Temporary employment and tooth loss: a cross-sectional study from the J-SHINE study

	SATO YUKIHIRO
	Tohoku University
	11301 18026
URL	http://hdl.handle.net/10097/00123690

博士論文

Temporary employment and tooth loss: a cross-sectional

study from the J-SHINE study

非正規雇用と歯の喪失：横断研究

佐藤遊洋

平成 29 年度提出

東北大学

1 Background

Oral diseases remain a significant public health problem due to their very high prevalence, major impact on quality of life [1], and costs on health care systems [2]. In addition, oral diseases are socially patterned and closely related to social deprivation [3]. Consequently, stark social inequalities in oral health are now a major public health concern [4].

Temporary employment has attracted the attention of health researchers in recent years, because it has significant adverse effects on health [5–9]. Owing to considerable changes in the labour markets, inferior working conditions such as temporary contracts and an imbalanced working organization have emerged as a significant risk factor for poor health [10]. Unstable employment, such as temporary contracts, has been regarded as being harmful to health [5], and therefore, employment status might worsen health inequalities through employment status [5]. Temporary employment also may be harmful to oral health because work stress might lead to smoking tobacco [11] and decreasing salivary flow, which increases the risk of periodontal disease [12]. In addition, temporary employees might experience more severe tooth loss than regular ones, because their incomes are in general lower than ones of regular employees and they often do not receive adequate social benefits, such as health pensions [13].

18   A few studies have examined the relationship between employment status and

19   oral health, including some that examined the association between unemployment and

20   oral health [14–16]. To my knowledge, only one cross-sectional study has reported

21   significant associations between the workplace-related factors such as precarious

22   employment status and poor self-rated oral health [17]. Our main hypothesis was that

23   changes in employment status between regular and temporary employment would have a

24   negative impact on tooth loss. The aim of this study was to examine whether the

25   experience of temporary employment is associated with tooth loss among working adults

26   in Japan.

27

28   **METHODS**

29   **Data sources and participants**

30   I used data from the Japanese Study on Stratification, Health, Income, and Neighborhood

31   (J-SHINE), which has been described in detail elsewhere [18]. This survey was conducted

32   between July 2010 and February 2011. Target participants were adults aged 25–50 years

33   old from 4 municipalities in Japan (2 in the Tokyo metropolitan area and 2 in neighboring

34   prefectures). Figure 1 shows a detailed flowchart of participant selection. A total of

35   13,920 participants were probabilistically selected from the residential registry. Trained

36 survey staff successfully contacted 8,408 community dwelling adults, and 4,385

37 participants agreed to participate in the survey (response rate 31.5%). The inclusion

38 criteria were being 25–50 years of age and being regular or temporary employees at initial

39 (previous) and current employment. The exclusion criteria were having missing values

40 among the independent or dependent variables and not having answered the survey

41 questions by themselves. I excluded 68 participants who did not answer the survey

42 questions by themselves, 1,256 participants who did not answer the question about current

43 employment status (regular and temporary), 43 participants who did not answer the

44 question about initial employment status (regular and temporary), 52 participants who

45 were not aged 25–50 years old, 4 participants who did not indicate their sex, and 310

46 participants who did not answer the question about tooth loss. The analytic population

47 was 2,652 participants (the details are shown in Figure 1).

48 **Study design**

49 This study was a cross-sectional study.

50 **Independent variable: changes in employment status**

51 I obtained information about current employment status from the question, "What is your

52 employment? If you have several jobs, please answer about your main job." Respondents

53 chose one answer from the following: "A president or an executive officer," "Regular

54 employment," "Temporary employment," "Contract employment," "Part-time

55 employment," "Self-employed," "Housekeeper," "Subsidiary jobs," and "Unknown." I

56 categorized participants who chose the answer regular employment into the regular

57 employment group and participants who chose the answers temporary employment,

58 contract employment, or part-time employment as temporary employment. I excluded

59 those who chose president or executive officer, self-employed, housekeeper, subsidiary

60 jobs, or unknown in the categorization of initial or current employment status (see Figure

61 1).

62   I asked all participants whether they had changed jobs. Among only those who

63 had changed jobs, I obtained information about their previous (initial) employment status

64 using the same questions posed for current employment status. For the main analysis, I

65 used the replies about current and initial employment status to prepare two categories for

66 the independent variable: continuous regular employment and the experience of

67 temporary employment. For a more analysis, I created four categories: continuous regular

68 employment (regular employee at both times), regular to temporary employment (regular

69 employee at initial employment and temporary employee currently), temporary to regular

70 employment (temporary employee at initial employment and regular employee currently),

71 and continuous temporary employment (temporary employee at both times).

72   **Dependent variable: self-reported tooth loss**

73   Dependent variable was self-reported tooth loss. I obtained this information using the

74   question, "How many teeth have you had removed/extracted (excepting tooth extraction

75   for orthodontic treatment, wisdom tooth extraction, and primary teeth)?" Respondents

76   chose one of the following: "None" (scored 0), "1 tooth" (scored 1), "2 teeth" (scored 2),

77   "3 teeth" (scored 3), "4 teeth" (scored 4), and "more than 4 teeth" (scored 5). I used self-

78   reported tooth loss as a count variable.

79   **Covariates**

80   I regarded the following factors as potential confounders, and included them in the

81   multivariable adjusted models: age (categorized as 25–30, 30–35, 35–40, 40–45, or 45–

82   50 years) and sex (men or women). Health status variables that may be related to

83   employment status and tooth loss were included: history of diabetes (none or present) and

84   body mass index (kg/m^2) ($\geq$25.0, 18.5–25.0, or <18.5). In addition, social determinants

85   variables that could affect oral health were also included: years of education (<9, 10–12,

86   or >12 years), self-rated household economic status in early life at 5 years old (rich, fair,

87   or poor), marital status (married or single), and number of family members in the

88   household (living alone, 2, 3, or $\geq$4).

89   I supposed potential pathways: income, psychological stress and disorders,

90   access to health care, and health behavior. Annual household income (0–300, 300–750,

91   or >750 million Japanese yen) was also included. I used feeling fear of job loss (yes or

92   no) and psychological distress (K6 score [19]; none (0–4) or present (≥5)) as a

93   psychological stress and disorders variable. To assess the access to health care, I included

94   visiting a dental clinic for preventative care (yes or no) and hesitation to use medical and

95   dental care (yes, no, or never felt a need to use). I included smoking status (current smoker,

96   former smoker, or never smoker) as a health behavior variable. I created dummy variables

97   for the missing values for each covariate.

98   **Statistical analysis**

99   I conducted negative binomial regression analysis stratified by sex to estimate prevalence

100   rate ratios (PRRs) and 95% confidence intervals (95%CIs) for tooth loss, because there

101   are clear different trends of employment status between men and women in Japan [20,21].

102   I also examined an interaction term between changes in employment status and sex

103   adjusting for age. I created 2 models for adjusting potential confounders. In model 1, I

104   controlled for age. In model 2, years of education, self-rated household economic status

105   in early life at 5 years old, marital status, and number of family members in the household,

106   history of diabetes, and body mass index were added to model 1. Subsequently, I

107   constructed a model to evaluate how potential pathway variables explain the association.

108   In model 3, I added annual household income to model 2. In model 4, I added visiting a

109   dental clinic for preventive care and hesitation to use medical and dental care to model 3.

110   In model 5, I added feel fear of job loss and psychological distress to model 4. Finally, in

111   model 6, I added smoking status to model 5. I further conducted an analysis using 4

112   categories of independent variables to validate the findings of the main analysis. In

113   addition, I conducted a linear regression analysis to confirm the validity of the results

114   from a negative binomial regression analysis. I applied a chi-squared test for cross-

115   tabulation. In addition, I constructed a directed acyclic graph (DAG) of proposed

116   associations between employment status and tooth loss to guide my analyses (Figure 2).

117   P values of <0.05 (two tailed) were considered significant. Analyses were conducted by

118   using STATA ver. 14.2 (Stata Corp., College Station, TX).

119

120   **RESULTS**

121   The median age was 37 years (first quartile to third quartile = 31 to 43). More than half

122   of the participants were men (n = 1,394, 52.6%). The percentage of the experience of

123   temporary employment was 14.5% (n = 202) in men and 61.3% (n = 771) in women.

124   Tables 1 and 2 show the characteristics and dependent variables among men and women.

7

125   There was no significant association between men who experienced temporary

126   employment and tooth loss. On the contrary, compared with women who were continuous

127   regular employees, there was a significant association between women who experienced

128   temporary employment and tooth loss.

129   Table 3 shows the associations between change in employment status and tooth

130   loss found with the multivariable ordered logistic regression models stratified by sex. I

131   found no significant interaction between employment status and sex after adjusting for

132   age ($p = 0.71$). In model 1, I confirmed a significant association between the experience

133   of temporary employment and tooth loss in both sexes. Model 2 also showed that the

134   experience of temporary employment was significantly associated with tooth loss after

135   adjusting for potential confounders (men: PRR = 1.50 [95%CI = 1.13, 2.00]; women:

136   PRR = 1.42 [95%CI = 1.14, 1.76]). In the additional analysis, compared with continuous

137   regular employment, changes from regular to temporary employment and temporary to

138   regular employment as well as continuous temporary employment were associated with

139   tooth loss in models 1 and 2.

140   In models 3 to 6, I observed associations between changes in employment status

141   and tooth loss after adjusting for potential pathway variables. Compared with continuous

142   regular employment, the PRR of having the experience of temporary employment

8

143   decreased in models 3 to 6 (men, PRR = 1.44 [95%CI = 1.07, 1.93] to 1.31 [95%CI =

144   0.98, 1.76]; women, PRR = 1.37 [95%CI = 1.10, 1.71] to 1.33 [95%CI = 1.06, 1.66]).

145   Similar trends were observed in the additional analysis of the regular to temporary

146   employment, temporary to regular employment, and continuous temporary employment

147   groups. The results from the linear regression analysis also showed similar trends with

148   the main analysis.

149

150   **DISCUSSIONS**

151   The results of my study showed that the experience of temporary employment was

152   associated with tooth loss in both men and women in Japan. In addition, changes from

153   regular to temporary employment and temporary to regular employment as well as

154   continuous temporary employment were associated with tooth loss.

155   The association between temporary employment and poor oral health is

156   important in public health because the level of unstable employment is increasing in both

157   the private and public sectors in many developed countries [5]. The number of temporary

158   employees continues to increase in these countries [9]: for example, the proportion of

159   temporary employees in Japan was only 18.3% in 1988 but reached 37.4%, or more than

160   1 in 3 workers, in 2014 [22]. Furthermore, more than half of employed young people (15–

161 24 years old) in certain European countries are temporary workers: 53.6% in Germany,

162 57.1% in Italy, and 59.6% in France in 2015 [23]. Dental health professionals and public

163 policy makers should understand the enormous impact of increasing temporary

164 employment on tooth loss.

165   I found that temporary employment was associated with tooth loss among both

166 male and female workers in Japan. A previous survey of the labor force showed that the

167 reasons for being temporarily employed differ between men and women. The primary

168 reasons for temporary employment in men were "Can't find regular employment jobs"

169 (26.9%), whereas the reason in women was "work only during convenient time" (27.6%)

170 [24]. Therefore, it is conceivable that the association between temporary employment and

171 oral health would also differ between sexes. That is, the negative effect of being

172 temporarily employed would be amplified in men. However, the evidence suggests a

173 different effect. Inoue et al. reported that temporary female employees faced precarious

174 situations such as low income, limited social safety net, and difficulty sustaining work–

175 life balance [21]. The current study also revealed that female participants who

176 experienced temporary employment were low paid and fearful about job loss. Therefore,

177 temporary employment could affect tooth loss in both sexes uniformly.

178   Several potential pathways can exist between temporary employment and oral

179   health. First, economic factors may link employment status and oral health. In general,

180   temporary employees have incomes lower than those of regular employees, and low

181   income is among the key risk factors for oral disease [25]. Low income is associated with

182   severe caries and periodontal disease, and poor people are less likely to use medical

183   services [26]. Indeed, the association between temporary employment and tooth loss was

184   explained by the analysis of income in the present study (models 2 and 3).

185   Second, psychological stress and disorders may explain the association between

186   temporary employment and tooth loss. Because they can be easily dismissed, temporary

187   employees tend to feel more job insecurity and work-related stress which lead to

188   psychological disorders [7,13,27]. Stress from fear of job loss and psychological disorders

189   could influence health behaviors such as less frequent toothbrushing and heavier smoking

190   [11]. In addition, stress may decrease salivary flow, which increases the occurrence and

191   progression of periodontal disease [12]. Temporary employees could lose their teeth for

192   any of these reasons. Indeed, the association between temporary employment and tooth

193   loss was explained by the fear of job loss and psychological disorders in the present

194   analysis (models 4 and 5).

195   Third, poor health behavior also might explain the association between

196   employment status and oral health. Work stress was associated with poor health behaviors

197   such as less frequent toothbrushing and heavy smoking [11]. In addition, low social

198   economic status could lead to poor oral health behaviors [26]. Indeed, the association

199   between temporary employment and tooth loss was explained by smoking status (models

200   5 and 6). However, I could not obtain data on oral health behavior variables such as

201   toothbrushing. It might also well explain the association between temporary employment

202   and tooth loss.

203   Finally, limited access to health care might explain the association between

204   employment status and oral health. Japan has universal healthcare coverage (UHC) and

205   patients pay only 10–30% of the total cost of treatment [28]. Also, the total cost itself is

206   relatively low because the cost is controlled by the government. In addition, the UHC

207   covers the most basic dental treatments, such as treatments for caries and periodontal

208   disease [28]. With the UHC, most people in Japan did not hesitate obtaining medical and

209   dental services. However, under long lasting economic depression, some people in

210   temporary employment, a new emerging type of unstable employment, were not able to

211   use health care service appropriately due to the following two reasons [29]; 1) even 10-

212   30% of the total cost of dental care could be a barrier for them to use dental care because

213 they were employed at a low wage, 2) they may be reluctant to take a time off from work

214 to visit dental services because they are concerned that they might be fired if they are

215 absent frequently owing to sickness. Indeed, the association between temporary

216 employment and tooth loss was explained by the frequency of visiting a dental clinic for

217 preventive care and the hesitation to use medical and dental care as analyzed in my study

218 (models 3 and 4).

219   The present study has limitations. First, both the independent and dependent

220 variables were self-reported, which may have introduced self-reporting bias. Although,

221 several studies have shown that the validity and reliability of self-reported oral health

222 status are acceptable [30], self-rated number of teeth lost is not validated. However,

223 previous studies have used self-reported number of teeth lost [31,32]. Second, the

224 response rate was relatively low, which could be another source of bias. However, the

225 respondents had characteristics that were fairly comparable to those of the target

226 population [18]. Therefore, my findings are likely to be generalizable in Japan.

227 **Conclusions**

228 In conclusion, I found a significant association between temporary employment and tooth

229 loss. A previous study indicated that there is a need to enhance the social safety net for

230 temporary employees even in high-income countries [5]. Secure employment is a social

231   determinant of health [5], and the assurance of safety/physical protections in workplaces,

232   health insurance, and more stable employment arrangements are needed. Policy makers

233   as well as dental health professionals should understand the impact of employment status

234   on population health.

235

236   **Abbreviations**

237   PRR: Prevalence rate ratios; 95%CI: 95% confidence interval; J-SHINE: Japanese Study

238   on Stratification, Health, Income, and Neighborhood; WHO: World Health Organization;

239   UHC: universal healthcare coverage

240

241   **Declarations**

242   **Ethics approval and consent to participate**

243   The J-SHINE study's ethics approval and informed consent procedure were reviewed and

244   approved by the ethics committee of the Graduate School of Medicine and Faculty of

245   Medicine at the University of Tokyo. Informed consent was obtained in writing from all

246   participants. I obtained permission from the J-SHINE research team to access and use the

247   data for my study.

248   **Funding**

255

256 **REFERENCES**

257 1. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, et al.

258 Global burden of oral conditions in 1990-2010: a systematic analysis. J. Dent. Res.

259 2013;92:592–7.

260 2. Listl S, Galloway J, Mossey PA, Marcenes W. Global Economic Impact of Dental

261 Diseases. J. Dent. Res. 2015;94:1355–61.

262 3. Watt RG, Sheiham A. Integrating the common risk factor approach into a social

263 determinants framework. Community Dent. Oral Epidemiol. 2012;40:289–96.

264 4. Sheiham   a, Alexander D, Cohen L, Marinho V, Moysés S, Petersen PE, et al.

265 Global oral health inequalities: task group--implementation and delivery of oral health

266 strategies. Adv. Dent. Res. 2011;23:259–67.

267   5. Benach J, Muntaner C, Santana V. Employment conditions knowledge network

268   (EMCONET). Employ. Cond. Heal. inequalities. Final Rep. to WHO Comm. Soc.

269   Determ. Heal. 2007.

270   6. Virtanen M, Kivimäki M, Joensuu M, Virtanen P, Elovainio M, Vahtera J.

271   Temporary employment and health: a review. Int. J. Epidemiol. 2005;34:610–22.

272   7. Virtanen P, Janlert U, Hammarström A. Exposure to temporary employment and job

273   insecurity: a longitudinal study of the health effects. Occup. Environ. Med.

274   2011;68:570–4.

275   8. Inoue A, Kawakami N, Tsuchiya M, Sakurai K, Hashimoto H. Association of

276   occupation, employment contract, and company size with mental health in a national

277   representative sample of employees in Japan. J. Occup. Health. 2010;52:227–40.

278   9. Kivimäki M, Vahtera J, Virtanen M, Elovainio M, Pentti J, Ferrie JE. Temporary

279   employment and risk of overall and cause-specific mortality. Am. J. Epidemiol.

280   2003;158:663–8.

281   10. Berkman LF, Kawachi I, Theorell T. Working Conditions and Health. Soc.

282   Epidemiol. Oxford University Press, New York; 2014. p. 153–81.

283   11. Wardle J, Steptoe A, Oliver G, Lipsey Z. Stress, dietary restraint and food intake. J.

284   Psychosom. Res. 2000;48:195–202.

285 12. Marcenes WS, Sheiham A. The relationship between work stress and oral health

286 status. Soc. Sci. Med. 1992;35:1511–20.

287 13. Ishiguro K. Japanese Employment in Transformation: The Growing Number of

288 Non-Regular Workers. Electron. J. Contemp. Japanese Stud. 2008;

289 14. Al-Sudani FYH, Vehkalahti MM, Suominen AL. The association between current

290 unemployment and clinically determined poor oral health. Community Dent. Oral

291 Epidemiol. 2015;43:325–37.

292 15. Al-Sudani FYH, Vehkalahti MM, Suominen AL. Association of current

293 employment status with oral health-related behaviors: findings from the Finnish Health

294 2000 Survey. Eur. J. Oral Sci. 2016;124:368–76.

295 16. Mundt T, Schwahn C, Mack F, Polzer I, Samietz S, Kocher T, et al. Risk indicators

296 for missing teeth in working-age Pomeranians--an evaluation of high-risk populations.

297 J. Public Health Dent. 2007;67:243–9.

298 17. Tsuboya T, Aida J, Kawachi I, Katase K, Osaka K. Early life-course socioeconomic

299 position, adult work-related factors and oral health disparities: cross-sectional analysis

300 of the J-SHINE study. BMJ Open. 2014;4:e005701.

301 18. Takada M, Kondo N, Hashimoto H, J-SHINE Data Management Committee.

302 Japanese study on stratification, health, income, and neighborhood: study protocol and

303 profiles of participants. J. Epidemiol. 2014;24:334–44.

304 19. Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SLT, et al.

305 Short screening scales to monitor population prevalences and trends in non-specific

306 psychological distress. Psychol. Med. 2002;32:959–76.

307 20. Estévez-abe M. An International Comparison of Gender Equality : Why Is the

308 Japanese Gender Gap So Persistent ? Japan Labor Rev. 2013;10:82–100.

309 21. Inoue M, Nishikitani M, Tsurugano S. Female non-regular workers in Japan: their

310 current status and health. Ind. Health. 2016;54:521–7.

311 22. The Japan Institute for Labour Policy and Training. Labor Situation in Japan and Its

312 Analysis: General Overview 2015/2016. 2016.

313 23. Organisation for Economic Co-operation and Development. OECD Employment

314 Outlook 2016. OECD Publishing, Paris; 2016.

315 24. Annual report on the labour force survey. Minist. Intern. Aff. Commun. Tokyo;

316 2015.

317 25. Steele J, Shen J, Tsakos G, Fuller E, Morris S, Watt R, et al. The Interplay between

318 socioeconomic inequalities and clinical oral health. J. Dent. Res. 2015;94:19–26.

319   26. Watt RG. Social determinants of oral health inequalities: implications for action.

320   Community Dent. Oral Epidemiol. 2012;40:44–8.

321   27. De Witte H. Job insecurity: Review of the international literature on definitions,

322   prevalence, antecedents and consequences. SA J. Ind. Psychol. 2005;31:1–6.

323   28. Ikegami N, Yoo B-K, Hashimoto H, Matsumoto M, Ogata H, Babazono A, et al.

324   Japanese universal health coverage: evolution, achievements, and challenges. Lancet

325   (London, England). Elsevier Ltd; 2011;378:1106–15.

326   29. Inoue M, Nishikitani M, Tsurugano S, Yano E. The health of permanent workers

327   and workers with precarious employment: a literature review. Sangyo eiseigaku zasshi.

328   2011;53:117–39.

329   30. Matsui D, Yamamoto T, Nishigaki M, Miyatani F, Watanabe I, Koyama T, et al.

330   Validity of self-reported number of teeth and oral health variables. BMC Oral Health.

331   BMC Oral Health; 2017;17:17.

332   31. Haugejorden O, Klock KS, Trovik TA. Incidence and predictors of self-reported

333   tooth loss in a representative sample of Norwegian adults. Community Dent. Oral

334   Epidemiol. 2003;31:261–8.

335   32. Hung H-C, Joshipura KJ, Colditz G, Manson JE, Rimm EB, Speizer FE, et al. The

336   association between tooth loss and coronary heart disease in men and women. J. Public

337   Health Dent. 2004;64:209–15.

338

Tables

Table 1. Characteristics and tooth loss in men (n = 1,394).

Men (n=1,394)			Number of tooth loss						
			none	1 tooth	2 teeth	3 teeth	4 teeth	more than 4 teeth	P-value*
Changes in employment status	Continuous regular employment	n	736	140	111	60	46	99	
	(n = 1,192)	(%)	(61.7)	(11.7)	(9.3)	(5.0)	(3.9)	(8.3)	0.68
	Having the experience of temporary employment	n	122	20	23	9	6	22	
	(n = 202)	(%)	(60.4)	(9.9)	(11.4)	(4.5)	(3.0)	(10.9)	
	Regular to temporary employment	n	32	7	10	7	0	9	
	(n = 65)	(%)	(49.2)	(10.8)	(15.4)	(10.8)	(0.0)	(13.9)	
	Temporary to regular employment	n	32	5	7	0	2	8	
	(n = 54)	(%)	(59.3)	(9.3)	(13.0)	(0.0)	(3.7)	(14.8)	
	Continuous temporary employment	n	58	8	6	2	4	5	
	(n = 83)	(%)	(69.9)	(9.6)	(7.2)	(2.4)	(4.8)	(6.0)	
Age (years old)	25–30	n	220	18	15	3	4	6	
		(%)	(82.7)	(6.8)	(5.6)	(1.1)	(1.5)	(2.3)	
	30–35	n	169	22	15	11	7	16	
		(%)	(70.4)	(9.2)	(6.3)	(4.6)	(2.9)	(6.7)	
	35–40	n	195	41	27	15	12	19	<0.05
		(%)	(63.1)	(13.3)	(8.7)	(4.9)	(3.9)	(6.2)	
	40–45	n	159	45	43	18	17	33	
		(%)	(50.5)	(14.3)	(13.7)	(5.7)	(5.4)	(10.5)	
	45–50	n	115	34	34	22	12	47	
		(%)	(43.6)	(12.9)	(12.9)	(8.3)	(4.6)	(17.8)	
History of diabetes	None	n	843	157	132	67	51	116	
		(%)	(61.7)	(11.5)	(9.7)	(4.9)	(3.7)	(8.5)	0.62
	Present	n	15	3	2	2	1	5	
		(%)	(53.6)	(10.7)	(7.1)	(7.1)	(3.6)	(17.9)	

									p-value
Body mass index (kg/m^2)	≥25.0	n	214	53	31	20	14	40	
		(%)	(57.5)	(14.3)	(8.3)	(5.4)	(3.8)	(10.8)	
	18.5–25.0	n	601	104	100	44	35	76	0.11
		(%)	(62.6)	(10.8)	(10.4)	(4.6)	(3.7)	(7.9)	
	<18.5	n	38	3	2	5	3	3	
		(%)	(70.4)	(5.6)	(3.7)	(9.3)	(5.6)	(5.6)	
Marital status	Married	n	575	113	99	53	43	93	
		(%)	(58.9)	(11.6)	(10.1)	(5.4)	(4.4)	(9.5)	<0.05
	Single	n	283	47	35	16	9	28	
		(%)	(67.7)	(11.2)	(8.4)	(3.8)	(2.2)	(6.7)	
No. of family members in the household	Living alone	n	109	21	18	13	3	19	
		(%)	(59.6)	(11.5)	(9.8)	(7.1)	(1.6)	(10.4)	
	2	n	163	25	25	10	9	24	
		(%)	(63.7)	(9.8)	(9.8)	(3.9)	(3.5)	(9.4)	0.56
	3	n	228	40	32	14	9	27	
		(%)	(65.1)	(11.4)	(9.1)	(4.0)	(2.6)	(7.7)	
	≥4	n	357	74	59	32	31	51	
		(%)	(59.1)	(12.3)	(9.8)	(5.3)	(5.1)	(8.4)	
Self-rated household economic status in early life at 5 years old	Rich	n	138	45	28	13	13	28	
		(%)	(52.1)	(17.0)	(10.6)	(4.9)	(4.9)	(10.6)	
	Fair	n	566	90	80	45	29	69	0.06
		(%)	(64.4)	(10.2)	(9.1)	(5.1)	(3.3)	(7.9)	
	Poor	n	145	24	25	11	10	23	
		(%)	(60.9)	(10.1)	(10.5)	(4.6)	(4.2)	(9.7)	
Years of education (year)	<9	n	31	3	6	6	1	6	
		(%)	(58.5)	(5.7)	(11.3)	(11.3)	(1.9)	(11.3)	
	9–12	n	113	32	31	12	8	35	<0.05
		(%)	(48.9)	(13.9)	(13.4)	(5.2)	(3.5)	(15.2)	
	>12	n	708	124	96	51	42	80	

		(%)	(64.3)	(11.3)	(8.7)	(4.6)	(3.8)	(7.3)	
Annual household income (million yen)	0–300	n	35	10	7	5	1	9	
		(%)	(52.2)	(14.9)	(10.5)	(7.5)	(1.5)	(13.4)	
	300–750	n	369	67	60	28	23	51	0.86
		(%)	(61.7)	(11.2)	(10.0)	(4.7)	(3.9)	(8.5)	
	≥750	n	287	59	47	26	16	46	
		(%)	(59.7)	(12.3)	(9.8)	(5.4)	(3.3)	(9.6)	
Feel fear of job loss	No	n	563	103	81	43	25	68	
		(%)	(63.8)	(11.7)	(9.2)	(4.9)	(2.8)	(7.7)	<0.05
	Yes	n	269	55	47	23	25	52	
		(%)	(57.1)	(11.7)	(10.0)	(4.9)	(5.3)	(11.0)	
Psychological distress (k6)	None (0-4)	n	565	106	89	45	32	78	
		(%)	(61.8)	(11.6)	(9.7)	(4.9)	(3.5)	(8.5)	0.99
	Present (≥5)	n	293	54	44	24	20	42	
		(%)	(61.4)	(11.3)	(9.2)	(5.0)	(4.2)	(8.8)	
Visiting a dental clinic for preventive care	Yes	n	201	38	24	25	11	27	
		(%)	(61.7)	(11.7)	(7.4)	(7.7)	(3.4)	(8.3)	0.12
	No	n	654	122	109	44	41	93	
		(%)	(61.5)	(11.5)	(10.3)	(4.1)	(3.9)	(8.8)	
Hesitation to use medical and dental care	Yes	n	374	78	58	28	28	69	
		(%)	(58.9)	(12.3)	(9.1)	(4.4)	(4.4)	(10.9)	<0.05
	No	n	353	70	55	34	18	38	
		(%)	(62.2)	(12.3)	(9.7)	(6.0)	(3.2)	(6.7)	
	Never felt a need to use	n	131	12	21	6	6	14	
		(%)	(69.0)	(6.3)	(11.1)	(3.2)	(3.2)	(7.4)	
Smoking status	Current smoker	n	258	61	62	29	26	58	<0.05
		(%)	(52.2)	(12.4)	(12.6)	(5.9)	(5.3)	(11.7)	
	Former smoker	n	226	43	41	22	15	30	

		(%)	(60.0)	(11.4)	(10.9)	(5.8)	(4.0)	(8.0)
Never smoker	n	373	56	31	18	11	32
		(%)	(71.6)	(10.8)	(6.0)	(3.5)	(2.1)	(6.1)

* P-value was calculated by chi-squared test.

Table 2. Characteristics and tooth loss in women (n = 1,258).

Women (n=1,258)			Number of tooth loss						
			none	1 tooth	2 teeth	3 teeth	4 teeth	more than 4 teeth	P-value*
Changes in employment status	Continuous regular employment	n	349	63	29	15	12	19	
	(n = 487)	(%)	(71.7)	(12.9)	(6.0)	(3.1)	(2.5)	(3.9)	<0.05
	Having the experience of temporary employment	n	449	116	66	47	26	67	
	(n = 771)	(%)	(58.2)	(15.1)	(8.6)	(6.1)	(3.4)	(8.7)	
	Regular to temporary employment	n	286	82	52	33	17	47	
	(n = 517)	(%)	(55.3)	(15.9)	(10.1)	(6.4)	(3.3)	(9.1)	
	Temporary to regular employment	n	39	7	2	2	0	5	
	(n = 55)	(%)	(70.9)	(12.7)	(3.6)	(3.6)	(0.0)	(9.1)	
	Continuous temporary employment	n	124	27	12	12	9	15	
	(n = 199)	(%)	(62.3)	(13.6)	(6.0)	(6.0)	(4.5)	(7.5)	
Age (years old)	25–30	n	248	20	8	5	6	5	
		(%)	(84.9)	(6.9)	(2.7)	(1.7)	(2.1)	(1.7)	
	30–35	n	163	24	12	6	7	9	
		(%)	(73.8)	(10.9)	(5.4)	(2.7)	(3.2)	(4.1)	
	35–40	n	152	47	21	8	4	16	<0.05
		(%)	(61.3)	(19.0)	(8.5)	(3.2)	(1.6)	(6.5)	
	40–45	n	133	47	25	16	11	19	
		(%)	(53.0)	(18.7)	(10.0)	(6.4)	(4.4)	(7.6)	
	45–50	n	102	41	29	27	10	37	
		(%)	(41.5)	(16.7)	(11.8)	(11.0)	(4.1)	(15.0)	
History of diabetes	None	n	793	178	94	60	38	86	
		(%)	(63.5)	(14.3)	(7.5)	(4.8)	(3.0)	(6.9)	0.24
	Present	n	5	1	1	2	0	0	
		(%)	(55.6)	(11.1)	(11.1)	(22.2)	(0.0)	(0.0)	
Body mass index (kg/m^2)	≥25.0	n	65	19	14	7	4	18	<0.05

			Col1	Col2	Col3	Col4	Col5	Col6	p
		(%)	(51.2)	(15.0)	(11.0)	(5.5)	(3.2)	(14.2)	
	18.5–25.0	n	580	131	63	43	27	60	
		(%)	(64.2)	(14.5)	(7.0)	(4.8)	(3.0)	(6.6)	
	<18.5	n	113	25	13	11	7	7	
		(%)	(64.2)	(14.2)	(7.4)	(6.3)	(4.0)	(4.0)	
Marital status	Married	n	455	124	58	51	27	62	
		(%)	(58.6)	(16.0)	(7.5)	(6.6)	(3.5)	(8.0)	<0.05
	Single	n	340	55	37	11	11	24	
		(%)	(71.1)	(11.5)	(7.7)	(2.3)	(2.3)	(5.0)	
No. of family members in the household	Living alone	n	75	6	7	5	3	5	
		(%)	(74.3)	(5.9)	(6.9)	(5.0)	(3.0)	(5.0)	
	2	n	161	43	15	10	6	21	
		(%)	(62.9)	(16.8)	(5.9)	(3.9)	(2.3)	(8.2)	0.32
	3	n	201	42	34	15	12	22	
		(%)	(61.7)	(12.9)	(10.4)	(4.6)	(3.7)	(6.8)	
	≥4	n	356	87	39	31	17	37	
		(%)	(62.8)	(15.3)	(6.9)	(5.5)	(3.0)	(6.5)	
Self-rated household economic status in early life at 5 years old	Rich	n	139	32	26	18	12	28	
		(%)	(54.5)	(12.6)	(10.2)	(7.1)	(4.7)	(11.0)	
	Fair	n	490	111	57	33	16	42	<0.05
		(%)	(65.4)	(14.8)	(7.6)	(4.4)	(2.1)	(5.6)	
	Poor	n	162	35	12	11	10	15	
		(%)	(66.1)	(14.3)	(4.9)	(4.5)	(4.1)	(6.1)	
Years of education (year)	<9	n	17	6	1	6	2	3	
		(%)	(48.6)	(17.1)	(2.9)	(17.1)	(5.7)	(8.6)	
	9–12	n	127	37	25	15	11	25	<0.05
		(%)	(52.9)	(15.4)	(10.4)	(6.3)	(4.6)	(10.4)	
	>12	n	647	135	68	41	25	57	
		(%)	(66.5)	(13.9)	(7.0)	(4.2)	(2.6)	(5.9)	

									p
Annual household income (million yen)	0–300	n	53	9	5	3	3	12	
		(%)	(62.4)	(10.6)	(5.9)	(3.5)	(3.5)	(14.1)	
	300–750	n	249	58	39	21	9	28	0.41
		(%)	(61.6)	(14.4)	(9.7)	(5.2)	(2.2)	(6.9)	
	≥750	n	233	57	26	20	14	27	
		(%)	(61.8)	(15.1)	(6.9)	(5.3)	(3.7)	(7.2)	
Feel fear of job loss	No	n	495	123	56	38	23	45	
		(%)	(63.5)	(15.8)	(7.2)	(4.9)	(3.0)	(5.8)	0.09
	Yes	n	272	46	32	21	13	39	
		(%)	(64.3)	(10.9)	(7.6)	(5.0)	(3.1)	(9.2)	
Psychological distress (k6)	None (0-4)	n	548	120	66	30	25	50	
		(%)	(65.3)	(14.3)	(7.9)	(3.6)	(3.0)	(6.0)	<0.05
	Present (≥5)	n	248	59	29	31	13	36	
		(%)	(59.6)	(14.2)	(7.0)	(7.5)	(3.1)	(8.7)	
Visiting a dental clinic for preventive care	Yes	n	247	57	40	27	18	20	
		(%)	(60.4)	(13.9)	(9.8)	(6.6)	(4.4)	(4.9)	<0.05
	No	n	548	122	55	35	20	65	
		(%)	(64.9)	(14.4)	(6.5)	(4.1)	(2.4)	(7.7)	
Hesitation to use medical and dental care	Yes	n	366	80	43	34	13	39	
		(%)	(63.7)	(13.9)	(7.5)	(5.9)	(2.3)	(6.8)	
	No	n	310	77	36	23	17	39	0.45
		(%)	(61.8)	(15.3)	(7.2)	(4.6)	(3.4)	(7.8)	
	Never felt a need to use	n	122	22	16	5	8	8	
		(%)	(67.4)	(12.2)	(8.8)	(2.8)	(4.4)	(4.4)	
Smoking status	Current smoker	n	91	26	15	17	11	21	
		(%)	(50.3)	(14.4)	(8.3)	(9.4)	(6.1)	(11.6)	<0.05
	Former smoker	n	115	34	20	12	5	20	
		(%)	(55.8)	(16.5)	(9.7)	(5.8)	(2.4)	(9.7)	

Never smoker	n	589	119	59	33	22	45
	(%)	(67.9)	(13.7)	(6.8)	(3.8)	(2.5)	(5.2)

* P-value was calculated by chi-squared test.

Table 3. Associations between change in employment status and tooth loss.

	Continuous regular employment	Changes in employment status			
		Having the experience of temporary employment	Regular to temporary employment	Temporary to regular employment	Continuous temporary employment
Negative binomial regression models	Reference	PRR (95%CI)	PRR (95%CI)	PRR (95%CI)	PRR (95%CI)
Men (n=1,394)	(n=1,192)	(n=202)	(n=65)	(n=54)	(n=83)
Model 1	1.00	1.55 (1.18, 2.04)	1.71 (1.11, 2.63)	1.69 (1.05, 2.73)	1.31 (0.86, 2.01)
Model 2	1.00	1.50 (1.13, 2.00)	1.62 (1.05, 2.52)	1.62 (0.99, 2.64)	1.30 (0.83, 2.02)
Model 3	1.00	1.44 (1.07, 1.93)	1.51 (0.96, 2.37)	1.63 (1.00, 2.65)	1.22 (0.77, 1.92)
Model 4	1.00	1.38 (1.03, 1.85)	1.44 (0.91, 2.26)	1.53 (0.94, 2.50)	1.20 (0.76, 1.88)
Model 5	1.00	1.32 (0.98, 1.78)	1.37 (0.87, 2.16)	1.46 (0.89, 2.39)	1.16 (0.74, 1.82)
Model 6	1.00	1.31 (0.98, 1.76)	1.41 (0.90, 2.21)	1.43 (0.88, 2.33)	1.13 (0.72, 1.77)
Women (n=1,258)	(n=487)	(n=771)	(n=517)	(n=55)	(n=199)
Model 1	1.00	1.44 (1.16, 1.79)	1.34 (1.06, 1.70)	1.33 (0.79, 2.24)	1.73 (1.28, 2.34)
Model 2	1.00	1.42 (1.14, 1.76)	1.35 (1.07, 1.72)	1.30 (0.77, 2.18)	1.62 (1.19, 2.19)
Model 3	1.00	1.37 (1.10, 1.71)	1.31 (1.02, 1.66)	1.31 (0.78, 2.20)	1.56 (1.14, 2.12)
Model 4	1.00	1.38 (1.11, 1.72)	1.32 (1.03, 1.68)	1.29 (0.76, 2.19)	1.58 (1.16, 2.15)
Model 5	1.00	1.37 (1.09, 1.71)	1.32 (1.03, 1.70)	1.27 (0.75, 2.17)	1.51 (1.10, 2.06)
Model 6	1.00	1.33 (1.06, 1.66)	1.31 (1.02, 1.68)	1.14 (0.67, 1.94)	1.44 (1.06, 1.97)
Linear regression models	Reference	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)	Coefficient (95%CI)
Men (n=1,394)	(n=1,192)	(n=202)	(n=65)	(n=54)	(n=83)
Model 1	-	0.38 (0.14, 0.62)	0.51 (0.12, 0.91)	0.47 (0.04, 0.90)	0.21 (-0.15, 0.57)
Model 2	-	0.37 (0.12, 0.62)	0.46 (0.06, 0.85)	0.42 (-0.01, 0.85)	0.25 (-0.12, 0.62)
Model 3	-	0.34 (0.09, 0.59)	0.41 (0.01, 0.81)	0.42 (-0.02, 0.85)	0.22 (-0.16, 0.59)
Model 4	-	0.32 (0.07, 0.57)	0.38 (-0.02, 0.78)	0.38 (-0.05, 0.81)	0.23 (-0.15, 0.60)
Model 5	-	0.28 (0.02, 0.53)	0.33 (-0.07, 0.74)	0.31 (-0.12, 0.74)	0.20 (-0.18, 0.58)
Model 6	-	0.25 (0.00, 0.50)	0.31 (-0.09, 0.71)	0.29 (-0.15, 0.72)	0.17 (-0.20, 0.55)

Women (n=1,258)	(n=487)	(n=771)	(n=517)	(n=55)	(n=199)
Model 1	-	0.25 (0.08, 0.41)	0.19 (0.00, 0.38)	0.25 (-0.16, 0.65)	0.36 (0.13, 0.60)
Model 2	-	0.23 (0.06, 0.40)	0.20 (0.00, 0.39)	0.25 (-0.15, 0.65)	0.31 (0.07, 0.54)
Model 3	-	0.20 (0.03, 0.38)	0.17 (-0.03, 0.36)	0.24 (-0.16, 0.64)	0.27 (0.02, 0.51)
Model 4	-	0.21 (0.04, 0.39)	0.17 (-0.02, 0.37)	0.24 (-0.16, 0.65)	0.28 (0.04, 0.53)
Model 5	-	0.20 (0.02, 0.38)	0.16 (-0.04, 0.36)	0.25 (-0.15, 0.65)	0.26 (0.01, 0.51)
Model 6	-	0.16 (-0.02, 0.33)	0.13 (-0.06, 0.33)	0.11 (-0.29, 0.51)	0.22 (-0.03, 0.46)

Model 1: Age was adjusted.

Model 2: Model 1 + years of education, self-rated household economic status in early life at 5 years old, marital status, no. of family members in the household, history of diabetes, and body mass index were adjusted.

Model 3: Model 2 + Annual household income was adjusted.

Model 4: Model 3 + Visiting a dental clinic for preventive care and hesitation to use medical and dental care were adjusted.

Model 5: Model 4 + Feel fear of job loss and psychological distress was adjusted.

Model 6: Model 5 + Smoking status was adjusted.

Abbreviation: PRR = prevalence rate ratios, 95%CI = 95% confidence interval

Figure 1. Flowchart of participants in the present study

```
┌─────────────────────────────────────┐       ┌──────────────────────────────────────────┐
│ 13,920 originally selected persons   │       │ 5512 not contacted                       │
└─────────────────────────────────────┘       │   3: death                               │
                 │                             │   20: not eligible age                   │
                 ├──────────────────────────►  │   894: address unidentified              │
                 │                             │   224: long-term absence                 │
                 ▼                             │   4,371: inaccessible contact            │
                                               └──────────────────────────────────────────┘
┌─────────────────────────────────────┐       ┌──────────────────────────────────────────┐
│ 8,408 persons accessible             │       │ 4,023 attrition                          │
└─────────────────────────────────────┘       │   3,677: refusal of invitation           │
                 │                             │   346: excluded because they completed    │
                 ├──────────────────────────►  │        less than                          │
                 │                             │        50% of the questionnaire items.    │
                 ▼                             └──────────────────────────────────────────┘
┌─────────────────────────────────────┐       ┌──────────────────────────────────────────┐
│ 4,385 persons agreed to participate  │       │ 1,733 were excluded                      │
│ and complete the survey             │       │   68: did not answer by themselves       │
│ (response rate = 31.5%)             │       │   1,256: did not answer current          │
└─────────────────────────────────────┘       │         employment status                 │
                 │                             │         (regular or temporary employment) │
                 ├──────────────────────────►  │   43: did not answer first employment     │
                 │                             │        status                             │
                 │                             │        (regular or temporary employment)  │
                 │                             │   52: were not in eligible ages           │
                 │                             │        (25-50 years old)                  │
                 │                             │   4: did not answer questionnaires on     │
                 │                             │       their sex                           │
                 ▼                             │   310: did not answer questionnaires on   │
┌─────────────────────────────────────┐       │        their tooth loss                   │
│ Analytic sample: N=2,652             │       └──────────────────────────────────────────┘
└─────────────────────────────────────┘
```
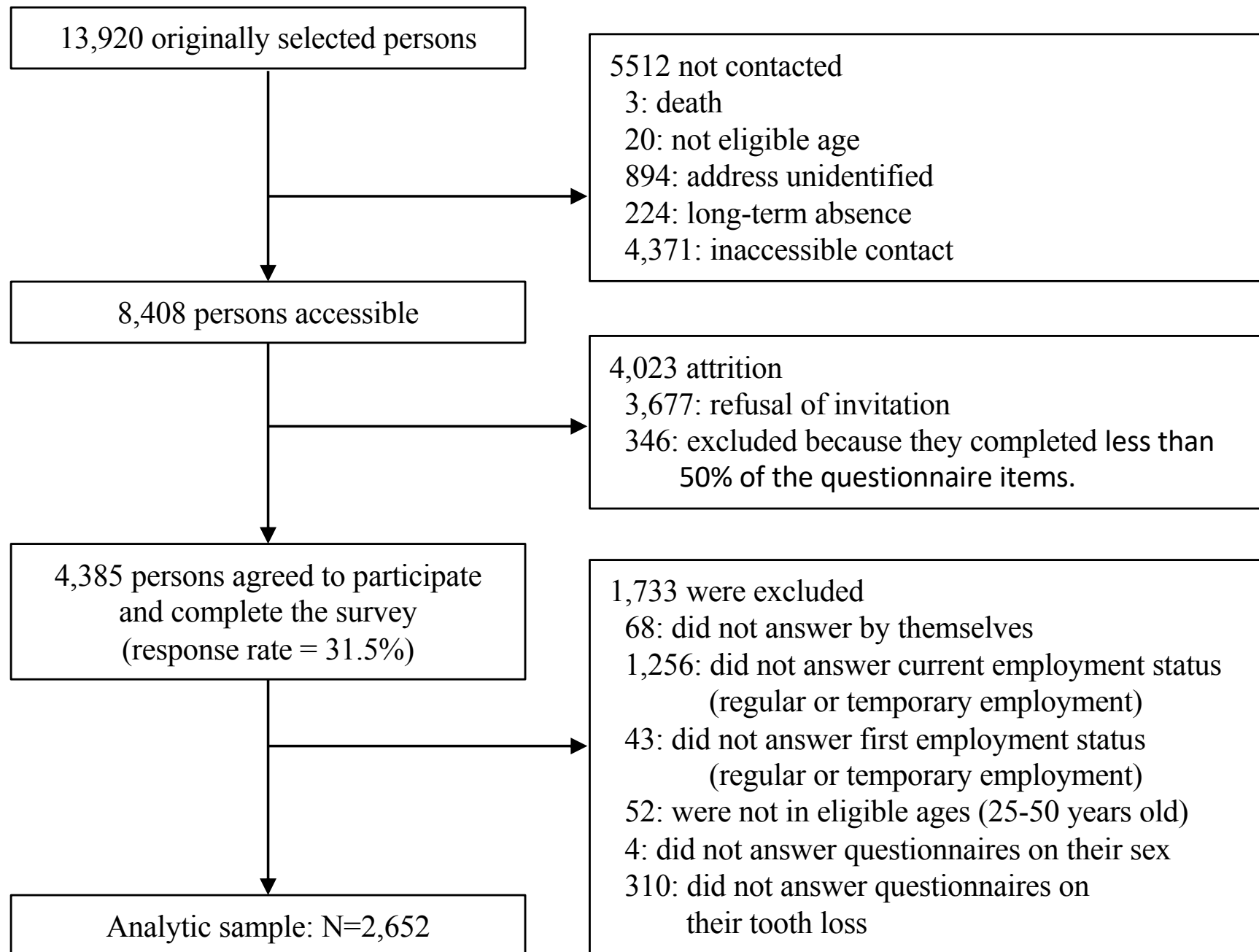
Figure 2. A directed acyclic graph (DAG) showing the association between employment status and tooth loss