REASONS AND RISKS OF PERMANENT TEETH EXTRACTION. THE GENERAL DENTAL PRACTICE IN GREECE

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Abstract

Aim: The aim of this retrospective study was to investigate the reasons for tooth extraction and their associations with possible risk indicators, such as socio-demographic and other epidemiological variables analyzed in dental practice in Greece. Materials and method: The study involved 2,250 individuals, 1,170 males and 1,080 females aged 18 to 78 years. Data were collected by means of an interviewer-administered questionnaire and oral clinical examination. Statistical analysis of the questionnaire items was performed with a multivariate regression analysis model in order to estimate the possible associations between dental caries and periodontal disease as dependent variables, as well as the socio-demographic and other epidemiological variables, as independent parameters. Results: A total of 5,568 permanent teeth were extracted for various reasons during the study. The results showed that the main reasons for tooth extraction were dental caries (37.3%) and periodontal disease (35.0%). Tooth extraction due to dental caries was associated with risk indicators of lower educational and income level, inadequate oral hygiene and lack of a regular dental follow-up, whereas tooth extraction due to periodontal disease was associated with the same variables, to which smoking was added. Conclusions: Dental caries and periodontal disease were the main reasons for tooth extraction in Greece. In addition, significant associations were recorded between the causes of tooth extraction and the possible risk indicators under analysis.

Keywords: tooth extraction, dental caries, periodontal disease

INTRODUCTION

Tooth extraction, regardless of the progress of modern dentistry, consists of a multi-complex problem for both the clinical dentist and the patient. Tooth missing results in poor dietary habits and deterioration of life quality, causing serious problems and disfunction of the masticitory system. In addition, the number of extracted teeth can serve as an indicator of the socio-economic and oral hygiene level. Therefore, it is of vital importance to investigate the reasons for tooth extraction in order to reveal the possible indicators or risk factors and to lay the foundations for putting into practice adequate dental policies.

The reasons of permanent teeth extraction include dental caries, periodontal disease, accidents-injuries, orthodontic treatment, failed dental-root canal treatments, impacted teeth, prosthetic indications and other causes, such as patients’ request. According to previous reports, even if dental caries and periodontal disease have consistently been shown as the two main causes of tooth extraction, dental caries remains the main cause of tooth extraction in many countries. Few studies have discovered that the periodontal disease was the main reason for tooth extraction, whereas other investigators have recorded that dental caries and periodontal disease were equally responsible.

Therefore, the aim of the present research was to investigate the reasons for tooth extractions of permanent teeth in an adult population sample, and their associations with several socio-demographic and epidemiological variables.

MATERIALS AND METHOD

Sample population

The population considered for the study was formed of 2,250 patients, 1,170 males and 1,080 females (18 to 78 years of age) from a private practice office in Patra, one of the biggest cities in Greece.
All patients filled in a health questionnaire and underwent oral clinical examination. The investigation was carried out between May 2007 and August 2012.

**Questionnaire**

Before the oral clinical examination, all participants filled in a self-administered questionnaire that included variables such as age, gender, marital status, smoking status, income level, education level and information about oral health habits.

The examined variables were classified into various categories, namely gender: males (code 1) and females (code 0); marital status: single (code 0) and married (code 1); smoking status: current smokers (code 1) and non-smokers (code 0). Incomes were classified into two categories: 0-1,000 € a month (code 1) and 1,001 € a month and above (code 0). Similarly, the education level was classified into two categories: university/higher education institutions (code 0) and primary/elementary/high-school (code 1).

Tooth brushing was determined by the frequency of brushing: two or more times a day (code 0) versus less or rarely (code 1), while the frequency of dental follow-ups was determined in a similar way: two or more times a year (code 0) versus less or rarely (code 1). The dependent variable: tooth extraction due to dental caries, was dichotomised as 0, for 1-12 teeth extracted, and as 1, respectively, for 13-32 teeth extracted per patient, and due to periodontal disease, using the same methodology.

The samples were divided into 7 groups, according to age.

**Clinical examination**

Oral clinical examinations were performed by a well-trained and calibrated dentist.

The criteria for tooth extraction due to dental caries included initial or recurrent caries, its sequelae, root remnants in case of lost crown being due to dental caries, while fractures due to weakening caused by dental caries. Tooth mobility, severity of the attachment loss and furcation involvement were the main criteria which recommended the extraction of periodontally affected teeth. Failed root canal treatments and fracture of weakened teeth diagnosed by radiographic and clinical examination were also included. The criterion for tooth extraction due to orthodontic reason was the lack of space.

**Ethical considerations**

The present study was not an experimental one as, in Greece, only the experimental studies must be reviewed and approved by authorized committees (Dental Schools, Greek Dental Associations, Ministry of Health, etc.).

The individuals who agreed to participate in the present study were informed about the evaluation to which they would be submitted and signed an informed consent form.

**Statistical analysis**

Statistical analysis of the questionnaire items was performed with a logistic regression model for determining the independent associations between the dependent variables: tooth extraction due to dental caries and to periodontal disease (dichotomised as already mentioned), and the examined variables.

Chi-square test was used to determine the associations between the category variables.

The criterion assuring the independent variables’ entering the model was set at 0.25 after which they were introduced in the model (after the chi-squared test), the operation being repeated in a backward fashion, for revealing which final indicators could be considered as risk factors of tooth extraction. Adjusted odd ratios with a 95% Confidence Interval (CI) were also assessed.

Data analysis was performed using the statistical package SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). A p value less than 5% (p<0.05) was considered to be statistically significant.

**RESULTS**

The total number of participants who met the selection criteria were 2,725. However, only 2,250 of them accepted the invitation to take part in the study, which gives a response rate of 82.6%. The mean age of the study sample was 44.3 ± 6.2 years. A total number of 5,568 permanent teeth
was extracted from 2,250 patients. The average number of extracted teeth was 2.47-2.57 in males and 2.37 in females, the difference being statistically significant (p=0.047).

The distribution of patients and of the extracted teeth by age and gender is shown in table 1.

The frequencies of teeth extracted due to dental caries, periodontal disease and other reasons are presented in table 2 according to gender.

The indicators associated with tooth extractions caused by dental caries and periodontal disease, according to the chi-square analysis, are shown in table 3, while the results after logistic regression analysis, and adjusted OR’s with 95% CI are presented in table 4. It was shown that males with a lower education and income level do not brush their teeth properly and do not follow a regular dental follow-up, being associated with a lower number of teeth (1-12) extracted due to dental caries, whereas smokers with a lower education and income level, who do not brush their teeth properly and do not follow a regular dental follow-up are associated with a higher number of teeth (13-32) extracted due to periodontal diseases.

DISCUSSION

Previous reports in several countries have shown that the main reasons of tooth extraction were dental caries and periodontal disease; however, dental caries appears to be the principal cause of tooth extraction, many countries recording a frequency from 43.1 to 86.2%. Few
studies have recorded that periodontal disease was the main reason for tooth extraction, whereas other investigators have found that dental caries and periodontal disease were equally responsible. The mentioned studies have recorded low frequencies for other reasons of tooth extraction, such as orthodontic treatment, impacted teeth, failed dental and root canal treatments, etc. The results also showed that the average number of extracted teeth between males and females was statically significant, agreeing with the observations of previous reports.

In the international literature of the field, few studies have investigated the possible associations between tooth extractions and indicators or risk factors.

Extractions due to dental caries were more frequent in males, which disagrees with the results of previous reports, according to which the periodontal disease was the main reason of tooth extraction in males. Many previous studies have recorded gender differences in the analysis of extractions due to the total number of causes.

Smoking was associated with tooth extraction due to periodontal disease and with the increasing number of extracted teeth (13-32), which agrees with the results of previous studies.

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**Table 3. Associations between socio-demographic/other epidemiological variables and the number of extracted teeth (0-12/13-32) caused by dental caries and other reasons, and by periodontal disease and other reasons**

<table>
<thead>
<tr>
<th>Reasons for extractions</th>
<th>Dental caries (no of patients)</th>
<th>Other (no of patients)</th>
<th>P</th>
<th>Periodontal reasons (no of patients)</th>
<th>Other (no of patients)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>socio-demographic/epidemiological</td>
<td>0-12 /12+ teeth</td>
<td>0-12/12+ teeth</td>
<td>P</td>
<td>0-12/12+ teeth</td>
<td>0-12/12+ teeth</td>
<td>P</td>
</tr>
<tr>
<td>variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Females</td>
<td>337/225</td>
<td>263/345</td>
<td>0.007*</td>
<td>156/234</td>
<td>435/345</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>302/186</td>
<td>204/388</td>
<td></td>
<td>183/223</td>
<td>384/290</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single</td>
<td>287/195</td>
<td>235/404</td>
<td>0.002*</td>
<td>154/206</td>
<td>376/295</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>352/216</td>
<td>233/329</td>
<td></td>
<td>185/251</td>
<td>443/340</td>
</tr>
<tr>
<td>Smoking Status</td>
<td>Smokers</td>
<td>384/266</td>
<td>288/424</td>
<td>0.136</td>
<td>187/246</td>
<td>498/375</td>
</tr>
<tr>
<td></td>
<td>Non-smokers</td>
<td>255/145</td>
<td>179/309</td>
<td></td>
<td>152/211</td>
<td>321/260</td>
</tr>
<tr>
<td>Education level</td>
<td>Low</td>
<td>476/283</td>
<td>326/584</td>
<td>0.000*</td>
<td>231/251</td>
<td>644/511</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>163/128</td>
<td>141/149</td>
<td></td>
<td>108/206</td>
<td>175/124</td>
</tr>
<tr>
<td>Income level</td>
<td>Low</td>
<td>415/247</td>
<td>295/507</td>
<td>0.014*</td>
<td>208/283</td>
<td>594/478</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>224/164</td>
<td>172/226</td>
<td></td>
<td>131/174</td>
<td>225/157</td>
</tr>
<tr>
<td>Tooth brushing</td>
<td>≥ 2 times/day</td>
<td>159/114</td>
<td>177/215</td>
<td>0.000*</td>
<td>138/215</td>
<td>342/244</td>
</tr>
<tr>
<td></td>
<td>&lt; 2 times/day</td>
<td>480/297</td>
<td>290/518</td>
<td></td>
<td>201/242</td>
<td>477/391</td>
</tr>
<tr>
<td>Dental follow-up</td>
<td>≥ 2 times/year</td>
<td>224/163</td>
<td>208/294</td>
<td>0.002*</td>
<td>129/193</td>
<td>381/283</td>
</tr>
<tr>
<td></td>
<td>&lt; 2 times/year</td>
<td>415/248</td>
<td>259/439</td>
<td></td>
<td>210/264</td>
<td>438/352</td>
</tr>
</tbody>
</table>

*: statistically significant
The lower education and income level was associated with tooth extraction due to dental caries and to periodontal disease, and seen as agreeing with those from previous reports.\textsuperscript{8, 27‑29} The number of extracted teeth due to periodontal disease was higher, 13‑32 teeth, in individuals with a lower education and income level, compared to those with a higher level. This finding may be attributed to the fact that the periodontal disease affects mainly older individuals, who have adopted a negative attitude in seeking preventive dental follow‑up.\textsuperscript{1}

According to the results of the present study, tooth‑brushing and dental follow‑up frequency had independent effects on tooth extraction, due to dental caries and periodontal disease. Similar findings have been reported in previous studies.\textsuperscript{9, 27, 30, 31}

The present study has some limitations that should be taken into account before any possible benchmarking with similar studies. Some of the mentioned differences may be attributed to the heterogeneous population samples which had been examined, to the progression of dental caries and periodontal disease during the last decades, to the different methods used for assessing the frequency of permanent teeth extraction (e.g., clinical examination, questionnaire) and to the importance given by the population samples to the value of oral health and to the need for a regular dental follow‑up. The present study concerned individuals who sought dental treatment.

### Table 4. Results of the stepwise regression analysis model (Wald method) using dental caries and periodontal disease as dependent variables

<table>
<thead>
<tr>
<th>Tooth extraction caused by dental caries</th>
<th>Coefficient (B)</th>
<th>Standard Error (SE)</th>
<th>P</th>
<th>OR</th>
<th>95% Confidence Interval (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education level</td>
<td>-0.810</td>
<td>0.116</td>
<td>0.000</td>
<td>0.445</td>
<td>0.354‑0.559</td>
</tr>
<tr>
<td>Income level</td>
<td>-0.755</td>
<td>0.108</td>
<td>0.000</td>
<td>0.470</td>
<td>0.380‑0.580</td>
</tr>
<tr>
<td>Tooth brushing</td>
<td>-0.353</td>
<td>0.099</td>
<td>0.000</td>
<td>0.703</td>
<td>0.579‑0.853</td>
</tr>
<tr>
<td>Dental follow‑up</td>
<td>-1.639</td>
<td>0.100</td>
<td>0.000</td>
<td>0.194</td>
<td>0.160‑0.236</td>
</tr>
<tr>
<td>Constant</td>
<td>1.496</td>
<td>0.132</td>
<td>0.000</td>
<td>4.466</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tooth extraction caused by periodontal disease</th>
<th>Coefficient (B)</th>
<th>Standard Error (SE)</th>
<th>P</th>
<th>OR</th>
<th>95% Confidence Interval (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking status</td>
<td>0.350</td>
<td>0.098</td>
<td>0.000</td>
<td>0.705</td>
<td>0.581‑0.855</td>
</tr>
<tr>
<td>Educational level</td>
<td>0.591</td>
<td>0.108</td>
<td>0.000</td>
<td>1.806</td>
<td>1.462‑2.231</td>
</tr>
<tr>
<td>Income level</td>
<td>0.469</td>
<td>0.104</td>
<td>0.000</td>
<td>1.599</td>
<td>1.304‑1.960</td>
</tr>
<tr>
<td>Tooth brushing</td>
<td>0.232</td>
<td>0.095</td>
<td>0.015</td>
<td>1.261</td>
<td>1.046‑1.520</td>
</tr>
<tr>
<td>Dental follow‑up</td>
<td>0.937</td>
<td>0.094</td>
<td>0.000</td>
<td>2.553</td>
<td>2.122‑3.070</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.430</td>
<td>0.099</td>
<td>0.000</td>
<td>0.650</td>
<td>—</td>
</tr>
</tbody>
</table>
in a private practice office; therefore, the sample could not be considered as a random one. Other parameters that should be taken into account are the variations in study designs, the over-representation of certain age ranges or tooth types that may have affected the samples under study or the differences in practice patterns and attitudes towards the retention of teeth by both patients and dental professionals. In addition, the above mentioned differences showed the difficulties of comparing tooth loss studies, as due to the different methodologies and populations studied, which requires caution in the interpretation of such comparisons.

CONCLUSIONS

- Dental caries (38.7%) and periodontal disease (35.7%) were the main reasons for tooth extraction observed in a dental practice office in Greece.
- The number of extracted teeth due to dental caries was associated with a lower education and socio-economic level, and with a lower frequency of tooth-brushing and dental follow-up.
- The lower education and socio-economic level, and the lower frequency of tooth-brushing and dental follow-up and smoking were associated with an increasing number of extracted teeth due to periodontal disease.

References

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