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Disparities in aspects of oral-health-related quality of life among Chilean adults

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Abstract – *Objective:* Socioeconomic disparities in oral health among adults have been observed in many countries, but it is not clear whether they exist in aspects of Oral Health-Related Quality of Life in Chile. *Methods:* Data were analyzed from the 1st National Health Survey (NHIS) of Chilean adults, conducted in 2003. It included questions on aspects of oral-health-related quality of life (OHRQoL), including problems ('always' or 'almost always') with speaking, eating, pain, or daily activities. These were the dependent variables. Covariates included age, sex, education level, rurality, smoking, general quality of life, the number of remaining teeth, the number of untreated decayed teeth, and the reason for the last dental visit. Multivariate modelling was used to describe disparities in aspects of OHRQoL, using education level as the marker for socioeconomic status. *Results:* The sample comprised 3050 participants (54.7% female), of whom 49.0%, 40.5% and 10.5% had been educated to primary, secondary or tertiary level respectively. In the bivariate analysis, there were significant gradients in all four aspects of OHRQoL across those three categories. Covariates significantly associated with poorer OHRQoL were female gender, rurality, and poor self-reported general quality of life, and these were subsequently controlled for in the multivariate analysis. Adults with primary education (or less) were more likely than their tertiary-educated counterparts to report problems speaking (relative risk = 2.38; CI: 1.41, 4.05), trouble or pain (relative risk = 2.77; CI: 1.56, 4.91), discomfort in eating with others (relative risk = 2.35; CI: 1.34, 4.10), and interference with activities of daily living (relative risk = 2.29; CI: 1.15, 4.55). Those educated only to secondary level had relative risks which were lower than these but still significantly different from the reference category. The number of teeth with untreated caries was positively associated with impaired OHRQoL, and the number of remaining teeth was negatively associated with it. *Conclusions:* Socio-economic disparities in oral-health-related quality of life are apparent among Chilean adults, and remain after adjusting for dental status.

Despite vast overall improvements in oral health during the 20th century, social inequality appears to be a universal phenomenon (1). However, a recent report by the World Health Organization (2) highlighted that the majority of the few studies, which have explored the relationship between social status and oral health have been conducted in developed, high-income countries, and there is an important lack of evidence from developing countries.

In Chile, epidemiological studies of oral health in adults are scarce (3), and there are no published articles about disparities in oral health and oral-health-related quality of life (OHRQoL) in adults. The need to understand disparities is an issue of paramount importance in public health. In Chile, it is even more relevant since the most recent health system reform was targeted to reduce health disparities. Investigating

oral health inequalities is an essential part of that process.

Dental indices (such as the DMFT index, the longest-used measure in dentistry) are actually disease measures, rather than measures of oral health *per se*. Recent decades have seen much attention focused on the effects of poor oral health, not only on general health, but also on people's day-to-day functioning, well-being, and ability to carry out activities of daily living, collectively referred to as OHRQoL (4). OHRQoL measures can be used in epidemiological surveys, not only to complement the more traditional clinical indices, but also as oral health measures in their own right. These measures have the advantage of incorporating the participant's perspective and are closer to the actual health perceptions and needs in the population (5).

The aim of this study was to report on socio-economic inequalities in aspects of OHRQoL in the Chilean adult population, using data from the 1st National Health Interview Survey of Chile, conducted in 2003.

Material and methods

The current study was a secondary analysis of data from the 1st National Health Survey 2003 in Chile (6) obtained with permission from Health Planning Division, Secretary of Public Health – Ministry of Health of Chile (MINSAL-Chile) in January 2011. The 1st National Health Survey completed in 2003 was a health examination survey of a representative sample of the Chilean population aged over 17 years. This was a random sample of the general population (*n* = 3619), representing Chilean men and women of different ages by socio-economic level, rurality, and educational attainment who had participated in the Quality of Life and Health Survey 2000 (Ministry of Health of Chile) and were invited to participate in the 1st National Health Survey in the 2003. The sampling frame was defined using information on housing and population collected in the 1992 Census of Population and Housing, including its base mapping. The three sampling stages of this design comprised geographic clusters (or sections), households, and one adult member selected randomly from the selected household.

Participants were examined at home, to measure their nutritional status, blood pressure, vision screening, hearing, and oral dental examination; they were also asked about symptoms or signs of the common chronic diseases which afflict adults. The survey protocol was submitted for review to the ethics committees of the Ministry of Health and the Catholic University of Chile. The sample for this survey had representation from the 13 different regions in the country at that time. The survey had a high participation rate (90%), even though it required two home interviews of about 1 h each. The dental examinations were undertaken in the second home interview by nurses who had been trained by the Dental Health Unit MINSAL and the regional dental team. The complete training program for nurses comprised about 19 h and included information on dentate status (edentulous or dentate), the number of untreated decayed teeth, the number of teeth present, and on denture use. The current study included the 3050 participants aged 21 years or older who had complete dental examination. Weighting was not used.

Measurement of aspects of OHRQoL

Four questions on aspects of OHRQoL were used; these used a Likert scale (response options: 'always', 'almost always', 'sometimes', 'seldom', and 'never'). For the current study, these were dichotomized as 'always/almost always' (coded as '1') and 'sometimes/seldom/never' (coded as 0). We included those reporting impacts only 'sometimes' with the 'seldom' and 'never' responses (rather than the 'always/almost always' responses) because those responses are likely to represent impacts occurring frequently rather than occasionally. Semantically, there may be little difference between 'sometimes' and 'seldom' for many respondents and including the 'sometimes' response in the determination of impact prevalence is likely to lead to a degree of over-estimation. The four OHRQoL items were as follows: have you felt that your teeth or dentures are uncomfortable when you speak or talk with others; have you felt that your teeth cause suffering (trouble) and pain; have you felt that your teeth cause discomfort when you eat with others; and have you felt that your teeth interfere with activities of daily living? These four questions were analyzed independently and a total score was not used.

Other information

Participants were assigned to an education level category based on the highest level of schooling which they had attained (Primary or less, Secondary or Tertiary). The Primary category included individuals without any education and those with

one or more years of primary education only (in Chile, primary education has comprised 8 years since 1965 and is known as 'Education básica'; prior to 1965, it was known as 'Educación primaria' and comprised 6 years). The Secondary category included those who had undertaken any of the next 4 or 5 years of what is known in Chile as 'Educación media' (which can be scientific-humanistic or technical-professional). The Tertiary category included individuals who had undertaken one or more courses at university or in superior technical institutes.

Each participant's employment status was classified as employed or unemployed (student, retired, housewife, or looking for work). Socio-economic status (SES) was classified using the ESOMAR (European Society for Opinion and Marketing Research) adapted to Chile; it builds a matrix constructed from the level of education and the occupational category of the household's main breadwinner. If that individual was unemployed, the household was assigned to an SES category using an inventory of six household goods, whereby the SES was determined by the number of those goods in the household (6).

General quality of life (QoL) was determined using the question 'How do you feel in your life in general?' with the response options of 'Very bad', 'Regular (average)', and 'Better than average'.

Data analysis

Bivariate analyses were conducted using Stata Version 11.0 (Stata Corp LP, College Station, TX, USA). The analysis began with univariate descriptive statistics, after which the bivariate analysis examined the occurrence of poor OHRQoL by sociodemographic and dental status characteristics. Chi-square tests were used to examine the statistical significance of differences observed with categorical dependent variables; analysis of variance was used for continuous variables. The threshold for statistical significance was $P < 0.05$. In the multivariate analyses, the GLM command in Stata was used with a modified Poisson approach to estimate the relative risk and confidence intervals using robust error variances (7). Each of the four OHR-QoL items was modeled in turn.

Results

These analyses are restricted to the 3050 adults (aged 21 years or older) who underwent clinical dental examination; these comprised 84% of the initial sample of 3619. The following were the exclusion criteria: age < 21 years; incomplete dental examination data; incomplete OHRQoL data; or incomplete education level data. There were no systematic differences between the 3050 included and the 569 excluded with respect to age, sex, or rurality (data available on request).

Data on the sociodemographic characteristics of the sample are presented by education level in Table 1. Education level was used as the proxy variable for socio-economic status because it was the most robust and internationally comparable indicator of social and economic standing. Just over half of the participants were women, and four-fifths of the sample lived in urban areas. A high proportion felt that their general quality of life was good (or better than average). One in eight participants was edentulous, and a higher proportion of those had had mainly primary education or less. Denture wearing showed a similar gradient, with the highest proportion of denture wearers seen among the least educated groups. There was also an education level gradient in both the mean number of natural teeth and the number of untreated decayed teeth: people with more education had fewer untreated decayed teeth and more natural teeth remaining.

Responses to items on aspects of OHRQoL (Have you felt that your teeth/dentures…) are presented by demographic characteristics in Table 2. The numbers and percentages of participants who reported problems in aspects of OHRQoL 'almost always' or 'always' are presented by demographic characteristics in Table 3. Women and those living in rural areas had a higher percentage of OHRQoL-related problems. By education level, there were consistent gradients in all four measured aspects of OHRQoL, whereby the prevalence of problems was lowest among the highest educated and highest among those with least education. Similarly, consistent gradients were observed with general quality of life.

Overall, the prevalence of impaired OHRQoL in Chilean adults was 22.4%; that is, 684 participants had one or more oral problems 'always/almost always'. Among those with primary education or less, it was 28.4%; among those educated to secondary level, it was 18.7%; and it was 8.7% among those with a tertiary education ($P < 0.001$). The prevalence of oral problems 'always/almost always' for all four items was 4.7% overall, and 6.4%, 3.4% and 1.6%, respectively in the primary-, secondary-, and tertiary-educated groups ($P < 0.001$).

Table 1. Characteristics of the sample by education level (brackets contain row percentages unless otherwise specified)

	Education level			All combined (column%)
	Primary/none	Secondary	Tertiary	
Sex				
Female	857 (51.4)	667 (40.0)	144 (8.6)[a]	1668 (54.7)
Male	638 (46.2)	567 (41.0)	177 (12.8)	1382 (45.3)
Age group				
21–34	145 (21.9)	364 (55.1)	152 (23.0)[a]	661(21.7)
35–44	221 (40.2)	269 (48.9)	60 (10.9)	550 (18.0)
45–64	538 (51.4)	417 (39.9)	91 (8.7)	1046 (34.3)
65 or more	591(74.5)	184 (23.2)	18 (2.3)	793 (26.0)
Employment status[b]				
Employed	455 (36.8)	593 (47.9)	190 (15.4)[a]	1238 (40.6)
Unemployed	1039 (57.4)	641 (35.4)	130 (7.2)	1810 (59.4)
Socio-economic level (household)				
High (ABC1)	7 (7.8)	27(30.0)	56 (52.2)	90 (3.0)
Middle (C2-C3)	127 (16.8)	422 (55.5)	208 (27.5)	757 (24.8)
Middle - low (D)	870 (53.5)	703 (43.2)	54 (3.3)	1627 (53.3)
Low (E)	491 (85.2)	82 (14.2)	3 (0.5)	576 (18.9)
Rurality				
Urban	1071 (42.8)	1119 (44.7)	311 (12.4)[a]	2501 (82.0)
Rural	424 (77.3)	115 (21.0)	10 (1.8)	549 (18.0)
Smoke history in his/her life[c]				
Have smoked 100 cigarettes or more	646 (40.7)	737 (46.4)	204 (12.9)	1587(52.4)
<100 cigarettes	835 (57.8)	492 (34.1)	117 (8.1)	1444 (47.6)
General quality of life[d]				
Poor	91 (64.1)	43 (30.3)	8 (5.6)[a]	142 (4.7)
Moderate	588 (57.8)	364 (35.8)	65 (6.4)	1017 (33.4)
Good	812 (43.0)	826 (43.8)	248 (13.2)	1886 (61.9)
Reason for last dental visit[b]				
Check up	414 (40.3)	486 (47.2)	128 (12.5)	1028 (33.7)
Episodic or problem	975 (51.6)	721(38.2)	192 (10.2)	1888 (62.0)
Never visited	106 (80.3)	25 (18.9)	1(0.8)	132 (4.3)
Dental status				
Edentulous	276 (77.1)	79 (22.1)	3 (0.8) [a]	358 (11.7)
1–19 remaining teeth	770 (66.7)	345 (29.9)	39 (3.4)	1154 (37.8)
20 or more remaining teeth	449 (29.2)	810 (52.7)	279 (18.1)	1538 (50.4)
Denture use[c]	718 (60.8)	406 (34.4)	57 (4.8)[a]	1181 (39.0)
Mean remaining teeth (SD)	12.6 (9.7)	20.3 (9.1)	25.3 (6.3)[e]	17.1(10.2)
Mean number of untreated decayed teeth in participant with teeth (SD)	3.6 (3.5)	2.7 (3.0)	1.8 (2.3)[e]	3.0 (3.3)
All combined	1495 (49.0)	1234 (40.5)	321 (10.5)	3050 (100)

[a]Test Chi^2, $P < 0.05$.
[b]2 missing data.
[c]19 missing data.
[d]5 missing data.
[e]Test ANOVA, $P < 0.05$.

Each of the four aspects of OHRQoL reported 'almost always' or 'always' was modeled (Table 4). After controlling for sex, age, rurality, general quality of life, dental status, those who had been educated only to primary level had a greater relative risk of feeling uncomfortable when speaking. Those educated only to secondary level also had a higher relative risk, but it was less than that for the primary-educated group. Similar gradients by education level were observed for the other three aspects of OHRQoL. The other consistent predictors of poorer OHRQoL were age (that is, being older), self-rated general QoL, having less natural remaining teeth, and having more untreated decayed teeth.

Discussion

This study investigated socio-economic and dental characteristics associated with aspects of OHRQoL in the Chilean adult population, using data from

Table 2. Responses to items on aspects of OHRQoL (Have you felt that your teeth/dentures...) by demographic characteristics (brackets contain row percentages)

	Are uncomfortable when speaking			Cause trouble and pain			Cause discomfort when eating with others			Interfere with activities of daily living		
	Always/ almost always	Sometimes	Seldom/ never	Always/ almost always	Sometimes	Seldom/ never	Always/ almost always	Sometimes	Seldom/ never	Always/ almost always	Sometimes	Seldom/ never
Sex												
Female	253 (15.2)	188 (11.3)	1227 (73.5)	225 (13.5)	249 (14.9)	1194 (71.6)	255 (15.3)	149 (8.9)	1264 (75.8)	163 (9.8)	102 (6.1)	1403 (84.1)
Male	173 (12.5)	163 (11.8)	1046 (75.7)	149 (10.8)	222 (16.1)	1011 (73.1)	177 (12.8)	128 (9.3)	1077 (77.9)	112 (8.1)	82 (5.9)	1188 (86.0)
Age group (years)												
21–34	77 (11.7)	70 (10.6)	514 (77.7)	81 (12.2)	103 (15.6)	477 (72.2)	60 (9.1)	46 (7.0)	555 (84.9)	47 (7.1)	37 (5.6)	577 (87.3)
35–44	72 (13.1)	62 (11.3)	416 (75.6)	73 (13.3)	94 (17.1)	383 (69.6)	67 (12.2)	46 (8.4)	437 (79.4)	48 (8.7)	34 (6.2)	468 (85.1)
45–64	155 (14.8)	128 (12.2)	763 (73.0)	137 (13.1)	165 (15.8)	744 (71.1)	159 (15.2)	108 (10.3)	779 (74.5)	108 (10.3)	67 (6.4)	871 (83.3)
65 or more	122 (15.4)	91 (11.5)	580 (73.1)	83 (10.5)	109 (13.7)	601 (75.8)	146 (18.4)	77 (9.7)	570 (71.9)	72 (9.1)	46 (5.8)	675 (85.1)
Education level												
Primary/none	275 (18.4)	185 (12.4)	1035 (69.2)	233 (15.6)	255 (17.1)	1007 (77.4)	294 (19.7)	162 (10.8)	1039 (69.5)	175 (11.7)	119 (8.0)	1201 (80.3)
Secondary	136 (11.0)	141 (11.4)	957 (77.6)	128 (10.4)	176 (14.3)	930 (75.3)	125 (10.1)	102 (8.3)	1007 (81.6)	91 (7.4)	56 (4.5)	1087 (88.1)
Tertiary	15 (4.7)	25 (7.8)	281 (87.5)	13 (4.0)	40 (12.5)	268 (83.5)	13 (4.1)	13 (4.1)	295 (91.9)	9 (2.8)	9 (2.8)	303 (94.4)
Employment status												
Employed	147 (11.9)	149 (12.0)	942 (76.1)	143 (11.6)	185 (14.9)	910 (73.5)	142 (11.5)	96 (7.7)	1000 (80.8)	108 (8.7)	67 (5.4)	1063 (85.9)
Unemployed	278 (15.4)	202 (11.1)	1330 (73.5)	231 (12.8)	285 (15.7)	1294 (71.5)	189 (16.0)	181 (10.0)	1340 (74.0)	167 (9.2)	117 (6.5)	1526 (84.3)
Socio-economic level (household)												
High (ABC1)	4 (4.4)	4 (4.4)	82 (91.1)	2 (2.2)	8 (8.9)	80 (88.9)	2 (2.2)	4 (4.5)	84 (93.3)	3 (3.3)	3 (3.3)	84 (93.4)
Middle (C2–C3)	68 (9.0)	80 (10.6)	609 (80.4)	62 (8.2)	97 (12.8)	598 (79.0)	60 (7.9)	53 (7.0)	644 (85.1)	37 (4.9)	27 (3.6)	693 (91.5)
Middle – low (D)	229 (14.1)	198 (12.2)	1200 (73.7)	202 (12.4)	266 (16.4)	1159 (71.2)	237 (14.6)	155 (9.5)	1235 (75.9)	147 (9.0)	100 (6.2)	1380 (84.8)
Low (E)	125 (21.7)	69 (12.0)	382 (66.3)	108 (18.7)	100 (17.4)	368 (63.9)	133 (23.1)	65 (11.3)	378 (65.6)	88 (15.3)	54 (9.4)	434 (75.4)
Rurality												
Rural	84 (15.3)	80 (14.6)	385 (70.1)	90 (16.4)	106 (19.3)	353 (64.3)	99 (18.0)	67 (12.2)	383 (69.8)	67 (12.2)	47 (8.6)	435 (79.2)
Urban	342 (13.7)	271 (10.8)	1888 (75.5)	284 (11.4)	365 (14.6)	1852 (74.0)	333 (13.3)	210 (8.4)	1958 (78.3)	208 (8.3)	137 (5.5)	2156 (86.2)
General QoL												
Poor	33 (23.2)	14 (9.9)	95 (66.9)	27 (19.0)	27 (19.0)	88 (62.0)	31 (21.8)	16 (11.3)	95 (66.9)	22 (15.5)	13 (9.1)	107 (75.4)
Moderate	183 (18.0)	148 (14.5)	686 (67.5)	166 (16.3)	188 (18.5)	663 (65.2)	204 (20.1)	115 (11.3)	698 (68.6)	129 (12.7)	83 (8.2)	805 (79.1)
Good	210 (11.1)	187 (9.9)	1489 (79.0)	181 (9.6)	255 (13.5)	1450 (76.9)	196 (10.4)	144 (7.6)	1546 (82.0)	124 (6.6)	87 (4.6)	1675 (88.8)
Dental status												
Edentulous	56 (15.7)	47 (13.1)	255 (71.2)	46 (12.9)	41 (11.5)	271 (75.7)	70 (19.6)	37 (10.3)	251 (70.1)	40 (11.2)	20 (5.6)	298 (83.2)
1–19 remaining teeth	231 (20.0)	164 (14.2)	759 (65.8)	187 (16.2)	199 (17.2)	768 (76.6)	243 (21.1)	146 (12.6)	765 (66.3)	146 (12.7)	95 (8.2)	913 (79.1)
20 or more remaining teeth	139 (9.0)	140 (9.1)	1259 (81.9)	141 (9.2)	231 (15.0)	1166 (75.8)	119 (7.7)	94 (6.1)	1325 (86.2)	89 (5.8)	69 (4.5)	1380 (89.7)
All combined	426 (14.0)	349 (11.5)	2270 (74.5)	374 (12.3)	470 (15.4)	2201 (72.3)	432 (14.2)	277 (9.1)	2341 (76.7)	275 (9.0)	184 (6.0)	2591 (85.0)

Table 3. Numbers and percentages of participants who reported 'almost always' or 'always' problems in aspects of OHRQoL by demographic variables (brackets contain row percentages)

	Have you felt that your teeth/dentures ('always'/'almost always')				
	Are uncomfortable when speaking n (%)	Cause trouble and pain n (%)	Cause discomfort when you eating with others n (%)	Interfere with activities of daily living n (%)	1 impact or more of any type n (%)
Sex					
Male	253 (15.2)[a]	225 (13.5)[a]	255 (15.3)[a]	163 (9.8)	412 (24.7)
Female	173 (12.5)	149 (10.8)	177 (12.8)	112 (8.1)	272 (19.6)
Age group (years)					
21-34	77 (11.7)	81 (12.3)	60 (9.1)[a]	47 (7.1)	124 (18.8)
35-44	72 (13.1)	73 (13.3)	67 (12.2)	48 (8.7)	113 (21.0)
45-64	155 (14.8)	137 (13.1)	159 (15.2)	108 (10.3)	251 (24.0)
65 or more	122 (15.4)	83 (10.5)	146 (18.4)	72 (9.1)	196 (24.7)
Education level					
Primary/none	275 (18.4)[a]	233 (15.6)[a]	294 (19.7)[a]	175 (11.7)[a]	425 (28.4)
Secondary	136 (11.0)	128 (10.4)	125 (10.1)	91 (7.4)	231 (18.7)
Tertiary	15 (4.7)	13 (4.0)	13 (4.1)	9 (2.8)	28 (8.7)
Employment status					
Employed	147 (11.9)[a]	143 (11.6)	142 (11.5)[a]	108 (8.7)	242 (19.6)
Unemployed	278 (15.4)	231 (12.8)	189 (16.0)	167 (9.2)	440 (24.3)
Socio-economic level (household)					
High (ABC1)	4 (4.4)[a]	2 (2.2)[a]	2 (2.2)[a]	3 (3.3)[a]	5 (5.6)
Middle (C2-C3)	68 (9.0)	62 (8.2)	60 (7.9)	37 (4.9)	124 (16.4)
Middle - low (D)	229 (14.1)	202 (12.4)	237 (14.6)	147 (9.0)	373 (22.9)
Low (E)	125 (21.7)	108 (18.8)	133 (23.1)	88 (15.3)	182 (31.6)
Rurality					
Rural	84 (15.3)	90 (16.4)[a]	99 (18.0)[a]	67 (12.2)[a]	146 (26.6)
Urban	342 (13.7)	284 (11.4)	333 (13.3)	208 (8.3)	538 (21.5)
General quality of life					
Poor	33 (23.2)[a]	27 (19.0)[a]	31 (21.8)[a]	22 (15.5)[a]	47 (33.1)
Moderate	183 (18.0)	166 (16.3)	204 (20.1)	129 (12.7)	296 (29.1)
Good	210 (11.1)	181 (9.6)	196 (10.4)	124 (6.6)	340 (18.0)
Dental status					
Edentulous	56 (13.2)[a]	46 (12.9) [a]	70 (19.6)[a]	40 (11.2)	91 (25.4)
1–19 remaining teeth	231 (20.0)	187 (16.2)	243 (21.1)	146 (12.7)[a]	361 (31.3)
20 or more remaining teeth	139 (9.0)	141 (9.2)	119 (7.7)	89 (5.8)	232 (15.1)
All combined	426 (14.0)	374 (12.3)	432 (14.2)	275 (9.0)	684 (22.4)

[a]Test Chi^2 p < 0.05.

the 1st National Health Survey of Chile, conducted in 2003. It has found that socio-economic disparities in aspects of OHRQoL are apparent among Chilean adults, confirming the existence of a social gradient, at least when SES is determined using education level. Our findings contribute important information about adult oral health in a country which is in transition (8).

Before discussing the findings, it is appropriate to consider the study's weaknesses and strengths. One weakness is that trained nurses were used (instead of dental personnel) to undertake the dental examinations. It is possible, therefore, that the validity of the disease experience, which was recorded was not as high as would be desirable. However, we are not aware of any published comparisons with the dental epidemiological diagnos-

tic abilities of nurses and dentists, and so, we are unable to determine the effects on the data. Another issue is that we did not use a multi-item OHRQoL scale, as is usual practice. Instead, this study used a battery of four questions included in the 1st National Health Survey of Chilean adults, which were designed to investigate discrete aspects of OHRQoL. This has resulted in useful information, but it has compromised our ability to compare the findings with those from other studies, and it was not possible to obtain a total score from the four items. The first multi-item assessment of OHRQoL in the US adult population (conducted in 2003) was added to the National Health and Nutrition Examination Survey (NHANES) (9). It used seven items drawn from the Oral Health Impact Profile (OHIP) (10). By contrast, national

Table 4. Multivariate models for aspects of *impaired* OHRQoL

	Aspect of OHRQoL that they felt 'always' or 'almost always'				
	Uncomfortable when speaking RR (95% CI)	Trouble and pain RR (95% CI)	Discomfort when eating with others RR (95% CI)	Interfere with activities of daily living RR (95% CI)	1 impact or more of any type RR (95% CI)
Female[a]	1.10 (0.92–1.31)	1.18 (0.97, 1.43)	1.06 (0.89,1.27)	1.11 (0.87, 1.41)	1.16 (1.01–1.33)
Age (years)	0.98 (0.97, 0.99)	0.97 (0.96, 0.98)	0.99 (0.98, 0.99)	0.98 (0.97, 0.99)	0.98 (0.98–0.99)
Primary education or less[b]	2.38 (1.41, 4.05)	2.77 (1.56, 4.91)	2.35 (1.34, 4.10)	2.29 (1.15, 4.55)	2.06 (1.41–3.00)
Secondary education[b]	1.78 (1.06, 2.99)	2.11 (1.20, 3.68)	1.73 (1.00, 3.00)	1.92 (0.98, 3.77)	1.68 (1.16–1.44)
Rural residence[c]	1.31 (1.05, 1.64)	0.98 (0.78, 1.22)	1.10 (0.90, 1.36)	0.97 (0.74, 1.26)	1.10 (0.94–1.30)
General QoL poor[d]	1.63 (1.19, 2.23)	1.67 (1.18, 2.37)	1.58 (1.14, 2.19)	1.88 (1.25,2.82)	1.50 (1.18–1.91)
General QoL moderate[d]	1.35 (1.22, 1.62)	1.45 (1.19, 1.76)	1.58 (1.32, 1.89)	1.61 (1.27, 2.04)	1.39 (1.21–1.59)
Number of remaining teeth	0.94 (0.93, 0.95)	0.95 (0.94, 0.96)	0.94 (0.93, 0.95)	0.94 (0.93, 0.96)	0.95 (0.94–0.96)
Number of untreated decayed teeth	1.07 (1.07, 1.12)	1.08 (1.05, 1.10)	1.09 (1.06, 1,11)	1.09 (1.06, 1.12)	1.07 (1.05–1.09)

[a]Reference category = male.
[b]Reference category = tertiary education.
[c]Reference category = urban residence.
[d]Reference category = better than average general QoL.

surveys in the United Kingdom (11), Finland (12), and Australia (13) and Germany (14) have used the 14-item OHIP. Three of the four questions used in the Chilean Survey are similar to the seven used in the US 2003–2004 NHANES (…have you had painful aching anywhere in your mouth; …have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures; … have you had difficulty doing your usual jobs (or attending school) because of problems with your teeth, mouth or dentures?) and these are included in the OHIP-14. This suggests that the items used in the current study were useful indicators of aspects of OHRQoL.

Turning to the study findings, the main one was the strong association between education level and OHRQoL. Such an observation has not been consistently observed in all previous studies. For example, it has been observed in the USA (15) and in London (16) (among older people), but a more local study among older people in Joaçaba (in Santa Catarina, Brazil) found no association between formal education level and OHRQoL (17). In a German national sample, denture status was a stronger predictor for impaired OHRQoL than demographic characteristics such as age and education level (14). Sanders et al. (18) concluded that the absence of a social gradient in OHRQoL in Germany is consistent with the findings of previous cross-national research, where the smallest health inequalities were found in corporatist welfare states (19). OHRQoL has been rarely studied at population level in

Chile, with only one reported survey in adolescents by Lopez and Baelum (20). In that study, both attachment loss and necrotizing ulcerative gingivitis impacted on adolescents' OHRQoL (after adjusting for age, gender, and tooth loss), and individuals in lower socio-economic positions (represented by lower maternal education, monthly paternal income, and number of cars owned) experienced higher impacts on their OHRQoL.

To examine the robustness of the observed social gradients, we repeated the analyses using the ESOMAR composite measure of socio-economic status and found similar gradients for all four aspects of OHRQoL. These were statistically significant in the bivariate analyses, but not in the multivariate models.

Our findings of an inverse association between the number of remaining teeth and impairment in aspects of OHRQoL support the finding from other studies that incremental tooth loss is an important contributor to poor OHRQoL. A recent review provides fairly strong evidence that tooth loss is associated with impairment in OHRQoL and that the association appeared to be independent from both the setting and the OHRQoL instrument used (21). In the current study, we also categorized participants into two groups based on their remaining teeth (fewer than 20 and 20 or more). This classification was based on a study that reported that persons with 20 or more remaining teeth had better masticatory ability than those with fewer teeth (22). Moreover, having 20 or more remaining teeth

has been shown to be associated with greater physical activity in older people (23).

That poor OHRQoL and poor general QoL were strongly associated is consistent with other findings. Such an association has been demonstrated in both epidemiological surveys of older people (24) and in clinical intervention studies (25).

Controlling for individual characteristics (age and gender) and variables related to dental status, education level emerges as one of the main characteristics associated with aspects of OHR-QoL in the Chilean population, along with having fewer than 20 teeth remaining. These findings have a number of practical implications. In research, for example, clinical trials using OHRQoL as an outcome will need to adjust by education level (and probably other indicators of socio-economic position). Policy-makers considering improving OHRQoL among Chilean adults need to be aware of the importance of structural characteristics such as education level. Moreover, the importance of incremental tooth loss as a key determinant of OHRQoL needs to be highlighted in policy development, with dental public health programs focused on the avoidance of unnecessary tooth loss.

This study shows that disparities in OHRQoL are apparent among Chilean adults when socio-economic status is represented by education level. Future studies should compare these OHRQoL findings with those from countries with similar characteristics, and health programs should aim to diminish these inequalities over time.

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