

## RESEARCH ARTICLE

# Prevalence of Gingival Recession and associated Risk Factors among 18–45-Year-Old Who Attended a Dental Practice in Greece

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## ABSTRACT

**Aim:** To assess the prevalence of gingival recession and to investigate possible associations among gingival recession and periodontal and epidemiological variables in a sample of Greek adults in a general dental practice.

**Materials and methods:** A sample of 640 Greek adults was examined clinically and interviewed regarding several periodontal and epidemiological variables. Collected data included demographic background (age, gender, level of education), oral hygiene habits, and smoking status. Clinical examination included the recording of dental plaque and supragingival calculus presence, gingival status, and gingival recession. In addition, the association between gingival recession and the following variables was assessed: gender, smoking status, calculus presence, plaque control methods, plaque index, gingival index, and level of education. Multiple linear regression analysis was carried out to model the association of gingival recession with the mentioned potential risk factors.

**Results:** The overall prevalence of gingival recession was 62.7%. The performance of multiple linear regression analysis indicated that smoking ( $p=0.001$ ), plaque index ( $p=0.021$ ), gingival index ( $p<0.0001$ ), plaque control methods ( $p<0.001$ ), and level of education ( $p<0.001$ ) were the most important associated factors of gingival recession.

**Conclusion:** The present study indicates that an association exists between gingival recession and presence of gingival inflammation, inadequate oral hygiene habits, and smoking.

**Keywords:** Adults, Gingival recession, Prevalence, Risk factors.

**How to cite this article:** Chrysanthakopoulos NA, Saini R. Prevalence of Gingival Recession and associated Risk Factors among 18–45-Year-Old Who Attended a Dental Practice in Greece. *Int J Experiment Dent Sci* 2016;5(1):28-33.

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

Gingival recession (GR) is the most common and undesirable condition of the gingiva and has been

described among populations of all ages throughout the world. It is defined as an apical shift of the gingival margin over the cemento-enamel junction (CEJ) and the exposure of the root surface to the oral environment.<sup>1</sup> Gingival recession describes the condition of periodontal tissue and mainly clinical displacement of the gingival margin along teeth root surface, and consequently, it is not considered as a disease. Its presence is disturbing for patients due to esthetic, psychological, and functional problems, for example, dentin hypersensitivity, root caries and abrasion, cervical wear, and dental erosion because of the exposure of the root surface to the oral environment.<sup>2</sup> Previous researches have recorded that GR prevalence ranged from 50.0% to higher percentages<sup>1,3-6</sup> or less.<sup>7</sup> The etiology of GR is multifactorial and is always the result of more than one factor acting together according to previous studies.<sup>1,8</sup> On the other hand, a wide range of factors has been suggested as significantly associated with GR including anatomical, inflammatory, and traumatic factors. These factors are destructive periodontal disease, inadequate toothbrushing, vigorous oral hygiene habits, presence of dental plaque and supra/subgingival calculus, alveolar bone dehiscence, high muscle attachment, occlusal trauma, oral piercing, frenal pull, thin biotype of gingival, and iatrogenic factors related to reconstructive, conservative, orthodontic, periodontologic, or prosthetic treatment and oral piercing.<sup>2,9-12</sup> Tobacco smoking is regarded as one of the main risk factors for the development of periodontal disease and considered as a factor associated with GR.<sup>3,13</sup>

The purpose of the present investigation was to assess the prevalence of GR and the possible associations among GR and periodontal and epidemiological variables in a sample of Greek adults who attended a general dental practice.

## MATERIALS AND METHODS

### Study Population

For this study, 640 individuals, 300 males and 340 females aged 18–45 years, were selected. The Greek Ministry of Health and the Greek Dental Association organized dental surveys for schoolchildren and adults annually, in order to assess the prevalence of diseases such as

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dental caries and periodontitis, the oral hygiene level, and the treatment needs of the Greek population. All the participants completed an oral health questionnaire and underwent an oral clinical examination in several private practices without charge. This precondition was an important motivation in order to create a representative random study sample. As part of the mentioned National Oral Health Survey, the present study was carried out between October and December 2014.

### Selection Criteria

The selection criteria of the participants comprised age above 18 and up to 45 years and a mean number of 20 natural teeth. None of the participants who had received scaling and root planing/periodontal treatment during the previous 6 months were included in the study. Third molars and residual roots were excluded from the study, as well.

### Questionnaire

Based on the information provided in the questionnaire, the individuals were categorized in the following groups, according to their educational level (primary, secondary college, and university level), smoking status (never smokers and current smokers—former smokers were included, whereas occasional smokers were excluded from the study), oral hygiene habits (toothbrushing and flossing, toothbrushing and none method). Collected data also included demographic variables, such as age and gender of the participants of the study. The classification of GR (mild, moderate, and advanced) based on the following criteria was determined by Marini et al<sup>14</sup>: Mild recession:  $\leq 3.0$  mm of root surface exposed to the oral environment, moderate recession: 3.0–4.0 mm of root surface exposed to the oral environment, and advanced recession:  $>4.0$  mm of root surface exposed to the oral environment.

### Clinical Examination

The clinical examinations were performed in a private dental practice, using a conventional dental unit and illumination. One well-trained and calibrated dentist performed the examinations. The following indices were recorded: Plaque index (PII) by L oe,<sup>15</sup> gingival index (GI),<sup>15</sup> and GR. As mentioned, supragingival dental plaque was visualized by the use of a disclosing solution (erythrocin, 3%) and scored as present or absent on all tooth surfaces. The measurements were performed by means of a William's manual probe (PCP10-SE, Hu-Friedy Mfg. Co. Inc., Chicago, IL, USA), and they were rounded off to the nearest millimeter; for example, a reading of 3.6 mm is recorded as 4.0 and 5.3 mm reading is recorded

as 5.0 mm. In case an abrasion was present at the tooth cervix, or a restoration extended apically to the CEJ the position of the CEJ was estimated by extrapolating the position of the CEJ from the adjacent teeth.

### Ethical Considerations

The present study was not an experimental one. In Greece, only experimental studies must be reviewed and approved by authorized committees (Dental Schools, Greek Dental Associations, Ministry of Health, etc.). Subjects who agreed to participate in the present study informed about the evaluation to which they would be submitted and signed an informed consent form.

### Statistical Analysis

In this study, the prevalence of GR was the percentage of patients with the worst score of recession. For each individual, the worst score of GR among his/her teeth was taken into account. The same methodology was used for estimation of PII and GI.

Kolmogorov–Smirnov test was carried out in order to determine the presence or absence of normal distribution of GR, which was the dependent variable. In case in which estimated p-value was  $>0.05$ , the distribution was characterized by normality, therefore the Chi-square test and Pearson's correlation could be carried out. Multiple linear regression analysis was carried out to model the association of GR with potential risk factors; firstly relations between dependent variable GR and independent variables were determined by the enter method (model 1) of the statistical package except for the independent variables that showed significant associations less than 5% ( $p < 0.05$ ) within that group.

Finally, all the independent variables included multiple linear regression model and the stepwise method analysis was carried out to estimate gradually the variables that showed significant associations with the dependent one. A p-value less than 5% ( $p < 0.05$ ) was considered to be statistically significant. The data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA).

### RESULTS

The total number of individuals who visited the private practice during the determined period by the Greek Dental Association for their annual dental follow-up was 772; however, 640 of them were selected to participate in the present study; according to the selection criteria mentioned, 48 did not meet the mentioned criteria and 84 refused to participate in the study, giving a response rate of 82.9%. The mean age of the sample was  $27.2 \pm 4.3$  years.

The prevalence of GR was overall 62.7%, and was present in 205 males and 191 females. Gingival recession was present in at least one tooth surface in 98.6% of the mentioned individuals. No significant difference between males and females regarding GR prevalence was recorded (p = 0.096).

The distribution of the sample according to smoking status, presence/absence of supragingival calculus, PII, GI, oral hygiene habits, and level of education by gender is shown in Table 1.

Kolmogorov–Smirnov’s test p value was calculated as 0.2 (>0.05; normal distribution of GR as dependent variable). Multiple linear regression modeling, using stepwise method (at alpha = 0.05), indicated that GR was associated with GI, level of education, smoking, oral hygiene habits and PII (Table 2). The difference between GR severity in smokers and nonsmokers was significant (p = 0.001). This finding means that smokers showed higher rates of GR than non-smokers. A significant difference was also recorded between PII and GR (p = 0.021); however, the effect of PII on the rate of GR was not positive, as shown in Table 3. This observation means that higher levels of dental plaque were not

**Table 1:** Distribution of the sample according to smoking status, presence/absence of supragingival calculus, plaque index, oral hygiene habits, gingival index and level of education by gender

Independent variables	Classification	Males (%)	Females (%)
Smoking status	Smokers	46.7	45.9
	Nonsmokers	53.3	54.1
Gingival calculus	Presence	58.7	57.7
	Absence	41.3	42.3
Plaque index (PII)	0*	4.4	3.6
	1†	26.0	25.0
	2§	38.1	44.2
	3	31.5	27.2
Gingival index (GI)	No inflammation	9.3	12.9
	Mild inflammation	29.3	30.6
	Moderate inflammation	37.3	32.9
	Severe inflammation	24.0	23.5
Oral habits	Toothbrushing and floss	20.0	16.5
	Toothbrushing	53.3	52.9
	None	26.7	30.6
Educational level	University	25.3	22.3
	College	32.0	30.6
	Secondary	26.7	28.2
	Primary	16.0	18.9

PII: 0\* (=no plaque), 1† (=dental plaque may be seen *in situ* only after application of disclosing solution or by using the probe on the tooth surface), 2§ (=soft deposits can be seen with naked eye), 3|| (=abundance of soft matter within the gingival pocket and/or the tooth gingival margin)

**Table 2:** Final multivariate model (stepwise model) for gingival recession and regression on the independent variables of gingival index, level of education, smoking, oral hygiene habits, and plaque index

Independent variables	Unstandardized coefficients (β) Standard error (SE)	Standardized coefficients (Beta)	p-value
Gingival index	0.160 0.029	0.408	0.000*
Educational level	0.148 0.021	0.411	0.000*
Smoking	0.100 0.030	0.134	0.001*
Oral hygiene habits	0.106 0.029	0.192	0.000*
Plaque index	-0.067 0.029	-0.124	0.021*
Constant	1.299 0.067	-	0.000

\*Statistically significant

associated with higher rates of GR. The association between GR and GI was found statistically (p < 0.001) as GR was at higher levels among individuals who had severe levels (e.g., moderate and severe GR) of gingival inflammation. Between GR and oral hygiene habits, a significant difference was recorded (p < 0.001). This finding means that individuals with inadequate oral hygiene showed higher rates of GR. Similar conclusions can be drawn between GR and educational level (p < 0.001) as individuals with upper level of education (college, university) showed mild levels of GR.

The distribution of GR by gender, smoking status, gingival calculus, PII, GI, and educational level is shown in Table 3.

## DISCUSSION

According to the literature, few studies have investigated the epidemiology and the associated factors of GR, whereas few similar studies have been carried out in Greece.<sup>5,6</sup>

The present study showed that the prevalence of GR was overall 62.7%. Previous works have shown that GR prevalence ranged from 50.0% to higher percentages.<sup>3-6</sup> Only in one study the prevalence was 27.7%.<sup>7</sup> The variation in prevalence among these studies may be explained by several factors. First, the different criteria used in the various studies could at least partly be the reason for this discrepancy, such as the percentage of patients with at least one GR in the study sample,<sup>16</sup> the number of affected sites divided by the number of sites examined multiplied by 100,<sup>17</sup> the total number of GR sites,<sup>4</sup> etc. It is clear that there does not exist a specific and acceptable index to measure GR. In addition, it is often difficult to distinguish the main forms of root destruction such as erosion, attrition, and abrasion from GR and it is likely that all these processes may have been included in some of the cases examined in the current study. Second, it is difficult to compare the results of prevalence studies

**Table 3:** The distribution of gingival recession by gender, smoking status, gingival calculus, plaque index, gingival index, oral habits, and educational level

Independent variables	Epidemiological aspects classification	Mild GR ( $\leq 3.00$ mm) n%	Moderate GR (3–4.00 mm) n%	Advanced GR ( $\geq 4.00$ mm) n%	GR absence n
Smoking status	Smokers	246 (94.6)	10 (3.8)	4 (1.6)	36
	Nonsmokers	151 (100.0)	0 (0.0)	0 (0.0)	208
Gingival calculus	Presence	266 (95.3)	8 (2.8)	5 (1.9)	93
	Absence	151 (100.0)	0 (0.0)	0 (0.0)	151
Plaque index	3	107 (90.5)	6 (5.3)	5 (4.2)	71
	2§	170 (97.8)	3 (1.8)	1 (0.4)	90
	1†	98 (98.7)	1 (0.9)	0 (0.4)	64
	0*	5 (100.0)	0 (0.0)	0 (0.0)	19
Gingival index	Severe inflammation	111 (89.2)	8 (6.4)	5 (4.4)	28
	Moderate inflammation	149 (100.0)	0 (0.0)	0 (0.0)	75
	Mild inflammation	111 (100.0)	0 (0.0)	0 (0.0)	81
	No inflammation	12 (100.0)	0 (0.0)	0 (0.0)	60
Oral habits	None	150 (86.2)	16 (9.4)	8 (4.4)	10
	Toothbrush	187 (100.0)	0 (0.0)	0 (0.0)	153
	Toothbrush and dental floss	35 (100.0)	0 (0.0)	0 (0.0)	81
Educational level	University	98 (100.0)	0 (0.0)	0 (0.0)	54
	College	113 (100.0)	0 (0.0)	0 (0.0)	87
	Secondary	132 (100.0)	0 (0.0)	0 (0.0)	44
	Primary	45 (85.7)	5 (8.6)	3 (5.7)	59

0\* (=no plaque), 1† (=dental plaque may be seen *in situ* only after application of disclosing solution or by using the probe on the tooth surface), 2§ (=soft deposits can be seen with naked eye), 3|| (=abundance of soft matter within the gingival pocket and/or the tooth gingival margin); GR: gingival recession

when different teeth and different surfaces are included in the measurement method. On the other hand, the permanent dentition analyzed in different investigations shows GR at ages ranging from young individuals to 65+ years, and this finding may also influence the results through differences in the time of exposure to risk factors.

The distribution of GR by gender, according to similar studies, implied higher rates in males than in females,<sup>3-6,18-20</sup> a finding that was in accordance with the current study. Only in one study,<sup>21</sup> 31.74% of females and 24.28% of males showed GR, a finding that could be attributed to the fact that females are more motivated with regard to oral hygiene practices and, thus, brush their teeth more frequently than males.<sup>22</sup>

The role of dental plaque and gingival inflammation in the development of GR has been analyzed in a number of epidemiological studies, which have shown that gingival inflammation was the most frequent precipitating etiological factor of GR.<sup>19,23</sup> A similar study in Turkey<sup>4</sup> showed that GR was associated with a high level of dental plaque. However, other authors<sup>12</sup> observed a negative correlation between presence of dental plaque on the buccal tooth aspect and GR. This finding could not dispute the role of dental plaque as a risk factor for periodontal disease and GR and could be considered as a random one as the majority of previous studies have confirmed the etiological role of dental plaque in the development of GR.<sup>4,16,17</sup> The results also showed no

association between presence of supragingival calculus and GR. However, according to previous reports,<sup>2-4,11,18,22</sup> formation of supra- and subgingival calculus was found to be one of the most important factors associated with GR.

Regarding oral hygiene habits of the sample, 28.64% of the individuals with GR did not brush their teeth at all, while 18.23% showed adequate oral hygiene habits. Similar researches<sup>4,22</sup> have found that inadequate oral hygiene was an important risk factor of GR, while other investigators<sup>11</sup> have emphasized the role of poor oral hygiene, dental plaque, and calculus in GR development. However, it has been recorded that GR was associated with vigorous, forceful, and excessive use of medium-hardness or hard toothbrushes in an horizontal direction,<sup>13,17,21,24</sup> and general mechanic-trauma<sup>4,7,23,25</sup> from toothbrushing. These findings could explain the development of GR in patients with a good standard of oral hygiene.

In contrast to the mentioned observations, other investigators<sup>5,26,27</sup> recorded no significant differences between GR and toothbrush type and frequency of toothbrushing, whereas in a study in Tanzanian women<sup>22</sup> it was found that toothcleaning practices were not significantly associated with GR. In addition, a systematic review<sup>28</sup> showed that out of 17 studies only 2 studies concluded that there appeared to be no relationship between toothbrushing frequency and GR, while 8 studies reported a positive association between

toothbrushing frequency and GR. It is clear that there exists a need to educate the patients to use proper toothbrushing methods and other available means for dental plaque control (dental floss, interdental brushes, oral solutions). The application of effective oral hygiene habits results in less plaque accumulation, less calculus formation, and less periodontal disease and GR.<sup>4,17</sup> An important observation of the present investigation was a positive association between smoking and GR. This finding is in accordance with previous studies, in which tobacco smoking is regarded as one of the main risk factors for development of destructive forms of periodontal disease,<sup>5,9</sup> while the combination of smoking and supragingival calculus was associated with localized and generalized GR.<sup>3,4,7,22,25</sup> However, a previous study<sup>29</sup> showed that smoking status was not identified as a risk factor for the development of GR. Similar studies suggested a negative impact on GR and periodontal health from tobacco smoking.<sup>30,31</sup> There is an established literature on the relationship between smoking and periodontal disease pathogenesis, development and progression of periodontal disease,<sup>3,13</sup> destructive periodontal disease, alveolar bone loss, and poor response to periodontal therapy, although the mechanisms of its negative influence are not well understood.<sup>32</sup> The influence of educational level on occurrence of GR was evident. This observation agrees with previous works,<sup>11,25</sup> suggesting that educational level was an important contributor to buccal GR. This association could be attributed to the fact that more educated patients have realized the value and importance of preventive dentistry and oral hygiene, have a good standard of oral hygiene, use the available means for dental plaque control, and follow a regular dental follow-up.

Multiple linear regression modeling, using stepwise method, indicated that GI, level of education, smoking, oral hygiene habits, and PII were the factors that were significantly associated with GR, while gender and presence of supragingival calculus were not. A report that was carried out in Brazil<sup>3</sup> and used the same model showed that cigarette smoking and presence of supragingival calculus were the factors most significantly associated with localized and generalized GR, whereas gender and socioeconomic status were not associated with it. Similarly, another study in adults<sup>18</sup> showed that gender, PII, and tobacco consumption were associated with the extent of GR and also indicated that the risk factors for GR were similar to the traditional risk factors for periodontitis.

Other researches have shown that smoking duration, traumatic toothbrushing, toothbrushing frequency, presence of dental plaque, and calculus were significantly associated with GR,<sup>4</sup> and toothbrush trauma and calculus

were the etiological factors which appeared to be related to GR<sup>7</sup> and that gingival inflammation and smoking were significantly associated with GR.<sup>5</sup> In addition, two studies, in Thai elderly<sup>18</sup> and in Japanese adults,<sup>20</sup> showed that GR was associated with gender and amount of calculus, and that gender and smoking habits were the risk factors associated with GR.

The differences that have been observed among the available previous studies regarding the association between GR and the examined variables could be attributed to several factors such as the heterogeneous population samples, the different criteria used by several examiners (clinical examination questionnaire) in order to collect data and estimate the prevalence of GR, the origin of the sample collected (dental hospital, private practice), etc.

The sample of the present study concerned individuals who visited a private dental practice for their annual dental follow-up and could be considered as a representative and a random one. In addition, it is important to highlight that the aetiology of GR is multifactorial and its occurrence is always the result of more than one factor acting together. As mentioned, few studies have investigated the combination of possible risk factors of GR.

There are probably many more implicating factors other than the ones already stated in the present study in the initiation of GR that may not have been considered in the present study such as anatomical factors (i.e., poorly adhered gingiva, tooth malposition and crowding, root prominence, and bone defects), occlusal trauma, thin gingiva biotype, iatrogenic factors (inappropriate fixed prostheses, orthodontic treatment), sociodemographic and socioeconomic factors, etc. Therefore, it is obvious that further prospective and cross-sectional studies are required to investigate this multifactorial condition.

## CONCLUSION

In conclusion, the present study showed that the prevalence of GR in males was higher than in females and that presence of dental plaque, gingival inflammation, smoking, inadequate oral hygiene habits, and lower level of education were important associated factors of GR. Thus, these findings highlight the importance of smoking cessation and maintaining good oral hygiene for achieving periodontal health in Greek adults.

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