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Chewing problems are associated with depression in the elderly: results from the InCHIANTI study.

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Abstract

Objective.—Depression is increasingly recognized in older populations, and associated with undernutrition, disability and increased mortality. Chewing problems (CPs) share with depression these associations. The aim of the study is to evaluate the association, if any, between CPs and depression in older subjects.

Methods.—We assessed 927 participants aged 65+, derived from the “InCHIANTI” study. Mood was evaluated using the CES-D scale, and defined depressed by a CES-D score ≥ 20 . CPs were self-reported. Logistic regression was performed to assess the adjusted association between depression and CPs. The adjusted model was analyzed after stratifying for use of complete, partial dentures and edentulism.

Results.—CPs were reported by 293/927 (31.6%) participants. Depression was present in 188/927 (20.3%) participants. In multivariable logistic regression, CPs were associated with depression (OR=1.81, 95% CI=1.26–2.58; P=.001). No significant association was found among subjects who used complete dentures (OR=1.12, 95% CI=.80–1.58, P=.515). Up to 27.8% of prevalent depression might be attributed to CPs.

Conclusions.—CPs are associated with depression in elderly populations. Use of complete dentures hinder this association. Older depressed subjects should be screened for the presence of CPs; further studies are needed to evaluate the impact of early detection and correction of CPs on the development of depression.

Keywords

Chewing problems; depression; elderly; epidemiology

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest in this study.

INTRODUCTION

Depressive symptoms are highly prevalent in elderly populations, ranging from 12 to 56%, according to the settings and methods of assessment used (Penninx *et al.*, 1998). According to the World Health Organization projections, by the year 2020 depression will become second only to ischaemic heart disease for disability-adjusted life years loss worldwide (World Health Organization 2001).

Chewing problems (CPs) are generally defined as a self-reported symptom, or as an objective deficit in chewing selected foods (Salleh *et al.*, 2007). Due to increased prevalence of disorders of the oral mucosa, impairment of masticatory, xerostomia, nervous system disorders, and edentulism, CPs are a common condition, yet often overlooked, in older populations (Locker, 2002). CPs, that are, at least in some cases, potentially reversible by adequate oral care and, when appropriate, by implant treatment, are a relevant cause of malnutrition in older populations (Feldblum *et al.*, 2007); in turn, alterations in dietary intake might cause weight loss and an increased risk of systemic diseases, such as osteoporosis (Laudisio *et al.*, 2007). Also, not surprisingly, chewing ability has been found to be associated with life satisfaction (Inukai *et al.*, 2010).

The aim of the present study was to assess whether self-reported CPs are associated with clinically relevant depressive mood in community-dwelling elderly.

METHODS

Participants

The present study is based upon data from the “Invecchiare in Chianti” (Aging in the Chianti Area, InCHIANTI) study, a prospective population-based study of older persons in Tuscany, Italy. The InCHIANTI study aims to identify risk factors for late-life disability (Ferrucci *et al.*, 2000).

Briefly, participants were selected from the city registries of Greve in Chianti and Bagno a Ripoli using a multistage sampling method. In 1998, 1155 subjects aged 65 plus randomly selected from the population agreed to participate in the project (91.6% response rate). Three and 6 years after the baseline visit (2001 – 2003 and 2004 – 2006), study participants underwent repeated phlebotomy, laboratory testing, and physical performance assessment.

The Italian National Research Council on Aging Ethical Committee ratified the study protocol and participants provided written consent to participate.

At baseline, analyses included 927 participants aged 65 plus; 228 participants had been excluded because of missing data for study variables (serum parameters in 119 subjects, urinary cortisol in 81, and mood status in 28). Subanalyses on use of denture included 911 subjects because 16 participants had missing data for this variable.

Chewing problems

CPs were tested as a self-reported symptom “Do you experience difficulties in chewing?”; “The amount of food you usually eat is decreased in the last year because of chewing problem?” CPs were diagnosed if at least one of these questions was answered affirmatively.

Several previous studies have adopted a similar approach using subjective, rather than objective evaluation (Inukai *et al.*, 2010; Laudisio *et al.*, 2010; Moriya *et al.*, 2011; Moriya *et al.*, 2012).

Depressed mood

Depressive symptoms were assessed using the original 20-item version of the Center for Epidemiological Studies-Depression Scale (CES-D), that was administered during the home interview. The CES-D is a self-report scale, ranging from 0 to 60 (Radloff, 1997), which has been proven a valid instrument for identifying depressive symptoms in older community-dwelling adults, including an Italian sample (Fava, 1983).

Analyses were performed using a CES-D score as a dichotomous variable for clinically relevant depressed mood (CES-D ≥ 20 ; referred to as depressed mood). Usually, a cutoff score of 16 on the CES-D is considered to represent clinically relevant depression; however, previous studies have demonstrated that a cutoff of 20 on the CES-D avoids overestimation in older adult populations (Penninx, *et al.*, 1998).

Covariates

Education was expressed as years of school attendance. Smoking was self-reported, and expressed as total lifetime pack-years (packs smoked per day)*(years of smoking). Current alcohol consumption was evaluated as glasses of wine per week, because this beverage represents by far the major form of alcohol consumption in Italy, independently of any seasonal variations Ferraroni *et al.*, 1996).

Diseases were ascertained by experienced clinicians according to pre-established criteria that combined information from self-reported physician diagnoses, current pharmacologic treatment, medical records, clinical examinations, and blood tests. Diagnostic algorithms for diseases were modified versions of those created for the Women’s Health and Aging Study (Guralnik *et al.*, 1995).

All drugs assumed by participants were coded according to the Anatomical, Therapeutic and Chemical codes (WHO Collaborating Centre for Drug Statistics Methodology).

Data on dietary intake were collected by the food-frequency questionnaire created for the European Prospective Investigation into Cancer and nutrition (EPIC) study (Pisani *et al.*, 1997). Specific software created for the EPIC study transformed data on food consumption into daily intake of energy, macronutrients, and micronutrients. BMI was calculated as weight (kg) divided by height squared (m^2). Weight was measured to the nearest 0.1 kg using a high-precision mechanical scale and standing height to the nearest 0.1 cm based on wall measure with participants wearing light indoor clothes and no shoes.

Functional disability was defined as need of assistance for performing one or more Katz' activities of daily living (Katz *et al.*, 1963).

Cognitive performance was evaluated using the 30-item Mini Mental State Examination, which is the most widely used neuropsychological measure of cognitive function, and is considered an effective screening instrument for cognitive impairment in general populations (Folstein *et al.*, 1975).

Blood samples were obtained from participants after 12-hour fasting and after resting for at least 15 minutes. Aliquots of serum were stored at -80°C and were not thawed until analyzed. Determination of high-sensitivity C-reactive protein (Hs-CRP) levels was based on high sensitivity enzyme-linked immunosorbent assay, using purified protein and polyclonal anti-CRP antibodies. The minimum detectable concentration was $0.16\text{ }\mu\text{g/mL}$. Hs-CRP plasma levels were defined high when $>3\text{ mg/L}$. Twenty-four hours urinary cortisol was measured by an immunochemiluminescence method and an ADVIA-Centaur immunoassay system (Bayer Diagnostics). Urinary cortisol level was defined as micrograms of cortisol excreted over 24 hours.

Statistical analyses

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS for Windows version 17.0, 2008, SPSS Inc., Chicago, IL); differences were considered significant at the $P < .050$ level. Data of continuous variables are presented as mean values $\pm$ standard deviation (SD). Analysis of variance for normally distributed variables according to the presence of CPs were performed by ANOVA comparisons; otherwise, the nonparametric Kruskal-Wallis H test was adopted. Chi-square analysis was used for dichotomous variables; in particular, Chi square analysis was performed to assess whether the distribution of clinically relevant depressed mood differed according to the presence of CPs. Serum Hs-CRP levels were analyzed after log transformation.

Also, ANOVA comparisons were performed within edentulous participants to assess any differences regarding dietary intake (and nutritional status) according to reported CPs.

Logistic regression analysis was used to estimate the association of variables of interest, including CPs, with depressive mood. To assess independent correlates of depressed mood, which might confound the association between CES-D score and CPs, groups of variables (demographics, nutrient intake, comorbid conditions, medications, and objective tests, as depicted in Tables 1 and 2) were first examined using separate age- and sex-adjusted regression models. Those variables, significant at the $P < .050$ level in these initial models (Table 3), were simultaneously entered into a summary model (Table 3). Also, the age- and sex-adjusted association between depressed mood and CPs was assessed in logistic regression after stratifying for use of complete dentures, partial dentures and edentulism (Figure 1).

In addition, as the correlates of depressive symptoms and depression often differ by sex, we assessed whether the effect CPs on depressed mood varied according to sex, by analyzing in

the summary logistic regression model the interaction term 'CPs by diagnosis of depressed mood.

Eventually, we calculated the percent population attributable risk, i.e., the proportion of depression attributable to CPs.

RESULTS

CPs were reported by 293/927 (31.6%) participants. The main characteristics of participants according to the presence of CPs are depicted in Table 1. Participants with CPs, as compared with other subjects, were significantly older and more often women, reported a lower education level, less prevalent protein, lipids and energy consumption, had more prevalent diagnosis of periodontitis, higher serum proteins, and reported more severe depressive symptoms and had lower cognitive performance; of borderline significance was a more prevalent use of benzodiazepines. Among subjects with edentulism, those who reported CPs had lower energy intake as compared with participants without CPs (1875 ± 512 kcal/day vs. 2056 ± 626 ; $P=.030$).

Clinically relevant depressed mood was present in 188/927(20.3%) participants. The main characteristics of subjects according to the presence of depressed mood are depicted in Table 2.

Subjects with clinically relevant depressed mood were significantly older and more often women, had more prevalent diagnosis of heart failure, and chewing problems; reported a more prevalent use of selective serotonin reuptake inhibitors, benzodiazepines, angiotensin-converting enzyme inhibitors, and loop diuretics; and they had lower hemoglobin levels, and higher 24h urinary cortisol levels; eventually they had lower cognitive performance.

Multivariable analyses

In the initial logistic age- and sex-adjusted regression models, age, sex, smoking, diagnosis of heart failure, use of selective serotonin reuptake inhibitors, benzodiazepines, and loop diuretics, total 24h urinary cortisol, and CPs were all associated with depressed mood at a $P<.050$ level (Table 3). After simultaneously adjusting for all these potential confounders in the summary model (Table 3), CPs were associated with increased probability of depressed mood (OR= 1.81, 95% CI= 1.26 – 2.58; $P=.001$). The age and sex-adjusted association between depressed mood and CPs (Figure 1), as calculated by logistic regression modeling, remained significant after stratifying for use of partial dentures (OR= 2.65, 95% CI= 1.45 – 4.82; $P=.001$) and in participants with edentulism (OR= 2.22, 95% CI= 1.22 – 4.03; $P=.009$); however, no significant association was found in participants who used complete dentures (OR= 1.12, 95% CI= .80 – 1.58; $P=.515$). Use of partial or complete dentures did not differ according to sex: 184 (36.2%) women used partial dentures vs 140 (33.4%) of men, $P=.406$; and 189 (37.2%) of female used complete dentures vs 152 (36.3%) of men, $P=.785$.

In the final logistic regression modeling, analysis of the interaction term indicated that the association between CPs and depressed mood did not vary according to sex ($P=.586$). Also,

the interaction term was not significant in the age-adjusted model ($P=.866$), as well as in the crude model ($P=.802$).

Eventually, the population attributable risk percent calculation indicated that CPs accounted for 27.8% of the cases of depression.

DISCUSSION

The results of the present study indicate that among community-dwelling older subjects CPs are independently associated with increased prevalence and severity of depressive symptoms. This association is significant among elderly with edentulism, as well as in those with partial dentures, but not among older subjects who use complete dentures.

Depression in old age is considered a public health problem, as it is frequent, and is associated with adverse outcomes (Penninx *et al.*, 1998). Depression in old age is associated with increased prevalence of functional impairment, reduced quality of life, as well as with more “non-specific” medical complaints, and with increased hospitalization rates (Beekman *et al.*, 1997; Laudisio *et al.*, 2010). Independently of these outcomes, the severity and duration of exposure to depression have been associated with a higher mortality risk in older community-living persons; also, depression has been associated with 30% increase in healthcare costs, independently of underlying medical conditions (Luppa *et al.*, 2008). However, despite its prognostic role, the determinants of depression in older age are largely unknown. Depression in advanced age has been associated with biological dysregulations which prevalence increases with advancing age, such as dysfunctions in the hypothalamic-pituitary-adrenocortical (HPA) system (Holsboer 2000), autonomic dysregulation, metabolic syndrome (Laudisio *et al.*, 2009) and inflammatory processes (Penninx *et al.*, 2003).

Therefore, depression is associated with several conditions which denote a condition of “frailty”; indeed, masticatory dysfunction is an acknowledged cause of frailty in older subjects (Fried *et al.*, 2001). In this view, the association reported in several studies of depression with malnutrition, anemia, or low cholesterol levels is not surprising (German *et al.*, 2008); in fact, masticatory dysfunction is a major cause of malnutrition in older populations (Moynihan and Bradbury 2001). As documented by several reports, perceived masticatory ability is strictly associated with comfort in chewing certain foods, which, in turn, affects food selection (Onder *et al.*, 2007). The association of chewing problems with clinically relevant depressed mood in the present study might therefore reflect the increased risk of malnutrition in subjects with CPs. Another potential determinant of the association of depressed mood with CPs might be represented by inflammation (Penninx *et al.*, 2003).

Periodontitis, which is by far the most common cause of teeth loss and CPs in older populations, is associated with increased serum levels of proinflammatory cytokines and serum cortisol (Johannsen *et al.*, 2006); indeed, in the present study 24-h urinary cortisol levels, but not hsCRP levels were significantly associated with depression. Eventually, the cross sectional nature of the present study does not allow to ascertain the direction of the association between CPs and depression; thus, it cannot be excluded that depressed mood might influence the reporting rate of CPs. However, masticatory dysfunction has been proven to induce in experimental studies (Ono *et al.*, 2010) chronic activation of the HPA axis with ensuing ipercortisolism, which is a hallmark of depression. Noticeably, advanced

age per se is associated with chronic activation of the HPA axis, which might therefore be enhanced by masticatory dysfunction.

The loss of association between CPs and depression among participants who used complete dentures deserves attention. Surveys of elderly people have found that one-third of participants had trouble with chewing or biting some foods, and this proportion rose to as high as three-fourths in edentulous elderly individuals. Chewing ability is a strong determinant of quality of life among subjects with partial dentures (Inukai *et al.*, 2010); also, it has been evidenced that oral health-related quality of life of subjects with Parkinson's disease is improved by use of dental implants (Packer *et al.*, 2009). Our results might indicate that complete dentures might be more effective in improving chewing ability of our participants, as compared with partial dentures. This might be related to the ability of consuming a larger variety of foods, to reduced discomfort or pain during chewing, or even to better nutrition status (Gunji *et al.*, 2009). Also, several studies reported that patient perception of chewing ability is not always associated with objective chewing ability in edentulous people. This discrepancy between subjective and objective chewing ability might explain the lack of association of depression with MD in complete denture participants (Ikebe *et al.* 2007; Kagawa *et al.* 2012).

Limitations

First, due to its cross-sectional design, this study does not allow to establish any cause-effect relationship.

Second, we did not have access to psychiatric diagnoses of depression. However, the CES-D is a commonly used scale to measure depressive symptoms and has been widely used in older population-based studies.

Third, in the present study CPs were self-assessed; self-assessed tools for evaluating masticatory function might underestimate CPs, as compared with objective evaluation. Nevertheless, this would represent a conservative bias, which further supports our finding of an association between CPs and depression. Also, self-assessment methods allow to detect the impact of several factors, not always measurable, on chewing ability, such as functional deficiencies of the tongue, painful disorders of the oral mucosa, dysgeusia, xerostomia, or nervous system disorders. Focusing on the outcomes of subjective, rather than objective, health status is in accordance with the Institute of Medicine's promotion of patient-centered care, and it is mandatory for formal cost-effectiveness calculations in healthcare.

CONCLUSION

CPs should be systematically screened in older subjects for a variety of reasons, among which is the assessment of correlates and, hopefully, the prevention of depression. Caring for CPs will allow to test the strength of the CPs-depression association by assessing changes in affective status following CPs care; in this perspective, efforts should be made to tailor the best treatment to individual needs. Indeed, CPs are very heterogeneous, and treatments should vary accordingly. The final objective is to reduce, through an effective CPs care, the burden of depressive symptoms on health status and healthcare-related costs.

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Key points:

- Both depression and chewing problem are common in older population and they are associated with poor outcomes, including malnutrition.
- Results of the present study indicate that chewing problems and depressed mood are associated in older community-dwelling subjects.
- Use of complete dentures seems to hinder such an association.
- Up to 27.8% of cases of depressed mood might be attributed to chewing problems.

Figure 1. Age- and sex-adjusted association (odds ratios) between depressed mood and chewing problems in participants with complete dentures, partial dentures and edentulism.

Table 1.

Characteristics of 927 participants according to the presence of chewing problems.

	Participants with chewing problems (n =293) n (%) or mean $\pm$ SD	Participants without chewing problems (n =634) n (%) or mean $\pm$ SD	P
<i>Demographics & lifestyle habits</i>			
Age (years)	75.6 $\pm$ 7.2	73.5 $\pm$ 6.4	<.0001
Sex (female)	178 (60.8%)	330 (52.1%)	.016
Education (years)	5.0 $\pm$ 3.0	5.7 $\pm$ 3.4	.001
Current alcohol consumption	14.5 $\pm$ 16.2	16.9 $\pm$ 16.4	.183
Smoking ^a	12.1 $\pm$ 21.4	13.1 $\pm$ 21.0	.186
<i>Dietary intake</i>			
Proteins (g/die)	73.61 $\pm$ 19.19	76.90 $\pm$ 21.35	.025
Available carbohydrates (g/die)	245.71 $\pm$ 80.83	253.50 $\pm$ 80.70	.174
Total lipids (g/die)	63.43 $\pm$ 18.94	66.28 $\pm$ 20.89	.048
Energy (kcal/day)	1873.16 $\pm$ 536.88	1971.55 $\pm$ 575.31	.014
<i>Comorbid conditions</i>			
Chronic pulmonary disease	7 (2.4%)	21 (3.3%)	.539
Heart failure	16 (5.5%)	27(4.3%)	.406
Stroke	12 (4.1%)	35 (5.5%)	.422
Parkinson's disease	1 (0.3%)	7 (1.1%)	.447
Coronary disease	18 (6.1%)	47 (7.4%)	.580
Diabetes	34 (11.6%)	76 (12.0%)	.913
Periodontitis	148 (50.5%)	266 (42.0%)	.016
<i>Medications</i>			
SSRI ^b	5 (1.7%)	7 (1.1%)	.534
Benzodiazepines	56 (19.1%)	89 (14.0%)	.052
ACE-inhibitors ^c	41 (14.0%)	79 (12.5%)	.529
Loop diuretics	28 (9.6%)	42 (6.6%)	.141
Corticosteroids	9 (3.1%)	8 (1.3%)	.067
<i>Objective tests</i>			
Hemoglobin (g/dl)	13.7 $\pm$ 1.3	13.8 $\pm$ 1.3	.086
Serum cortisol (μ g/dl)	13.6 $\pm$ 4.3	13.6 $\pm$ 4.7	.268
C Reactive Protein-high-sensitivity (μ g/ml)	5.0 $\pm$ 6.3	5.1 $\pm$ 10.3	.875
Total cholesterol (mg/dl)	219.4 $\pm$ 37.1	218.3 $\pm$ 40.0	.690
Total proteins (g/dl)	7.2 $\pm$ 0.4	7.1 $\pm$ 0.4	.020
Serum creatinine (mg/dl)	0.9 $\pm$ 0.19	0.9 $\pm$ 0.23	.978
Total 24h urinary cortisol (μ g)	100.0 $\pm$ 56.0	102.5 $\pm$ 67.6	.535
Thyroid stimulating hormone (mIU/l)	2.30 $\pm$ 6.09	1.67 $\pm$ 2.87	0.41
Body Mass Index	27.7 $\pm$ 4.2	27.3 $\pm$ 3.9	.175
Functional disability ^d	20 (6.8%)	17 (2.7%)	.006
Mini Mental State Examination	24.8 $\pm$ 3.4	25.5 $\pm$ 3.0	<.0001

	Participants with chewing problems (n =293) n (%) or mean $\pm$ SD	Participants without chewing problems (n =634) n (%) or mean $\pm$ SD	P
CES-D ^e	14.9 $\pm$ 9.4	11.4 $\pm$ 7.9	<.0001
Use of complete dentures	106 (37.2%)	235 (37.5%)	.941
Use of partial dentures	104 (35.5%)	220(34.7%)	.824
Edentulism	75 (25.6%)	171(27.0%)	.690

^aTotal lifetime pack years.

^bSelective serotonin reuptake inhibitors.

^cAngiotensin-Converting Enzyme inhibitors.

^dKatz' activities of daily living score <6.

^e20-item version of the Center for Epidemiological Studies-Depression Scale.

Table 2.

Characteristics of 927 participants according to the presence of depressed mood.*

	Participants with a CES-D* score ≥ 20 (n = 188) n (%) or mean ± SD	Participants with a CES-D* score < 20 (n = 739) n (%) or mean ± SD	P
<i>Demographics & lifestyle habits</i>			
Age (years)	76.2 ± 6.5	73.7 ± 6.7	<.0001
Sex (female)	138 (73.4%)	370 (50.1%)	<.0001
Education (years)	5.2 ± 3.5	5.6 ± 3.2	.114
Current alcohol consumption	16.2 ± 16.3	18.5 ± 21.4	.961
Smoking ^a	8.2 ± 19.9	13.9 ± 21.2	<.0001
<i>Dietary intake</i>			
Proteins (g/die)	70.87 ± 20.26	77.12 ± 20.69	<.0001
Available carbohydrates (g/die)	237.84 ± 72.85	254.37 ± 82.36	.013
Total lipids (g/die)	62.57 ± 20.40	66.09 ± 20.26	.035
Energy (kcal/day)	1807.18 ± 513.65	1974.10 ± 572.71	<.0001
<i>Comorbid conditions</i>			
Chronic pulmonary disease	4 (2.1%)	24 (3.2%)	.632
Heart failure	15 (8%)	28 (3.8%)	.020
Stroke	10 (5.3%)	37 (5%)	.853
Parkinson's disease	3 (1.6%)	5 (0.7%)	.209
Coronary disease	14 (7.4%)	51 (6.9%)	.751
Diabetes	18 (9.6%)	92 (12.4%)	.314
Periodontitis	77 (41%)	337 (46.5%)	.286
Chewing problems	86 (45.7%)	207 (28%)	<.0001
<i>Medications</i>			
SSRI ^b	8 (4.3%)	4 (0.5%)	.001
Benzodiazepines	59 (31.4%)	86 (11.6%)	<.0001
ACE-inhibitors ^c	34 (18.1%)	86 (11.6%)	.028
Loop diuretics	25 (13.3%)	45 (6.1%)	.002
Corticosteroids	5 (2.7%)	12 (1.6%)	.361
<i>Objective tests</i>			
Hemoglobin (g/dl)	13.4 ± 1.3	13.9 ± 1.3	<.0001
Serum cortisol (µg/dl)	13.0 ± 4.4	13.5 ± 4.6	.212
C Reactive Protein-high-sensitivity (µg/ml)	6.76 ± 15.88	4.67 ± 6.53	.593
Total cholesterol (mg/dl)	219.1 ± 34.7	218.5 ± 40.1	.851
Total proteins (g/dl)	7.2 ± 0.5	7.2 ± 0.4	.792
Serum creatinine (mg/dl)	0.9 ± 0.2	0.9 ± 0.3	.673
Total 24h urinary cortisol (µg)	110.46 ± 100.51	99.34 ± 50.81	.034
Thyroid stimulating hormone (mIU/l)	2.72 ± 8.24	1.66 ± 2.13	.235
Body Mass Index	27.5 ± 4.5	27.5 ± 3.9	.971
Functional disability ^d	16 (8.5%)	21 (2.8%)	.001

	Participants with a CES-D* score ≥ 20 (n = 188) n (%) or mean $\pm$ SD	Participants with a CES-D* score < 20 (n = 739) n (%) or mean $\pm$ SD	P
Mini Mental State Examination	24.7 $\pm$ 3.1	25.5 $\pm$ 3.1	.001
Use of complete dentures	78 (41.5%)	263 (35.6%)	.150
Use of partial dentures	59 (31.4%)	265 (35.9%)	.266
Edentulism	45 (23.9%)	201 (27.2%)	.405

* Depressed mood was defined by a Center for Epidemiological Studies-Depression Scale score ≥ 20 .

^a Total lifetime pack years.

^b Selective Serotonin Reuptake Inhibitors;

^c Angiotensin-Converting Enzyme inhibitors.

^d Katz' activities of daily living score < 6.

Table 3.

Association (OR coefficients, and 95% confidence intervals, CI) of depressive mood with the variables of interest according to the initial (age and sex-adjusted), and the summary (fully adjusted) regression models. All the covariates were entered simultaneously into the regression models.

	Age- and sex-adjusted models			Summary model		
	OR	95% CI	P	OR	95% CI	P
<i>Demographics & lifestyle habits</i>						
Age (years)	1.04	.94 – 1.15	.423	1.03	1.01 – 1.05	.039
Sex (female)	17.09	2.84 – 102.92	.002	2.31	1.45 – 3.68	<.0001
Education (years)	1.13	.97 – 1.33	.118			
Current alcohol consumption	1.03	0.99 – 1.07	.075			
Smoking ^a	1.03	1.01 – 1.05	.026	.99	.98 – 1.01	.267
<i>Dietary intake</i>						
Proteins (g/die)	.98	.96 – 1.01	.093			
Available carbohydrates (g/die)	1.03	1.01 – 1.05	.012	1.00	.99 – 1.02	.789
Total lipids (g/die)	1.01	1.01 – 1.02	.041	1.00	.99 – 1.01	.752
Energy (kcal/day)	.99	.99 – 1.01	.083			
<i>Comorbid conditions</i>						
Chronic pulmonary disease	.85	.27 – 2.66	.779			
Heart failure	2.14	1.05 – 4.34	.036	1.43	.66 – 3.10	.363
Stroke	1.07	.49 – 2.33	.859			
Parkinson's disease	3.45	.75 – 15.93	.112			
Coronary disease	1.14	.59 – 2.23	.695			
Diabetes	.77	.44 – 1.35	.368			
Periodontitis	.78	.55 – 1.19	.156			
Chewing problems	1.97	1.40 – 2.79	<.0001	1.81	1.26 – 2.58	.001
<i>Medications</i>						
SSRI ^b	7.31	2.04 – 26.17	.002	6.50	1.72 – 24.60	.006
Benzodiazepines	2.66	1.78 – 3.97	<.0001	2.64	1.75 – 4.00	<.0001
ACE-inhibitors ^c	1.26	.77 – 2.06	.364			
Loop diuretics	2.02	1.12 – 3.63	.019	2.10	1.44 – 3.86	.017
Corticosteroids	1.27	.40 – 4.06	.690			
<i>Objective tests</i>						
Hemoglobin (g/dl)	.90	.76 – 1.06	.201			
Serum cortisol (µg/dl)	.97	.93 – 1.01	.197			
C Reactive Protein high-sensitivity (µg/ml) ^d	1.03	.86 – 1.25	.736			
Total cholesterol (mg/dl)	.99	.98 – 1.02	.749			
Total proteins (g/dl)	.88	.57 – 1.35	.564			
Serum creatinine (mg/dl)	2.07	.70 – 6.11	.186			
Total 24h urinary cortisol (µg)	1.03	1.01 – 1.06	.034	1.01	1.01 – 1.02	.009
Thyroid stimulating hormone (mIU/l)	1.04	.99 – 1.09	.061			

	Age- and sex-adjusted models			Summary model		
	OR	95% CI	P	OR	95% CI	P
Body Mass Index	.98	.94 – 1.03	.535			
Functional disability ^e	4.31	1.78 – 10.45	.001	2.78	1.27 – 6.06	.010
Mini Mental State Examination	.98	.93 – 1.05	.622			

^aTotal lifetime pack years.

^bSelective serotonin reuptake inhibitors;

^cAngiotensin-Converting Enzyme inhibitors.

^d20-item version of the Center for Epidemiological Studies-Depression Scale.

^dLog-transformed.

^eKatz' activities of daily living score <6.