Epidemiology of periodontal status in dentate adults in France, 2002–2003

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Background and Objective: Few recent nationwide studies of the periodontal landscape in European countries have been developed from the point of view of attachment loss and pocket depth. Decision makers are not always in a position to estimate the burden of periodontal disease. The purpose of this study was to investigate the prevalence and the oral distribution of periodontal status among dentate adults in the general population of France.

Material and Methods: In 2002–2003, a National Periodontal and Systemic Examination Survey was organized to a stratified quota sample of 2144 adults, aged 35–64 years, nationwide. Participants with six or more teeth were selected from the Health Examination Centers of the National Health Insurance. Measurement of periodontal health was assessed by clinical attachment level and probing depth.

Results: A total of 95.40% and 82.23% of adults were found to have clinical attachment loss and periodontal pockets, respectively. Population prevalence estimates indicated that loss of attachment ≥ 5 mm is 46.68% and probing depth (> 5 mm) is 10.21%. However, clinical attachment loss of ≥ 5 mm occurred in only 0.88 sites in an individual. Periodontal depth pocket generalized forms were as follows: 78% slight, 18% moderate and 4% severe. Multiple logistic regression analyses showed significant differences of attachment loss values between types of tooth (molar, incisors, canines, or premolars).

Conclusion: Based on the International Classification of Periodontal Diseases, $\approx 50\%$ of adults in France may suffer from a severe attachment loss problem. Periodontal pockets are an uncommon condition in France. Significant differences in the prevalence of loss of attachment and probing depth with respect to location of attack have implications in the purchase and development of screening and treatment services. Copyright © Blackwell Munksgaard Ltd

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In Europe, although the impact on public health of periodontal health is, most of the time, validated in the scientific literature, decision makers are not always in a position to estimate the burden of periodontal disease and risk factors on the morbidity rates and quality of life of the population. The major reason for this is that the description of periodontal conditions is difficult owing to the scarcity of data from national studies based on a representative sample of the population of the country. In addition, the variation in methodological aspects of epidemiological studies markedly limits comparisons between countries and regions (1).

The first National Periodontal and Systemic Examination Survey, based

on a cross-sectional multicenter design, was conducted in France over the period 2002–2003. The primary aim of this project was twofold: first, to evaluate the periodontal status of the French population; and, second, to describe the associations between periodontal health status and various systemic conditions (2), such as diabetes (3) and cardiovascular diseases. The concept was to associate a system of periodontal data harvesting over a limited period with a national surveillance system for noncommunicable diseases and their risk factors.

The objective of the present report was to describe the prevalence of periodontal disease in the adult in France, seeking to estimate the nationwide amplitude in a global perspective.

Material and methods

Programme overview

The programme was guided by a National Screening Steering Group, comprising multidisciplinary representation from relevant clinical and public health bodies engaged in oral public health, periodontology, general practice, diabetes, cardiovascular diseases, education, health promotion, surveillance and statistics. Two national level institutions came together to run the first National Periodontal and Systemic Examination Survey project: the French Union for Oral Health, a World Health Organization Collaborating Center with expertise in oral health epidemiology, acted as project manager, having run national dental studies in 1987, 1993 and 1998 (4); and the health examination centers of the Caisse Nationale d'Assurance Maladie des Travaileurs Salariés, which conduct the periodic health checks required by French law for the adult population. More than 100 such centers throughout France together perform over 600,000 examinations per year, making this health examination centers network a prime tool in the work of prevention carried out by the National Health Insurance system. It provides unique epidemiological possibilities, enabling the state of health of the population as a whole to be described, and the health needs of those covered by national health insurance to be analyzed. In recent years, the health examination centers have produced quality data for estimating nationwide prevalence and risk factors for certain selected pathologies, but not, however, for periodontal health. A global overview of the first National Periodontal and Systemic Examination Survey project can be consulted on the site http://lass.university-lyon1.fr/pub/ NPASES.pdf

Sampling

The population studied to meet the first National Periodontal and Systemic Examination Survey objectives comprised adults aged between 35 and 64 years, living in all 22 administrative regions of metropolitan France, who underwent a health check in one of the 116 Caisse Nationale d'Assurance Maladie des Travaileurs Salariés Health Examination Centers between September 2002 and June 2003 (i.e. 20,323,726 individuals, the target population from which sampling was undertaken). Recruitment was carried out in the framework of the normal activity of the 29 health examination centers taking part in the study. The number of health examination centers, randomly selected by region, depended on the weight of the regional population. On the basis of an estimated prevalence of 3.9% for mild to severe periodontal disease in adults (data obtained from the International Collaborative Study II study developed in France in 1993), the sample size necessary to obtain a precision rate of 95% (confidence interval: 95%) was calculated to be 2144 (5).

The sample of 2144 subjects was 51% women, with a median age of 49.6 years (Q1 = 42.44 years; Q3 = 58.37 years). The sampling technique adopted in the light of the study objectives was that of site quotas, a nonprobabilistic method based on a Bayesian model. The quotas method consists of building up a sample that reproduces faithfully the studied population. The sampling method was similar to that used in the World Health Organization's 1995 International Collaborative Study II France programme (6). It involved a fourfold stratification (by age, gender, socioprofessional category and region), with reference to the 1999 French National Institute for Statistics and Economic Studies survey. The number of subjects included per health examination center depended on the weighting of the center's catchment and the center's annual turnover in terms of examinations. The distribution of retired persons per socio-professional category occurred in terms of their declared previous occupation. Only the category of 'Farmers' did not feature among the survey's socio-professional categories (while amounting to 3.2% of the study population, as they do not come to health examination centers for check-ups). The posthoc representativeness of the sample matched the regional and national distribution for the stratification variables employed.

The 29 health examination centers taking part in the project were selected on the following basis: (i) a call for applications by the health examination centers was made in May 2000; (ii) a kick-off technical meeting was held to brief the physicians in charge of the health examination centers; (iii) health examination centers were asked to agree to take part, in February 2001; and (iv) health examination centers were finally selected to ensure an even geographic spread over the whole of France, in co-ordination with the Health Examination Center Technical Support and Training Center. Twentynine centers in metropolitan France (i.e. excluding overseas territories) took part in the study.

Subject inclusion and information

The study protocol was approved by the Ethics Committee of Lyon, France. Subjects who agreed to participate signed an informed consent form. As recommended and developed in the third National Health and Nutrition Examination Survey (NHASES III) by the National Institute of Dental Research (7), consenting subjects had six or more teeth. At the end of the examination, patients with diagnosed pathological conditions were provided with a written report and advised to seek oral health consultation.

Measurement of periodontal health

Periodontal examination employed a sterile, disposable US Williams PDT Sensor probe, at a pressure of 20 g.

Clinical attachment level was defined as the distance from the cementoenamel junction to the tip of the probe. Attachment loss was measured (to the nearest mm) by simple probing by identifying the cemento-enamel junction and measuring the distance to the base of the pocket. Probing depth was defined as the distance from the soft tissues margin to the tip of the probe. The plaque index and gingival bleeding index were recorded at the same sites. Excluded sites (2.4% of the sites) due to missing teeth were not detected and unfeasible examinations were marked down as A and X, respectively. All teeth were examined. Third molars were excluded from analysis. The mean number of decayed, missing and filled teeth (\pm standard error) of the 2144 adults aged 35-64 years was, respectively, 1.6 (95% confidence interval: 0.0-3.2); 3.8 (95% confidence interval: 1.6-7.6) and 6.7 (95% confidence interval: 2.9-10.5).

Variables were assessed for four sites per tooth: mesio-vestibular; distovestibular; lingual/palatine; and vestibular. Periodontal sites were measured interproximally at lines angles. Periodontal indices were recorded in the following order: plaque index; gingival bleeding index; probing depth; and probing attachment loss. The recording sequence was as follows: first, distal 18 for the four indices; second, vestibular; third, mesial; and fourth, palatine. The recording sequence for the four quadrants was quadrant 1, quadrant 2, quadrant 3, then quadrant 4.

Periodontal disease classification

The periodontal status of each subject was assessed on the basis of the amount of clinical attachment loss (8). Severity based on the site in the mouth with the most severe loss was characterized as follows: slight = 1 or 2 mm clinical attachment loss; moderate = 3-4 mm clinical attachment loss; moderate = 3-4 mm clinical attachment loss; and severe = ≥ 5 mm clinical attachment loss. Extent by severity (slight, moderate, severe) was characterized as 'localized' (> 30% of sites involved), or 'generalized' (> 30% of sites involved).

Medical exclusions

The following conditions constituted exclusion criteria: severe cardiovascular diseases (valvular disease, endocarditis, pacemaker, or advanced cardiovascular diseases); anticoagulant and/or platelet aggregation inhibitor therapy; or hemophilia.

Examiner consistency and reliability

The intra- and interexaminer variability of five regional dental officers was assessed from clinical practice, as per the 'Calibration of Examiners for the International Collaborative Study of Oral Health Outcomes' (9). The weighted kappa value was based on clinical attachment loss of individual sites in 10 patients. The agreement at the end of the training phase, calculated on the average of all pairwise comparisons between examiners for a six-grade index (2.3.4.5.7.9), was 0.75.

Each regional officer conducted on the 24 sites a similar training of calibration among the local dental examiners during the first 2 weeks of the clinical data-harvesting programme, in line with the above calibration document and objectives. The mean value obtained by the study examiners was compared with that of the regional examiners to obtain a minimum agreement of 0.75. A second site visit was made 2 wk later, to assess the quality of data collection.

Data analysis

The descriptive analysis presented here concerns attachment loss and probing depth. Cross-sectional descriptive analyses of the population tested, and assessment of factors - age and gender associated with periodontal health (clinical attachment loss and probing depth), were performed. Associations between periodontal health status and socio-professional category will be published at a later date. Tables were drawn according to the model of Albandar et al. (10). The distributions of demographic and test characteristics within the population were tabulated. Chi-square tests, univariate analyses and analysis of variance were calculated. Survey design and statistical process were conducted by Laboratory of Analysis in Health Systems, National Centre of Scientifical Research, Lyon, France (Professor J. P. Auray). All data analysis was performed using spss 12.0 for Windows (SPSS Inc., Chicago, IL, USA), with two-tailed significance levels of p < 0.05.

Results

Attachment loss

Table 1 indicates that the prevalence of severe attachment loss (i.e. ≥ 5 mm) was 46.68% (95% confidence interval: 46.17–47.19). Population estimates indicate that more than 1.1 million subjects have attachment loss of at least 7 mm. Only 4.6% did not present attachment loss of ≤ 2 mm. This percentage varied by 6% between the youngest and oldest age-groups.

The number of subjects presenting each level of attachment loss increased significantly with age (p < 0.01). The prevalence of severe attachment loss was 32.31% (95% confidence interval: 31.81-32.81) in the 35-39-year-old age group. This prevalence was 1.32-fold greater among 40-49-year-old subjects, 1.71-fold greater among 50-59-year-old subjects and 1.83-fold greater among 60-64-year-old subjects. The progression was constant and significant (p < 0.001) except for the 60–64-yearold subjects, whose scores were similar to those of the 50-59 year-age age-group $(\mathbb{R}^{60-64/50-59} \ge 5000 \text{ smm} = 1.06; p > 0.05).$

Overall, men showed a greater percentage of attachment loss than women (P < 0.001), regardless of age category (p > 0.001). The male/female ratios of attachment loss $(\mathbb{R}^{M/F})$ for the whole sample were as follows: $\mathbb{R}_{2mm}^{M/F} = 1.01$; $\mathbb{R}_{3mm}^{M/F} = 1.10$; $\mathbb{R}_{4mm}^{M/F} = 1.22$; $\mathbb{R}_{5mm}^{M/F} =$ 1.43; $\mathbb{R}_{7mm}^{M/F} = 2.41$; and $\mathbb{R}_{9mm}^{M/F} = 5.0$. The most marked difference was in subjects of the 50–59-year-old age group, in which $\mathbb{R}_{7mm}^{M/F}$ and $\mathbb{R}_{9mm}^{M/F}$ values were 2.66 and 8.30, respectively (p < 0.001).

Table 2 shows the percentage of sites with attachment loss per subject. In general, one subject had 29.13% (95% confidence interval: 26.81–31.45) of the 112 sites showing attachment loss of

Table 1. Prevalence of subjects (n = 2144) with attachment loss according to age and gender ($\% \pm SE$), and estimate population affected by attachment loss

	35–39 years	40-49 years	50-59 years	60-64 years	Total	Estimate population
All subjects						
> 2 mm	91.20 ± 0.29	95.11 ± 0.20	95.62 ± 0.21	97.19 ± 0.21	95.40 ± 0.22	19,388,834
> 3 mm	62.49 ± 0.52	73.59 ± 0.37	82.09 ± 0.39	83.80 ± 0.39	$75.32~\pm~0.38$	15,303,765
> 4 mm	32.31 ± 0.50	42.62 ± 0.50	55.23 ± 0.52	59.03 ± 0.53	46.68 ± 0.51	9,491,180
> 5 mm	8.92 ± 0.29	15.89 ± 0.42	27.12 ± 0.36	28.61 ± 0.40	19.70 ± 0.40	4,003,774
> 7 mm	1.28 ± 0.11	$5.01~\pm~0.18$	$7.50~\pm~0.29$	$9.79~\pm~0.27$	5.70 ± 0.21	1,158,452
> 9 mm	0.70 ± 0.11	1.31 ± 0.11	$1.58~\pm~0.09$	2.10 ± 0.11	1.39 ± 0.12	284,532
Men						
> 2 mm	92.95 ± 0.26	96.40 ± 0.19	97.54 ± 0.16	97.58 ± 0.15	96.10 ± 0.19	9,570,239
> 3 mm	64.32 ± 0.48	79.22 ± 0.41	84.51 ± 0.36	89.70 ± 0.30	78.88 ± 0.41	7,855,364
> 4 mm	$35.68~\pm~0.48$	49.58 ± 0.50	58.45 ± 0.49	66.67 ± 0.47	51.47 ± 0.50	5,125,704
> 5 mm	11.20 ± 0.32	17.73 ± 0.38	31.69 ± 0.47	$38.18~\pm~0.49$	23.22 ± 0.42	2,312,392
> 7 mm	1.66 ± 0.13	$6.37~\pm~0.24$	10.92 ± 0.31	16.97 ± 0.38	8.18 ± 0.27	814,615
> 9 mm	$0.83~\pm~0.09$	1.94 ± 0.14	2.82 ± 0.17	4.24 ± 0.20	2.28 ± 0.15	227,056
Women						
> 2 mm	90.45 ± 0.29	96.23 ± 0.24	97.60 ± 0.15	96.86 ± 0.17	94.78 ± 0.22	9,818,595
> 3 mm	60.45 ± 0.49	94.19 ± 0.47	79.79 ± 0.40	79.37 ± 0.40	71.91 ± 0.45	7,448,401
> 4 mm	$28.64~\pm~0.45$	$49.22~\pm~0.48$	52.05 ± 0.50	$53.36~\pm~0.50$	42.18 ± 0.49	4,365,476
> 5 mm	6.36 ± 0.24	19.38 ± 0.35	22.60 ± 0.42	21.52 ± 0.41	16.29 ± 0.37	1,691,382
> 7 mm	$0.91~\pm~0.09$	$5.04~\pm~0.19$	4.11 ± 0.20	4.48 ± 0.21	$3.39~\pm~0.18$	343,837
> 9 mm	$0.45~\pm~0.07$	$0.78~\pm~0.07$	$0.34~\pm~0.06$	$0.45~\pm~0.07$	$0.46~\pm~0.07$	57,476

Table 2. Prevalence of sites with attachment loss per subject (n = 2144) according to age and gender ($\% \pm SE$)

	35-39 years	40-49 years	50-59 years	60-64 years	Total
Total					
> 2 mm	22.04 ± 2.13	$27.82~\pm~2.38$	32.08 ± 2.25	37.49 ± 2.44	29.13 ± 2.32
> 3 mm	4.54 ± 0.71	8.11 ± 1.17	11.74 ± 1.34	13.88 ± 1.43	9.14 ± 1.21
> 4 mm	$1.23~\pm~0.35$	$2.65~\pm~0.66$	4.55 ± 0.71	$5.56~\pm~0.80$	$3.28~\pm~0.66$
> 5 mm	0.25 ± 0.14	0.75 ± 0.35	1.23 ± 0.36	$1.52~\pm~0.32$	$0.88~\pm~0.31$
> 7 mm	$0.04~\pm~0.05$	$0.16~\pm~0.01$	$0.21~\pm~0.09$	0.31 ± 0.11	$0.17~\pm~0.09$
> 9 mm	$0.01~\pm~0.02$	$0.04~\pm~0.04$	0.04 ± 0.03	0.05 ± 0.03	$0.03~\pm~0.03$
Men					
> 2 mm	24.27 ± 2.15	31.68 ± 2.54	34.65 ± 2.27	40.67 ± 2.44	31.84 ± 2.39
> 3 mm	$5.20~\pm~0.76$	9.59 ± 1.32	39.94 ± 1.48	17.62 ± 1.65	10.69 ± 1.36
> 4 mm	$1.49~\pm~0.41$	$3.26~\pm~0.77$	42.34 ± 8.46	8.06 ± 1.02	$4.14~\pm~0.79$
> 5 mm	$0.34~\pm~0.17$	$1.01~\pm~0.46$	30.62 ± 4.65	$2.44~\pm~4.25$	$1.24~\pm~0.41$
> 7 mm	$0.06~\pm~0.06$	$0.24~\pm~0.13$	18.85 ± 1.21	0.54 ± 1.42	$0.26~\pm~1.18$
> 9 mm	0.02 ± 0.23	0.06 ± 0.50	23.53 ± 0.55	0.07 ± 0.31	$0.06~\pm~0.44$
Women					
> 2 mm	$19.62~\pm~2.09$	23.87 ± 2.14	$29.69~\pm~2.22$	35.19 ± 4.38	$26.52~\pm~2.24$
> 3 mm	3.82 ± 0.64	$6.59~\pm~0.96$	9.78 ± 0.16	11.17 ± 1.19	$7.65~\pm~1.04$
> 4 mm	$0.95~\pm~0.26$	2.03 ± 0.51	$3.34~\pm~0.53$	$3.75~\pm~0.55$	$2.45~\pm~0.50$
> 5 mm	$0.16~\pm~0.08$	0.48 ± 0.19	0.71 ± 0.18	$0.86~\pm~0.20$	$0.54~\pm~0.18$
> 7 mm	$0.01~\pm~0.01$	$0.08~\pm~0.05$	$0.10~\pm~0.05$	$0.15~\pm~0.07$	$0.08~\pm~0.05$
> 9 mm	$0.00~\pm~0.01$	$0.01~\pm~0.07$	$0.01~\pm~0.01$	$0.03~\pm~0.03$	$0.01~\pm~0.02$

more than 2 mm. This percentage increased significantly with age, regardless of the degree of attachment loss (p < 0.001). In the 35–39-year-old age group, 1.23% (95% confidence interval: 0.88–1.58) of sites presented severe attachment loss (i.e. ≥ 5 mm). The percentage of severely affected sites increased by 2.15 in subjects of the 40–49-year-old age group, and then by 1.71

in subjects of the 50–59-year-old age group and by 1.22 in subjects of the 60– 64-year-old age group (p < 0.01). The difference in prevalence of ≥ 5 mm attachment loss between the youngest and oldest age groups corresponds clinically to an extra 4.33 affected sites per subject (p < 0.01).

The mean attachment loss recorded was 2.50 mm (95% confidence interval,

1.90–3.10). Analysis of variance confirmed that men were significantly more affected than women (2.58 \pm 0.69 mm vs. 2.42 \pm 0.48 mm; p < 0.01). Also, for each degree of severity taken separately, mean attachment loss increased significantly with age (2.30 \pm 0.35; 2.44 \pm 0.54; 2.56 \pm 0.57; 2.73 \pm 0.81; p < 0.01), as it also did for either gender taken separately (p < 0.01).

Table 3. Distribution of all subjects (n = 2144) by ordered categories of clinical attachment loss (in mm)

Age (years)		Clin	ical at	tachme	nt loss												
		None		1–2				3–4				≥ 5				Total	
				Loca	lized	Gene	ralized	Loca	lized	Gener	ralized	Loca	lized	Gene	ralized		
	Gender	n	%	n	%	n	%	n	%	n	%	n	%	n	%	п	%
35–39	Male	16	6.7	63	26.1	75	31.1	8	3.3	52	21.6	1	0.4	26	10.8	241	100
	Female	20	9.1	68	30.9	68	30.9	8	3.6	42	19.0	1	0.5	13	5.9	220	100
40-49	Male	13	3.6	68	18.8	101	28.0	4	1.1	111	30.7	5	1.4	59	16.3	361	100
	Female	20	5.6	106	29.6	105	29.3	8	2.2	69	19.3	4	1.1	46	12.9	358	100
50-59	Male	3	1.1	47	16.5	66	23.2	4	1.4	73	25.7	4	1.4	87	30.6	284	100
	Female	7	2.4	65	22.3	68	23.3	5	1.7	82	28.1	5	1.7	60	20.5	292	100
60-64	Male	2	1.2	20	12.3	32	19.4	5	3.1	43	26.1	1	0.6	62	38.0	165	100
	Female	5	2.2	38	17.0	60	26.9	3	1.4	67	30.3	3	1.4	47	20.8	223	100
	Total	86	4.0	475	22.2	575	26.8	45	2.1	539	25.1	24	1.1	400	18.7	2144	100

Table 3 indicates the distribution of all subjects according to their degree and extent of attachment loss. Of the 2144 subjects, 25.4, 70.6% and 4.0% had, respectively, localized, generalized or no clinical attachment loss > 1 mm. Most localized forms of clinical attachment loss were slight (87.3%), well ahead of the moderate (8.3%). Severe forms of clinical attachment loss (i.e. > 5 mm) were marginal (4.4%). The distribution of generalized forms of clinical attachment loss was as follows: 38.0% slight, 35.6% moderate and 26.4% severe. Overall, men (22.7%) showed a greater percentage

of generalized attachment loss of > 5 mm than women (15.1%) (p < 0.001), regardless of the age category (p < 0.001). The male ratio R^{60-64/35-40} years was 3.51 vs. 3.53 for women.

Attachment loss: overall implication per tooth type

The mean attachment loss values show significant differences between types of tooth (Fig. 1). Tooth types implication decreased as follow: molars > premolars > incisors and canines (mixed model for repeated measures,



Fig. 1. Mean clinical attachment loss percentiles by tooth type (incisors and canines, pre-molars, molars) in the sample of 2144 adults in France, 2002–2003.

p < 0.0001). The mean attachment loss per tooth ranged from 2.72 to 2.27 mm for upper right molars and upper central incisors, respectively (Fig. 2). According to the tooth type, the mean attachment loss distribution decreased as follow: first upper molars > second upper and lower molars > first lower molars > upper and lower premolars, lower incisors > upper incisors and canines, and lower canines (p < 0.01). No significant left/right differences emerged per tooth or tooth type (p > 0.05).

Probing depth

The prevalence of probing depth $\geq 2 \text{ mm}$ was 82.2% (Table 4). Less than 18% of the sample did not present a probing depth of > 2 mm. One or more deep pocket (> 5 mm) was present in 10.2% of the sample, representing more than 2×10^6 subjects.

Between the youngest and oldest age groups, the difference in the prevalence of probing depths ≥ 2 mm was significant (p < 0.01). The difference, however, lay primarily between the 35–39 and 40–49-year-old age groups, with no significant difference between 40 and 64 years of age (p > 0.05).

In the study population, 1.73%(95% confidence interval: 1.60-1.86) presented probing depths of > 7 mm. The distribution of probing depth for the maximum severity category (> 9 mm) increased with age, and notably between the 50–59 and 60–64year-old age groups (ratio, 3.06;



Fig. 2. Distribution of mean attachment loss per tooth in the sample of 2144 adults in France, 2002-2003.

p < 0.01), with a relatively low overall prevalence (95% confidence interval: 0.15–0.23).

Men showed a significantly higher prevalence than women, regardless of the age category (p < 0.01). This difference became greater with greater severity of the periodontal depth pocket, as seen from the following male/female ratios ($\mathbb{R}^{M/F}$): $\mathbb{R}^{M/F}_{2mm} = 1.03$; $\mathbb{R}^{M/F}_{3mm} = 1.17$; $\mathbb{R}^{M/F}_{4mm} = 1.37$; $\mathbb{R}^{M/F}_{5mm} = 1.60$; $\mathbb{R}^{M/F}_{7mm} = 1.91$; and $\mathbb{R}^{M/F}_{9mm} = 3.8$ (p < 0.001).

Table 5 shows the mean prevalence of sites regarding probing depth in the sample population. Significant differences were found between the 35–39and 40–49-year age groups for probing depths between 2 and > 5 mm (p < 0.01). Thereafter, the percentage of sites affected by probing depth became relatively stable (p > 0.05). Beyond 7 mm, the prevalence of the affected site appeared to be low in all age groups.

Table 6 presents the distribution of all subjects according to the degree and extent of the periodontal depth pocket. The distribution of subjects with localized forms of periodontal depth pocket was 96% mild, 3% moderate and 1% severe; and the distribution of subjects with generalized forms of periodontal depth pocket was 78% slight, 18% moderate and 4% severe. The clinical situation between men and women was globally similar regardless of the extent (i.e. localized or generalized) and/or severity (1–2 mm, 3–5 mm and > 5 mm) of the periodontal depth pocket. The only difference (p < 0.01) concerned the 50–59- and 60–64 year age groups in relation to the 3–5 mm generalized periodontal depth pocket, where men showed a greater percentage of generalized attachment loss of > 5 mm than women.

Discussion

The first National Periodontal and Systemic Examination Survey applied the quotas method based upon the Bayesian model. Quota sampling is the nonprobability equivalent of stratified sampling (11). Like stratified sampling, the researcher first identifies the stratums and their proportions as they are represented in the population. Then, convenience or judgment sampling is used to select the required number of subjects from each stratum (6). This differs from stratified sampling, where the stratums are filled by

Table 4. Prevalence of subjects (n = 2144) with probing depth according to age and gender ($\% \pm SE$), and estimate population affected by probing depth

	35-39 years	40-49 vears	50-59 years	60-64 years	Total	Estimate population
	55 57 years	to to years	so sy jeurs	oo or years	Total	population
All subjects						
> 2 mm	76.57 ± 0.47	$82.89~\pm~0.38$	$84.90~\pm~0.36$	$83.76~\pm~0.37$	$82.23~\pm~0.38$	16,712,178
> 3 mm	44.03 ± 0.50	51.04 ± 0.50	$56.08~\pm~0.50$	$56.44~\pm~0.50$	51.87 ± 0.50	10,541,903
> 4 mm	$19.74~\pm~0.40$	$27.82~\pm~0.45$	$35.59~\pm~0.48$	$31.19~\pm~0.46$	$28.78~\pm~0.45$	5,849,160
> 5 mm	$4.34~\pm~0.20$	$10.43~\pm~0.31$	$15.28~\pm~0.36$	$9.28~\pm~0.29$	$10.21~\pm~0.30$	2,075,049
> 7 mm	$0.43~\pm~0.07$	$2.36~\pm~0.15$	$2.08~\pm~0.14$	$1.55~\pm~0.12$	$1.73~\pm~0.13$	351,600
> 9 mm	0.00	$0.14~\pm~0.04$	$0.17~\pm~0.04$	$0.52~\pm~0.07$	$0.19~\pm~0.04$	3,864
Men						
> 2 mm	80.91 ± 0.39	$86.70~\pm~0.34$	$86.9~\pm~0.34$	85.45 ± 0.35	$82.25~\pm~0.35$	8,190,969
> 3 mm	45.23 ± 0.50	$58.45~\pm~0.49$	59.15 ± 0.49	$60.00~\pm~0.49$	55.85 ± 0.50	5,561,892
> 4 mm	$24.07~\pm~0.43$	$32.69~\pm~0.47$	$40.49~\pm~0.49$	$36.36~\pm~0.48$	$33.40~\pm~0.47$	3,326,181
> 5 mm	4.56 ± 0.21	$10.80~\pm~0.31$	$19.01~\pm~0.39$	$17.58~\pm~0.38$	12.65 ± 0.33	1,259,766
> 7 mm	$0.83~\pm~0.09$	$2.77~\pm~0.16$	$2.82~\pm~0.17$	$2.42~\pm~0.15$	$2.28~\pm~0.15$	227,056
> 9 mm	0.00	$0.28~\pm~0.05$	$0.35~\pm~0.06$	$1.21~\pm~0.11$	$0.39~\pm~0.06$	3,864
Women						
> 2 mm	71.82 ± 0.45	$79.05~\pm~0.41$	$82.88~\pm~0.38$	$82.51~\pm~0.38$	$79.32~\pm~0.41$	8,521,209
> 3 mm	42.73 ± 0.50	$43.58~\pm~0.50$	$53.08~\pm~0.50$	$53.81~\pm~0.50$	$48.03~\pm~0.50$	4,980,011
> 4 mm	$15.00~\pm~0.36$	$22.91~\pm~0.42$	$30.82~\pm~0.46$	$27.35~\pm~0.45$	$24.34~\pm~0.43$	2,522,979
> 5 mm	$4.09~\pm~0.20$	$10.06~\pm~0.30$	11.64 ± 0.32	$3.14~\pm~0.17$	$7.87~\pm~0.27$	815,283
> 7 mm	0.00	$1.96~\pm~0.14$	$1.37~\pm~0.1$	$0.90~\pm~0.09$	$1.19~\pm~0.11$	124,544
> 9 mm	0.00	0.00	0.00	0.00	0.00	0

	35-39 years	40-49 years	50-59 years	60-64 years	Total
Total					
> 2 mm	14.90 ± 20.25	19.80 ± 24.29	19.75 ± 21.20	20.33 ± 20.65	18.74 ± 22.05
> 3 mm	$3.16~\pm~7.04$	5.82 ± 10.79	$5.96~\pm~9.34$	$5.90~\pm~9.32$	$5.26~\pm~9.47$
> 4 mm	$0.67~\pm~2.27$	$1.88~\pm~5.57$	$2.21~\pm~4.79$	$1.91~\pm~4.47$	$1.69~\pm~4.64$
> 5 mm	0.09 ± 2.27	$0.46~\pm~2.46$	0.46 ± 1.44	0.37 ± 1.56	$0.36~\pm~1.78$
> 7 mm	$0.00~\pm~0.07$	$0.04~\pm~0.37$	$0.04~\pm~0.26$	$0.04~\pm~0.32$	$0.03~\pm~0.29$
> 9 mm	0.00	$0.00~\pm~0.04$	0.00	$0.01~\pm~0.07$	$0.00~\pm~0.04$
Men					
> 2 mm	16.12 ± 2.10	23.22 ± 2.61	20.88 ± 2.09	21.02 ± 0.19	$20.57~\pm~2.28$
> 3 mm	$3.61~\pm~0.76$	6.94 ± 1.21	$6.97~\pm~0.99$	$7.10~\pm~1.08$	$6.15~\pm~1.05$
> 4 mm	0.86 ± 0.28	2.42 ± 0.68	2.83 ± 0.54	2.93 ± 0.61	$2.21~\pm~0.56$
> 5 mm	$0.12~\pm~0.10$	$0.63~\pm~0.32$	$0.66~\pm~0.18$	$0.75~\pm~0.23$	$0.53~\pm~0.23$
> 7 mm	$0.01 ~\pm~ 0.01$	0.06 ± 0.05	$0.04 ~\pm~ 0.02$	$0.08~\pm~0.05$	$0.05~\pm~0.04$
> 9 mm	0.00	$0.00~\pm~0.05$	$0.00~\pm~0.06$	$0.01~\pm~0.01$	$0.00~\pm~0.06$
Women					
> 2 mm	13.57 ± 1.93	16.30 ± 2.17	18.71 ± 0.15	19.83 ± 2.15	16.98 ± 2.11
> 3 mm	2.68 ± 0.63	4.67 ± 0.91	5.02 ± 0.87	$5.03~\pm~0.80$	$4.39~\pm~0.83$
> 4 mm	$0.47~\pm~0.16$	$1.32~\pm~0.38$	1.64 ± 0.41	1.17 ± 0.25	$1.19~\pm~0.33$
> 5 mm	$0.05~\pm~0.03$	$0.28~\pm~0.12$	$0.29~\pm~0.10$	$0.09~\pm~0.05$	$0.20~\pm~0.09$
> 7 mm	0.00	$0.02~\pm~0.02$	$0.03~\pm~0.03$	$0.01~\pm~0.09$	$0.02~\pm~0.02$
> 9 mm	0.00	0.00	0.00	0.00	0.00

Table 5. Prevalence of sites with probing depth per subject (n = 2144) according to age and gender ($\% \pm SE$)

Table 6. Distribution of all subjects (n = 2144) by ordered categories of periodontal depth pocket (in mm)

Age (years)		Periodontal depth pocket																
				1–2				3–4				≥ 5						
		None	e	Loca	lized	Gene	ralized	Loca	lized	Gene	ralized	Loc	alized	Gene	ralized	Total	Fotal	
	Gender	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
35–39	Male	46	19.1	101	41.9	83	34.5	2	0.8	7	2.9	1	0.4	1	0.4	241	100	
	Female	62	28.2	83	37.7	66	30.0	2	0.9	7	3.2	0	0.0	0	0.0	220	100	
40-49	Male	48	13.3	141	39.1	133	36.8	2	0.6	27	7.5	2	0.6	8	2.2	361	100	
	Female	75	20.9	153	42.7	94	26.3	2	0.6	27	7.4	1	0.3	6	0.9	358	100	
50-59	Male	37	13.0	120	42.2	73	25.7	5	1.8	41	14.4	1	0.4	7	2.5	284	100	
	Female	50	17.1	115	39.4	93	31.9	5	1.7	25	8.6	1	0.3	3	1.0	292	100	
60–64	Male	24	14.6	65	39.4	47	28.5	6	3.6	19	11.5	1	0.6	3	1.8	165	100	
	Female	38	17.0	93	41.7	84	37.7	3	1.4	2	0.9	1	0.4	2	0.9	223	100	
	Total	380	17.7	871	40.6	673	31.2	27	1.3	155	7.2	7	0.3	30	1.4	2144	100	

random sampling. Quota sampling is one of the more rigorous nonprobability sampling methods, which attempts to ensure representativeness by sampling individuals from known groups in the population or groups of interest to the survey design (12,13).

Sampling is carried out until a specific number of units (quotas) for various subpopulations have been selected. As there are no rules as to how these quotas are to be filled, quota sampling is really a means for satisfying sample size objectives for certain subpopulations (14). When the quotas method is carried out with care in respect to the application of the Bayesian conditions (variables of stratification, survey plan, non-zero probability of being selected and respect of the source of variability), the results are not significantly different (6,15). It is necessary to make a good choice of the variables on which the quotas would focus, to introduce, in the questionnaire, variables known as control variables or variables of interest, in order to have reliable projections based on the sample (16).

Two indices – attachment loss and pocket depth – served as references

for this transverse snapshot. Clinical measurements (i.e. probing depth and clinical attachment level), are commonly used to evaluate the periodontal destruction and prevalence in epidemiological studies in humans. It is generally believed that the progression of periodontitis may lead in fine to tooth loss. Thus, probing depth and/or clinical attachment loss are commonly used as surrogate variables for tooth loss. It should be underlined that $10.21 \pm 0.30\%$ of dentate adults presented at least one periodontal pocket in excess of 5 mm depth. The figures for attachment loss

are generally even higher. However high these figures may be when extrapolated to the entire population of France, they confirm the hypothesis put forward elsewhere that severe forms of periodontal damage affect only a minority of the population (10,17-19).

The present evaluation of periodontal conditions in this population must be interpreted in view of the cross-sectional design of the study, which does not include edentulous subjects. This exclusion criterion may lead to an underestimation of the prevalence of periodontal diseases. The magnitude of this estimate is still impossible to evaluate. However, one must bear in mind that France seems to have one of the lowest prevalences of edentulous people in western Europe (20). Thus, our outcomes may picture the closest reality of periodontal conditions in France.

The main international reference study was NHANES III (7), and we would be cautious regarding the legitimacy of extrapolating or comparing data without standardizing results for age, gender and socio-economic status between the two study populations. The methodologies likewise greatly differed (reference age, selection of sites, type of classification, etc.) (21). However, it would appear that, at a 15year interval, our results converge with the data of Albandar et al. (10). In the USA in 1988-1994, 53.1% of subjects presented $\geq 3 \text{ mm}$ attachment loss; two-thirds of the study population had moderate, and one-third severe, periodontitis. Severity and extent increased with age. Men tended to be more severely affected than women - as indeed is reported elsewhere (22,23). Tooth groups showed equivalent behavior with respect to periodontal damage.

There have been few recent nationwide studies of the periodontal landscape in European countries seen from the point of view of attachment loss and pocket depth, with a few exceptions, such as the UK for 1988 (24). However, periodontal epidemiological studies in Europe using a Periodontal Health Index (the Community Periodontal Index) are available (25). Even if one were to accept some of the limitations of the Community Periodontal Index (26,27), one cannot get away from the fact that deep pocket (Community Periodontal Index Score 4) is very uncommon in European adults (28). Between 1985 and 1995, the Community Periodontal Index generated an abundance of data and reviews (29). This golden age would seem to be over now, and there is a dearth of information in terms of both quality and quantity. Nevertheless, our results further confirm the hypotheses put forward by developed countries around 1995 (17), situating severe periodontitis in a bracket of 7-15% (30-33). It is hard to place our results with respect to other European countries, because of a lack of references.

The only reference study in France concerning adults was run under the World Health Organization's International Collaborative Study II programme and dates from 1993 (5). The major limitation of this study was the sample, which was representative of the Rhône-Alpes region but not of the national population. Ten years later, the data seem to show stability in the incidence of periodontal damage among young adults.

The present study provides indications, at a European level, as to which teeth should be examined for screening or epidemiological purposes. There is a match between attachment loss levels from left to right, and groups of teeth show similar behavior with regard to periodontal damage. This seems to argue in favor of gathering even partial clinical and epidemiological information (34).

Periodontal health as a public health problem, according to the World Health Organization definitions, must be dissociated to the potential impact it has in terms of periodontal treatments. Our findings show that the prevalence of deep pockets (> 5 mm) is low (10.21%), and underline that periodontal pockets is an uncommon condition in France. In view of this finding, in terms of treatment need, periodontitis in adults may not be considered as a major public health issue in France. This emphasizes the limitation of a cross-sectional study, which cannot evaluate the attachment loss over time. Further longitudinal studies are needed to evaluate treatment needs in France.

A possible explanation of the differences between clinical attachment loss and pocketing figures must be considered. When considering the public health importance of a condition it is vital to consider whether current treatments will alter the life history of the condition for the better. If the differences between clinical attachment loss and pocketing figures are that there is gingival recession, then there is little need to treat attachment loss. It should be advanced that recession is a likely explanation of the differences between clinical attachment loss and pocketing figures, and alter the interpretation of the results in the light of that explanation.

In the present study, the estimates, based on a representative sample of the national population in France, can be useful for studying the periodontal status of adults in Europe as essential components of oral health information systems for the analysis of trends in oral disease and the evaluation of oral health programmes at the country, regional and global levels (35). These outcomes may be important for evaluating the level of periodontitis, and can be valuable for decision makers to estimate the burden of periodontal diseases

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References

- Irfan UM, Dawson DV, Bissada NF. Epidemiology of periodontal disease: a review and clinical perspectives. *J Int Acad Periodontol* 2001;3:14–21.
- Bouchard P, Boutouyrie P, Mattout C, Bourgeois D. Risk assessment for severe clinical attachment loss in an adult population. J Periodontol 2006;77:479–489.
- Mattout C, Bourgeois D, Bouchard P. Type 2 diabetes and periodontal indicators: epidemiology in France 2002–2003. *J Periodont Res* 2006;41:253–258.
- Bourgeois DM, Roland E, Desfontaine J. Caries prevalence 1987–1998 in 12-yearolds in France. *Int Dent J* 2004;54:193– 200.
- Bourgeois D, Hescot P, Doury J. Periodontal conditions in 35–44-yr-old adults in France, 1993. J Periodont Res 1997;32: 570–574.
- Guillaud M, Bourgeois D, Leclercq MH, Duru G. Application of the method of quota in a WHO international oral health programme. *Health Syst Sci* 1997;6:570– 574.
- National Institute of Dental Research. Oral Health of United States Adults. National Findings. Bethesda, MD: US Department of Health and Human Services, 1987 (NIH Publication no. 87–2868).
- Armitage GC. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol* 1999;4:1–6.
- Eklund SA. Calibration of Examiners for Oral Health Epidemiological Surveys. WHO Technical Report, ORH/EIS/ EPID199. Geneva: World Health Organization, 1994.
- 10. Albandar JM, Brunelle JA, Kingman A. Destructive periodontal disease in adults

30 years of age and older in the United States, 1988–1994. *J Periodontol* 1999; **70**:13–29.

- Doherty M. Probability versus non-probability sampling in sample surveys. NZ Stat Rev 1994;3:21–28.
- Kearney JM, Kearney MJ, McElhone S, Gibney MJ. Methods used to conduct the pan-European Union survey on consumer attitudes to physical activity, body weight and health. *Public Health Nutr* 1999;2:79– 86.
- Gschwend T. Analyzing quota sample data and the peer-review process. *French Politics* 2005;3:88–91.
- Sudman S, Blair E. Sampling in the twenty-first century. J Acad Market Sc 1999;27:269–277.
- Sudman S, Lannom LB. A comparison of alternative panel procedures for obtaining health data. J Am Stat Ass 1977;71:511– 516.
- Sudman S. Probability sampling with quotas. J Am Stat Assoc 1966;32:749–771.
- Baehni PC, Bourgeois DM. Epidemiology of periodontal health and disease. In: Lang NP, Attström R, Löe H, eds. Proceedings of the European Workshop on Mechanical Plaque Control. Berlin: Quintessence Publishing Co., 1998:19–34.
- Kavanagh DA. The incidence of periodontal disease and its impact on future dental practice. *Dent Update* 1998;25:435– 440.
- Albandar JM, Rams TE. Global epidemiology of periodontal diseases: an overview. *Periodontol 2000* 2002;29:7–10.
- WHO. WHO Oral Country/Area Profile. Geneva: World Health Organization, 27 May 2005. (Available at: http:// www.whocollab.od.mah.se/index.html)
- Oliver RC, Brown LJ, Löe H. Periodontal diseases in the United States population. *J Periodontol* 1998;69:269–278.
- Norderyd O, Hugoson A. Risk for severe periodontal disease in a Swedish adult population. A cross-sectional study. J Clin Periodontol 1998;28:1022–1028.
- Paulander J, Axelsson P, Lindhe J, Wenstrom J. Some characteristics of 50/55year-old individuals with experience of destructive periodontal disease: a cross-

sectional study. *Acta Odontol Scand* 2004; **62:**199–206.

- Morris AJ, Steele J, White DA. The oral cleanliness and periodontal health of UK adults in 1998. Br Dent J 2001;25:186–192.
- Petersen PE, Ogawa H. Strengthening the prevention of periodontal diseases: the WHO approach. J Periodontol 2005; 76:2187–2193.
- Baelum V, Papapanou PN. CPITN and the epidemiology of periodontal disease. *Community Dent Oral Epidemiol* 1996;24:367–368.
- Bourgeois DM, Baehni PC. Surveillance, epidemiology and periodontal diseases. In: Bourgeois DM, Llodra JC, eds. Health Surveillance in Europe. European Global Oral Health Indicators Development Project. 2003 Report Proceedings. Paris: Quintessence Publishing Co., 2004:81–92.
- Sheiham A, Netuvel GS. Periodontal diseases in Europe. *Periodontol 2000* 2002;29:104–121.
- Gera I. Periodontal treatment needs in Central and Eastern Europe. J Int Acad Periodontol 2000;2:120–128.
- Papapanou PN, Tonetti MS. Diagnosis and epidemiology of periodontal osseous lesions. *Periodontol 2000* 2000;22:8–21.
- Papapanou PN. Epidemiology of periodontal diseases: an update. J Int Acad Periodontol 1999;1:110–116.
- Baelum V, Chen X, Manji F, Luan WM, Fejerskov O. Profiles of destructive periodontal disease in different populations. *J Periodont Res* 1996;31:17–26.
- Brown LJ, Löe H. Prevalence, extent, severity and progression of periodontal disease. *Periodontol 2000* 1993;2:57–71.
- Benigeri M, Brodeur JM, Payette M, Charbonneau A, Ismail AI. Community periodontal index of treatment needs and prevalence conditions. *J Clin Periodontol* 2000:27:308–312.
- Petersen PE, Bourgeois D, Bratthall D, Ogawa H. Oral health information systems – towards measuring progress in oral health promotion and disease prevention. *Bull World Health Organ* 2005;83:686– 693.

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