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Periodontal Diseases in Greek Senior Citizens-Risk Indicators

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1. Introduction

Periodontal diseases are among the most common chronic diseases affecting people of all ages worldwide. However, their severe forms are more pronounced in older individuals primarily due to prolonged exposure to risk factors. One of the major risk factors of periodontal diseases is considered to be poor oral hygiene since the accumulation of dental plaque biofilms on clean tooth surfaces results in the development of an inflammatory process encompassing local gingival and periodontal tissues around teeth (Albandar, 2002). If the microbial film is not removed the local inflammation will persist and chronic gingivitis will be developed. Hence, dental plaque is considered today the primary etiologic factor of chronic gingivitis, while chronic periodontitis is now seen as resulting from a complex interplay of bacterial infection and host response, often modified by local factors within the mouth, systemic factors related to the host, and external (environmental) factors (Albandar, 2002).

For example, current preventive oral health practices, such as frequent tooth brushing and flossing as well as regular dental attendance, were found to be significantly associated with lower plaque, gingivitis and calculus scores (Lang et al., 1995). In addition, through these associations, the aforementioned preventive behaviors appeared to be indirectly related to shallower pocket depths and less attachment loss (Lang et al., 1995). Furthermore, socio-demographic variables like area of residence, gender, education and income are considered as risk indicators for periodontal diseases (Albandar, 2002; Locker & Leake 1992; Mamai-Homata et al., 2010)

Some of these, as well as other variables that have been associated with periodontal status may change overtime and therefore the prevalence and severity of periodontal diseases in a population may also change. Therefore, periodic surveys of the periodontal health status of the population and redetermination of the variables that may affect the initiation and/or progression of periodontal diseases are needed.

In Greece, a national oral health pathfinder survey was organized in 1985 by the dental department of the Ministry of Health, Welfare and Social Security in cooperation with the Regional Office for Europe of the World Health Organization. The purpose of that survey was to evaluate the oral health status and treatment needs of the population aged 7, 12 and 35-44 years-old and formulate measures for the prevention of dental caries and the elimination of periodontal diseases.

Twenty years later the Hellenic Dental Association in cooperation with the Dental Schools of Athens and Thessaloniki decided to carry out a second national oral health pathfinder survey in order to investigate trends in oral diseases epidemiology. In this survey the 65-74-years-old group was also included since the aging of the population in Greece (Karagiannaki, 2005), as in most industrialized countries (WHO, 1996), and the economic, social and health consequences of this demographic evolution made the investigation of the oral health of the elderly very important.

In this chapter, the oral hygiene behavior and dental attendance of Greek senior citizens aged 65-74-years-old will be analyzed, in relation to certain socio-demographic variables. Furthermore, their periodontal and oral hygiene status will be presented and the variations in these measures according to socio-demographic and behavioral parameters will be outlined.

2. Material and methods

A stratified cluster sample was selected according to WHO guidelines for national pathfinder surveys, which ensures the participation of a satisfactory size of people that may present different disease prevalence in the conditions that are being examined (WHO, 1997). The study covered two big cities (Athens and Thessaloniki), six counties (Achaia, Chania, Evros, Ioannina, Kastoria, Larissa) and three islands (Lesbos, Naxos and Kefallinia). Three communities of different socio-economic backgrounds were selected randomly within each of the big cities, while one urban and one rural community were selected randomly within each county or island. Therefore, the survey was conducted in 24 sites (15 urban and 9 rural) and 50 subjects were examined in each site. Samples of subjects aged 65-74 years were drawn from their homes and day centers for the elderly, according to WHO national pathfinder survey methodology for these age groups (WHO, 1997). The sample consisted of 1093 65-74-year-old senior citizens of Greek nationality, leaving in urban and rural areas. Three hundred and forty four (344) of the subjects examined (31.5%) were edentulous in both jaws and were excluded from the present study. Therefore, the final sample consisted of 749 dentate individuals aged 65-74 years.

Prior to the survey, a meeting was organized in Athens Dental School to train and calibrate the examiners. Inter- examiner reliability and agreement was assessed with an experienced investigator as gold standard. For the examined indices, levels of concordance were very good (kappa coefficient > 0.85). The examinations were carried out under artificial light (daray lamps) using dental mirrors and the WHO CPI periodontal probe. Cotton rolls and gauze were available for moisture control and removal of plaque when necessary.

The recorded variables were periodontal and oral hygiene status. The periodontal conditions were measured using the Community Periodontal Index (CPI) (WHO, 1997) and are presented according to the highest score recorded for each person (indicating the prevalence of conditions) and the mean number of sextants by score per person (indicating the severity or extent of the problem). The oral hygiene status was recorded by means of the simplified Oral Hygiene Index (OHI-S) (Green & Vermillion, 1964) and its scores were classified into three levels as described by Greene (Greene, 1967).

Socio-demographic (gender, area, education, monthly income) and behavioural (tooth brushing frequency, flossing frequency and reason for dental attendance) data reported to be associated with oral health were collected through a structured questionnaire that was completed face-to- face at the time of the clinical examination. The classification of education was based on the total number of years of education and was divided in four categories (6

years or less, 9 years, 12 years and more than 12 years). The economic status of the participants was recorded according to their monthly income and it was divided in two income categories (≤590 € and ≥591 €). Tooth brushing frequency was classified in four categories (never, <once a day, once a day and >once a day), while flossing frequency was classified in three categories (never, <once a day and ≥once a day). Finally, the surveyed population was divided in three categories according to the usual reason for dental attendance (pain, treatment, check-up).

Fig. 1. Map of Greece. White stars represent the regions where the survey took place.

2.1 Data analysis

The outcome variables were oral health behaviours and attitude of the subjects (brushing frequency, flossing frequency and reason for dental visits), as well as CPI and OHI-s scores. The statistical analyses were conducted in three main stages. First, the prevalence of each dependent variable in the sample was calculated. Second, the potential effect of each socio-demographic factor (gender, area, education and monthly income) on the aforementioned variables was investigated univariately. Chi-square test was used to test the strength of associations between independent and categorical sample proportions. Mann-Whitney and Kruskall-Wallis tests were also conducted due to the non-Gaussian distribution of the mean number of sextants per CPI score.

Finally, the estimates of the relative risks of all outcome variables were reported by calculating the odds ratios (ORs) and the corresponding 95% confidence intervals (CIs), using ordinal and binary logistic regression analysis. The independent predictors were socio-demograhic and behavioural data. Significant confounders, as well as interactions were retained in the models. Deviance residuals were calculated in order to evaluate the model's goodness-of-fit. All reported probability values (p-values) were based on two-sided tests and compared to a significant level of 5%. The analysis of coded data was carried out using SPSS software version 19.0.

3. Results

3.1 Behavioural parameters

The reported tooth brushing frequency of Greek senior citizens according to their socio-demographic characteristics is presented in table 1. Regular tooth brushing (≥twice a day) was claimed by only 25.3% of the respondents, while most of them reported that they brushed their teeth once a day (33.0%). The percentages of those reporting that they never brushed their teeth (14.5%) or that they brushed their teeth less than once a day (27.2%) were relatively high.

The univariate analysis of the data (table 1) showed that women and those living in urban areas tended to brush teeth more often than men and those living in rural areas. Also, the educational level was found to positively affect the tooth brushing frequency of the surveyed population. However, when multivariate analysis was undertaken (table 2), only being a woman and having a high educational attainment increased the odds of having better tooth brushing habits.

Flossing frequency, as reported by the respondents is presented in table 3. Most subjects reported that they never used dental floss (92.5%), and only 3.1% that they used it once a day. Those living in urban areas used dental floss more frequently than those living in rural ones. The educational level as well as monthly income were found to positively affect the usage of dental floss. The results of the multiple regression modeling (table 4) showed that area of residence and education remained significant predictors of dental floss usage. Residents of urban areas and those with a high educational level were 8.5 times more likely to use dental floss regularly.

The distribution of participants according to the usual reason for dental attendance is shown in table 5. Most subjects (60.1%) reported visiting the dentist because of pain, 26.9% for treatment and only 13.0% for check-up. The percentage of people that attended

the dentist because of pain was significantly higher amongst those living in rural areas and decreased significantly as their educational level and monthly income increased. Of all the statistically significant variables found in the initial univariate analyses, only high education was found to increase the likelihood of visiting the dentist for check-up in the multivariate model (table 6).

3.2 Clinical parameters

The mean DI-S, CI-S and OHI-S values in the overall sample were 1.06, 0.83 and 1.90 respectively. The classification of participants according to their OHI-S score showed that most subjects (43.0%) had good oral hygiene status (table 7). However, the percentage of those with poor oral hygiene was relatively high (21.3%). Women had better oral hygiene status than men. The percentage of people with poor oral hygiene status decreased significantly as their educational level and monthly income increased. Those with better oral hygiene habits (more frequent brushing and flossing) and those who used to visit the dentist for check-up had significantly better oral hygiene status. No significant differences were found between individuals living in rural or urban areas.

When all the socio-demographic and behavioural variables were introduced in multiple regression analysis to control for the effects of confounding factors gender, area, tooth brushing frequency and reason for dental attendance were found to strongly predict oral hygiene status (table 8). Being a woman, living in an urban area, brushing teeth at least once a day and visiting a dentist for check-up increased the odds of having better oral hygiene status.

Table 9 shows the distribution of the study population by CPI scores for each socio-demographic and behavioral characteristic. Since nine dentate subjects had a score X (excluded) in all sextants (the required two teeth were not present or were indicated for extraction), the final sample in the present analysis consisted of 740 individuals.

The percentage of subjects with healthy periodontium in the overall sample was 8.4%. The most frequently observed condition was shallow pockets of 4-5 mm (44.5%). Deep pockets of more than 6 mm were found in 15.4% of the subjects. Calculus with or without bleeding was present in the 23.5% of the population surveyed, while bleeding on probing was found in only 8.2% of the persons examined.

The univariate analysis of the data showed that women and those living in urban areas had better periodontal condition (table 9). Also, tooth brushing and flossing frequency were found to affect positively the periodontal health of the subjects examined. No significant differences were observed by education, monthly income and reason for visiting the dentist.

The ordinal logistic regression analysis (table 10) confirmed area, tooth brushing frequency and flossing frequency to be strong determinants for periodontal health in the surveyed population. Residents of rural areas experienced more periodontal diseases, while frequent daily tooth brushing and daily usage of dental floss resulted in lower CPI scores

The mean numbers of sextants by score per person are presented in table 11. On average there were 0.72 healthy sextants, 0.72 with bleeding on probing, 0.81 with calculus, 1.20 with shallow pockets and 0.25 with deep pockets, while a large proportion of sextants (2.36) were excluded due to tooth loss.

Independent variables	N	Percent of participants who brush teeth			
		Never	<Once a day	Once a day	≥Twice a day
Gender					
Women	320	9.4	19.7	36.6	34.4
Men	423	18.4	32.9	30.3	18.4
X²=42.404, p<0.0001					
Area					
Rural	240	17.5	32.5	34.6	15.4
Urban	503	13.1	24.7	32.2	30.0
X²=19.796, p<0.0001					
Education					
6 years or less	580	16.2	29.1	32.4	22.2
9 years	59	11.9	22.0	35.6	30.5
12 years	68	4.4	27.9	29.4	38.2
More than 12 years	31	12.9	0.0	41.9	45.2
X²=29.304, p<0.001					
Monthly income (€)					
≤590	381	15.7	27.3	35.2	21.8
≥591	125	8.8	24.8	35.2	31.2
X²=6.919, p<0.075					
Total	743	14.5	27.2	33.0	25.3

Table 1. Tooth brushing frequency of 65-74 year-old Greeks according to gender, area, education and monthly income.

Dependent variable	Independent variables	Odds ratio	95% CI for Odds Ratio	
Brushing frequency[a]	*Constant*	*0.717*		
	Gender (female vs male)	2.148	1.448	3.186
	Area (urban vs rural)	1.458	0.983	2.162
	Highest educational level	6.747	1.912	23.811
	Income ≥591€	1.106	0.689	1.776

[a] ≥1 time vs <1 time per day

Table 2. Odds ratios (OR) and 95% confidence intervals (CI) derived from multivariate binary logistic regression analysis with brushing frequency as the dependent variable in 65-74-year-old Greeks.

Independent variables	N	Percent of participants who used dental floss		
		Never	<Once a day	≥Once a day
Gender				
Women	317	90.5	6.3	3.2
Men	421	94.1	2.9	3.1
X²=5.235, p<0.073				
Area				
Rural	237	96.6	3.0	0.4
Urban	501	90.6	5.0	4.4
X²=10.299, p<0.006				
Education				
6 years or less	576	94.4	3.3	2.3
9 years	59	94.9	1.7	3.4
12 years	68	80.9	14.7	4.4
More than 12 years	30	76.7	6.7	16.7
X²=40.850, p<0.0001				
Monthly income (€)				
≤590	379	94.4	4.0	2.6
≥591	125	86.4	6.4	7.2
X²=6.920, p<0.031				
Total	738	92.5	4.3	3.1

Table 3. Flossing frequency of 65-74 year-old Greeks according to gender, area, education and monthly income.

Dependent variable	Independent variables	Odds ratio	95% CI for Odds Ratio	
Flossing frequency[a]	*Constant*	*0.004*		
	Gender (female vs male)	1.054	0.392	2.832
	Area (urban vs rural)	8.543	1.110	65.726
	Highest educational level	8.438	2.033	35.026
	Income ≥591€	1.220	0.392	3.798

[a] ≥1 time vs <1 time per day

Table 4. Odds ratios (OR) and 95% confidence intervals (CI) derived from multivariate binary logistic regression analysis with flossing frequency as the dependent variable in 65-74-year-old Greeks.

Independent variables	N	Percent of participants who attended the dentist for		
		Pain	Treatment	Check-up
Gender				
Women	311	57.2	27.0	15.8
Men	414	62.3	26.8	10.9
X^2=4.036, p<0.133				
Area				
Rural	233	73.4	14.2	12.4
Urban	492	53.9	32.9	13.2
X^2=30.797, p<0.0001				
Education				
6 years or less	563	63.9	26.3	9.8
9 years	59	55.9	30.5	13.6
12 years	67	44.8	29.9	25.4
More than 12 years	31	38.7	22.6	38.7
X^2=35.932, p<0.0001				
Monthly income (€)				
≤590	368	64.4	23.9	11.7
≥591	124	46.0	28.2	25.8
X^2=18.098, p<0.0001				
Total	725	60.1	26.9	13.0

Table 5. Usual reason for dental attendance of 65-74 year-old Greeks according to gender, area, education and monthly income.

Dependent variable	Independent variables	Odds ratio	95% CI for Odds Ratio	
Reason of dental attendance[a]	*Constant*	*0.088*		
	Gender (female vs male)	1.674	0.983	2.850
	Area (urban vs rural)	1.023	0.574	1.821
	Highest educational level	4.469	1.819	10.979
	Income ≥591€	1.751	0.952	3.220

[a] check-up vs pain or treatment

Table 6. Odds ratios (OR) and 95% confidence intervals (CI) derived from multivariate binary logistic regression analysis with reason of dental attendance as the dependent variable in 65-74-year-old Greeks.

Independent variables	N	DI-S mean	CI-S mean	OHI-S mean (sd)	Percent of participants who have oral hygiene		
					Good score= 0.0-1.2	Fair score= 1.3-3.0	Poor score= 3.1-6.0
Gender							
Women	299	0.84	0.61	1.48 (1.35)	53.8	33.4	12.7
Men	378	1.23	0.99	2.23 (1.72)	34.4	37.6	28.0
X^2=33.946, p<0.0001							
Area							
Rural	234	0.99	0.81	1.90 (1.55)	40.6	37.6	21.8
Urban	443	1.09	0.82	1.89 (1.64)	44.2	34.8	21.0
X^2=0.886, p<0.649							
Education							
6 years or less	512	1.13	0.87	2.03 (1.61)	37.5	39.6	22.9
9 years	54	1.00	0.65	1.65 (1.56)	53.7	27.8	18.5
12 years	66	0.73	0.69	1.42 (1.48)	62.1	21.2	16.7
More than 12 years	33	0.61	0.55	1.09 (1.23)	69.7	24.2	6.1
X^2=29.412, p<0.0001							
Monthly income (€)							
≤590	345	1.04	0.81	1.93 (1.63)	41.2	38.0	20.9
≥591	115	0.87	0.64	1.51 (1.48)	55.7	`31.3	13.0
X^2=7.894, p<0.019							
Tooth brushing frequency							
<1 time per day	271	1.45	1.16	2.67 (1.74)	24.0	37.3	38.7
≥1 time per day	395	0.79	0.57	1.35 (1.24)	56.2	34.7	9.1
X^2=105.672, p<0.0001							
Flossing frequency							
<1 time per day	618	1.07	0.83	1.90 (1.57)	42.2	36.7	21.0
≥1 time per day	23	0.47	0.29	0.76 (1.18)	73.9	21.7	4.3
X^2=9.530, p<0.009							
Reason for dental attendance							
Pain or treatment	560	1.12	0.86	1.98 (1.63)	40.2	36.6	23.2
Check-up	90	0.62	0.55	1.16 (1.14)	65.6	30.0	4.4
X^2=25.628, p<0.0001							
Total	677	1.06	0.83	1.90 (1.61)	43.0	35.7	21.3

Table 7. Oral hygiene status of 65-74-year-old Greeks, measured by the simplified oral hygiene index, according to socio-demographic and behavioral parameters.

Dependent variable	Independent variables	Odds ratio	95% CI for Odds Ratio	
OHI-S score[a]	*Constant*	*0.379*		
	Gender (female vs male)	0.350	0.179	0.686
	Area (rural vs urban)	2.566	1.349	4.881
	Highest educational level	0.608	0.071	5.202
	Income ≥591€	0.604	0.285	1.283
	Tooth brushing frequency per day (≥1 time vs <1 time)	0.214	0.118	0.388
	Flossing per day (≥1 time vs <1 time)	0.499	0.062	4.038
	Reason for dental attendance (prevention vs pain or treatment)	0.249	0.071	0.868

[a] *OHI-S score= 3 represented the cut-off point*

Table 8. Odds ratios (OR) and 95% confidence intervals (CI) derived from multivariate binary logistic regression analysis with OHI-S score as the dependent variable in 65-74-year-old Greeks.

The statistical analysis of the data (table 11) showed that the mean number of healthy sextants was significantly greater in women, those with a high educational attainment, those that brushed and flossed teeth frequently and those who attended the dentist for check-up. On the other hand, residents of rural areas and individuals that used dental floss less than once a day had more sextants with shallow pockets, while men and those who brushed teeth less than once a day had more sextants with deep pockets. The mean number of excluded sextants (score X) was significantly greater in residents of urban areas, individuals with low level of education, those that brushed and flossed teeth less than once a day and those that used to visit the dentist because of pain or for treatment.

4. Discussion

The present study, which is part of the 2nd National Pathfinder Survey on the oral health of the Greek population, is the first nationwide reference on the periodontal and oral hygiene status of non-institutionalized Greek adults aged 65-74 years. Since the simplified pathfinder sampling methodology developed by WHO was used (WHO, 1997), the sample cannot be characterized as random, but it can be considered as illustrative of the whole population, as it ensures the participation of a satisfactory size of people living in representative urban and rural areas of Greece. Furthermore, the thorough training and calibration of the examiners ensures the reliable recording of the study parameters.

Independent variables	N	Percent of persons who have as highest score				
		0 Healthy	1 Bleeding	2 Calculus	3 Pockets 4-5 mm	4 Pockets ≥ 6 mm
Gender						
Women	322	10.6	9.6	21.1	47.8	10.9
Men	418	6.7	7.2	25.4	41.9	18.9
$X^2=15.017, p<0.005$						
Area						
Rural	257	4.7	5.1	11.3	63.0	16.0
Urban	483	10.4	9.9	30.0	34.6	15.1
$X^2=66.991, p<0.0001$						
Education						
6 years or less	564	6.9	8.0	23.6	45.6	16.0
9 years	60	10.0	10.0	31.7	36.7	11.7
12 years	68	10.3	10.3	16.2	50.0	13.2
More than 12 years	35	17.1	8.6	28.6	37.1	8.6
$X^2=13.132, p<0.360$						
Monthly income (€)						
≤590	377	8.0	9.5	20.2	46.2	16.2
≥591	127	11.0	9.4	26.0	40.9	12.6
$X^2=3.887, p<0.422$						
Tooth brushing frequency						
<1 time per day	303	3.3	5.6	23.8	46.5	20.8
≥1 time per day	425	11.8	10.4	24.0	43.1	10.8
$X^2=33.349, p<0.0001$						
Flossing frequency						
<1 time per day	679	7.4	7.8	24.6	46.5	13.7
≥1 time per day	23	26.1	26.1	21.7	17.4	8.7
$X^2=23.254, p<0.0001$						
Reason for dental attendance						
Pain or treatment	615	7.2	8.3	24.2	44.7	15.6
Check-up	96	15.6	9.4	21.9	40.6	12.5
$X^2=8.331, p<0.080$						
Total	740	8.4	8.2	23.5	44.5	15.4

Table 9. Periodontal conditions of 65-74 year-old Greeks measured by CPI according to socio-demographic and behavioral variables.

Dependent variables	Independent variables	Odds ratio	95% CI for Odds ratio	
CPI scores[a]	Gender (males vs females)	1.110	0.778	1.585
	Area (rural vs urban)	2.008	1.377	2.928
	Lowest educational level	1.384	0.638	3.002
	Income ≥591€	0.989	0.643	1.620
	Tooth brushing frequency per day (≥1 time vs <1 time)	0.558	0.387	0.805
	Flossing per day day (≥1 time vs <1 time)	0.288	0.123	0.668
	Reason for dental attendance (prevention vs pain or treatment)	0.885	0.548	1.495

[a] *CPI scores: 0= healthy; 1= bleeding, 2= calculus; 3= gingival pocket (4-5mm); 4= gingival pocket (>5mm).*

Table 10. Odds ratios (OR) and 95% confidence intervals (CI) derived from ordinal logistic regression analysis with CPI scores as the dependent variables in 65-74-year-old Greeks.

Periodontal health was assessed by means of the Community Periodontal Index (CPI) that measures the prevalence and severity or extent of periodontal diseases (WHO, 1997). The CPI recording system has attracted much criticism (Jenkins & Papapanou, 2001; Leroy et al., 2010) mainly because it does not measure tooth mobility or attachment loss and therefore increasingly underestimates periodontal disease extent and severity with increasing age. However, it is a simple, not time consuming index (Pilot & Miyazaki, 1994; Benigeri et al., 2000) that may provide useful data for planning and adjustment of preventive and treatment services in a population. It also constitutes the major source of descriptive epidemiological data on periodontal diseases in many countries, allowing international comparisons

Oral hygiene level was assessed using the simplified Oral Hygiene Index (OHI-S). A limitation of this index is that it scores the extent of plaque on the exposed tooth surface. Thus, it does not take into account the mass of plaque in the gingival margin that is considered more important in the pathogenesis of periodontal diseases. Yet, it is an easy to use index because its criteria are objective, the examination can be carried out quickly and a high level of reproducibility is possible with minimum training of the examiners. In addition, it has been widely used to evaluate the level of oral cleanliness in epidemiological studies.

Independent variables	Mean number of sextants with CPI score					
	0 Healthy	1 Bleeding	2 Calculus	3 Pockets 4-5 mm	4 Pockets ≥6 mm	X Excluded
Gender						
Women	0.87*	0.85*	0.63*	1.33	0.20*	2.23
Men	0.60*	0.60*	0.96*	1.12	0.29*	2.45
*Mann-Whitney U test, *p<0.05*						
Area						
Rural	0.59	0.73	0.50*	1.84*	0.22	2.11*
Urban	0.77	0.69	0.97*	0.91*	0.26	2.48*
*Mann-Whitney U test, *p<0.05*						
Education						
6 years or less	0.61*	0.68	0.82	1.24	0.24	2.47*
9 years	0.78*	0.86	1.03	1.05	0.22	2.03*
12 years	0.94*	0.88	0.60	1.37	0.34	1.88*
More than 12 years	1.87*	0.74	0.90	0.58	0.19	1.71*
*Kruskal-Wallis test, *p<0.05*						
Monthly income (€)						
≤590	0.78	0.72	0.64	1.33	0.22	2.41
≥591	0.91	0.68	0.86	0.92	0.29	2.31
Mann-Whitney U test, p>0.05						
Tooth brushing frequency						
<1 time per day	0.32*	0.51*	0.91	1.25	0.30*	2.72*
≥1 time per day	1.00*	0.85*	0.75	1.19	0.20*	2.08*
*Mann-Whitney U test, *p<0.05*						
Flossing frequency						
<1 time per day	0.67*	0.70	0.82	1.24*	0.25	2.39*
≥1 time per day	2.22*	1.35	0.83	0.61*	0.09	0.91*
*Mann-Whitney U test, *p<0.05*						
Reason for dental attendance						
Pain or treatment	0.56*	0.68	0.81	1.19	0.24	2.58*
Ceck-up	1.75*	0.98	0.80	1.27	0.31	0.92*
*Mann-Whitney U test, *p<0.05*						
Total	0.72	0.72	0.81	1.20	0.25	2.36

Table 11. Mean number of sextants per CPI score among 65-74 years-old Greeks according to socio-demographic and behavioral variables.

4.1 Behavioral parameters

The analysis of the data concerning the oral hygiene behavior of the surveyed population showed that regular tooth brushing (≥2 times per day) was reported by only one quarter of the dentate subjects, while less than one tenth of seniors used dental floss. Similar findings have been reported for the populations of Lithuania (Petersen et al., 2000) and China (Zhu et al., 2005). However, in most industrialized countries, the percentages of senior citizens claiming to use dental floss and brush teeth regularly or at least once a day were much higher (Chadwick et al.; Christensen et al., 2003; Davidson et al., 1997; Murtomaa et al., 1994; Payne & Locker, 1992; Whelton et al., 2007). In the present study, as in all other relevant studies (Chadwick et al.2011; Christensen et al.,2003; Payne & Locker, 1992; Whelton et al., 2007) flossing frequency was much lower than brushing frequency probably because flossing is a more complex activity requiring more time and a certain degree of manual dexterity.

In some surveys tooth brushing and/or flossing was reported as being less frequent in older age groups (Christensen et al., 2003; Davidson et al., 1997; Kelly et al., 2000; Payne & Locker, 1994; Petersen et al., 2000; Whelton et al., 2007; Zhu et al., 2005). Such a trend is confirmed by the comparison of the present results with those of Greek adults aged 35-44-years-old (Mamai-Homata et al., 2010). According to this comparison (figure 2) the percentage of senior citizens that brushed teeth regularly was about one-half of those aged 35-44-year-olds, while the percentage of those that used dental floss was less than one-third of the middle aged adults. It has been suggested that older age groups are less likely to have been exposed to preventive orientations early in life when socialization to self-care behaviors is thought to be most efficacious (Gift, 1988; Payne & Locker, 1992). Therefore, this may be a reason for the low levels of oral hygiene practices of the elderly.

The finding that those with a higher educational attainment brushed and flossed their teeth more often is consistent with those of other studies (Christensen et al., 2003; Davidson et al., 1997; Payne & Locker, 1994). Also, the observation that women were more likely to brush teeth at least once a day supports the view that the oral hygiene behavior of women is better than that of men (Chadwick et al.2011; Christensen et al., 2003; Davidson et al., 1997; Payne & Locker, 1992; Tada et al., 2004; Whelton et al., 2007). Finally, the correlation between flossing frequency and area of residence demonstrated in the present study supports earlier findings (Petersen et al., 2000) and indicates that people living in urban areas are better informed about the individual's role in the prevention of oral diseases.

The dental attendance of Greek seniors as measured by the reason for visiting a dentist indicates that their orientation towards prevention was weak. Only 13% reported that they attended the dentist for regular check-ups. Similar findings have been reported for the population of China (Zhu et al., 2005), while the percentage of those that used to visit a dentist for check-ups in Ireland was higher, but not satisfactory (Whelton et al., 2007). However, according to the latest report from the United Kingdom almost two thirds of dentate adults claimed that the usual reason they attended the dentist was for a regular check-up (Morris et al., 2009). The finding that dental visiting habits are influenced by education supports those of previous studies (Chen, 1986; Petersen, 1986).

The low number of seniors that used to go to the dentist for check-up is a worrying observation since it indicates that these people that are considered as high risk for root caries and oral cancer will have poor chances to detect early such conditions, as could have happened if they used to visit the dentist regularly.
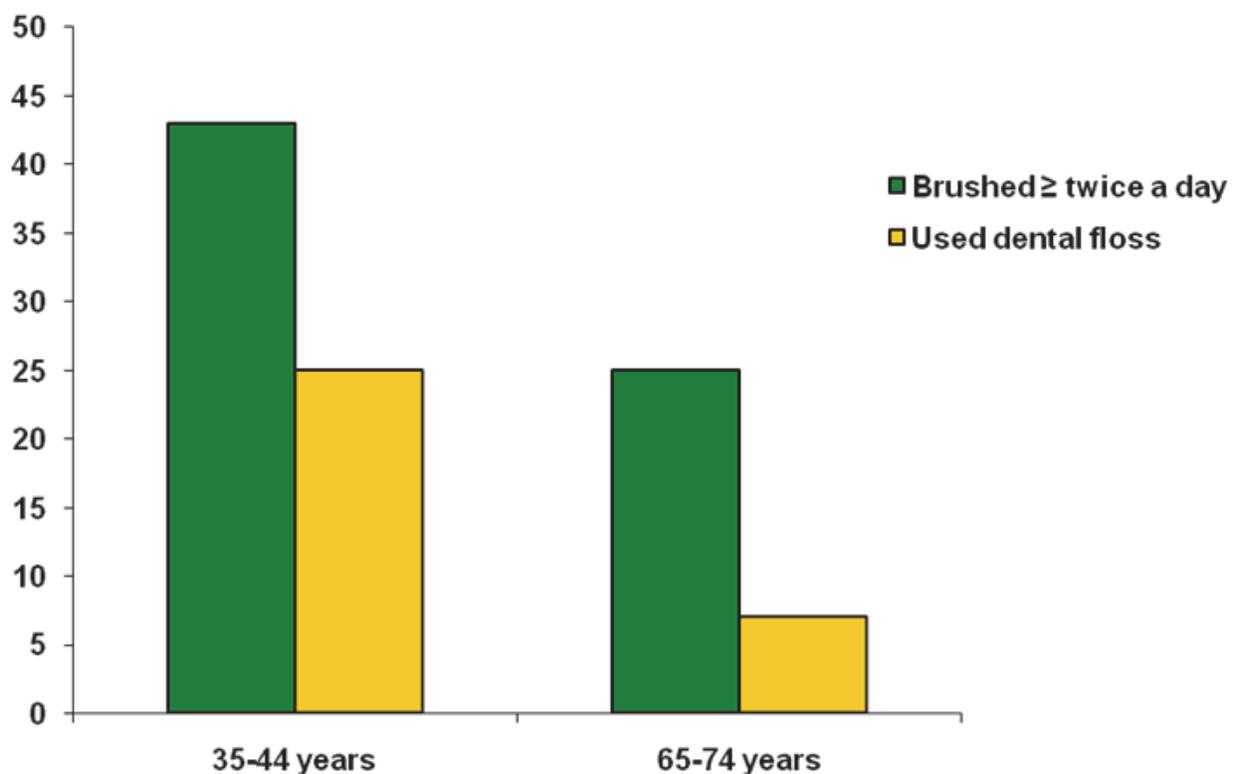
Fig. 2. Percentages of 35-44 and 65-74-year-old Greeks that brushed teeth ≥ twice a day and used dental floss.

4.2 Clinical parameters

The oral hygiene status of the Greek seniors cannot be considered as satisfactory, since more than half of the subjects had fair or poor oral hygiene scores. Comparison of these results with those of other countries is difficult since we didn't manage to find comparable recent data for non-institutionalized elderly. However, the mean OHI-S index is greater than that found among white Americans in the NHANNES I survey conducted in USA more than thirty years ago (Kelly & Harvey, 1979).

The results of the logistic regression analysis that gender, area of residence, tooth brushing frequency and reason for dental attendance are significantly correlated with oral hygiene level are in accordance with those of earlier studies (Christersson et al., 1992; Kelbauskas et al., 2003; Lang et al., 1995; Morris et al. 2001). The better oral hygiene status of women and those who brush teeth regularly is attributed to their better oral hygiene habits. Individuals that visit the dentist for check-ups are more likely to have professional tooth cleaning and oral hygiene instructions and therefore a better oral hygiene level. The poor oral hygiene status of people living in urban areas may be due to social inequalities.

The adult Dental Health Survey (ADHS) conducted in the United Kingdom in 1998 reported that 74% of adults claimed to clean their teeth at least twice daily and that 69% of them had visible plaque, compared with 79% who reported brushing only once per day (Kelly et al., 2000). In the present study 25.3% of seniors claimed to clean their teeth at least twice a day and 40% of them had fair or poor oral hygiene level, compared with 46% who reported brushing once per day. These findings indicate that both populations need oral hygiene instruction in order to improve their brushing techniques and achieve efficient plaque control.

The data of the study concerning the periodontal status of subjects examined have shown that only a few dentate participants had healthy periodontium and that the most frequently observed condition was shallow pocketing. These findings are in accordance with those observed in Croatia, Denmark, Germany, Ireland and Bulgaria (Artukovic et al., 2007; Krustrup et al., 2006; Schiffner et al., 2009; Whelton et al., 2007; Yolov, 2002), although in some other countries like France, Turkey, Hungary, China and Spain the most frequently observed condition in that age group was calculus (Bourgeois et al., 1999; Gokalp et al., 2010; Hermann, 2009; Hong-Ying et al., 2002; WHO, 2011).

Severe periodontal conditions (CPI scores 3 and 4) were found in 59.9% of the population. Comparison of these results with those reported for other European countries (figure 3) indicate that there are great differences across countries as regards the prevalence of periodontitis. They also indicate that the periodontal health status of the elderly in Greece is relatively poor, although better than that reported for Bulgaria, Croatia, Germany and Denmark. These differences could be attributed to different preventive regimes offered by the oral health systems of the countries, as well as to different exposures to risk factors of the populations like poor oral hygiene, tobacco-use and excessive consumption of alcohol that have been positively associated with periodontal diseases (Albandar, 2002; Tezal, 2001; Tomar & Asma, 2000). Also, some of the variations can be attributed to the fact that surveys are carried out by different examiners, under varying field conditions and with different sampling methods.
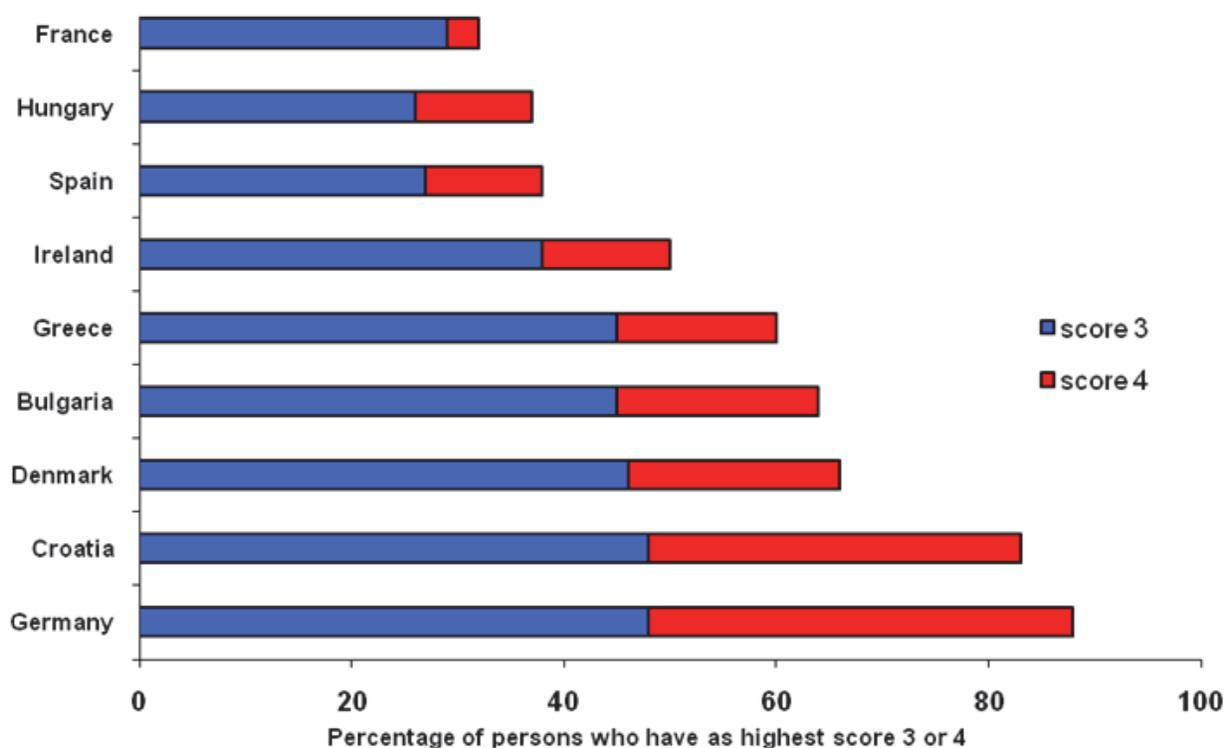
Fig. 3. Percent of persons with shallow or deep pockets (score 3 or 4) in European countries.

Of the independent variables considered in the present study, area of residence, as well as tooth brushing and flossing frequency were found to be the strongest determinants of

periodontal diseases. These findings are consistent with those of other studies (Bourgeois et al., 1999; Marques, et al., 2000; Mengel et al., 1993). Given that the oral hygiene habits of the Greek seniors, as indicated from the present study, are far from been considered as satisfactory, improvement in oral hygiene practices should be an important public health issue.

The worse periodontal conditions of subjects living in rural areas may be explained by the fact that in rural areas of Greece, Public Health Centers provide preventive and restorative dental health services in children and adolescents up to 18-year-olds and treatment services in adults with acute dental problems. Therefore, adults living in rural areas are usually obliged to seek dental treatment in private dentists that practice mainly in urban areas, with a high cost and difficulties in accessing them. Such inefficiencies of the public health sector result in social inequalities that affect dental attendance and oral health.

The evaluation of the mean number of sextants affected per CPI score revealed that dentate elderly had on average 0.25 sextants with deep pockets indicating that the extent of severe periodontitis was relatively low. On the other hand, the average number of excluded sextants was high (2.36) suggesting a high prevalence of tooth loss. Similar findings have been reported for most other countries (Bourgeois et al., 1999; Hong-Ying et al., 2002; Kazeko & Yudina, 2004). The finding that frequent tooth brushing and flossing, as well as visiting the dentist for check-ups significantly affected the mean number of healthy and excluded sextants, emphasizes the role of good self-care practices on the maintenance of oral health.

5. Conclusions

Severe periodontal conditions (shallow and deep pocketing) were frequent among 65-74-year-old Greeks. However, the extent of deep pocketing was relatively low indicating that many of the elderly Greeks could retain their natural teeth in the future. On the other hand, their oral hygiene status cannot be considered as satisfactory in view of the fact that most of them had fair or poor level of oral hygiene. Their orientation towards prevention was weak since their oral hygiene habits were poor and their usual motive for visiting the dentist was pain or treatment. Socio-demographic factors and especially education significantly influenced the oral hygiene habits as well as the reason for dental attendance of the surveyed population. In turn, oral hygiene habits were significant predictors of periodontal and oral hygiene status. Residents of rural areas experienced more severe periodontal conditions and worse oral hygiene status.

These findings suggest that the periodontal health of Greek senior citizens could be greatly improved by preventive and oral health education efforts. Public health strategies should target the high-risk population groups, which according to the results of the study are the residents of rural areas and those with low educational attainment. Rural residents are mainly in need of preventive and treatment services since they experience more severe periodontal conditions and worse oral hygiene status. Individuals with low level of education are mainly in need of oral health education and oral hygiene instruction as they have worse oral self-care practices. Private dentists must also contribute to the improvement of the periodontal health of the population in spite of the fact that building patient's interest in effective oral hygiene procedures is time consuming (Krustrup &Petersen, 2006). Since this is the first national survey investigating the periodontal status of 65-74-year-old Greeks, it could serve as baseline for the surveillance of the periodontal health of the elderly.

6. Implications of the study: Future perspectives

As it has already been mentioned, periodic surveys of the periodontal health status of the elderly are needed in order to assess trends in periodontal diseases epidemiology in this population group. Since several covariates that have been associated with periodontal diseases may change overtime, the variables that may affect the initiation and/or progression of periodontal diseases should be also redefined. This redetermination is also necessary due to the demographic changes that have been occurred in Greece during the last decades. More specifically, the Greek population, in common with most industrialized countries, is rapidly ageing. Indicative of the magnitude of the demographic change that occurred over the last 25 years is that during the period 1974-99 the ratio of the population of 65 and over to the population between 15 and 64, decreased from about 5.2 to about 3.9 (Kariagiannaki, 2005). Therefore, it is necessary to develop specific oral health promotion strategies in order to manage the oral health problems of the senior citizens, such as periodontal diseases. Therefore, the results of the present survey could provide data which may contribute to a better understanding of the problem and a better planning of oral health care services for this specific age group.

Thus far, a relatively limited number of longitudinal studies have been conducted, in order to confirm whether previously reported risk factors, such as age, smoking and periodontal pathogens, are true risk factors and also to identify others that have not been included in studies conducted to date (e.g. blood pressure levels, serum levels of disease markers, nutritional factors) (Ogawa et al., 2002). Especially in Greece, since this is the first national survey investigating the periodontal status of 65-74-year-old Greeks, further research is required in order to confirm/identify more explanatory risk factors and to infer causal effects with the less possible bias.

According to the results of the present survey that support previous reports (Petersen, 2003; Pyle & Stoller, 2003), senior citizens are often at risk of periodontal diseases and also experience limited access to oral health care because of a variety of factors, such as place of residence, income, educational level and other individual as well as social factors. Consequently, disparities remain for access-limited groups despite oral health improvement for many Greeks. Thus, dental practitioners as well as dental public health policy makers should continue to work toward equity in oral health and focus not only on dental characteristics but also on the life characteristics of older adults, and on their quality of life issues (Chalmers, 2003).

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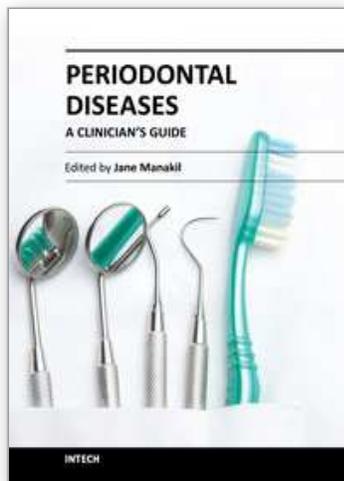
Periodontal Diseases - A Clinician's Guide

Edited by Dr. Jane Manakil

"Periodontal diseases" is a web-based resource intended to reach the contemporary practitioners as well as educators and students in the field of periodontology. It is fully searchable and designed to enhance the learning experience. Within the book a description is presented of the current concepts presenting the complex interactions of microbial fingerprint, multiple genotypes, and host modulations. In addition, an overview is given of the clinical outcome of the disease's progression, as influenced by the epigenetic factors. Emerging concepts on periodontitis as a risk factor for various systemic diseases and as a bilateral modulating factor have been elucidated in detail as well.

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