Prevalence and determinants of periodontal disease in Portuguese adults: results from a multifactorial approach

Manuel Desport Marques, Armando Teixeira-Pinto, Altamiro da Costa-Pereira and Harald M. Eriksen

Department of Preventive Dentistry, Faculty of Dentistry, University of Oporto, Portugal; Department of Biostatistics and Medical Informatics, Faculty of Medicine, University of Oporto, Portugal; and Department of Operative Dentistry, Faculty of Dentistry, University of Oslo, Norway

Marques MD, Teixeira-Pinto A, da Costa-Pereira A, Eriksen HM. Prevalence and determinants of periodontal disease in Portuguese adults: results from a multifactorial approach. Acta Odontol Scand 2000;58:201–206. Oslo. ISSN 0001-6357.

The purpose of the present investigation was to study prevalence of periodontal disease among 30 to 39-years-old from Oporto in the north of Portugal. In addition, an attempt was made to elucidate possible periodontal disease determinants in this population. A random sample consisting of a total of 322 individuals was drawn based on electoral lists. The attendance rate was 61%. The CPITN index was used and the results indicate a high prevalence of periodontal disease and a substantial need for periodontal treatment in this population, with 41% of the individuals investigated having one or more sites with a CPITN score 4 (pockets deeper than 5.5 mm). Dental visiting habits, gender (lower CPITN scores for females) and oral hygiene were the determinants most significantly associated with variation in CPITN scores. □ Adults; periodontal health; Portugal

Harald M. Eriksen, Dental Faculty, University of Oslo, P.O. Box 1142, Blindern NO-0317 Oslo, Norway. Tel. + 47 22 85 21 62, fax. + 47 22 85 23 32, e-mail. heriksen@odont.uio.no

Studies indicate that oral health problems are prevalent among Portuguese adults and untreated carious lesions and missing teeth are frequently found even among young individuals (1–4). Periodontal health is reported to be inferior to many other European countries (2, 5–8), but with substantial regional differences (3, 9). In addition, oral hygiene and oral hygiene habits have been found to be insufficient for a substantial part of the population (2, 3, 9, 10).

It is well established that bacterial plaque on tooth surfaces constitutes a major etiologic factor for development of periodontal diseases. Complementary to this biological factor, accumulation of plaque and the individual inflammatory response may also be directly or indirectly influenced by psycho-social and behavioural factors (11, 12). It may therefore be of relevance to study the prevalence of periodontal disease not only in a biological context but to include additional dimensions applying a multifactorial approach (13).

The aim of the present study was to record the level of periodontal disease by using the CPITN index according to the recommendations given by WHO (14) and correlate the index values with selected disease determinants among 30 to 39-year-olds in the Oporto area of Portugal. A socio-ecological model (13) was used as the conceptual basis for selecting relevant variables for statistical testing. This study was part of a more extensive oral health investigation (10) and caries data have been published previously (4, 15).

Material and methods

The original sample comprised 322 individuals, 30–39 years of age and living in the Oporto area. The sample was randomly drawn based on electoral lists and constituted approximately 0.5% of the background population. The sample size was chosen based on power estimates performed in connection with similar oral health studies carried out in Oslo, Norway (16). From the initial sample of 322 individuals, 197 (61%) were available for the investigation. Of the non-attenders, 65 invitations were returned due to unknown address and 35 refused to participate due to lack of interest. From the last 25, no response was obtained.

The clinical examination was performed at the dental school (Faculdade de Medicina Dentária) in Oporto and included a caries registration (4, 15) and a registration of periodontal conditions based on the Community Periodontal Index of Treatment Needs (CPITN) (14, 17). Maximum scores were entered as the individual values. The CPITN index system was originally designed for recording of treatment need but it has been found to be useful also for epidemiological monitoring of periodontal disease (18, 19) and is recommended for this purpose by WHO (14). We are aware of the limitations of this index system for estimation of periodontal disease in populations (19–21), but a more detailed recording based on tooth level rather than the sextants as units of registration was

Table 1. Individual distribution according to environmental and biological variables related to CPITN scores (*n* = 195)

| | | Distribution of CPITN scores | | | |
| | | 0–2 *n* = 25 | 3 *n* = 91 | 4 *n* = 79 | |
Independent variables	*n*	%	%	%	*P*
Environment					
No. of years of education					
Primary (0–4)	69	32	31	42	*0.19*
Secondary (5–11)	77	40	12	37	
High (=> 12)	49	28	27	21	
Social class					
Low	61	24	30	35	*0.22*
Medium	98	56	49	50	
High	36	20	21	15	
Economic status, degree of satisfaction (0–10)					
Low (0–5)	101	52	54	49	*0.87*
Medium (6–8)	76	36	37	42	
High (9–10)	18	12	9	9	
No. of years lived in Porto					
<30	65	44	32	32	*0.37*
=>30	130	56	68	68	
Civil status					
Not married	28	20	18	9	*0.08*
Married	167	80	82	91	
Human biology					
Gender					
Male	99	20	47	65	*<0.01*
Female	96	80	53	35	
No. of missing teeth					
<8	119	56	60	63	*0.51*
=>8	76	44	40	37	
Saliva secretion (stimulated)					
<1 ml/min	47	28	26	20	*0.34*
=>1 ml/min	147	72	74	80	
Dry mouth					
No	130	56	66	71	*0.18*
Yes	65	44	34	29	
Saliva buffer capacity					
Low	19	16	8	10	*0.80*
Medium	74	32	41	37	
High	101	52	52	53	
Chronic disease					
No	158	72	81	84	*0.25*
Yes	37	28	19	16	
Current medication					
No	152	76	76	81	*0.46*
Yes	43	24	24	19	

impossible to implement under the present research conditions. Oral hygiene was scored according to the Simplified Oral Hygiene Index (OHI-S) (22). The clinical investigation was performed by one examiner (M.D.M.) after thorough training and calibration with a Norwegian group of epidemiologists (4, 15).

Additional independent variables (disease determinants) were collected through a questionnaire and a structured interview focusing on oral health habits and conditions. Independent variables and their operationalized categories are presented in Tables 1 and 2. The variables were organized under four main items, "Environment", "Biology", "Behavior" and "Oral health care" according to the

Health Field Concept (13). Education was measured as years of formal education. Four years in primary school was mandatory for this age cohort and more than 11 years indicates higher education, establishing the rationale for the present division. Social class was divided into three groups based on information on occupation, low (unskilled and manual workers), medium ("white collar" workers) and high (professionals and executives). Economic status was measured according to degree of satisfaction with own economy (11) and psychological status as level of life satisfaction, both utilizing a visual scale from 0 to 10 according to Cantvil (23). Missing teeth were recorded based on a 32 teeth dentition (16). For the other

Table 2. Individual distribution according to behavioral and healthcare variables related to CPITN scores ($n = 195$)

Independent variables	n	Distribution of CPITN scores			P
		0-2 $n = 25$ %	3 $n = 91$ %	4 $n = 79$ %	
Behavior					
Oral hygiene (OHI-S) (22)					
Good (0–2.4)	49	52	24	18	*<0.01*
Medium (2.5–3.4)	72	28	40	37	
Poor (3.5–6.0)	74	20	36	45	
Psychological status level of satisfaction (0–10)					
Unsatisfied (0–5)	48	24	28	22	*0.31*
Moderately satisfied (6–8)	98	56	49	49	
Satisfied (9–10)	49	20	23	29	
Meals per day					
2 or less	108	64	46	63	*0.38*
3 or more	87	36	54	37	
Sweets consumption per day					
<1	135	68	62	78	*0.08*
=>1	60	32	38	22	
Tooth-brushing frequency					
<=1/day	94	40	42	58	*0.03*
>1/day	101	60	58	42	
Smoking					
No	107	64	58	48	*0.11*
Yes	88	36	42	52	
Healthcare					
Interval of complete dental treatment					
<=1 year	37	28	23	11	*0.03*
>1 year	36	28	13	22	
Never	122	44	64	67	
Last dental visit					
<1 year	92	52	52	41	*0.17*
1–3 years	47	32	17	29	
>3 years or never	56	16	31	30	
Regular visits					
No	138	48	68	81	*<0.01*
Yes	57	52	32	19	
Reason for consulting a dentist					
Pain	122	56	60	67	*0.25*
Other reason	73	44	40	33	

independent variables, information about operationalization may be obtained from Tables 1 and 2.

The statistical analysis was made using the SPSS software. For analytical purposes, the dependent variable (CPITN scores) was dichotomized in two different ways: (i) periodontal disease with a simple treatment need (CPITN scores 0–3) versus a complex treatment need (score 4) or (ii) excluding the CPITN score 3 group in order to create a more contrasting model. Both approaches were utilized in the final multivariate analyses (Tables 3 and 4). The association between each independent variable and the dichotomized CPITN variable using all information available was made using the chi-square test (Tables 1 and 2). In order to disclose covariance, a complete test of all the independent variables was performed by calculating Spearman's rank correlation coefficients and making a correlation matrix (Table 5). Finally, a logistic multiple regression model was estimated using a forward stepwise method with entry probability of 0.05 and removal probability of 0.10 (Tables 3 and 4).

Results

The distribution of CPITN scores is presented in Fig. 1. Because of incomplete information from two of the participants, the final sample in the present analyses constituted 195 individuals. Forty-one percent of those investigated presented with a CPITN score 4 and an additional 47% with score 3. This indicates a high prevalence of individuals with one or more periodontal pockets deeper than 5.5 mm being in need of complex periodontal treatment and a an overall high prevalence of periodontal disease.

The bivariate relationships between the independent variables and CPITN scores are presented in Tables 1 and

Table 3. Relationship between CPITN scores and significant variables in the logistic regression model (CPITN, 0–3/4), unadjusted and adjusted odds ratio values ($n = 195$)

Variables	Unadjusted		Adjusted	
	Odds ratio	95% CI	Odds ratio	95% CI
Regular visits				
Yes	1.00		1.00	
No	2.42	1.23–4.77	2.11	1.05–4.23
Gender				
Male	1.00		1.00	
Female	0.39	0.21–0.70	0.42	0.23–0.79

Table 4. Relationship between CPITN scores and significant variables in the logistic regression model (CPITN, 0–2/4), unadjusted and adjusted odds ratio values ($n = 104$)

Variable	Unadjusted		Adjusted	
	Odds ratio	95% CI	Odds ratio	95% CI
Oral Hygiene				
Good (0–2.4)	1.00	—	1.00	—
Medium (2.5–3.4)	1.69	0.77–3.67	3.37	1.01–11.22
Poor (3.5–6.0)	2.37	1.10–5.11	5.33	1.74–16.36
Gender				
Male	1.00	—	1.00	—
Female	0.14	0.05–0.40	0.16	0.05–0.49

2. None of the environmental variables (i.e. social class, education, economy, residency or civil status) reached statistically significant associations with variation in CPITN scores (Table 1). Of the biological variables, gender was the only factor showing a statistically significant association with CPITN scores, with males showing statistically significantly higher CPITN scores than females. Neither chronic disease nor medication was found to be associated with higher disease prevalence. Oral hygiene and brushing frequency were the only behavioral variables showing statistically significant associations with periodontal disease (Table 2). Smoking habits were not found to be associated with periodontal disease. Regularity in the use of dental health services seemed to have an impact on distribution of CPITN scores (Table 2) with higher CPITN scores among irregular than regular attenders.

All the statistically significant variables ($P < 0.05$) found in the initial bivariate analyses (Tables 1 and 2) were then introduced in a forward stepwise logistic regression analysis. From these variables, the only two included in the final multivariate model were gender and dental visiting habits (Table 3). After excluding the 91 participants with CPITN score 3, oral hygiene and gender were the two most influential variables found in the final model (Table 4).

Correlating all the independent variables using Spearman's rank correlation coefficients in a matrix, a substantial amount of correlation was demonstrated among the independent variables. For the variables included in the final models (Tables 3 and 4), gender, oral hygiene and regular dental visits were inter-correlated and in addition correlated significantly with some environmental, behavioral and oral health care factors (Table 5).

Discussion

The sample studied was randomly drawn from electoral lists and the attendance was 61%. The various reasons for non-attendance were unknown address (20%) and lack of interest (11%), while the reasons for the remaining 8% were unknown. No apparent selection bias was found and the sample might therefore be considered representative for the background population of 30 to 39-year-olds in Oporto. This age cohort was chosen primarily for comparative reasons (4, 15) and estimation of the sample size was done based on calculations performed in connection with the Oslo investigations (16).

Clinical calibration including training in applying the various clinical indices was performed prior to the investigation (4). The validity of the independent variables used in the questionnaire and in the interview session has been considered in preliminary testing. However, a formal evaluation of intra-observer reliability was not performed.

Table 5. Spearman's rank correlation coefficients for the three variables showing the strongest association with CPITN scores in the two logistic models (oral hygiene, regular visits and gender) and the other variables classified under environment, human biology, behavior and healthcare. Only the coefficients reaching statistical significance are included ($n = 195$)

	Oral hygiene		Regular dental visits		Gender	
	Coeff	*P*-value	Coeff	*P*-value	Coeff	*P*-value
Environment						
Education	0.30	<0.001	0.31	<0.001	N.S.	
Social class	0.31	<0.001	0.29	<0.001	N.S.	
Economy	0.20	0.005	0.15	0.04	N.S.	
Years lived in Porto	0.15	0.03	N.S.		0.17	0.02
Human biology						
Gender	0.16	0.02	0.18	0.01	—	—
Chronic disease	N.S.		0.15	0.04	N.S.	
Behavior						
Oral hygiene	—	—	0.30	<0.001	0.16	0.02
Life satisfaction	N.S.		N.S.		0.20	0.005
Toothbrushing frequency	0.27	<0.001	0.21	0.003	0.34	<0.001
Smoking	0.18	0.01	N.S.		0.34	<0.001
Healthcare						
Interval of complete dental treatment	0.29	<0.001	0.60	<0.001	0.15	0.04
Regular dental visits	0.30	<0.001	—	—	0.18	0.01
Reason for consult (pain/other)	0.18	0.01	0.48	<0.001	N.S.	

N.S. = Not significant.

The prevalence of subjects with CPITN score 4 was found to be high compared with other European countries (6–8) and also in comparison with previous oral health surveys from Portugal (2, 5). It is commonly assumed that only a minority of any population (5–15%) is susceptible to severe periodontal disease with rapid progression (24). Although the present high prevalence of periodontal disease indicated by the registered need for complex periodontal treatment (CPITN score 4) in part may be explained by inter-individual variation in levels of recording CPITN index values, it should be of concern that 41% of the present sample of adults from Portugal was recorded with one or more periodontal pockets > 5.5 mm.

Of the independent variables considered in the present study, oral hygiene, dental visit pattern, and gender seemed to be the most influential variables explaining variation in CPITN scores (Tables 1–4). This is in accordance with the results from many other studies (25–28), although some investigations have questioned the importance and direct relationship between oral hygiene levels and progression of periodontal disease on an individual level (29–32). For the situation in Portugal, with inferior oral hygiene levels indicated both from the present study and from other investigations (2, 3, 9), improvement in oral hygiene should be an important public health issue.

None of the environmental variables included reached statistically significant associations with variation in CPITN scores. Particularly for the variables related to socio-economic status, this is different from what is recorded in many industrialized countries, where distribution of periodontal disease is shown to have a socio-economic profile (14, 32, 33). Likewise, smoking was not found to be associated with variation in periodontal

disease which differs from established knowledge (24). This might be due to the reliability and/or operationalization of the recorded variables, but it may also reflect a cultural dimension related to health and disease in Portugal which was also demonstrated for variation in dental caries in the same cohort (4).

The logistic regression analyses confirmed gender, oral hygiene and dental visiting habits to be the strongest determinants related to periodontal disease in the present population. Oral hygiene was also found to be a strong determinant for periodontal health in two Norwegian samples of 35-year-olds (21), and gender reached statistical significance among 50-year-old Norwegians (13, 27).

The cross-correlation matrix made including all the independent variables revealed a high degree of correlation, particularly for variables measuring aspects of the same dimension, i.e. questions related to dental visiting
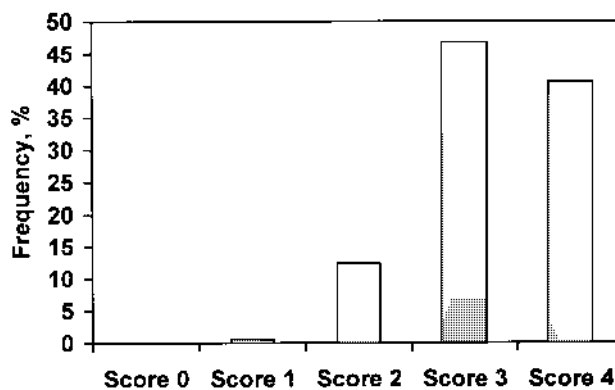

Fig. 1. Individual distribution of CPITN scores ($n = 197$).

habits, aspects of life satisfaction and oral hygiene habits (data not shown). This pattern of inter-correlation was also evident for the variables included in the final explanatory models, indicating that many variables are related with the factors included in these models (Table 5). In future studies, more emphasis should probably be spent on covariance among independent variables in order to understand the underlying pattern of periodontal disease in society.

References

1. Marthaler TM. Caries status in Europe and predictions for future trends. Caries Res 1990;24:381–96.
2. Almeida CM, Emilio MC, Møller I, Marthaler TM. Inqueiro nacional preliminar de saude oral. Lisbon: Escola Superior de Medicina Dentaria de Lisbon; 1987.
3. Meyer K, Freitas E, Davis RK, Freitas J, Kristoffersen T. Dental health among young adult Portuguese in relation to socio-economic differences. Rev Port Estomatol Cir Maxilofac 1983; 24:495–526.
4. Marques MD, Bjertness E, Eriksen HM. Caries prevalence of young adults in Oslo, Norway and Porto, Portugal. Acta Odontol Scand 1994;52:111–5.
5. Freitas E, Meyer K, Davis RK, Kristoffersen T. A baseline study of periodontal conditions among youths and adults in Portugal. Community Dent Oral Epidemiol 1983;11:250–4.
6. Pilot T, Barmes DE, Leclercque HM, McCombie BJ, Sardo Infirri J. Periodontal conditions in adults 35–44 years of age: an overview of the WHO Global Oral Health Data Bank. Community Dent Oral Epidemiol 1986;14:310–2.
7. Pilot T, Miyazaki H. Periodontal conditions in Europe. J Clin Periodontol 1991;18:353–7.
8. Gjermo P. Epidemiology of periodontal diseases in Europe. J Parodontol Implantol Orale 1998;17:111–21.
9. Meyer K. Oral health of Portuguese adults: a study of oral health and its determinants in four different population groups. Thesis. University of Bergen, Norway 1990.
10. Marques MD. Saude oral de uma populacao do Porto, do groupo etario dos 30–39 anos. Dissertatio, Universidade do Porto, Portugal; 1994.
11. Schou L. Social and behavioural dimensions. In: Cohen LK, Gift HC, editors. Disease prevention and oral health promotion. 1st ed. Copenhagen: Munksgaard; 1995. p. 213–70.
12. Breivik T, Thrane PS, Murison R, et al. Emotional stress effects on immunity, gingivitis and periodontitis. Eur J Oral Sci 1996;104:327–34.
13. Hansen BF, Bjertness E, Grønnesby JK. A socio-ecologic model for periodontal diseases. J Clin Periodontol 1993;20:584–90.
14. Oral health surveys. Basic methods, 3rd ed. Geneva: WHO; 1987.
15. Eriksen HM, Marques MD, Bjertness E, et al. Dental caries determinants in an adult Portuguese population and comparison with Norwegian adults. Acta Odontol Scand 1996;54:49–54.
16. Bjertness E. A multidimensional study of dental health in urban, Norwegian adults. Thesis. University of Oslo, Norway; 1990.
17. Ainamo J, Barmes DE, Beagrie G, et al. Development of the World Health Organization (WHO) Community Periodontal Index of Treatment Needs (CPITN). Int Dent J 1982;32:281–91.
18. Cutress TW, Ainamo J, Sardo-Infirri J. The Community Periodontal Index for Treatment Need (CPITN) procedure for population groups and individuals. Int Dent J 1987;37:222–33.
19. Gjermo P. Dental practice: CPITN as a basic periodontal examination. Int Dent J 1994;44:547–52.
20. Baelum V. The epidemiology of destructive periodontal disease. Thesis. Aarhus: University of Aarhus; 1998.
21. Hansen BF, Bjertness E, Gjermo P. Changes in periodontal disease indicators in 35-year-old Oslo citizens from 1973 to 1984. J Clin Periodontol 1990;17:249–54.
22. Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc 1964;68:25–31.
23. Cantvil H. Pattern of human concerns. New Brunswich: Rutgers University Press; 1965.
24. Burt BA. The pattern of periodontal destruction in industrialized countries. In: Johnson WN, editor. Markers of disease susceptibility and activity for periodontal disease, 1st ed. London: Cambridge University Press; 1991. p. 9–26.
25. Løvdal A, Arnø A, Wærhaug J. Incidence of clinical manifestations of peridontal disease in light of oral hygiene and calculus formation. J Am Dent Assoc 1958;56:21–33.
26. Sheiham A. Dental cleanliness and chronic periodontal disease: studies on populations in Britain. Br Dent J 1970;120:413–8.
27. Bjertness E, Hansen BF, Berset G, et al. Oral hygiene and periodontitis in young adults. Lancet 1993;342:170–1.
28. Baelum V, Fejerskov O, Manji F. Periodontal disease in adult Kenyans. J Clin Periodontol 1988;15:445–52.
29. Hugoson A, Jordan T. Frequency distribution of individuals aged 20–70 years according to severity of periodontal disease. Community Dent Oral Epidemiol 1982;10:187–92.
30. Løe H, Ånerud A, Boysen H, et al. Natural history of periodontal disease in man: rapid, moderate and no loss of attachment in Sri-Lankan laborers 14 to 46 years of age. J Clin Periodontol 1986;13:431–40.
31. Okamoto H, Yoneyama T, Lindhe J, et al. Methods of evaluating periodontal disease data in epidemiologic research. J Clin Periodontol 1988;15:430–9.
32. Douglass CW, Gillings D, Sollecite W, et al. National trends in the prevalence and severity of the periodontal diseases. J Am Dent Assoc 1983;107:403–7.
33. Markkanen H, Rajala M, Paunio K. Periodontal treatment need of the Finnish population aged 30 years and over. Community Dent Oral Epidemiol 1983;13:431–40.