Oral Pain and Eating Problems in Spanish Adults and Elderly in the Spanish National Survey Performed in 2005

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Aims: *To analyze and quantify the sociodemographic, behavioral, and clinical factors influencing the oral pain and eating difficulties reported by Spanish 35- to 44-year-old adults and more elderly people in the most recent Spanish National Oral Health Survey.* ***Methods:*** *Pain and chewing difficulties were gathered in a Likert-scale format from a representative sample of the Spanish general population between the ages of 35 and 44 years (n = 540) and 65 to 74 years (n = 540). Risk factors were identified using bivariate analysis, after which the crude association between risk factors (sociodemographic, behavioral, and clinical) and outcome variables (pain and eating problems) was assessed by adjusted odds ratios, calculated by means of multivariate logistic regression.* ***Results:*** *In the 35- to 44-year-old adults, eating problems were mainly associated with caries and prosthetic treatment needs and oral pain by the number of decayed teeth. In the more elderly individuals, eating problems and oral pain were influenced by prosthetic needs and the number of missing teeth. Female sex was seen to be a risk factor for suffering pain and eating restrictions. Additionally, several independent variables such as social class, place of residence, brushing habits, or periodontal needs became nonsignificant after logistic regression modelling.* ***Conclusion:*** *According to this high-specificity regression model, caries and prosthetic treatment needs should be considered key factors in determining the oral well-being of the Spanish population. Missing teeth represent the most relevant influencing factor for the elderly and decayed teeth for younger adults.* J OROFAC PAIN 2011;25:141–152

Key words: eating difficulties, epidemiological studies, oral health-related quality of life, oral pain, self-assessment

Data concerning the impact of dental conditions on oral health-related quality of life are of paramount importance because they can be used as a crosscultural measure of oral health needs, identifying the most impaired population groups, helping to allocate public health resources by using an impact-based approach, and evaluating programs.

In Spain, five epidemiological studies were performed between 1984 and 2005 that were based on World Health Organization (WHO) standardized criteria (1984,[1] 1987,[2] 1994,[3] 2000,[4] and 2005[5]), and the results demonstrated a gradual improvement in oral health (caries and periodontal disease) within all age groups, although mainly in the younger cohorts.

However, this improvement was demonstrated using standardized clinical criteria,[6,7] which are able to detect changes in oral

disease but cannot describe oral health because, according to the WHO,[8] the evaluation of the health of subjects requires an assessment of their physical, psychological, and emotional well-being, not merely confirmation of the absence of disease. In fact, using the Spanish versions of both the Oral Impacts on Daily Performance (OIDP)[9] and the Oral Health Impact Profile (OHIP-14),[10] some authors have reported a disturbingly high prevalence of impact on Oral Health-related Quality of Life (OHQoL) among healthy Spanish adults and more elderly people not seeking dental treatment. To complement the clinical data obtained from a representative sample of the Spanish population, the most recent national oral health survey performed in Spain[5] gathered data on the impact of oral health on subjective perceptions such as pain and eating problems that the individuals had experienced over the previous year. However, the prevalence of impact and the factors influencing these perceptions have not yet been addressed. The aim of the present study was to analyze and quantify the sociodemographic, behavioral, and clinical factors influencing the oral pain and eating difficulties reported by Spanish 35- to 44-year-old adults and more elderly people in the most recent Spanish National Oral Health Survey.

Materials and Methods

Setting

The database used was generously lent by the Spanish Dental Association and a more in-depth description of the study has been published elsewhere.[5] A pathfinder epidemiological study was undertaken in Spain based on WHO recommendations. Briefly, a clustered stratified representative sample of two groups of the general population with ages between 35 and 44 years (n = 540) and 65 to 74 years (n = 540) were recruited from 12 geographical areas from 2005 to 2006. These sample sizes were those recommended by WHO for adequate precision in the description of clinical prevalences. However, since this study is a reanalysis of those data for different purposes, here an estimation of the statistical power is presented. According to the SamplePower version 2.0 (SPSS, IBM) program, the sample sizes for the subgroups to be able to detect (with a power of 80% and a 5% type-I error) minimal (0.2), moderate (0.5), or large (0.8) standardized differences (effect sizes)[11] on the pain (or eating) scores are n = 398, n = 64, and n = 26, respectively. Thus, most of the comparisons in this reanalysis can detect minimal effects.

Data Collection

A consented, standardized clinical oral examination for caries, periodontal disease, temporomandibular joint (TMJ) function, and prosthodontic status[7] was performed by calibrated examiners. TMJ disorders were only assessed for the younger adults (n = 540).

Data on sociodemographic (age, sex, residence, and social class) and behavioral variables (brushing habits) were recorded from all participants. Their places of residence were categorized as urban (cities with more than 100,000 inhabitants), suburban (towns with 20,000 to 100,000 inhabitants or those located in the metropolitan area of provincial capitals), and rural (towns with fewer than 20,000 inhabitants who are not located in the metropolitan areas of provincial capitals). Social class was categorized as high, medium-high, medium, medium-low, and low based upon the last employment of the head of the household.[12]

Self-perception Data

All participants were questioned about how frequently they experienced any sort of pain (or eating difficulties) because of problems with their mouth, teeth, or dentures in the previous 12 months. These two single items of subjective impairment were extracted from a European Project addressing Oral Health Subjective Indicators.[13] The replies of the participants concerning pain or eating problems were recorded on a Likert-type scale (0 = never, 1 = hardly ever, 2 = sometimes, 3 = fairly often, and 4 = very often). The prevalence of impact was estimated using the *sometimes* threshold to visualize the proportion of subjects suffering from pain or eating problems with a certain frequency. For analyzing the subjective data, the total score was calculated by transforming the 0 to 4 range of the Likert scale into a 0 to 100 score because of the greater popularity of the percentage range and to achieve better visualization of the differences. Thus, 1 was recoded as 25; 2 as 50; 3 as 75, and 4 as 100, and only these values (0, 25, 50, 75, and 100) were used. Thus, the higher the total score, the greater the impact. This transformation has previously been used and validated in other quality-of-life measures, such as the Medical Outcomes Trust's short-form 36 (SF-36) survey,[14] and in other symptom-related instruments.[15]

Data Analysis

Means, standard deviations (SD), and confidence intervals (95% CI) were used to describe the sample. Although a Likert-type scale is an ordinal variable,

the specific frequency range from "never" to "very often" has been widely used and has provided reliable results since its original development.[16] Accordingly, it was considered that the scale could be used as a quantitative variable, providing a good picture of the prevalence of impact. Thus, parametric tests (Student's *t* test and ANOVA) were used to compare the mean total score between two or more groups, respectively, and the prevalence of impact was compared using the chi-square test. Modulating factors were initially explored using Pearson correlation coefficients (r).

The crude association between risk factors and the outcome variables (pain and eating problems) was assessed by the odds ratio (OR, 95% CI). These adjusted ORs were calculated by means of multivariate logistic regression, using generalized linear models with a binomial distribution and a logistic link, with all risk/protective factors as independent variables and the presence of "pain" and "eating difficulties" (at the "sometimes" threshold) as dependent variables.

The quantitative cariological variables were previously grouped into factors according to an exploratory factor analysis with varimax rotation in order to simplify the visualization of the modulating effect and to minimize the risk of removing important predictor variables due to collinearity. Forward selection (likelihood ratio) was used to estimate the models, ie, the stepwise selection method with entry testing based on the significance of the statistical value, and removal testing based on the probability of a likelihood-ratio statistic, in turn based on the maximum partial likelihood estimates. For a variable to be included in the model, the *P* value should be below .05. For categorical covariates, each category of the predictor variable was compared to the reference category.

For parsimonious reasons, on presenting the results, both ages (adults and elderly) were collapsed when analyzing the association between different sociodemographic and clinical variables with pain and eating (both as quantitative scores and prevalences). Although the *P* values derive from bivariate statistical tests, all associations were replicated by correcting for potential confounding of age group and social class, with logistic regression analysis (for prevalences) and multiple linear regression (for the quantitative scores) and, in all cases (results not shown), the association and its significance did not differ importantly from those obtained with the bivariate analysis. The Statistical Package for the Social Sciences version 16 (SPSS, IBM) was used for the statistical analyses. The cutoff level for statistical significance was .05.

Results

The oral health status of the two Spanish cohorts is summarized in Table 1. Both groups studied had a relative healthy oral status, but mainly the youngest cohort. The DMFT index (sum of decayed, missing, and filled permanent teeth) was mainly dependent on the number of filled teeth in the adults and missing teeth in the elderly. The periodontal status of the majority of sextants was coded as 0 or 1 in both age cohorts. Most of the 35- to 44-year-old adults did not have a dental prosthesis, although most of the more elderly group wore complete or partial dentures. In both groups, most of the subjects had no prosthetic needs. Table 1 also summarizes the sociodemographic and behavioral profile of both age cohorts. Sex and social class distributions were discrepant between the cohorts. Brushing habits were significantly better within the younger cohort. The place of residence had an identical distribution within each age cohort, with 180 subjects in each of the categories (urban, suburban, and rural).

Table 2 depicts the prevalence and total scores of pain and eating problems regarding selected sociodemographic and behavioral characteristics of the subjects. The prevalence of pain and eating problems in the whole sample (using the "sometimes" threshold) was 34.0% and 22.4%, respectively. The prevalence of eating problems was significantly higher in the elderly group than in the younger adults, but the prevalence of pain was similar in both cohorts. Pain and eating difficulties were also influenced by social class, ie, the lower the class, the higher the impact. Women also showed a higher level and prevalence of pain and eating problems. Brushing habits were also associated with prevalence and the scores of these subjective perceptions of oral impact, with the observation of a clear trend for impact to increase as the frequency of brushing was reduced. Furthermore, rural residents reported a lower impact of pain and eating problems than their urban and suburban counterparts, although this trend was only statistically significant for the total score for oral pain.

Table 3 shows the impact of pain and eating difficulties based on some clinical traits. TMJ data were only collected from the adult cohort. The prevalence of oral pain and eating problems between the groups with or without TMJ symptoms and TMJ pain were not significantly discrepant. However, the total scores for pain and eating difficulties were significantly higher in individuals with TMJ symptoms or TMJ pain. Moreover, the prevalence of eating problems was significantly higher in people with TMJ sounds than their counterparts without them, and the total score for eating problems was signifi-

Table 1 Clinical, Behavioral, and Sociodemographic Description of Age Cohorts (n = 1,080)

	Age intervals			
	35 to 44 (y) (n = 540)		65 to 74 (y) (n = 540)	
	Mean	95% CI	Mean	95% CI
Clinical variables				
Natural teeth present*	25.0	24.4–25.5	14.2	12.7–15.7
DMFT*	9.6	9.0–10.3	16.8	15.5–18.0
Decayed teeth	1.4	1.2–1.6	1.4	1.2–1.6
Missing teeth*	3.0	2.7–3.3	13.8	13.0–14.6
Filled teeth*	5.2	4.9–5.5	1.6	1.4–1.8
CPI*				
Sextants coded 0*	2.5	2.2–2.9	1.3	1.1–1.6
Sextants coded ≥ 1*	3.3	3.0–3.7	3.0	2.7–3.3
Sextants coded ≥ 2*	1.9	1.6–2.1	1.9	1.6–2.2
Sextants coded ≥ 3	0.6	0.3–0.8	0.7	0.5–0.9
Sextants coded 4*	0.1	0.0–0.1	0.2	0.1–0.2
NR sextants*†	0.2	0.1–0.2	1.7	1.5–1.9
Prosthetic status*	N	%	N	%
None	430	79.6	180	33.3
Fixed prosthesis	71	13.1	68	12.6
Partial denture	35	6.5	156	28.9
Complete denture	4	0.7	136	25.2
Prosthetic needs*				
None	390	72.2	352	65.2
Single unit	47	8.7	19	3.5
Multiunits	99	18.3	131	24.3
Complete units	4	0.7	38	7.0
Sociodemographic variables				
Sex*				
Male	232	43.0	278	51.5
Female	308	57.0	262	48.5
Social class*				
High	31	5.8	8	1.5
Medium-high	44	8.2	17	3.3
Medium	85	15.9	51	9.8
Medium-low	317	59.3	388	74.6
Low	58	10.8	56	10.8
Behavioral variables				
Brushing habits*				
> Once/day	308	57.0	233	43.1
Once/day	157	29.1	173	32.0
Once/week	47	8.7	70	13.0
< Once/week	28	5.2	64	11.9

CPI = Community Periodontal Index according to WHO guidelines.
*Student's *t* test (for quantitative variables) or chi-square test (for ordinal and nominal variables) detected significant differences between adults and elderly ($P < .01$).
†Not registered sextants owing to the absence of target teeth (those in which CPI has to be evaluated).

Table 2 Prevalence and Total Scores of Pain and Eating Problems Compared with Selected Sociodemographic and Behavioral Characteristics of the Respondents (n = 1,080)

	Pain				Eating problems			
	Prevalence		Total score		Prevalence		Total score	
	n	%	Mean	SD	n	%	Mean	SD
Age cohorts* (y)	367	34.0	23.3	30.4	242	22.4	15.9	28.1
35 to 44 (n = 540)	174	32.2	21.4	29.3	97	18.0	12.1	24.7
65 to 74 (n = 540)	193	35.7	25.1	31.3	145	26.9	19.7	30.8
	NS		$P < .05$		$P < .001$		$P < .001$	
Social class†	362	34.3	23.5	30.4	238	22.6	16.4	28.2
High (n = 39)	8	20.5	13.5	22.1	3	7.7	4.5	13.9
Medium-high (n = 61)	8	13.1	8.2	19.8	4	6.6	4.1	15.9
Medium (n = 136)	44	32.4	21.5	30.5	20	14.7	10.5	23.5
Medium-low (n = 705)	252	35.7	24.9	30.8	168	23.8	17.6	29.5
Low (n = 114)	50	43.9	29.0	32.4	43	37.7	23.5	30.2
	$P < .001$		$P < .001$		$P < .001$		$P < .001$	
Sex‡	367	34.0	23.3	30.4	242	22.4	15.9	28.1
Male (n = 510)	158	31.0	21.6	28.9	95	18.6	13.6	26.5
Female (n = 570)	209	36.7	24.8	31.6	147	25.8	18.0	29.4
	$P < .05$		$P < .05$		$P < .01$		$P < .05$	
Residence§	367	34.0	23.3	30.4	242	22.4	15.9	28.1
Urban (n = 360)	121	33.6	21.7	29.2	88	24.4	16.5	27.4
Suburban (n = 360)	133	36.9	27.1	32.5	85	23.6	17.7	30.0
Rural (n = 360)	113	31.4	21.0	28.9	69	19.2	13.5	26.8
	NS		$P < .05$		NS		NS	
Brushing habits	367	34.0	23.3	30.4	242	22.4	15.9	28.1
> once/day (n = 541)	163	30.1	20.4	29.3	97	17.9	12.7	25.5
Once/day (n = 330)	115	34.8	23.1	28.7	77	23.3	16.1	27.6
Once/week (n = 117)	51	43.6	30.1	33.4	37	31.6	22.0	32.4
< once/week (n = 92)	38	41.3	32.3	35.1	31	33.7	26.4	35.0
	$P < .01$		$P < .001$		$P < .001$		$P < .001$	

*Student *t* test detected differences between adults and elderly individuals with $P < .001$ for eating and $P < .05$ for pain.
†Social class was recorded in 1,055 subjects. Bonferroni post-hoc comparisons revealed significant differences in eating and pain scores between the lowest social classes and the medium-to-high range of social classes ($P < .001$).
‡Student's *t* test detected significant differences in pain and eating problems between males and females ($P < .05$).
§Bonferroni post-hoc comparisons revealed that pain was significantly more frequent in peri-urban residents than their counterparts ($P < .05$).

cantly different among all the TMJ groups. Prosthodontic status was related to the prevalence and level of impact on eating but was not a pain-related condition. Nevertheless, prosthetic and periodontal needs were coherently related to the oral impacts evaluated (pain and eating problems). The number of healthy, missing, or decayed teeth was also found to influence the prevalence and level of both subjective impairments, but eating difficulties above all.

The total scores for pain and eating problems were significantly intercorrelated ($r = 0.54$; $P < .05$) in this sample. Some sociodemographic, behavioral, and clinical modulating factors are shown in Table 4. The main clinical factor associated with pain was decayed teeth. Eating problems were mainly correlated with prosthodontic needs, natural teeth present, missing teeth, and the DMFT (sum of decayed, missing, and filled teeth) index. Social class and brushing habits significantly modulated both perceptions.

Once the main clinical factors associated with pain and eating problems had been determined (Table 4), a principal component analysis was performed on the most relevant quantitative variables ($r > 0.15$) in order to reduce the number of these variables and to capture the underlying clinical domains for both

Table 3 Prevalence and Total Scores of Pain and Eating Problems in Some Clinical Conditions (n = 1,080)

	Pain				Eating problems			
	Prevalence		Total score		Prevalence		Total score	
	n	%	Mean	SD	n	%	Mean	SD
TMJ symptoms (n = 538)	174	32.3	21.5	29.3	97	18.0	12.1	24.8
No (n = 461)	143	31.0	20.4	28.3	78	16.9	11.1	23.5
Yes (n = 77)	31	40.3	28.2	34.3	19	24.7	18.5	30.5
	NS		$P < .05$		NS		$P < .05$	
TMJ sounds (n = 538)	174	32.3	21.5	29.3	97	18.0	12.1	24.8
No (n = 393)	126	32.1	21.0	28.6	57	14.5	10.0	22.9
Yes (n = 145)	48	33.1	22.9	21.3	40	27.6	17.9	28.5
	NS		NS		$P < .001$		$P < .01$	
TMJ pain (n = 538)	174	32.3	21.5	29.3	97	18.0	12.1	24.8
No (n = 511)	161	31.5	20.8	28.7	91	17.8	11.6	24.0
Yes (n = 27)	13	48.1	34.3	38.1	6	22.2	21.3	35.8
	NS		$P < .05$		NS		$P < .05$	
Prosthodontic status (n = 1,080)	367	34.0	23.3	30.4	242	22.4	15.9	28.2
None (n = 610)	199	32.6	22.5	19.8	116	19.0	13.5	26.2
Fixed prosthesis (n = 139)	51	36.7	24.5	31.9	31	22.3	16.9	30.1
Partial denture (n = 191)	66	34.6	24.4	31.3	51	26.7	18.7	29.9
Complete denture (n = 140)	51	36.4	23.9	30.1	44	31.4	21.4	31.0
	NS		NS		$P < .01$		$P < .01$	
Prosthetic needs (n = 1,080)	367	34.0	23.3	30.4	242	22.4	15.9	28.2
None (n = 742)	220	29.6	19.9	28.2	110	14.8	10.4	22.9
Single unit (n = 66)	26	39.4	25.8	30.7	21	31.8	20.8	29.0
Multiunits (n = 230)	104	45.2	32.4	30.0	84	36.5	27.1	35.1
Complete units (n = 42)	17	40.5	29.8	34.1	27	64.3	43.5	33.2
	$P < .001$		$P < .001$		$P < .001$		$P < .001$	
Periodontal needs (n = 961)	327	34.0	23.4	30.4	197	20.5	14.7	27.3
None (n = 123)	34	27.6	16.7	27.3	23	18.7	11.2	23.6
Scaling (n = 123)	40	32.5	22.2	28.8	30	24.4	16.9	29.8
Root planing (n = 648)	223	34.4	23.9	30.7	127	19.6	14.2	26.8
Surgery (n = 67)	30	44.8	32.5	33.4	17	25.4	21.3	32.1
	$P < .05$		$P < .01$		NS		$P < .05$	
Healthy teeth (n = 1,080)	367	34.0	23.3	30.4	242	22.4	15.9	28.2
None (n = 129)	42	32.6	22.7	31.3	44	34.1	24.6	30.1
1 to 10 (n = 200)	79	39.5	26.4	31.3	63	31.5	20.9	30.4
11 to 20 (n = 505)	173	34.3	24.0	30.8	105	20.8	15.5	28.3
> 20 (n = 246)	73	29.7	19.6	27.8	30	12.2	8.0	19.9
	NS		NS		$P < .001$		$P < .001$	
Missing teeth (n = 1080)	367	34.0	23.3	30.4	242	22.4	15.9	28.2
None (n = 872)	294	33.7	23.1	30.2	181	20.8	14.7	27.3
1 to 2 (n = 88)	27	30.7	21.9	30.5	18	20.5	13.9	24.8
2 to 4 (n = 24)	10	41.7	31.3	32.4	6	25.0	18.8	25.8
5 to 20 (n = 53)	25	47.2	32.1	35.1	22	41.5	32.1	38.1
> 20 (n = 43)	11	25.6	14.5	23.3	15	34.9	22.1	31.9
	NS		$P < .05$		$P < .001$		$P < .001$	

Table 3 (*continued*)

	Pain				Eating problems			
	Prevalence		Total score		Prevalence		Total score	
	n	%	Mean	SD	n	%	Mean	SD
Decayed teeth (n = 1,080)	367	34.0	23.3	30.4	242	22.4	15.9	28.2
None (n = 552)	160	29.0	19.1	28.3	97	17.6	12.3	25.4
1 (n = 201)	65	32.3	22.4	30.9	41	20.4	15.4	28.5
2 to 3 (n = 187)	81	43.3	30.2	31.5	59	31.6	21.9	31.7
≥ 4 (n = 140)	61	43.6	32.0	32.9	45	32.1	22.7	30.6
	$P < .001$		$P < .001$		$P < .001$		$P < .001$	

cohorts before applying the logistic regression analysis (Table 5). According to principal component analysis, nine clinical variables proved to be coherently loaded within three factors. Thus, the original clinical variables were reduced to the nine most relevant ones, after which they were grouped together in three factors that essentially matched both elderly and adult ages. Factor 1, designated "missing," was conceived as a latent variable related to tooth loss, as suggested by the nature and loadings of the variables integrating it (missing teeth, standing natural teeth, DMFT index, healthy teeth). Factor 2, designated "decayed," comprised decayed teeth, restored or not. Factor 3, termed "restored," was mainly loaded by the number of healthy restored teeth in both ages. The DMFT index and DMFT-M1 (sum of decayed, missing, and filled permanent first molars) loaded differently in the adults and the elderly according to the main component of its value, ie, missing teeth in elderly and filled teeth in adults (See Table 1). The three factors, all of them with eigenvalues above three, were included in the subsequent logistic regressions analysis.

Table 6 shows the results of the logistic regression for predicting pain and eating problems in the two cohorts. In general, the ORs were strongly reduced after adjustment in both effects (pain and eating restrictions), and, after this process, several independent variables became nonsignificant, as was the case of social class, place of residence, brushing habits, and periodontal needs (results not shown); however, none of them changed the direction of the association. In the younger adults, eating problems were mainly modulated by caries and prosthetic treatment needs. According to this model, these adults needing multiple or total teeth replacements were at 3.0 and 2.2 times greater risk (OR), respectively, of suffering eating problems than those with no prosthetic needs. Similarly, those needing treatment for four or more decayed teeth had 4.1 times more risk (OR, 95% CI: 1.6–10.3) of suffering from eating

Table 4 Modulating Factors Assessed by Pearson Correlation Coefficients (r)

	Pain	Eating problems
Sociodemographic variables		
Age (y)	0.02	0.11**
Social class	0.14**	0.18**
Behavioral variables		
Brushing habits	0.12*	0.14*
Caries variables		
Healthy permanent teeth	–0.06*	–0.21**
Decayed permanent teeth	0.16**	0.16**
Healthy restored teeth	–0.10**	–0.15**
Restored but decayed teeth	0.18**	0.16**
DMFT Index	0.06*	0.21**
No. of teeth needing endodontics	0.14**	0.12**
No. of teeth needing extraction	0.14**	0.14**
Periodontal variables		
Sextants without loss of attachment	–0.08**	–0.17**
Sextants with CPI = 0	–0.05	–0.12**
Sextants with CPI = 1	0.00	–0.04
Sextants with CPI = 2	0.01	–0.08**
Sextants with CPI = 3	0.04	0.01
Sextants with CPI = 4	0.08**	0.05
CPI maximum within sextants	0.10**	0.07*
Periodontal needs	0.11**	0.05
Prosthodontic variables		
Prosthodontic status	0.02	0.11**
Prosthodontic needs	0.16**	0.29**
Missing teeth	0.09**	0.24**
Natural teeth present	–0.09**	–0.24**

*Correlation is significant at $P < .05$.
**Correlation is significant at $P < .01$.

Table 5 Factor Loadings ≥ 0.50 of the Quantitative Cariological Variables in the 35- to 44-year-old Adult Cohort and More Elderly Cohort Obtained from an Exploratory Analysis Followed by Varimax Rotation

	Factor 1: missing		Factor 2: decayed		Factor 3: restored	
Variables	Elderly	Adults	Elderly	Adults	Elderly	Adults
Healthy teeth	–0.95	–0.64				–0.69
Decayed teeth			0.99	0.99		
Restored but decayed teeth				0.99	0.50	
Healthy restored teeth					0.94	0.93
Missing teeth due to caries	0.70	0.90				
Standing natural teeth	–0.93	–0.99				
Missing teeth due to other reasons	0.93	0.99				
DMFT index	0.98	0.62				0.71
DMFT-M1 index	0.80					0.73
Eigenvalues	4.9	3.8	3.2	3.5	2.4	3.4
Variance explained	34.7	24.0	22.6	21.6	16.8	21.4
Cumulative variance	34.7	24.0	57.3	45.5	74.1	66.9

DMFT-M1 = sum of decayed, missing, and filled permanent first molars.

problems than those without decayed teeth. The presence of oral pain in these younger adults was mainly associated with the decayed-factor variables depicted in Table 5. Moreover, in this age cohort, the men were at lower risk than women of reporting eating problems (OR, 95% CI: 0.2–0.7) and oral pain (OR, 95% CI: 0.4–1.0).

In the case of the more elderly cohort, eating problems were also mainly influenced by prosthetic needs and missing teeth, and oral pain was associated with the "missing" factor (See Table 5). The elderly needing full replacement of teeth had a 16.6-fold greater risk (OR, 95% CI: 3.9–71.9) of having eating problems than those without prosthetic needs. Moreover, those with more than 20 missing teeth had a 1.8 to 176.5-fold greater risk of having frequent eating problems. Caries treatment needs also seemed to be an important factor influencing eating. Moreover, within this linear adjusted model, the women were seen to be at higher risk of suffering pain and eating restrictions, except for oral pain in the elderly cohort.

This regression model confirmed very high specificity but low sensitivity for predicting pain and eating problems in the cohorts. The specificity values (proportion of subjects without pain or eating problems, reported as "sometimes" or, more frequently, correctly predicted by this model) were 97.6% for eating problems and 94.1% for pain in the 35- to 44-year-old adults and 93.6% for eating problems and 100% for pain in the more elderly cohort. By contrast, the sensitivity values for predicting pain or eating problems were very low and mainly for pain in the more elderly individuals.

Discussion

Pain and chewing difficulties are the two most common outcomes of oral illness, such as caries or periodontal diseases, and tend to be prevalent among the 35- to 44-year-old adults and the more elderly populations. Accordingly, pain and eating problems are the two strongest predictors for oral disadvantage[17] and the most relevant domains of the OHQoL construct.[18] Thus, both dimensions are contained in OHQoL instruments.[19] Here, two items and the response format suggested by European experts were used.[13] However, both dimensions were collected as single-item instruments, and, consequently, the authors are well aware that the multidimensional construct of OHQoL can never be covered by this approach. However, it could be sufficient to explore the prevalence of the relevant impacts perceived by the two populations and to detect the underlying factors. In this sense, a well-conducted national survey is an optimal scenario for obtaining a global picture of the situation. The probabilistic sampling carried out met WHO requirements in order to ensure a representative sample of the targeted ages in Spain. One strength of this study was that the participants represented the full range of socioeconomic status, health, and illness burden of the targeted Spanish age groups. Nevertheless, given that this was a cross-sectional survey, no temporal relationship can be inferred. However, for several of the results reported in this paper, the authors assumed the most likely direction of the significant associations, although they recognize that the direction of the

Table 6 Logistic Regression Models Using a Stepwise Selection Method for Predicting Eating Problems and Dental Pain in 35- to 44-year-old Adult Cohort and More Elderly Cohort

					95% CI	
Step/variables	B	SE	*P*	OR	Lower	Upper
Adults						
Eating problems						
Step 1						
Prosthetic needs[a]: 0			.037			
Prosthetic needs[a]: 2	1.09	0.45	.016	2.98	1.23	7.21
Prosthetic needs[a]: 3	0.79	0.37	.034	2.21	1.06	4.60
Step 2						
Sex (male/female)	–1.02	0.34	.002	0.36	0.18	0.69
Step 3						
Caries treatment needs[b]: 0			.010			
Caries treatment needs[b]: 1	0.70	0.41	.090	2.01	0.89	4.52
Caries treatment needs[b]: 2	1.17	0.42	.005	3.23	1.42	7.31
Caries treatment needs[b]: 3	1.40	0.47	.003	4.07	1.62	10.25
Step 4						
Factor 1: missing	0.36	0.16	.022	1.43	1.05	1.95
Oral pain						
Step 1						
Factor 2: decayed	0.65	0.13	.000	1.91	1.50	2.44
Step 2						
Sex (male/female)	–0.47	0.22	.034	0.63	0.41	0.97
Elderly						
Eating problems						
Step 1						
Prosthetic needs[a]: 0			.000			
Prosthetic needs[a]: 1	1.39	0.60	.021	4.02	1.23	13.13
Prosthetic needs[a]: 2	1.19	0.30	.000	3.30	1.83	5.93
Prosthetic needs[a]: 3	2.81	0.75	.000	16.63	3.86	71.69
Step 2						
No missing teeth			.000			
1 to 2 missing teeth	0.50	0.44	.269	1.64	0.68	3.95
5 to 20 missing teeth	1.58	0.40	.000	4.84	2.19	10.70
> 20 missing teeth	2.88	1.17	.014	17.88	1.81	176.46
Step 3						
Sex (male/female)	–0.82	0.30	.006	0.44	0.25	0.79
Step 4						
Caries treatment needs[b]: 0			.011			
Caries treatment needs[b]: 1	0.04	0.39	.909	1.05	0.48	2.27
Caries treatment needs[b]: 2	1.10	0.36	.002	3.02	1.49	6.12
Caries treatment needs[b]: 3	0.40	0.43	.350	1.50	0.64	3.47
Oral pain						
Step 1						
Factor 1: missing	0.27	0.14	.050	1.30	1.00	1.70

B = the logistic regression coefficient.
[a]Prosthetic needs coded as 0: no prosthetic needs; 1: need for a single tooth replacement; 2: need for multiple tooth replacements; 3: need for complete replacement of teeth.
[b]Caries treatment needs coded as 0: no need of caries treatment; 1: need of treatment of decayed tooth; 2: need of treatment of 2 or 3 decayed teeth; 3: need of treatment of 4 or more decayed teeth.

relationship could never be supported by the study design and, in some situations, the inverse direction could also be plausible.

In terms of caries, young Spaniards (aged 12 years) are considered a low-disease population group, but Spanish adults are still classified as having a moderate and very high level of caries, pointing to a cohort effect.[20] In terms of prosthodontic status, the mean numbers of natural teeth present in this study's two cohorts are clearly higher than those reported for most European populations[21] and is considered a high predictor of oral well-being.[22] Additionally, the periodontal status of the ages studied is comparable or better than that in most European countries.[23]

The main finding of this study was that one in three of the two cohorts reported experiencing oral pain as a result of oral disorders "sometimes," or more frequently, in the previous year. In the same period, one in five of the 35- to 44-year-old adults and one in four of the more elderly cohort had suffered from eating difficulties because of problems with their mouth, teeth, or dentures. The prevalence of pain and eating problems is comparable to that reported by other authors who used the same questions at the same threshold among elderly Australians.[16] This prevalence is marginally lower than that reported for adults in Australia, the United States, and the United Kingdom[24,25] but is markedly higher than in adult Canadians.[26] In any case, the prevalence of subjective perceptions among both cohorts in Spain is still disturbingly high if it is taken into account that the sample only comprised individuals who were not seeking dental treatment and had a relatively healthy mouth. As a result of this, it would be expected that there would be a relatively lower prevalence of pain or eating problems and, therefore, a higher "floor effect" (ie, respondents reporting no impact at a given frequency threshold). The small percentage of the Spanish population who visits the dentist irregularly owing to fear may be the underlying reason for this latent burden of impact among these Spanish age cohorts.[27]

Another worrying finding is that the prevalence of pain and eating restrictions was much higher in the low social class respondents than in individuals from higher social classes. It has been suggested that socioeconomic conditions might influence OHQoL both directly and indirectly.[28,29] These subjective perceptions revealed a detectable gap between socioeconomically advantaged and disadvantaged groups and should be addressed simultaneously by researchers and policymakers to resolve this issue. Place of residence has also been shown to be an influential variable in the prevalence of caries, with suburban populations being at higher risk,[20] and this sociodemographic characteristic may have acted directly or indirectly on the subjective perceptions reported because a clear tendency was found for the suburban populations to report higher levels of oral pain and eating restrictions.

Some clinical conditions were found to be related to prevalence and total scores of pain and chewing difficulties. TMJ disorders were mainly related to eating problems. The impact of TMJ disorders was not always found to be statistically significant because of the small cell size of this condition among adults, but the percentage distribution revealed a discrepant proportion of subjects with TMJ problems and the oral impacts evaluated. The impact of TMJ disorders on quality of life has been reported previously,[30–32] and the present data suggest that, in spite of these being rare among the general adult population, subjects with pain-associated TMJ present significantly higher impact than those without pain. Moreover, several sociodemographic, behavioral, and clinical factors were seen to be correlated with the pain and eating scores, although these statistically significant relationships may not be clinically significant, and some of these significant but weak correlations may be due only to the large sample size, therefore being spurious.

By contrast, the study found a clear gradient in prevalence rates and the total scores of both items, according to the prosthodontic and periodontal needs, and the number of healthy, missing, and decayed teeth. Regarding prosthodontic status and needs, it should be noted that the higher the number of missing or replaced teeth, the greater the impact on eating. Tooth loss is the ultimate consequence of the most prevalent oral pathologies (caries and periodontal disease) and is therefore a very common situation in adults and, above all, in the more elderly. Prosthetic needs and missing teeth were shown to be the most relevant factors affecting chewing in both cohorts after adjusting the logistic model. In fact, these could be the key factors accounting for the discrepant prevalence of eating impact among age cohorts, social classes, and places of residence.[5] However, the differences found between males and females do not seem to be related to oral health status but, instead, to certain particularities in the conception of the oral well-being that lead women to perceive a greater disadvantage and less satisfaction than males in comparable clinical situations.[33] In fact, in the adjusted logistic model, sex had an independent effect on chewing problems and pain in the 35- to 44-year-old adults and on chewing problems in the more elderly individuals.

In summary, in this model, after controlling for the interference of the confounding factors, two key factors arose, ie, missing teeth and decayed teeth. Missing teeth represent the most relevant influential factor in the elderly cohort and decayed teeth in the younger adults. The impact generated by the loss of teeth and prosthetic needs has been addressed by several authors,[34–37] showing its modulating effect.

A striking finding is that pain was even higher in those individuals needing a multiunit replacement than those requiring a complete replacement of missing teeth, as reported elsewhere.[38,39] This was also confirmed using the number of healthy teeth as an ordinal variable, ie, those in the 1 to 10 group suffered much more from pain than those without any healthy teeth, probably because the most common origin of oral pain is from tooth-related diseases. However, it may also be explained by the fact that the transitional adaptation from partial to complete edentulism had already occurred, and these subjects were already adapted. This finding has also been reported by several authors.[35,38–41]

In periodontal terms, the present findings agree with some authors who suggest that the severity of periodontal disease impinges on several dimensions of oral well-being.[42,43] Nevertheless, most studies addressing this have been carried out on periodontal patients with the expected pain-discomfort-related events, and, hence, the influence of periodontal needs in population-based studies has rarely been broached, in spite of being a very common condition in adults and older people.[44] Despite this, periodontal status and periodontal needs were not able to predict pain or chewing difficulties when a multivariable analysis was performed in the present study.

According to this high-specificity model, subjects with the above-mentioned risk factors will probably report that they suffer from pain or eating problems frequently (because this model provided low false-positives). However, since the model affords low-sensitivity, it is a possibility that people belonging to the non-risk categories (few missing or decayed teeth) would also report pain or eating problems because there are some other common pain-related or chewing-related conditions that were not recorded in this study, such as proximal food packing, unfitted dentures, sore spots, ulcers, and occluding pairs of teeth. Moreover, other impact-related factors, such as social class, brushing habits, or periodontal needs, were also found to influence the effect in bivariate analysis, but they were not captured in the adjusted model because of the high collinearity between variables (confounding factors).

Further efforts should be directed towards gaining a comprehensive estimation of the OHQoL in Spain and surrounding countries, but the authors consider that simple estimation of individuals' pain and eating problems is a very valuable indicator that responds to the main issue of oral well-being and could easily be introduced into large epidemiological studies with no special cost as regards the time required for exploration. Within the limitations of this study, it could be argued that caries and prosthetic treatment needs should be considered the key factors in determining the oral well-being of the Spanish population, and these results could likely be generalized to other countries where oral health and dietary habits are similar. Nevertheless, this should be investigated in further research.

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References

1. Cuenca i Sala E. La encuesta de la O.M.S. sobre la salud buco-dental en España. Una aproximación personal. Arch Odontoestomatol 1986;2:15–22.
2. Sicilia A, Cobo J, Noguerol B. Prevalencia de caries en los niños y jóvenes escolares españoles de siete, doce y quince a diecinueve años. Av Odontoestomatol 1990;6:323–330.
3. Noguerol Rodríguez B, Llodra Calvo JC, Sicilia Felechosa A, Follana Murcia M. La salud bucodental en España. 1994. Antecedentes y perspectivas de futuro. Madrid: Ediciones Avances, 1995.
4. Llodra Calvo JC, Bravo Pérez M, Cortés Martinicorena FJ. Encuesta de salud oral de España (2000). RCOE 2002;7:19–63.
5. Bravo Pérez M, Casals Peidró E, Cortés Martinicorena FJ, Llodra Calvo JC. Encuesta de salud oral en España 2005. RCOE 2006;11(suppl 1):409–456.
6. World Health Organization. Oral Health Surveys: Basic Methods, ed 3. Geneva: World Health Organization, 1987.
7. World Health Organization. Oral Health Surveys: Basic Methods, ed 4. Geneva: World Health Organization, 1997.
8. World Health Organization. Preamble to the Constitution of the World Health Organization as Adopted by the International Health Conference. New York: World Health Organization, 1948.
9. Montero J, Bravo M, Albaladejo A. Validation of two complementary oral health-related quality of life indicators in two qualitatively distinct samples of the Spanish population. Health Qual Life Outcomes 2008;18:101–115.
10. Montero J, Bravo M, Albaladejo A, Hernández LA, Rosel EM. Validation of the Oral Health Impact Profile (OHIP-14) for adults in Spain. Med Oral Patol Oral Cir Bucal 2009;14:e44–e50.
11. Cohen J. Statistical power analysis for the behavioral sciences, ed 2. Hissdale, NJ: Lawrence Erlbaum, 1988.
12. Grupo de trabajo de la Sociedad Española de Epidemiología y de la Sociedad Española de Medicina de Familia y Comunitaria. Una propuesta de medida de la clase social. Aten Primaria 2000;25:350–363.

13. Bourgeois DM, Llodra JC, Nordblad A, Pitts NB. Health surveillance in Europe. A selection of essential oral health indicators. Lyon: European Commission Health and Consumer Directorate General, 2005.
14. Ware JE. SF-36 health survey update. Spine 2000;25: 3130–3139.
15. Borritz M, Rugulies R, Bjorner JB, Villadsen E, Mikkelsen OA, Kristensen TS. Burnout among employees in human service work: Design and baseline findings of the PUMA study. Scand J Public Health 2006;34:49–58.
16. Slade GD, Spencer AJ. Development and evaluation of the oral health impact profile. Community Dent Health 1994;11:3–11.
17. Chavers LS, Gilbert GH, Shelton BJ. Two-year incidence of oral disadvantage: A measure of oral health-related quality of life. Community Dent Oral Epidemiol 2003;31:21–29.
18. Locker D. Measuring oral health: A conceptual framework. Community Dent Health 1988;5:3–18.
19. Slade GD. Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, 1997.
20. Bravo M, Cortés J, Casals E, Llena C, Almerich-Silla JM, Cuenca E. Basic oral health goals for Spain 2015/2020. Int Dent J 2009;59:78–82.
21. World Health Organization Oral Health Epidemiological Profiles website. http://www.whocollab.od.mah.se/. Accessed 25 January 2011.
22. Mason J, Pearce MS, Walls AW, Parker L, Steele JG. How do factors at different stages of the life-course contribute to oral health-related quality of life in middle age for men and women? J Dent Res 2006;85:257–261.
23. Global Oral Data Bank Periodontal Country Profiles website. http://www.dent.niigata-u.ac.jp/prevent/perio/contents.html. Accessed 25 January 2011.
24. Sanders AE, Slade GD, Lim S, Reisine ST. Impact of oral disease on quality of life in the US and Australian populations. Community Dent Oral Epidemiol 2009;37:171–181.
25. Slade GD, Nuttall N, Sanders AE, Steele JG, Allen PF, Lahti S. Impacts of oral disorders in the United Kingdom and Australia. Br Dent J 2005;198:489–493.
26. Locker D, Quiñonez C. Functional and psychosocial impacts of oral disorders in Canadian adults: A national population survey. J Can Dent Assoc 2009;75:521.
27. Pohjola V, Lahti S, Suominen-Taipale L, Hausen H. Dental fear and subjective oral impacts among adults in Finland. Eur J Oral Sci 2009;117:268–272.
28. Chen MS, Hunter P. Oral health and quality of life in New Zealand: A social perspective. Soc Sci Med 1996;43:1213–1222.
29. Lawrence HP, Thomson WM, Broadbent JM, Poulton R. Oral health-related quality of life in a birth cohort of 32-years old. Community Dent Oral Epidemiol 2008; 36:305–316.
30. Segú M, Collesano V, Lobbia S, Rezzani C. Cross-cultural validation of a short-form of the oral health impact profile for temporomandibular disorders. Community Dent Oral Epidemiol 2005;33:125–130.
31. Barros V de M, Seraidarian PI, Côrtes MI, de Paula LV. The impact of orofacial pain on the quality of life of patients with temporomandibular disorder. J Orofac Pain 2009;23:28–37.
32. Reissmann DR, John MT, Schierz O, Wassell RW. Functional and psychosocial impact related to specific temporomandibular disorder diagnoses. J Dent 2007;35:643–650.
33. Inglehart MR, Silverton SF, Sinkford JC. Oral health-related quality of life: Does gender matter? In: Inglehart MR, Bagramian RA (eds). Oral Health-Related Quality of Life. Chicago: Quintessence, 2002:111–121.
34. Locker D, Slade GD. Association between clinical and subjective indicators of oral health status in an older adult population. Gerodontology 1994;11:108–114.
35. John MT, Koepsell TD, Hujoel P, Miglioretti DL, LeResche L, Micheelis W. Demographic factors, denture status and oral health-related quality of life. Community Dent Oral Epidemiol 2004;32:125–132.
36. Steele JG, Sanders AE, Slade GD, et al. How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. Community Dent Oral Epidemiol 2004;32:107–114.
37. Åstrom AN, Haugejorden O, Skaret E, Trovic TA, Klock KS. Oral impacts on daily performance in Norwegian adults: The influence of age, number of missing teeth, and sociodemographic factors. Eur J Oral Sci 2006;114:115–121.
38. Lahti S, Suominen-Taipale L, Hausen H. Oral health impacts among adults in Finland: Competing effects of age, number of teeth, and removable dentures. Eur J Oral Sci 2008;116:260–266.
39. Pallegedara C, Ekanayake L. Effect of tooth loss and denture status on oral health-related quality of life of older individuals from Sri Lanka. Community Dent Health 2008;25:196–200.
40. Bae KH, Kim C, Paik DI, Kim JB. A comparison of oral health related quality of life between complete and partial removable denture-wearing older adults in Korea. J Oral Rehabil 2006;33:317–322.
41. Jones JA, Orner MB, Spiro A, Kressin NR. Tooth loss and dentures: Patients' perspectives. Int Dent J 2003;53(suppl 5):327–334.
42. Needleman I, McGrath C, Floyd P, Biddle A. Impact of oral health on the life quality of periodontal patients. J Clin Periodontol 2004;31:454–457.
43. Saito A, Hosaka Y, Kikuchi M, et al. Effect of initial periodontal therapy on oral health-related quality of life in patients with periodontitis in Japan. J Periodontol 2010;81: 1001–1009.
44. Wandera MN, Engebretsen IM, Rwenyonyi CM, Tumwine J, Astrøm AN. Periodontal status, tooth loss and self-reported periodontal problems effects on oral impacts on daily performances, OIDP, in pregnant women in Uganda: A cross-sectional study. Health Qual Life Outcomes 2009;14:89–99.