吸わない				
4年以内にやめて今は吸わない	2.022	1.719	2.379	p<0.001
現在も喫煙している	2.282	2.017	2.583	p<0.001

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分担研究報告書

前向きコホート研究による、日本人高齢者の閉じこもりのリスク要因
—口腔機能に注目した解析—

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研究要旨

歯の喪失は、食品選択と栄養摂取を左右し高齢者の全身の健康に影響することが知られている。また発音や外見、表情の形成 や咀嚼能力を左右して、他人とのコミュニケーションに影響する。そのため、残存歯数が少ないことが、社会的孤立のリスクとなる可能性が存在する。そこで本研究の目的は、高齢者における残存歯数とその後の閉じこもりとの関連を、繰り返し測定の前向きコホート研究で検討することとした。データとして日本老年学的評価研究プロジェクト（JAGES プロジェクト）の 2003 年度調査をベースライン、3 年後の 2006 年度の追跡調査時点の閉じこもりをアウトカムに用いた。ベースライン時に閉じこもりでない者 2309 名を対象にした分析の結果、9.5%が 3 年後に閉じこもりになっていた。残存歯数別には、ベースライン時に残存歯 19 本以下だと 11.2%、20 本以上であると 5.1%が 3 年後に閉じこもりであった。多変量ロジスティック回帰分析の結果、閉じこもりのリスク要因として、残存歯数が少ないこと、年齢が高いこと、主観的健康感が低いこと、都市ではなく郊外に住んでいることに統計学的に有意な閉じこもりリスクの上昇が認められた。ベースライン時の残存歯数が 20 本以上の人に対して、19 本以下の人は単変量解析で 2.34 倍、多変量解析で 1.69 倍 3 年後の閉じこもりのオッズが有意に高かった。これらの事から、残存歯数の少ない高齢者は 3 年後の閉じこもりとなるリスクが有意に高かった。口腔機能の低下が、外出や社会的交流の阻害要因になっている可能性が考えられ、口腔機能の維持・向上が閉じこもり予防に有用である可能性が示唆された。

A. 研究目的

歯の喪失は食品選択と栄養摂取を左右し、高齢者の全身の健康に影響することが知られており、これまで歯の喪失と要介護状態の発生や死亡の発生についての報告が存在する[1,2]。歯を喪失した者において、義歯により咀嚼・咬合機能が回復されることは、咬合バランスや脳への刺激を通じて認知症や転倒の発生にも影響する可能性が指摘されている[3,4]。また高齢者における閉じこもりは心身機能低下を招き、寝たきりや痴呆のなることなど多数の有害な影響につながるとされている[5,6]。

これまでの研究で、閉じこもりのリスク要因として年齢や性別、婚姻状態、心身の健康状態などが報告されている[7]。しかし、口腔の健康と閉じこもりの関係を調べた研究は存在しない。そこで本研究では、高齢者における残存歯数とその後の閉

じこもりとの関連を繰り返し測定の前向きコホート研究で検討することとした。

B. 研究方法

日本老年学的評価研究プロジェクト（JAGES プロジェクト）の 2003 年度調査をベースライン、3 年後の 2006 年度に追跡調査したデータを用いて前向きコホート研究を実施した。自立高齢者を対象として自記式質問紙調査で残存歯数、外出頻度、性、年齢、等価所得、教育歴、婚姻状態、主観的健康感、通院状態、うつ状態（GDS）、歩行時間、同居家族を把握した。

目的変数を追跡調査（2006 年調査）での外出頻度、説明変数としてベースライン時の残存歯の本数（19 本以下と 20 本以上の 2 カテゴリ）、共変量をベースライン時における性別、年齢、教育歴、婚姻状態、主観的健康感、通院状態、所得、うつ状態（GDS）、歩行時間、同居家族として多変量ロジスティック回帰分析により検討を行った。その際、2003 年のベースライン時の外出頻度が週一回以上の者だけを解析に含めた。

C. 結果

ベースライン時に閉じこもりでない者2309名を対象にした場合、9.5%が3年後に閉じこもりになっており、ベースライン時に残存歯19本以下だと11.2%、20本以上であると5.1%が3年後に閉じこもりであった（表1）。閉じこもりのリスク要因として、単変量ロジスティック回帰分析では残存歯数が少ないこと、年齢が高いこと、主観的健康感が低いこと、子供のみと同居していること、うつ状態であること、都市ではなく郊外に住んでいることに統計学的有意差を認めた。多変量ロジスティック回帰分析では、閉じこもりのリスク要因として、残存歯数が少ないこと、年齢が高いこと、主観的健康感が低いこと、都市ではなく郊外に住んでいることに統計学的に有意な閉じこもりリスクの上昇が認められた（表2）。

D. 考察

残存歯数の少ないものは3年後の閉じこもりとなるリスクが有意に高くなっていた。残存歯数の低下が咀嚼能力と栄養摂取状態、外観や会話機能に影響をして、外出や社会的交流の阻害要因になり、このことが閉じこもりを増加させている可能性が存在する。今回の分析では義歯の利用等の介入について十分な検証が行えなかった。今後さらなる解明のための分析が必要である。

E. 結論

ベースライン時に閉じこもりではなかった高齢者を対象とした解析の結果、残存歯数が 20 本以上の人に比べて、19 本以下の人は単変量解析で 2.34 倍、多変量解析で 1.69 倍 3 年後の閉じこもりのリスクが有意に高かった。口腔機能の維持・向上が閉じこもり予防に有用である可能性が示唆される。

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G. 知的財産権の出願・登録状況（予定を含む）

1. 特許取得

なし

2. 実用新案登録

なし

3. その他

なし

表 1.　2006 年時点での閉じこもりと、ベースライン時（2003 年）の特性の記述統計（N=2309）

	閉じこもりの者(%)		閉じこもりの者(%)
残存歯数		教育歴	
＜19	118 (9.5)	<6years	9 (16.4)
20=<	27 (4.4)	6-9years	83 (8.3)
年齢		10-12years	38 (7.0)
65-69	12 (4.6)	13years=<	12 (6.3)
70-74	39 (6.1)	欠損値	3 (4.8)
75-79	45 (9.1)	世帯所得	
80-84	21 (8.8)	200 万円未満	41 (6.9)
85-	18 (17.3)	200 万-300 万円未満	27 (6.0)
欠損値	10 (8.7)	300 万-400 万円未満	19 (6.7)
主観的健康感		400 万円以上	10 (5.8)
とてもよい	4 (2.9)	欠損値	48 (13.7)
まあよい	87 (7.1)	性別	
あまりよくない	43 (11.2)	男性	65 (8.0)
よくない	9 (13.8)	女性	75 (7.7)
欠損値	2 (7.4)	欠損値	5 (7.9)
同居家族		婚姻状態	
一人暮らし	13 (7.6)	既婚	103 (7.7)
配偶者のみと同居	53 (7.9)	未婚、離婚、死別	33 (7.6)
配偶者、子供と同居	38 (7.0)	欠損値	9 (11.7)
子供のみと同居	19 (7.7)	歩行時間（分/1 日）	
欠損値	22 (10.3)	<30	50 (8.7)
うつ状態（GDS）		30-60	48 (7.5)
0-4	82 (6.8)	60-90	15 (5.8)
5 月 9 日	32 (9.5)	90<	15 (7.4)
10=<	8 (10.7)	欠損値	17 (9.9)
欠損値	23 (9.6)		
通院状態			
病気・障害ともになし	19 (5.4)		
病気・障害あるが、治療必要なし	9 (5.4)		
自己判断で治療中断	15 (12.7)		
治療中	94 (8.3)		
欠損値	8 (10.3)		

表 2. 3 年後の閉じこもりに関連する要因のロジスティック回帰分析の結果 (N=2309)

	閉じこもりのオッズと 95%信頼区間(OR (95%CI))と p 値			
	単変量解析		多変量解析*	
残存歯数(ref:20=<)				
＜19	2.34 (1.62-3.39)	<0.001	1.69(1.14-2.50)	0.009
地域(ref:常滑市)				
阿久比町	4.02 (2.18-7.44)	<0.001	3.96(2.12-7.40)	<0.001
常滑町	2.42 (1.28-4.56)	0.006	2.74(1.43-5.22)	0.002
美浜町	4.66 (2.53-8.58)	<0.001	4.94(2.65-9.20)	<0.001
南知多町	6.69 (3.73-12.00)	<0.001	5.81(3.19-10.57)	<0.001
年齢(ref:65-69)				
70-74	1.46 (1.00-2.14)	0.053	1.28(0.85-1.91)	0.236
75-79	1.80 (1.20-2.70)	0.004	1.43(0.92-2.21)	0.111
80-84	3.22 (1.86-5.59)	<0.001	2.55(1.38-4.72)	0.003
85-	2.75 (1.23-6.15)	0.014	1.86(0.77-4.52)	0.170
主観的健康感(ref:とてもよい)				
まあよい	2.05 (0.94-4.46)	0.072	1.96(0.86-4.46)	0.111
あまりよくない	3.27 (1.47-7.29)	0.004	2.49(1.03-5.99)	0.043
よくない	5.88 (2.35-14.71)	<0.001	4.78(1.73-13.24)	0.003
同居家族(ref:配偶者、子供と同居)				
一人暮らし	0.91 (0.50-1.66)	0.767	1.00(0.42-2.42)	0.995
配偶者のみと同居	1.11 (0.77-1.60)	0.584	1.22(0.82-1.81)	0.324
子供のみと同居	1.81 (1.19-2.77)	0.006	1.71(0.84-3.48)	0.137
うつ状態(GDS) (ref:0-4)				
5-9	1.48 (1.04-2.10)	0.031	1.07(0.72-1.58)	0.736
10=<	1.81 (1.02-3.22)	0.043	1.16(0.61-2.19)	0.648
通院状態(ref:病気・障害ともになし)				
病気・障害あるけど、治療必要なし	0.60 (0.32-1.12)	0.108	0.70(0.36-1.37)	0.299
自己判断で治療中断	1.58 (0.81-3.08)	0.180	1.26(0.62-2.57)	0.525
治療中	1.09 (0.66-1.80)	0.740	0.83(0.48-1.42)	0.487
教育歴(ref:13 年以上)				
6 年未満	2.18 (0.90-5.24)	0.083	2.63(0.72-9.53)	0.141
6-9 年	1.04 (0.51-2.13)	0.907	2.03(0.62-6.67)	0.241
10-12 年	0.75 (0.35-1.58)	0.446	1.80(0.53-6.09)	0.348

世帯所得(ref:400 万円以上)				
200 万円未満	1.47 (0.78-2.78)	0.235	1.34 (0.68-2.65)	0.399
200 万-300 万円未満	1.41 (0.73-2.73)	0.311	1.52 (0.76-3.03)	0.240
300 万-400 万円未満	1.25 (0.61-2.56)	0.539	1.39 (0.66-2.92)	0.386
性別(ref:男性)				
女性	1.14 (0.86-1.52)	0.359	0.96(0.69-1.34)	0.961
婚姻状態(ref:既婚)				
離婚、死別	1.30 (0.94-1.80)	0.107	0.83(0.43-1.63)	0.595
未婚	0.32 (0.04-2.36)	0.263	0.27(0.03-2.18)	0.219
歩行時間(分/1 日)(ref:90＜)				
<30	1.18 (0.72-1.94)	0.507	1.07(0.64-1.81)	0.788
30-60	0.97 (0.59-1.61)	0.915	0.98(0.58-1.68)	0.954
60-90	0.58 (0.30-1.13)	0.112	0.64(0.32-1.28)	0.208

Ⅳ. 研究成果の刊行に関する一覧

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Ⅴ．研究成果の刊行物・別刷

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COMMUNITY DENTISTRY AND ORAL EPIDEMIOLOGY

Inequalities of dental prosthesis use under universal healthcare insurance

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Abstract – *Background:* Social inequalities in oral health exist in various countries. In Japan, a country with universal healthcare insurance policy, people can receive medical and dental care and pay only 10–30% of the total cost of treatment. Additionally, very poor Japanese can receive care without any charge, by the benefit of public assistance. These policies are considered to affect oral health inequalities. *Objectives:* This study examined the association between using a dental prosthesis and household income among older Japanese people. *Methods:* Self-administered questionnaires were mailed to subjects as part of the Japan Gerontological Evaluation Study (JAGES) project in 2010. Of the 8576 people aged 65 years or more living in Iwanuma, Japan, 5058 responded. We used 4001 respondents with no missing values. We stratified into two groups by having 20 teeth or not. Then, cross-tabulation, univariate logistic regression, and multivariate logistic regression were conducted for these two groups. The covariates are sex, age, education, and size of household. *Results:* Of the all respondents included in the analyses, poorer respondents tended to have lower proportions with 20 or more teeth, and 54.6% respondents used dental prostheses. In the respondents with 19 or fewer teeth, higher-income group tended to show significantly higher dental prosthesis use. But the poorest income group showed high prevalence of dental prosthesis use as same as highest income group. Multiple logistic regression among respondents with 19 or fewer teeth showed that after adjustment for sex, age, education, and size of household, compared with the respondents with annual incomes of US$ <5000, those with incomes of US$5000–9999 and US$10 000–14 999 had significantly lower odds ratios for using a dental prosthesis (OR = 0.48 [95% CI = 0.28–0.83], 0.56 [95% CI = 0.33–0.95], respectively). The other respondents did not show significant differences. *Conclusions:* Although universal healthcare insurance covered dental prostheses, a social gradient in dental prosthesis use was still observed. Low-income respondents tended to not use dental prosthesis, but the poorest respondents showed dental prosthesis utilization as high as the highest income group.

Key words: access; epidemiology; health services research; prosthodontics; public health policy

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Social inequalities in oral health exist in various countries (1–7) and are considered to be an important research priority (8). Social inequalities in oral health follow a gradient (3, 4, 6); oral health status is worse for each consecutive lower socioeconomic position group, because health inequalities affect everyone (9).

There is also a social gradient in access to dental care (10–13), and it is considered as a potential explanation for oral health inequalities (14, 15).

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Access to dental care is affected not only by income, but also by healthcare policy (16, 17). The lack of dental insurance is one of the main barriers affecting access to dental services (18, 19). In Japan, there are two kinds of healthcare policy for the adult population: universal healthcare insurance (20, 21) and public assistance. The universal healthcare insurance system enables people who need medical and dental treatment to pay only 10–30% of the total cost of treatment depending on income, age, and/or health condition. This insurance scheme covers most basic dental treatments including prosthetics such as bridges, removable partial dentures, and complete dentures. Public assistance for the poorest people, named *'Seikatsu-hogo'*, provides minimum living expenses and medical and dental care without charge. In addition, poor people receiving several public welfare services are more likely to communicate with public sector social workers, nurses, and/or dental hygienists who can provide information about access to health care. Although these sociopolitical situations are considered to affect access to dental care among the poorest Japanese, previous studies have not focused on dental care utilization among the very poorest (10, 13). We hypothesized that (1) there were social inequalities in dental prosthesis use despite the availability of universal healthcare insurance and (2) the poorest elderly Japanese would have a higher prevalence of dental prosthesis use. The aim of this study was to examine the association between dental prosthesis use, considered to be a variable reflecting dental care access, and annual household income among older people with perceived needs for dental prosthesis because of having few remaining teeth.

Materials and methods

Study population

This analysis was based on part of the data from the Japan Gerontological Evaluation Study (JAGES) project, an ongoing Japanese prospective cohort study (22–24). JAGES investigates health factors related to functional decline or cognitive impairment among individuals aged 65 years or more. We used cross-sectional data in Iwanuma city, which is located in Miyagi prefecture in the Tohoku area in northern Japan. In 2010, the population was 44 187; 19.7% of people were aged 65 years or more, which is lower than the Japanese average (22.8%). In August 2010, a questionnaire was sent and returned by mail. The questionnaire was sent to all people aged 65 or more living in Iwanuma, Japan. Of a total of 8576 subjects, 5058 responded (response rate: 59.0%). Our analyses are based on 4001 respondents, because respondents with missing data on the main exposure (household annual income) or outcome (dental prosthesis use) were excluded. Participants with missing data for any other variable were included in the analysis, and the missing data were substituted with dummy variables. The study protocol was approved by the Research Ethical Committee of Tohoku University, Graduate School of Dentistry.

Outcome variable

To examine dental care inequalities, we considered dental prosthesis use, which was ascertained by a single broad question: 'Do you use any removable dentures or fixed bridges?' This reflects the participants' perceptions about the use of prostheses. The possible responses were 'none', 'use in upper jaw', 'use in lower jaw', or 'use in both upper and lower jaws'. Respondents were divided into two categories: those using prostheses and those not using any prostheses.

Main predictor

Annual household income was ascertained by a single question with 14 categories, and the responses were divided into seven groups: <$5000, $5000–9999, $10 000–14 999, $15 000–19 999, $20 000–29 999, $30 000–39 999, and ≥$40 000 (US $1 = \100).

Covariates

Sociodemographic characteristics such as sex, age group (65–69 years, 70–74, 75–79, 80–84, 85–89, and 90 years or older), and educational attainment (<6, 6–9, 10–12, or ≥13 years) were included in the analysis as covariates. Because we asked about household income, size of household (number of family members: 1, 2, 3, 4, 5, 6, ≥7) was also adjusted. The missing answers for covariates were categorized as 'missing'.

Data analysis

The prevalence of people with 20 or more teeth by annual household income was analyzed. Then, we calculated odds ratios (ORs) for dental prosthesis use. For the elderly population, 10 occluding pairs of teeth are needed to satisfy functional and social demands (25). Therefore, we stratified respondents by the number of remaining teeth into two groups:

19 or fewer remaining teeth (N = 2650), and 20 or more remaining teeth (N = 1351). First, we calculated the prevalence and 95% confidence interval (CI) of the respondents without dental prosthesis use by income. Then, univariate and multivariate ORs and 95% CIs for dental prosthesis use were calculated by logistic regression. In the multivariate model, annual household income, size of household, age, sex, and educational attainment were included. SPSS version 19.0 (IBM, Armonk, NY, USA) was used for all analyses.

Results

In total, 828 (31.2%) respondents with 19 or fewer teeth and 988 (73.1%) with 20 or more teeth did not use a dental prosthesis. The distribution of the prevalence and 95% CI of dental prosthesis use according to income is shown in Figs 1 and 2. Among respondents with 19 or fewer teeth, there was an association between dental prosthesis utilization and income, with a higher prevalence of prosthesis use for each higher-income group, except for the poorest income group (less than US $5000), which in contrast showed the close prevalence of dental prosthesis use to highest income group (Fig. 1). This association between dental prosthesis use and income was significant among respondents with 19 or fewer teeth, but not significant among respondents with 20 or more teeth.

Among all respondents, poorer respondents tended to have 19 or fewer remaining teeth (Fig. 2). Among respondents with 19 or fewer teeth, univariate logistic regression showed that compared with the respondents with an annual income of <US $5000, respondents with incomes of US$5000–9999 and US$10 000–14 999 had significantly higher odds ratios for dental prosthesis use (OR = 0.48 [95% CI = 0.28–0.83], 0.56 [95% CI = 0.33–0.95], respectively). On the other hand, US$15 000–19 999, US$20 000–29 999, US$30 000–39 999, and ≥US$40 000 did not show a significant difference (OR = 0.80 [95% CI = 0.47–1.33], 0.94 [95% CI = 0.58–1.52], 1.07 [95% CI = 0.65–1.75], and 1.07 [95% CI = 0.67–1.71], respectively) (Table 1).

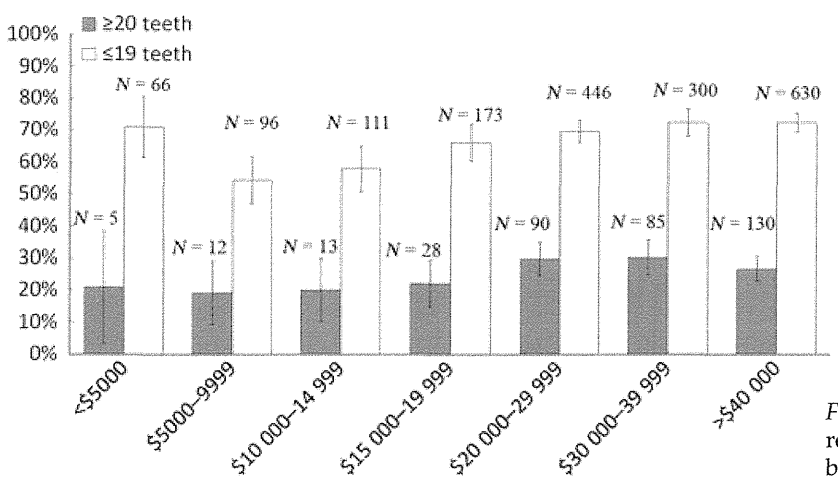

Fig. 1. Percentage (95% CI) of respondents with a dental prosthesis by household annual income (US$).

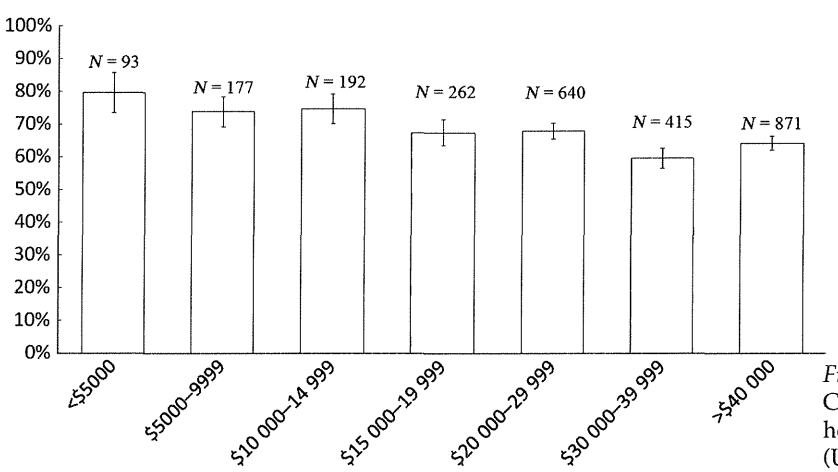

Fig. 2. Distribution of the prevalence (95% CI) of having 19 or fewer teeth by annual household income among all respondents (US$, N = 4001).

Table 1. Distribution of the respondents with dental prosthesis use and odds ratios for prosthesis use, stratified by the number of remaining teeth (N = 4001)

	Odds ratio of respondents with dental prosthesis use					
	No. of respondents	Dental prosthesis use N (%)	Univariate OR (95% CI), P-value		Multivariate OR (95% CI)*, P-value	
0–19 teeth (N = 2650)						
<$5000	93	66 (71.0)	1.00 (reference)		1.00 (reference)	
$5000–9999	177	96 (54.2)	0.48 (0.28–0.83)	0.008	0.47 (0.27–0.81)	0.007
$10 000–14 999	192	111 (57.8)	0.56 (0.33–0.95)	0.033	0.54 (0.32–0.92)	0.025
$15 000–19 999	262	173 (66.0)	0.80 (0.47–1.33)	0.384	0.74 (0.44–1.25)	0.266
$20 000–29 999	640	446 (69.7)	0.94 (0.58–1.52)	0.802	0.86 (0.53–1.41)	0.559
$30 000–39 999	415	300 (72.3)	1.07 (0.65–1.75)	0.797	0.98 (0.59–1.62)	0.925
>$40 000	871	630 (72.3)	1.07 (0.67–1.71)	0.780	0.99 (0.61–1.61)	0.976
≥20 teeth (N = 1351)						
<$5000	24	5 (20.8)	1.00 (reference)		1.00 (reference)	
$5000–9999	63	12 (19.0)	0.89 (0.28–2.88)	0.851	0.94 (0.29–3.13)	0.926
$10 000–14 999	65	13 (20.0)	0.95 (0.30–3.02)	0.931	0.83 (0.25–2.73)	0.761
$15 000–19 999	127	28 (22.0)	1.07 (0.37–3.14)	0.895	0.89 (0.30–2.69)	0.839
$20 000–29 999	302	90 (29.8)	1.61 (0.58–4.45)	0.356	1.23 (0.43–3.55)	0.698
$30 000–39 999	282	85 (30.1)	1.64 (0.59–4.54)	0.341	1.16 (0.40–3.35)	0.788
≥$40 000	488	130 (26.6)	1.38 (0.50–3.77)	0.530	0.99 (0.35–2.84)	0.986

*Size of household, age, sex, and educational attainment were included.

After adjustment for covariates, compared with the respondents with an annual income of <US $5000, respondents with incomes of US$5000–9999 and $10 000–14 999 showed significantly lower adjusted odds ratio for dental prosthesis use (OR = 0.47 [95% CI = 0.27–0.81], 0.54 [95% CI = 0.32–0.92], respectively). On the other hand, respondents with an annual income of US$15 000–19 999, US$20 000–29 999, US$30 000–39 999, and ≥US$40 000 did not show a significant difference (OR = 0.74 [95% CI = 0.44–1.25], 0.86 [95% CI = 0.53–1.41], 0.98 [95% CI = 0.59–1.62], and 0.99 [95% CI = 0.61–1.61], respectively) (Table 1).

Discussion

This cross-sectional study showed that although Japan has a universal healthcare insurance policy that includes dental care, 31.2% of older Japanese with 19 or fewer teeth who did not use a dental prosthesis. There was a social gradient in the number of remaining teeth. However, a social gradient in dental prosthesis use among the respondents with 19 or fewer teeth was not observed in the poorest people; poorest people had the highest utilization of dental prosthesis use.

Previous studies in various countries have reported socioeconomic inequalities in access to dental care. Listl (12) examined the access to dental care among older people in 14 European countries. Higher income was found to be significantly associated with greater dental care access in all 14 countries. In the United States, regardless of insurance status, lower income was associated with lower utilization of dental care (26).

Previous studies in other countries have shown that healthcare insurance did not completely eliminate the socioeconomic inequalities in dental care access (26–28). In Thailand, which established universal healthcare insurance in 2002, there were still socioeconomic inequalities in access to dental care (28). Although Japan also has a universal healthcare insurance policy, patients have to pay between 10% and 30% of the total cost of treatment. This cost is considered to be a barrier to access to dental care (10). The poorest older people in this study had a higher possibility of receiving social welfare including free dental care. That may partly explain why the poorest people had a higher prevalence of dental prosthesis use than other socioeconomic groups.

Although previous studies in Japan have examined the association between income and dental care use, these studies did not assess dental care use among very poor people (10, 13). Babazono et al. (10) assumed a linear association between income and dental care utilization and applied multiple linear regressions. A study by Murata et al. (13) used only three categories for the income variable: tertiles of equivalized income. The categorization of the income variable was

based on the distribution. Therefore, these two studies failed to examine the pattern of dental care utilization among very low-income people. The present study applied suitable statistical analysis and detailed categorization of income. Therefore, the present study was able to detect reverse health inequalities among the poorest people. Despite the general trend being that lower-income people tended to make less use of dental prostheses, this study found a reverse pattern of social inequalities in dental prosthesis use among the poorest people.

There are possible explanations for the present results. First, the social welfare benefit for poor people encourages dental care utilization. In Japan, people with income lower than the minimum living standard are eligible to receive public assistance, *Seikatsu-hogo*, which includes free medical and dental care. So denture and bridge construction is provided without any charge to people on public assistance. Although the eligibility criteria for receiving this benefit are means tested and complicated, and also depend on their living conditions, our category for the lowest income group (<US$5000 per year) would be expected to satisfy the criteria to receive public assistance. Second, the poorest people may have lost their teeth at a relatively younger age than affluent people. As they have spent longer periods being edentulous or with fewer teeth, they may have had more needs of dental prosthesis and opportunities to gain access to a dental clinic. Third, poor people receiving some public welfare services have a greater possibility of communicating with social workers, public nurses, and/or public dental hygienists, who can provide information for healthcare utilization. That may encourage them to access dental care. Although our study focused on people with 20 or fewer teeth, the numbers of remaining teeth affect using dentures. However, the supplemental analysis for people with 19 or fewer teeth which adjusted for the number of remaining teeth also showed similar results (fully adjusted OR; $5000–9999 = 0.47 [95% CI = 0.27–0.81]; $10 000–14 999 = 0.53 [95% CI = 0.31–0.92]; US$15 000–19 999 = 0.77 [95% CI = 0.46–1.31]; US$20 000–29 999 = 0.88 [95% CI = 0.54–1.44]; US$30 000–39 999 = 0.99 [95% CI = 0.60–1.65]; and ≥US$40 000 = 1.02 [95% CI = 0.62–1.65]). Further research is needed to determine the reason for the reverse of inequalities in dental prosthesis use among the poorest people.

In addition, it is possible that the provision of free medical care to a particular population may result in overtreatment and supplier-induced demand, because patients with no financial stake in the treatment proposed by a dentist may be more likely to accept it regardless of the intended or likely benefit. Basing the provision of treatment on needs, assessment can help remedy this potential misuse of social welfare. However, only very poor people in Japanese society are eligible for free care and are also the group with the highest treatment needs.

This study has several limitations. First, the response rate was moderate (59.0%), which raises issues of potential response bias. Although there were no data available on nonresponders, we compared the age distribution between respondents and all residents in Iwanuma city using census data. The distributions were similar, although there were proportionately fewer respondents aged 85 years or older in this study (data not shown). To further address this issue, we re-analyzed the data set excluding people aged 85 years or older; the results were almost identical (data not shown). Second, our measurements used, including that of dental status, were based on a self-administered questionnaire. It could be argued that the questionnaire used did not provide a full and accurate picture of the differences in numbers of remaining natural teeth. However, the self-reporting of number of teeth is a well-established and reliable measure among Japanese (29).

Third, the outcome variable referred to dental prosthesis use, because this was the information available in the data set. This is obviously not the same as the provision of dental prostheses. It is possible that some participants categorized among those 'not using dental prostheses' may indeed have removable dentures but do not use them, particularly because of poor fit. This may have theoretically affected the present findings, because such individuals with this issue would primarily be of lower SES, who would have more problems than people of higher SES, who would have their dentures repaired or get new ones. However, this was not so much the case in the present study, because the poorest people could easily receive dental treatment, including the provision or repair of dentures through public assistance or other benefits. Therefore, the main result that the poorest people had higher dental prosthesis use may not be largely affected by this issue. An additional limitation related to the available data regarding outcomes is the inclusion of fixed and removable

prostheses in the same group; these are clearly different treatment items and may partly reflect differential service provision across the socioeconomic spectrum, with lower SES groups receiving more removable prostheses and those in higher SES groups using bridges more often.

Fourth, we categorized respondents into those who had 20 or more and fewer than 20 teeth. This is a rather crude indicator of dental status and may not accurately reflect different patterns of need and treatment preferences, particularly among the large group of those with fewer than 20 teeth. For example, it is possible that within this group, respondents with more teeth tended to use fixed bridges, while those with fewer teeth tended to use dentures. However, such information was not available. After stratifying our analyses according to broad groups of number of teeth, the results were similar among respondents with 0–9 and 10–19 teeth (data not shown). Therefore, we presented findings for respondents with 0–19 teeth. Fifth, the main predictor, annual household income, may be a reasonable proxy of income but does not precisely reflect the spending power of the individuals in the household. Additional individual measures of income and wealth would further enhance the findings.

One of the strengths of this study was that it was a relatively large epidemiological study. In addition, the study subjects were the entire elderly population in a city, which reduced the possibility of sampling bias.

To reduce oral health inequalities, approaches for influencing not only individual factors but also the underlying social determinants of health through upstream public health interventions are needed (30). The present study suggested that social and social policy environments, including healthcare insurance or public assistance supporting the poorest Japanese, may eliminate or reduce health inequalities in dental care utilization.

In conclusion, this study showed income inequalities in the number of remaining teeth and dental prosthesis use in Japan, where universal medical and dental healthcare insurance including denture and bridge treatments has been established. But income inequalities in dental prosthesis use were not observed among the poorest older people.

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Social Participation and Dental Health Status among Older Japanese Adults: A Population-Based Cross-Sectional Study

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Abstract

Background: Although social participation is a key determinant of health among older adults, few studies have focused on the association between social participation and dental health. This study examined the associations between social participation and dental health status in community-dwelling older Japanese adults.

Methods and Findings: In 2010, self-administered postal questionnaires were distributed to all people aged ≥65 years in Iwanuma City, Japan (response rate, 59.0%). Data from 3,517 respondents were analyzed. Data on the number of remaining natural teeth, for determining the dental health status, and social participation were obtained using self-administered questionnaires. The number, type, and frequency of social activities were used to assess social participation. Social activities were political organizations or associations, industrial or professional groups, volunteer groups, senior citizens' clubs, religious groups or associations, sports groups, neighborhood community associations, and hobby clubs. Using ordinal logistic regression, we calculated the odds ratios (OR) and 95% confidence intervals (95% CI) for an increase in category of remaining teeth based on the number, type, and frequency of social activities. Sex, age, marital status, current medical history, activity of daily living, educational attainment, and annual equivalent income were used as covariates. Of the respondents, 34.2% reported having ≥20 teeth; 27.1%, 10–19 teeth; 26.3%, 1–9 teeth; and 12.4%, edentulousness. Social participation appeared to be related with an increased likelihood of having a greater number of teeth in old age, even after adjusting for covariates (OR = 1.30, 95% CI = 1.10–1.53). Participation in sports groups, neighborhood community associations, or hobby clubs was significantly associated with having more teeth.

Conclusions: Our results suggest a protective effect of social participation on dental health. In particular, participation in sports groups, neighborhood community associations, or hobby clubs might be a strong predictor for retaining more teeth in later life.

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Introduction

Enhanced social participation, a social determinant of health [1,2], is one of the 3 pillars of a World Health Organization (WHO) policy framework for an active aging society [3]. Social participation is a source of social relations and describes a person's participation in formal and informal group activities [4,5,6]. As many older retired people are assumed to have more time to participate in other activities, the role of social participation in the health of older adults is increasing in today's aging society.

Previous studies have examined the association between social participation and various health outcomes. A meta-analysis determined that social participation reduced the risk for mortality and that the magnitude of this effect was comparable with smoking cessation [7]. A study conducted in Asia reported that maintaining or initiating social participation in later life benefited the mental health of older adults [8]. A study conducted in Japan reported that lack of social participation was significantly related to an increased risk for onset of long-term care insurance certification [9]. In addition to the effect itself, social participation is important because it is a component of social capital [10]. According to Putnam, social capital refers to "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" [11]. Recent studies have demonstrated a positive association between social capital and various health outcomes, including dental health [12,13,14,15,16,17].

Social participation is also considered to affect dental health [18,19]. Previous studies have demonstrated that lower levels of social participation were associated with a higher risk for