drinks, and body mass index.

and salespersons: OR=5.41, 95% CI=1.48–19.78). After adjusting for all potential confounders, the fully adjusted ORs of female professionals and managers and service and salespersons were 3.51 (95% CI=1.04–11.87) and 5.29 (95% CI=1.39–20.11), respectively, which were higher than that of female homemakers and unemployed. In addition, although not significant, female agricultural, forestry, and fishery workers had higher risk of the presence of untreated caries than any other female occupation group (OR=3.71, 95% CI=0.82–16.79) (Table 3).

## Discussion

This cross-sectional study demonstrated that there was a significant difference in the presence of untreated caries according to occupational status among Japanese females. This indicates that female professionals and managers and service and salespersons tend to have greater risks of the presence of untreated caries than female homemakers and unemployed. This tendency remained significant even

after controlling for potential confounders. However, this tendency was not observed among males.

Although a recent Japanese study by Zaitzu *et al.* revealed that occupational status was not significantly associated with the presence of untreated caries among adults<sup>15)</sup>, our study demonstrates that there is a significant association between occupational status and the presence of untreated caries among female but not among male participants. This discrepancy might be owing to the criteria of occupational status classification. Our study performed more detailed occupational status classification including service and salespersons, agricultural, forestry, and fishery workers, and even homemakers and unemployed. On the other hand, Zaitzu *et al.* simply classified all these occupations into “other workers”. Furthermore, this discrepancy may have arisen from a difference in control for the effects of gender (adjusted vs. stratified). Thus, to our knowledge, this is the first study revealed the gender specific association between occupational status and the presence of untreated caries.

One possible explanation may account for the association between occupational status and the presence of untreated caries. Individuals with high skill occupations are usually placed in psychologically stressful circumstances, which can cause a decrease in salivary flow<sup>23, 24</sup>). Thus, reduced salivary flow in turn contribute to the development of dental caries<sup>25, 26</sup>). According to the previous report, individuals with higher levels of academic stress had greater risks of developing dental caries<sup>27</sup>). Further, Kawakami *et al.* reported that service and salespersons were likely to have higher levels of stress because of greater job demand<sup>28</sup>). Thus, professionals and managers and service and salespersons may have higher risks of untreated caries. On the other hand, in the present study, the occupational status inequality in the presence of untreated caries was observed only among females. This could be explained by the large gap between males and females in Japan. According to the report from the World Economic Forum in 2017, Japan ranks 114 of the 144 countries in terms of gender equality based on the analysis of females' participation rates and gaps between males and females in the categories of politics, economy, education, and health<sup>29</sup>). Thus, full gender equality is not expected to materialize in Japan, especially in workplaces. In addition, a previous study mentioned that Japanese females experience higher job strain and job insecurity than males because females' health is usually affected by family responsibilities and social relationships outside of work<sup>28</sup>). This study has an implication that improvement of working environment of female workers might contribute to prevent dental caries.

This study had several limitations. First, we did not assess the oral hygiene practice such as frequency of tooth brushing, which can potentially show the link between occupational status and untreated caries. Second, we did not measure the participant's psychological stress, which might explain the occupational status inequality in untreated caries. Third, as this study was a cross-sectional study, it was difficult to generate any statement about the causal relationship between occupational status and untreated caries. Accordingly, longitudinal studies are needed to determine the effects of occupational status on the development of untreated caries. Fourth, this study targeted only those who underwent health check-ups in one healthcare center in an urban municipality in Japan. Thus, the findings of this study should be carefully interpreted when generalizing them. According to the Survey of Dental Diseases in Japan at 2011, the prevalence rates of untreated caries among the study participants (12.3% of males and 9.7% of females) were lower, especially women, than those in

the general Japanese adults (35.2% of males and 35.6% of females aged 40–64 yr)<sup>30</sup>). Thus, inequality in the presence of untreated caries due to occupational status might be underestimated. Finally, we did not consider the number of years that the participants were engaged in the occupation. However, unlike other developed countries, the system of lifetime employment has been adopted in Japan after the economic transformation following World War II<sup>31</sup>). Therefore, the possibility of a job change is relatively low in these participants.

In conclusion, this study indicated the difference in the risk of the presence of untreated caries according to the occupational status among Japanese female adults. Our findings emphasize the importance of improvement in the working environment for particular females from the viewpoint of caries prevention.

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