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Experience of childhood abuse and later number of remaining teeth in older Japanese: a life-course study from Japan Gerontological Evaluation Study project

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	remaining teeth (mean age: 73.9; male: 46.5%), 14.8% had experience of childhood abuse. Distributions of ≥20, 10-19, 5-9, 1-4, and no teeth were: 46.6%, 22.0%, 11.4%, 8.2%, and 11.8% among respondents with childhood abuse; while 52.3%, 21.3%, 10.3%, 6.6%, and 9.5% among respondents without childhood abuse. Childhood abuse was significantly associated with fewer remaining teeth after adjusting for covariates including socioeconomic status (odds ratio=1.14; 95% confidence interval: 1.06, 1.22). Conclusions: Childhood abuse could have a longitudinal adverse effect on later dental health in older age. This study emphasizes the importance of early life experiences on dental health throughout later life.

Title

Experience of childhood abuse and later number of remaining teeth in older Japanese: a life-course study from Japan Gerontological Evaluation Study project

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Abstract

Objectives: From a life-course perspective, adverse childhood experiences (ACEs) such as childhood abuse are known risk factors for adult diseases and death throughout life. ACEs could also cause poor dental health in later life because they could induce poor dental health in childhood, initiate unhealthy behaviors, and lower immune and physiological functions. However, it is not known whether ACEs have a longitudinal adverse effect on dental health in older age. This study aimed to investigate the association between experience of childhood abuse until the age of 18 and current number of remaining teeth among a sample of older Japanese adults.

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Results: Of the 25,189 respondents who indicated their number of remaining teeth (mean age: 73.9; male: 46.5%), 14.8% had experience of childhood abuse. Distributions of ≥20, 10-19, 5-9, 1-4, and no teeth were: 46.6%, 22.0%, 11.4%, 8.2%, and 11.8% among respondents with childhood abuse; while 52.3%, 21.3%, 10.3%, 6.6%, and 9.5% among respondents without childhood abuse. Childhood abuse was significantly associated with fewer remaining teeth after adjusting for covariates including socioeconomic status (odds ratio=1.14; 95% confidence interval: 1.06, 1.22).

Conclusions: Childhood abuse could have a longitudinal adverse effect on later dental health in older age. This study emphasizes the importance of early life experiences on dental health throughout later life.

Introduction

The World Health Organization has highlighted that a good start to life should be ensured for every child in order to provide the foundations for health and well-being and to tackle health inequalities, which can be observed even in the earliest stage of life[1]. Every child has the right to live a healthy life free from violence[2]. However, many children have adverse childhood experiences (ACEs). For example, in Japan, 31.9% of adults[3] and worldwide 38.8% of adults[4] have experienced one or more ACEs, such as interpersonal loss, parental substance abuse, physical or sexual abuse, neglect, and economic adversity during their childhood. Reducing ACEs is therefore an important public health issue[1].

Life-course epidemiology has highlighted that ACEs are risk factors for later adult diseases and death[5]. Two conceptual life-course models, critical period model and accumulation of risk model, are suggested as possible pathways. In the critical period model, exposures during critical or sensitive periods irreversibly change anatomical structures, such as the hypothalamic–pituitary–adrenal axis, or psychological functions and could result in disease later in life. In the accumulation of risk model, exposures in early life stages and other risk factors accumulate throughout life and, in turn, damage health later in life either independently or by interacting with each other[6–8].

ACEs could have a longitudinal adverse effect on oral health. In the critical period model, physically abused children's teeth are sometimes injured. Fractured and avulsed teeth were found among physically abused children, suggesting that the teeth of abused children were injured by physical violence from a parent[9,10]. If permanent teeth were injured, later oral health would be influenced. Severe chronic stress induced by ACEs could alter children's hypothalamic–pituitary–adrenal axis function and could

irreversibly damage their immune systems[11]. A compromised immune system is associated with periodontal disease in adulthood[12]. Individuals who have experienced ACEs tend to exhibit addictive and unhealthy behaviors[13] because their inhibitory control system has been damaged[14]. Such people tend to consume 'comfort' foods (such as energy-dense foods high in sugar and/or fat) to cope with stress[15–17]. Consumption of these sugary food items is associated with both dental caries and overweight/obesity[18]. These eating habits in childhood could persist into adulthood[19,20] and might contribute to later poor dental health. Moreover, people with ACEs feel daily stress, which might result in a lower salivary flow rate through sympathetic nerve functioning[21]. A low salivary flow rate is a recognized risk factor for dental caries[22]. Thus, it is reasonable to assume that ACEs might induce poor dental health in adulthood.

Among ACEs, childhood abuse warrants particular attention for dental health later in life since it could cause poor dental health in childhood. Valencia-Rojas et al. (2008) reported an association between child abuse and early childhood caries among Canadian children[23]. Other studies have found an association between high levels of paternal punishment in childhood and dental injuries as well as dental caries experience[24,25]. However, there are only a few life-course studies focusing on the effects of early childhood abuse on dental health outcomes in older age. With regard to dental health in middle age, Nicolau et al. (2007) reported that people with high paternal punishment in childhood had clinically examined poorer periodontal status at age 40[12]. Listl et al. (2014) reported that people with childhood financial hardship had poorer chewing ability at 50 years of age[26]. However, to our knowledge, no previous studies have examined the harmful effects of childhood abuse on dental health in older age. In particular, no study has examined the effect on tooth loss in middle or older age, which

reflects one's dental health status across the life-course. We aimed to investigate the association between experience of childhood abuse and the number of remaining teeth among older adults in Japan.

Methods

Study design and setting

This study was a retrospective cohort study investigating the association between experience of childhood abuse and current dental health status in older age. We used data from the Japan Gerontological Evaluation Study (JAGES) project, in particular from the 2013 JAGES survey which was conducted between October 2013 and February 2014. JAGES is an ongoing prospective cohort study aiming to investigate the association between social and behavioral factors and community-dwelling older people's health in multiple cities in Japan[27]. In the 2013 JAGES survey, 30 municipalities in 14 of the 47 prefectures in Japan were included. Self-administered questionnaires were mailed to 193,694 community-dwelling residents aged ≥65 years. Random sampling from small administrative regions was used to select participants in 17 large municipalities, while all eligible residents in 13 small municipalities were included. One in five participants were randomly sent the questionnaire containing questions on experience of childhood abuse (N=38,731).

Measurement

We used the number of remaining teeth for the outcome. The data were gathered using the following single question: "How many remaining teeth do you have? Including teeth covered by crowns. The total number of remaining teeth of an adult, including wisdom

teeth, should be 32." Response choices were: ≥20 teeth, 10–19 teeth, 5–9 teeth, 1–4 teeth, and no teeth. Self-reported number of teeth was used in another study[28]. We coded these five categories from "≥20 teeth" as 1 to "No teeth" as 5 and used these as an ordered variable for the analyses.

Our main predictor was experience of childhood abuse up to the age of 18, which was determined from the following three questions with response choices of "Yes/No": "I was beaten by a parent and injured", (Answering "Yes" meant having an experience of physical abuse), "I was insulted and verbally abused by a parent" (Answering "Yes" meant having an experience of psychological abuse), and "I have been loved by a parent" (Answering "No" meant having an experience of psychological neglect). These questions were derived from the Adverse Childhood Experiences Study[29]. We defined having any one of these experiences as a main exposure.

The following variables were adjusted to estimate the independent effect of childhood abuse: age (65-69, 70-74, 75-79, 80-84, and ≥85 years old), sex (male/female), economic adversity in childhood (Yes/No), years of education (<6, 6-9, 10-12, and ≥13), longest occupation ("high occupational status": professional/technical and administrative positions, and "low occupational status": clerical, sales/service and skilled/labor positions, agriculture/forestry/fishery workers, the self-employed, other occupations, and those with no occupation), and current household equivalent annual income ("low": <16,000 USD, "middle": 16,000-24,999 USD, and "high": ≥25,000 USD; 100 JPY=1 USD), self-reported co-morbid status (diabetes/stroke/depression), and smoking status (current smoker/cessation/never smoker).

Statistical analyses

Multivariable ordered logistic regression models were fitted to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth. We first examined crude association (model 1) and adjusted for age and sex (model 2). Then, we constructed a model to evaluate how socioeconomic status (SES) explains the association (model 3) and a model in which all covariates were adjusted (model 4). Additionally, we examined the association between number of remaining teeth and each type of childhood abuse experience as well as the total number of childhood abuse experiences. People with missing information on the number of remaining teeth were excluded from the analyses. Missing information on other variables was categorized as dummy variables at first. Then, to account for bias due to missing information, we assumed missing at random and created ten multiple imputed datasets using the multivariate normal imputation method[30]. All variables in our main models were included in the imputation models. Estimated parameters were combined using Rubin's combination methods[31]. All analyses were conducted using Stata 13.1 software (Stata Corp, College Station, TX).

Ethical considerations

Ethical approval for this study was obtained from the Ethics Committee at Nihon Fukushi University (13-14). The questionnaires with encrypted codes and explanations of this study were sent to the participants by mail. Therefore, the researchers cannot identify individual participants. The participants were informed that their participation was voluntary and returning the self-administered questionnaire by mail was taken as consent.

Results

Of the 38,731 people who were mailed the survey, 27,525 responded (response rate=71.1%). After excluding those whose information on sex and age was missing or invalid and those whose information on the number of remaining teeth was missing, 25,189 (65.0%) participants were included in the final analyses (mean age was 73.9 (standard deviation = 6.2, ranged between 65 and 100); male =46.5%). The prevalence of any experience of childhood abuse was 14.8% (1.4% physical abuse, 5.3% psychological abuse, 11.3% psychological neglect; 12.1%, 2.1%, and 0.6% had one, two, and three types of abuse, respectively). The characteristics associated with fewer remaining teeth were having an experience of childhood abuse, older age, male sex, having economic adversity in childhood, low years of education, low occupational status, low income, diabetes, stroke, and current smoking (Table 1).

Ordered logistic regression analyses using multiply imputed datasets to account for bias due to missing information showed that an experience of any type of childhood abuse was significantly associated with fewer remaining teeth (model 1: OR [95% CI] = 1.27 [1.19, 1.35]) (Table 2). The association was significant after adjusting for age and sex (model 2: OR [95% CI] =1.28 [1.20, 1.37]). SES partly attenuated the association (model 3: OR [95% CI] =1.15 [1.08, 1.23]), and it remained significant after adjusting for other covariates (model 4: OR [95% CI] =1.14 [1.06, 1.22]). In addition, each type of childhood abuse was significantly associated with fewer remaining teeth (Table 3). The ORs increased as the number of different types of childhood abuse increased. Analyses including missing predictor information as dummy variables showed similar outcomes (Appendices 1 & 2).

Discussion

We found a significant association between experience of childhood abuse and fewer remaining teeth in older age. Experience of childhood abuse increased the risk of having fewer remaining teeth by 14% after controlling for covariates. Each type of childhood abuse had a significant association, and a biological gradient was observed.

This is the first study to investigate the long-term adverse effect of childhood abuse on dental health in older age. We used large samples from 30 municipalities in Japan. However, this study has several limitations. First, recall bias may have been present since older respondents retrospectively answered questions about their experience of childhood abuse. However, we targeted community-dwelling, non-disabled older residents and Havari and Mazzonna (2011) reported that older people robustly remember their childhood circumstances[32]. In addition, we adjusted for depression, which can induce recall bias for experience of childhood abuse. Thus, we believe the problem of recall bias is not a serious flaw in this study. Second, we used a self-reported outcome. However, the validity of the self-reported number of remaining teeth was elucidated using clinical examination data from the sample of JAGES 2010 survey[33]. Third, we could not consider respondents' dental health status in childhood or their dental health behavior because of a lack of information. However, these are not confounders because it is unreasonable to assume that poor dental health or unhealthy dental health behavior causes child abuse. Rather, they are mediators that connect childhood abuse to poor dental health in older age. Thus, experience of childhood abuse is associated with fewer remaining teeth in older age even if the association is explained by poor dental health or unhealthy dental behavior. Fourth, because of lack of information, the reason and age of losing teeth were unknown. Furthermore specific

clinical data on dental health status (e.g. periodontitis and dental caries) at each life stage would be useful to investigate the mechanisms whereby child abuse affects dental status in older age. Fifth, we could not evaluate sexual abuse because it might recall the severe traumatic experience. Sexual abuse is known as a severe risk factor for adult disease[4] and thus, could have a strong harmful longitudinal effect on dental health in older age. Sixth, external validity might be limited because our samples were not randomly selected from older Japanese population, and sampling rate differ among cities; however, the distribution of number of remaining teeth was similar to that of the Japanese national sample (data not shown). Seventh, residual confounding might exist because the association between experience of childhood abuse and number of remaining teeth was not large.

Although there has been little focus on the association between experience of childhood abuse and dental health in older populations, our study is consistent with previous life-course studies on ACEs and dental health in adulthood[26,34–36]. Poulton et al. (2002) investigated the long-lasting negative influences of socioeconomic disadvantage on adult dental health; people who grew up in families with low SES had a threefold increase in adult periodontal disease and dental caries at the age of 26[34]. The association remained significant when Thomson et al. (2004) additionally considered dental health status in childhood[35]. However, these studies focused only on early adult or middle-aged populations. To our knowledge, our present study is the first to investigate the association between experience of childhood abuse and dental health in an older population.

One of the major reasons for tooth loss in Japan is dental caries and their sequela[37], and it is reasonable to expect that older people with experiences of childhood

abuse to have more dental caries during childhood[23,24,38]. Children who are abused by their caregivers tend to have dental neglect[39]. In addition, such children tend to prefer comfort foods (such as these containing high sugar) and sweet taste because of their high stress and damaged inhibitory control systems[17,40]. Unfortunately, these exposures, which cause dental caries, have a major effect in this critical period because children's young permanent teeth are more susceptible to demineralization[41].

Another major reason for tooth loss in Japan is periodontal disease[37], and child abuse might influence fewer remaining teeth in older age via periodontal disease. A study of a middle-aged population showed that adults who experienced high levels of paternal punishment during childhood had poor periodontal status at the age of 40[12]. Adults with childhood abuse experience are more likely to smoke[13] and thus, easily develop periodontal disease. In addition, some previous studies have suggested that children with ACEs have impaired immune systems and altered hypothalamic function, which affects the adaptive responses of organs to stressors[11]. An epigenetic DNA modification is suggested to be associated with this change, which could last until adulthood[11]. This could make people vulnerable to stress- and immune function-related diseases, such as periodontal disease[12].

SES would be one of the other risk factors linking experience of childhood abuse and fewer remaining teeth in older age. Children who experience abuse are more likely to have low SES in adulthood and at older ages[42]. Low SES is associated with dental diseases and unhealthy behavior[43]. In fact, the association between experience of child abuse and number of remaining teeth in older age was partly explained by SES in the present study.

The importance of childhood circumstances is recognised by the World Health Organization[1]. To reduce child abuse requires multi-strategy approaches operating at individual, social, societal and community levels[2]. Societal and community strategies include development of legal frameworks such as banning any physical punishment of children. Social relationship strategies include home visitation programs and training programs for parents to improve their parenting skills. In Japan, home visitation programs at age of 1-2 months and age of 4 months are conducted, however, it is questionable whether two home visits would reduce parents' stress[44]. Individual strategies include increasing access to pre-and postnatal welfare services and support. Such multilevel strategies might be able to reduce child abuse.

Conclusion

This study showed that older people with experience of childhood abuse had significantly fewer remaining teeth at age ≥65. Our study highlighted the importance of the early stages for dental health throughout life. Legal frameworks to prevent child abuse, building social relationships for parents, and spreading welfare service information would enhance a good start in life for all children, and such strategies may also have a beneficial effect on oral health across the life-course.

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Table 1. Participant demographic characteristics and number of remaining teeth before applying multiple imputations (n=25,189)

	No. of remaining teeth					
	Total	20+	10-19	5-9	1-4	0
	n	%	%	%	%	%
Total	25189	50.6	21.5	10.6	7.0	10.2
Experience of childhood abuse						
No	20211	52.3	21.3	10.3	6.6	9.5
Yes	3730	46.6	22.0	11.4	8.2	11.8
Missing	1248	35.3	22.9	14.0	10.3	17.5
Age years old)						
65-69	7139	63.9	20.4	7.4	4.1	4.2
70-74	7554	55.8	22.6	9.5	5.5	6.6
75-79	5585	44.4	22.3	12.7	8.6	12.1
80-84	3370	34.0	21.8	14.5	10.6	19.2
≥85	1541	21.8	18.7	14.8	14.8	29.9
Sex						
Male	11700	49.0	21.4	10.8	7.5	11.3
Female	13489	52.0	21.6	10.4	6.6	9.3
Economic adversity in childhood						
No	12588	52.3	21.0	10.4	6.5	9.7
Yes	11230	50.2	22.0	10.4	7.2	10.1
Missing	1371	38.0	22.7	13.6	9.8	15.9
Years of education						
<6	418	23.9	19.6	14.8	12.4	29.2
6-9	9888	42.2	22.8	12.6	8.8	13.7
10-12	9268	55.4	21.4	9.6	5.7	7.9
≥13	5131	61.4	19.4	8.1	5.2	5.9
Missing	484	38.8	22.3	13.4	10.7	14.7
Occupation						
High occupational status	5346	57.3	20.6	8.9	5.8	7.5
Low occupational status	16731	50.5	21.3	10.7	7.0	10.5
Missing	3112	39.6	24.1	13.3	9.2	13.8
Income						
Low	7836	43.8	22.9	12.5	8.5	12.3
Middle	6347	56.3	21.2	8.7	6.0	7.8
High	6202	59.9	19.3	8.4	4.9	7.5

	Missing	4804	42.2	22.5	12.8	8.9	13.6
Diabetes							
	No	20395	51.3	21.4	10.4	7.0	9.9
	Yes	3380	46.0	22.4	12.0	7.5	12.2
	Missing	1414	51.7	21.1	11.0	6.2	10.0
Depression							
	No	23518	50.5	21.5	10.6	7.1	10.3
	Yes	257	49.4	21.8	14.0	6.2	8.6
	Missing	1414	51.7	21.1	11.0	6.2	10.0
Stroke							
	No	22948	50.8	21.6	10.5	7.0	10.1
	Yes	827	42.2	21.0	12.5	9.9	14.4
	Missing	1414	51.7	21.1	11.0	6.2	10.0
Smoking status							
	Current smoker	2554	38.1	24.8	13.0	8.9	15.1
	Cessation	3895	49.1	22.1	11.5	7.2	10.2
	Never smoker	18350	53.0	20.8	10.0	6.7	9.5
	Missing	390	34.9	25.9	14.6	10.0	14.6

Table 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth after applying multiple imputations (n =25,189)

	Model 1		Model 2		Model 3		Model 4	
	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)
Experience of childhood abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.27	(1.19, 1.35)	1.28	(1.20, 1.37)	1.15	(1.08, 1.23)	1.14	(1.06, 1.22)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Table 3. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth, different type of childhood abuse and its accumulation; after applying multiple imputations (n =25,189); each exposures were separately included into models

	Model 1		Model 2		Model 3		Model 4	
	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)
Physical abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.63	(1.35, 1.97)	1.66	(1.37, 2.02)	1.42	(1.17, 1.72)	1.41	(1.16, 1.71)
Psychological abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.23	(1.11, 1.36)	1.30	(1.18, 1.44)	1.21	(1.09, 1.35)	1.20	(1.08, 1.34)
Psychological neglect								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.25	(1.16, 1.34)	1.25	(1.16, 1.34)	1.10	(1.02, 1.19)	1.09	(1.01, 1.17)
Number of childhood abuse								
0	1.00	reference	1.00	reference	1.00	reference	1.00	reference
1	1.26	(1.17, 1.35)	1.26	(1.17, 1.36)	1.14	(1.06, 1.23)	1.13	(1.05, 1.21)
≥2	1.32	(1.14, 1.52)	1.38	(1.20, 1.60)	1.20	(1.04, 1.40)	1.19	(1.03, 1.38)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, longest occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Appendix 1. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth with missing information on predictors included as dummy variables (n =25,189)

	Model 1		Model 2		Model 3		Model 4	
	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)
Experience of childhood abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.27	(1.19, 1.35)	1.29	(1.20, 1.37)	1.15	(1.07, 1.23)	1.13	(1.06, 1.21)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Appendix 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth, different type of childhood abuse and its accumulation; missing information on predictors was corded as dummy variables (n =25189); each exposures were separately included into models

	Model 1		Model 2		Model 3		Model 4	
	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)	OR	(95%CI)
Physical abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.73	(1.43, 2.09)	1.73	(1.43, 2.09)	1.44	(1.19, 1.75)	1.44	(1.18, 1.74)
Psychological abuse								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.25	(1.13, 1.39)	1.32	(1.19, 1.47)	1.23	(1.11, 1.37)	1.22	(1.10, 1.36)
Psychological neglect								
No	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Yes	1.24	(1.16, 1.34)	1.25	(1.16, 1.34)	1.09	(1.01, 1.17)	1.07	(1.00, 1.16)
Number of childhood abuse								
0	1.00	reference	1.00	reference	1.00	reference	1.00	reference
1	1.26	(1.17, 1.35)	1.26	(1.17, 1.36)	1.13	(1.05, 1.22)	1.12	(1.04, 1.21)
≥2	1.32	(1.15, 1.52)	1.40	(1.21, 1.61)	1.21	(1.05, 1.40)	1.19	(1.03, 1.38)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, longest occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Table legends

Table 1. Participant demographic characteristics and number of remaining teeth before applying multiple imputations (n=25,189)

Table 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth after applying multiple imputations (n =25,189)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Table 3. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth, different type of childhood abuse and its accumulation; after applying multiple imputations (n =25,189); each exposures were separately included into models

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, longest occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Appendix 1. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer

remaining teeth with missing information on predictors included as dummy variables (n =25,189)

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted

Appendix 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for having fewer remaining teeth, different type of childhood abuse and its accumulation; missing information on predictors was corded as dummy variables (n =25189); each exposures were separately included into models

Model 1: crude OR

Model 2: model 1 + age and sex were adjusted

Model 3: model 2 + economic adversity in childhood, years of education, longest occupation, and income were adjusted

Model 4: model 3 + diabetes, depression, stroke, and smoking status were adjusted