Title: Self-report Poor Oral Health and Chronic Diseases: The Hong Kong FAMILY Project

Running head: Self-report Poor Oral Health and Chronic Diseases

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**ABSTRACT**

**Objectives:** To assess the association between self-reported oral health (SROH) and general health, this study examined the cross-sectional associations between SROH and nine chronic health conditions, namely cancer, diabetes, high blood pressure, high cholesterol, thyroid disease, nervous system disease, eye/nose/throat disease, stomach/intestinal disease, and musculoskeletal disease in Hong Kong.

**Methods:** This study included 41,641 participants recruited in the FAMILY Project cohort study during March 2009 to March 2011. SROH was measured on a 5-point Likert scale. Multiple logistic regression model was used to analyze the effect of dichotomized SROH (0: very good/good/average, 1: bad/very bad) on nine chronic health conditions, adjusted for age, sex, education, personal income, smoking and drinking habits, BMI, and blood pressures.

**Results:** All the nine chronic health conditions investigated were associated with SROH. SROH showed the strongest cross-sectional association with nervous system disease (odds ratio = 3.30, $p < 0.001$), while the odds ratio with other significant chronic health conditions ranged from 1.13 (high cholesterol, $p = 0.033$) to 1.73 (stomach/intestinal disease, $p < 0.001$).

**Conclusions:** Poor SROH is associated with cancer, diabetes, high blood pressure, high cholesterol, thyroid disease, nervous system disease, eye / nose / throat disease, stomach / intestinal disease, and musculoskeletal disease.

Keywords: chronic disease; dentistry; diabetes; epidemiology; hypertension; survey

## INTRODUCTION

Oral health (OH) has often been considered in isolation of other health problems despite growing recognition that OH is an integral part of general health (1). It has long been accepted that oral health conditions themselves may give rise to and/or exacerbate existing general health problems, most notably diabetes, cardiovascular, and respiratory problems (2-4). Furthermore, more recently evidence is emerging to suggest that management of oral health problems can prevent and/or improve control of general health problems, for example glycemic control and aspiration pneumonia (5, 6).

Evidence of the association between oral health and general health has been obtained largely from relatively small clinical samples of patients attending dental clinics or patients at medical centres with specific general health problems. Several epidemiological studies have investigated the association between general and oral health (7, 8) but are limited in terms of small sample size and breath of general health aspects considered. Thus, the effects of specific oral health conditions and specific general health problems have tended to be the focus of interest. Hence, comprehensive exploration of the relationship of OH and general health is warranted. For the promotion of OH as an integral component of general health, there is a need to consider the association of OH with general health problems in the population as a whole to raise both inter-professional and public awareness (9).

By making use of the survey data from more than 40,000 participants, a sample size much larger than any of the aforementioned national surveys, we report for the first time the relationship between SROH and chronic health conditions. We hypothesize that poor SROH is associated

with chronic health conditions. To test our hypothesis, we explore the association between self-reported oral health (SROH) with nine common chronic health conditions, namely cancer, diabetes mellitus (DM), high blood pressure, high cholesterol, thyroid disease, nervous system disease, eye / nose / throat (ENT) disease, stomach / intestinal disease, and musculoskeletal disease in a Chinese population-based study.

## MATERIALS AND METHODS

### Participants

The design of this study was a large scale cross-sectional survey. The sample was derived from the FAMILY Project cohort study, funded by a local charity, the Hong Kong Jockey Club Charities Trust, as an initiative to promote family health, happiness and harmony in Hong Kong. Families, defined as a group of persons living at the same address, were recruited from March, 2009 to March, 2011; all members aged 15 years or above living at the same address had to agree to participate. The cohort was designed to cover about 20,000 households, including about 1% of the Hong Kong population. Details of the sampling and interview have been described in the FAMILY Project website (http://www.family.org.hk/household-survey) and elsewhere (10). Written consent was obtained from participants (parental consent was also obtained for participants under 18) and this study was approved by the Institutional Review Board of the University of Hong Kong (reference number UW 09-387).

### Measurements

*Single item SROH.* Participants were asked to rate their OH in a 5-point Likert scale (1: very good; 5: very bad). It was validated against other SROH scales (11).

*Health behaviors.* Current smoker was defined using a self-report item. Excess drinker was defined as consumption at least 210 g (male) / 140 g (female) of alcohol per week derived from a beverage frequency questionnaire (12).

*Body Mass Index and blood pressures.* Height (using the SECA 214 stadiometer, http://www.seca.com), weight (using the Omron fat analyzer scale HBF-356, http://www.omron-healthcare.com.sg), and systolic (SBP) and diastolic (DBP) blood pressures (using the Omron electronic blood pressure monitor HEM-7000, http://www.omron-healthcare.com.sg) were measured by trained interviewers following standard protocols. Body Mass Index (BMI) was calculated as weight (kg) divided by the square of height ($m^2$). Obesity was defined as BMI $\geq$25 (Asian standard). The means of two measurements of SBP and DBP with five minutes apart were used.

*Chronic health conditions.* Participants were asked whether they had been diagnosed with cancer, diabetes mellitus (DM), high blood pressure, high cholesterol, thyroid disease, nervous system disease (e.g. epilepsy, Parkinson's disease), eye / nose / throat (ENT) disease (e.g. sinusitis, allergic rhinitis, tinnitus), stomach / intestinal disease (e.g. gastric ulcer), and musculoskeletal disease (e.g. arthritis, gout, osteoporosis) by a medical practitioner. We also recorded self-reported medicine use for those who reported a chronic health condition, as a validation of the reported of chronic conditions. More than 95% of the participants self-reported having chronic diseases also reported taking the corresponding medicine, supporting face validity of the self-report chronic disease items.

*Social desirability*. Social desirability was measured using 6 items from the 17-item Social Desirability Scale (13). Participants decide whether the statement described in the 6 items pertain their personality with a true/false response.

*Other covariates.* Tertiary education was defined as having a bachelor's degree or further education. Personal income was defined as the monthly combined income from all sources. These two covariates were used as measures of socio-economic status.

**Statistical Analysis**

We excluded from the analyses 90 participants who did not answer the self-reported OH item, leaving a final sample size of 41,666. Age-sex weighting according to the 2010 Hong Kong population data from Census and Statistics Department of Hong Kong was applied to the sample, and the sample size became 41,641 as a result of the weighting. One way analysis of variance (ANOVA) and its *p*-value for trend were used to examine the association and linear trend respectively between SROH and continuous factor (age), as there is clear evidence on the linearity between age and poor oral health (participants were divided into six groups (age 15-24, 25-34, 35-44, 45-54, 55-64, 65+), and the prevalence of self-report poor oral health for these six groups were 7.0%, 8.4%, 10.7%, 13.0%, 17.3%, and 21.4% respectively). Pearson $\chi^2$ test and its *p*-value for trend were used to examine the association and linear trend respectively between SROH and dichotomous factors, for example sex and income. Three sets of multiple logistic regression models was used to analyze the association between dichotomized SROH as independent variable (0: very good / good / average, 1: bad / very bad) and chronic health

conditions as dependent variables, the first set adjusted for age and sex, the second set adjusted further on education, income, health behaviors, BMI, and blood pressures, and the last set adjusted further on social desirability. All statistical analysis was performed using Predictive Analytics SoftWare (PASW 18.0, formerly known as SPSS).

## RESULTS

Of the 41,641 participants included in the present analysis, 34.6% rated their OH as very good / good, 52.4% as average, and 13.0% as bad / very bad (Table 1). 26,643 (64.0%) of them were married, and 5,551 (13.3%) of them had attained tertiary education. These demographic characteristics were very similar to the Hong Kong population (57.7% married, 18.0% attained tertiary education) (14). There were significant increasing trends between self-report OH and all demographic variables (Table 1), between SROH and health behaviors (Table 1), between health behaviors and all chronic health conditions (Table 2), and between SROH and all chronic health conditions (Table 3). Older participants, male, those without tertiary education, with personal income less than 20,000 Hong Kong dollar (1 US dollar ~ 7.8 Hong Kong dollar) per month (Table 1), and had chronic health conditions (Table 3) were more likely to rate their OH poorly.

After adjusting for age and sex, and further adjustment on education, income, health behaviors, BMI, blood pressures, and social desirability, the association between SROH and chronic health conditions still existed (Table 4). The three sets of models yielded similar odds ratios. Among all chronic health conditions, nervous system disease has the strongest association with self-reported OH. Those having bad / very bad SROH were associated with an adjusted odds ratio of 3.30 times ($p < 0.001$) of self-reported nervous system disease compare with those with very good /

good / average SROH, while the adjusted odds ratios on other chronic health conditions ranged from 1.13 (high cholesterol, $p = 0.033$) to 1.73 (stomach / intestinal disease, $p < 0.001$).

## DISCUSSION

As a large scale epidemiological study of SROH, this study may help expand our understanding of the relationship between OH and general health and may suggest new directions for future research and OH policies. Significant associations found in this study are important as they may lead to design and testing of intervention programs on both preventing oral diseases and promoting healthy oral habits to those having the aforementioned conditions, and on preventing chronic diseases in those with poor oral health. In assessing OH, this study relied on global ratings of SROH. Despite the rather simplistic nature of global SROH ratings, they are powerful assessment tools and have been shown to be associated with clinical OH attributes and subjective perceptions (15). Global rating of general health has been shown to be associated with self-reports of systemic diseases and other health problems (16). Having indentified association between SROH and general health status, further exploration of the clinical OH features in pathways and mechanisms of their association may be useful.

Consistent with the past studies, this study confirms that demographic factors have a strong association with both SROH (17-19) and chronic health conditions (20) in the population. Socio-demographics are recognized as key determinants of SROH and chronic health conditions, but as our results were cross-sectional, the causal relationship is yet to clarified, that is, whether socio-demographic disadvantage gives rise to poor general health or poor general health leads to such disadvantage remains unclear. Past studies also showed a relationship between low socio-

economic status and higher glucose intolerance in Hong Kong (21). This question is important to consider in addressing social inequalities in oral health (22). The use of lifecourse epidemiology studies should be useful in explaining the trajectory of socio-demographics and poor SROH and its interplay/ mediation with poor general health. As the most westernized and urbanized city in China, Hong Kong has an extensive and efficient public health care system similar to the UK National Health Service (23), we believe our findings in Hong Kong could be generalized to other Western countries and can forewarn the future problems of health and diseases in China Mainland which is developing rapidly.

Bivariate analyses identified cross-sectional association with SROH on all of the general health problems, and for all conditions this remained significant after controlling for demographics. It is not too surprising to note the association between poor SROH and diabetes, as there are many such reports in the literature (3). Indeed, interdisciplinary collaboration between dentistry and endocrinology has expanded in recent years for the screening of diabetes and OH problems, as well as mutual advocacy for dental care in glycaemic control (6). Likewise the association between poor SROH and musculoskeletal problems could be anticipated, and this lends support to the growing body of reports on the relationship between OH and common musculoskeletal problems such as osteoporosis (24).

Interestingly is the observed cross-sectional association between poor SROH with ENT and stomach/digestion problems; in part because of the obvious anatomical proximity and potential consideration in differential diagnoses of both health problems, and yet there is little about such issue in the literature. Also the observed cross-sectional association between poor SROH and

208 thyroid problems, as well as with neurological conditions, provides a further expansion into the
209 likely multiple interrelationships with SROH and general health that warrants further attention.
210 Given the key aetiological factors of poor SROH are diet, hygiene, and smoking – and these too
211 are central to many general health problems, a multi-sector, common risk factor approach to
212 address them seems prudent (25).
213
214 The weak but significant cross-sectional association for cholesterol and blood pressure in our
215 study (odds ratio = 1.1) worth particular attention as a recent U.S. population-based survey
216 showed that metabolic syndrome was moderately associated with severe periodontitis (26). This
217 weak association suggests further studies on SROH and clinically observed factors, such as
218 lipoprotein levels, are warranted.
219
220 The major limitation is the cross-sectional nature of the study. The associations found in this
221 research may not imply causality, for example poor general health may reduce psychological
222 well-being and cause symptoms of depression, which may lead to smoking and drinking.
223 Nonetheless, our results warranted further prospective studies and randomized controlled trials to
224 confirm whether the association is causal and whether improving OH can improve general health.
225 The co-morbidity shown between OH and general health, although adjusted for socio-
226 demographic variables, may be inflated as there are other common risk factors for OH and
227 general health. Another limitation is that self-selection bias might exist because every member in
228 a household had to participate in order to be eligible. Nonetheless, given the representativeness
229 of our sample (10), the study benefits from being a large population based study of SROH and
230 multiple health problems and our results are unique among Chinese population studies. Lastly,

the chronic health conditions were all self-reported, since it was not feasible to examine clinically such a large group of participants during the household interview. Nonetheless, face validity was examined through agreement with medicine usage, so this limitation should not affect our results substantially.

To conclude, this study has identified cross-sectional associations of SROH with chronic health conditions including cancer, DM, high blood pressure, high cholesterol, thyroid disease, nervous system disease, ENT disease, stomach / intestinal disease, and musculoskeletal disease. Further studies on the underlying pathological mechanisms behind the associations between OH and general health (for instance, whether the treatment of oral health diseases could lead to better general health) and the trajectory and pathway of the relationships over time are encouraged. Both dental and general health care professionals should be aware of such associations in addressing health problems of the community.

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**CONFLICTS OF INTEREST**

The authors declared no conflict of interest.

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Table 1. Relationship between self-reported oral health and demographics in the FAMILY project cohort study, 2009-2011

| Self-reported Oral health | Frequency | Age [a] | Male[b] | Tertiary educated[b] | Income >20000[b,c] | Current smoker[b] | Excess drinker[b,d] | Obese[b,e] |
|---|---|---|---|---|---|---|---|---|
| Very good | 501 | 40.32 | 215 (42.9%) | 80 (16.0%) | 93 (18.6%) | 69 (13.8%) | 21 (4.2%) | 136 (27.4%) |
| Good | 14,020 | 43.98 | 6,053 (43.2%) | 1,805 (12.9%) | 1,990 (14.2%) | 1,865 (13.3%) | 293 (2.1%) | 4,041 (29.1%) |
| Average | 21,849 | 43.15 | 10,387 (47.5%) | 2,178 (11.4%) | 2,483 (11.4%) | 3,757 (17.2%) | 572 (2.6%) | 6,669 (30.8%) |
| Bad | 4,801 | 50.32 | 2,363 (49.2%) | 304 (6.3%) | 392 (8.2%) | 1,005 (20.9%) | 158 (3.3%) | 1,633 (34.3%) |
| Very bad | 470 | 52.95 | 220 (46.8%) | 34 (7.2%) | 29 (6.2%) | 116 (24.7%) | 23 (4.9%) | 143 (31.0%) |
| Overall | 41,641 | 44.44 | 19,238 (46.2%) | 4,401 (10.6%) | 4,987 (12.0%) | 6,812 (16.4%) | 1,067 (2.6%) | 12,622 (30.6%) |
| *p* | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| *p* for trend | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Data are reported in frequencies (row percentage) of participants within each oral health status group, except for age.

[a] *p*-value of one way analysis of variance (ANOVA).

[b] *p*-value of $\chi^2$ test.

[c] Personal income per month in Hong Kong dollar (1 US dollar ~ 7.8 Hong Kong dollar).

[d] Consume at least 210 g (male) / 140 g (female) of alcohol per week.

[e] BMI ≥25.

Table 2. Relationship between chronic health conditions and demographics in the FAMILY project cohort study, 2009-2011

| Self-reported Oral health | Age [a] | Male[b] | Tertiary educated[b] | Income >20000[b,c] | Current smoker[b] | Excess drinker[b,d] | Obese[b,e] |
|---|---|---|---|---|---|---|---|
| Cancer | | | | | | | |
| Yes | 58.53 | 209 (39.5%) | 30 (5.7%) | 32 (6.0%) | 61 (11.5%) | 16 (3.0%) | 167 (32.1%) |
| No | 44.37 | 19,028 (46.3%) | 4,372 (10.6%) | 4,954 (12.1%) | 6,751 (16.4%) | 1,052 (2.6%) | 12,454 (30.5%) |
| Diabetes mellitus | | | | | | | |
| Yes | 63.15 | 1,094 (48.1%) | 93 (4.1%) | 136 (6.0%) | 311 (13.7%) | 44 (1.9%) | 1,136 (50.3%) |
| No | 43.47 | 18,143 (46.1%) | 4308 (10.9%) | 4,850 (12.3%) | 6,502 (16.5%) | 1,024 (2.6%) | 11,485 (29.4%) |
| High blood pressure | | | | | | | |
| Yes | 64.22 | 2,613 (45.7%) | 261 (4.6%) | 373 (6.5%) | 689 (12.1%) | 139 (2.4%) | 2,998 (53.0%) |
| No | 41.42 | 16,625 (46.3%) | 4,141 (11.5%) | 4,614 (12.9%) | 6,124 (17.1%) | 929 (2.6%) | 9,623 (27.0%) |
| High cholesterol | | | | | | | |
| Yes | 58.88 | 1,290 (45.4%) | 295 (10.4%) | 429 (15.1%) | 344 (12.1%) | 56 (2.0%) | 1,375 (48.8%) |
| No | 43.50 | 17,948 (46.3%) | 4,106 (10.6%) | 4,557 (11.8%) | 6,469 (16.7%) | 1,012 (2.6%) | 11,246 (29.2%) |
| Thyroid disease | | | | | | | |
| Yes | 50.29 | 187 (19.1%) | 88 (9.0%) | 99 (10.1%) | 108 (11.1%) | 19 (1.9%) | 309 (31.9%) |
| No | 44.41 | 19,050 (46.8%) | 4,314 (10.6%) | 4,887 (12.0%) | 6,705 (16.5%) | 1,049 (2.6%) | 12,312 (30.5%) |
| Nervous system disease | | | | | | | |
| Yes | 52.77 | 75 (44.4%) | 16 (9.4%) | 11 (6.5%) | 11 (6.5%) | 4 (2.4%) | 56 (33.9%) |
| No | 44.52 | 19,162 (46.2%) | 4,385 (10.6%) | 4,976 (12.0%) | 6,801 (16.4%) | 1,063 (2.6%) | 12,565 (30.6%) |
| ENT disease | | | | | | | |
| Yes | 49.51 | 2,528 (44.9%) | 615 (10.9%) | 678 (12.0%) | 829 (14.7%) | 147 (2.6%) | 1,722 (30.8%) |
| No | 43.77 | 16,709 (46.4%) | 3,786 (10.5%) | 4,308 (12.0%) | 5,984 (16.6%) | 921 (2.6%) | 10,899 (30.5%) |
| Stomach / intestinal disease | | | | | | | |
| Yes | 49.81 | 419 (45.6%) | 106 (11.5%) | 150 (16.3%) | 169 (18.4%) | 33 (3.6%) | 267 (29.2%) |
| No | 44.43 | 18,819 (46.2%) | 4,295 (10.5%) | 4,837 (11.9%) | 6,644 (16.3%) | 1,035 (2.5%) | 12,354 (30.6%) |
| Musculoskeletal disease | | | | | | | |
| Yes | 57.51 | 1,296 (39.3%) | 254 (7.7%) | 359 (10.9%) | 455 (13.8%) | 96 (2.9%) | 1,395 (42.8%) |
| No | 43.44 | 17,942 (46.8%) | 4,148 (10.8%) | 4,627 (12.1%) | 6,358 (16.6%) | 972 (2.5%) | 11,226 (29.5%) |
| Overall | 44.44 | 19,238 (46.2%) | 4,401 (10.6%) | 4,987 (12.0%) | 6,812 (16.4%) | 1,067 (2.6%) | 12,622 (30.6%) |
| *p* | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| *p* for trend | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Data are reported in frequencies (row percentage) of participants within each oral health status group, except for age.

[a] *p*-value of one way analysis of variance (ANOVA).

[b] *p*-value of $\chi^2$ test.

[c] Personal income per month in Hong Kong dollar (1 US dollar ~ 7.8 Hong Kong dollar).

[d] Consume at least 210 g (male) / 140 g (female) of alcohol per week.

[e] BMI ≥25.

Table 3. Relationship between self-reported oral health and chronic health conditions

| Self-reported Oral health | Cancer | Diabetes mellitus | High blood pressure | High cholesterol | Thyroid disease | Nervous system disease | ENT disease | Stomach / intestinal disease | Musculoskeletal disease |
|---|---|---|---|---|---|---|---|---|---|
| Very good | 8 (1.6%) | 15 (3.0%) | 45 (9.0%) | 35 (7.0%) | 12 (2.4%) | 0 (0.0%) | 57 (11.4%) | 18 (3.6%) | 34 (6.8%) |
| Good | 164 (1.2%) | 606 (4.3%) | 1,611 (11.5%) | 845 (6.0%) | 296 (2.1%) | 34 (0.2%) | 1,630 (11.6%) | 242 (1.7%) | 885 (6.3%) |
| Average | 233 (1.1%) | 1,171 (5.4%) | 2,961 (13.6%) | 1,454 (6.7%) | 479 (2.2%) | 78 (0.4%) | 2,883 (13.2%) | 457 (2.1%) | 1,653 (7.6%) |
| Bad | 109 (2.3%) | 433 (9.0%) | 990 (20.6%) | 447 (9.3%) | 178 (3.7%) | 47 (1.0%) | 949 (19.8%) | 174 (3.6%) | 651 (13.6%) |
| Very bad | 16 (3.4%) | 49 (10.4%) | 107 (22.8%) | 58 (12.3%) | 12 (2.5%) | 11 (2.3%) | 115 (24.5%) | 28 (6.0%) | 72 (19.9%) |
| Overall | 530 (1.3%) | 2,274 (5.5%) | 5,714 (13.7%) | 2,839 (6.8%) | 977 (2.3%) | 170 (0.4%) | 5,634 (13.5%) | 919 (2.2%) | 3,295 (7.9%) |
| $p$ [a] | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| $p$ for trend | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

ENT: Ear / Nose / Throat

Data are reported in frequencies (row percentage) of participants within each oral health status group.

[a] $p$-value of $\chi^2$ test.

Table 4. Relationship between self-reported bad/very bad oral health and chronic health conditions

| Chronic health conditions | OR 1 [a] | 95% CI | OR 2 [b] | 95% CI | OR 3 [c] | 95% CI |
|---|---|---|---|---|---|---|
| Cancer | 1.59*** | (1.29, 1.95) | 1.58*** | (1.27, 1.96) | 1.55*** | (1.25,1.93) |
| Diabetes mellitus | 1.28*** | (1.15, 1.43) | 1.25*** | (1.12, 1.41) | 1.25*** | (1.11, 1.40) |
| High blood pressure | 1.10* | (1.01, 1.20) | 1.14** | (1.04, 1.26) | 1.14** | (1.04, 1.25) |
| High cholesterol | 1.09 | (0.98, 1.21) | 1.15* | (1.03, 1.28) | 1.13* | (1.01, 1.26) |
| Thyroid disease | 1.53*** | (1.30, 1.80) | 1.59*** | (1.34, 1.89) | 1.54*** | (1.30, 1.83) |
| Nervous system disease | 3.03*** | (2.19, 4.20) | 3.34*** | (2.34, 4.77) | 3.30*** | (2.31, 4.72) |
| ENT disease | 1.56*** | (1.45, 1.68) | 1.57*** | (1.45, 1.70) | 1.51*** | (1.39, 1.64) |
| Stomach / intestinal disease | 1.77*** | (1.51, 2.08) | 1.79*** | (1.51, 2.12) | 1.73*** | (1.46, 2.05) |
| Musculoskeletal disease | 1.57*** | (1.43, 1.72) | 1.61*** | (1.46, 1.77) | 1.55*** | (1.41, 1.71) |

CI: confidence interval, ENT: Ear / Nose / Throat

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] Odds ratio of bad / very bad self-reported oral health on the corresponding chronic health condition adjusting for age and sex.

[b] Odds ratio of bad / very bad self-reported oral health on the corresponding chronic health condition adjusting for age, sex, education, income, health behaviors, BMI, and blood pressures.

[c] Odds ratio of bad / very bad self-reported oral health on the corresponding chronic health condition adjusting for age, sex, education, income, health behaviors, BMI, blood pressures, and social desirability.