Acta Odontologica Scandinavica, 2006; 64: 123–128

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Socio-economic risk indicators for apical periodontitis

FREDRIK FRISK[1,3] & MAGNUS HAKEBERG[2,4,5]

[1]*Department of Endodontology and* [2]*Department of Oral Behavioural Sciences, Sahlgrenska Academy, Göteborg University, Göteborg, Sweden,* [3]*Department of Endodontology, Institute for Postgraduate Dental Education, Jönköping, Sweden,* [4]*School of Health Sciences, Jönköping University, Jönköping, Sweden and* [5]*Public Dental Service, Göteborg, Sweden*

Abstract

Objective. The aim of this study was to reveal possible socio-economic risk indicators for apical periodontitis. ***Material and Methods.*** In 1992–93 a representative sample of women in Göteborg, Sweden, aged 38–84 years, participated in a medical and dental survey ($n = 981$) which included dental and medical examinations and dental radiographic examination (OP). The dependent variable was apical periodontitis (AP = 0, AP > 0). The independent variables were age, number of teeth, number of restored teeth, number of root-filled teeth, number of teeth with carious lesions, satisfactory masticatory function, and dental esthetics as crude measures of self-reported dental health, dental anxiety, time elapsed since last visit to a dental office, regular dental visiting habits, smoking, alcohol habits, and marital status. A subjective evaluation of economy, health and life situation (acceptable or poor) was accounted for as socio-economic variables. The oldest age group, women born 1908, and edentulous individuals were omitted, leaving 844 subjects for analysis. Statistical analysis included multivariate logistic regression, chi-squared test, and independent *t*-test for comparison of group characteristics (AP = 0 vs AP > 0). ***Results.*** For socio-economic variables there was a significant association between acceptable health and apical periodontitis (OR = 1.72 (CI = 1.09–2.70)). For oral-related variables, root-filled teeth (OR = 1.17 (CI = 1.10–1.23)) and teeth with carious lesions (OR = 1.48 (CI = 1.19–1.85)) were predictive of apical periodontitis. ***Conclusions.*** In the present study, socio-economic variables and dental visiting habits did not appear to have obvious implications for periapical health, whereas root-filled teeth and carious lesions were associated with apical periodontitis.

Key Words: *Dental fear, epidemiology, health, periapical disease, women*

Introduction

Socio-economic status has implications for oral and general health. This has been demonstrated for diseases such as caries and cardiovascular disease [1,2]. The pathways between socio-economic status and disease are not fully understood, but authors suggest that socio-economic variables act through environmental factors, influencing health behavior and psychosocial stress [2]. Moreover, some argue that the prevalence of disease has a social gradient which differs between diseases and populations [2,3].

Several studies have demonstrated a social gradient in the prevalence of caries among children and adolescents [4]. To our knowledge, this difference is less studied among adults, and in studies providing relevant data the social gradient is less pronounced in adults [5,6]. However, Thomson et al. [1] have demonstrated that poor childhood oral health and low childhood socio-economic status are predictive of poor adult oral health, including caries. Thus, the cumulative nature of caries has consequences in terms of more unsound teeth in adulthood.

Caries and its related restorative treatment is a common cause of apical periodontitis [7]. Results from epidemiological studies from different countries are fairly concordant in that apical periodontitis is a prevalent disease with sample prevalences ranging between 14% and 70% [8–12]. Since caries and its related restorative treatment is a common cause of apical periodontitis, it is reasonable that the same social gradient found in the prevalence of caries could have implications for apical periodontitis, too.

Kirkevang & Wenzel [13] studied several potential risk indicators for apical periodontitis in 613 individuals in Denmark. The results from a multivariate

Correspondence: Fredrik Frisk, Department of Endodontology, Institute for Postgraduate Dental Education, Box 1030, SE-551 11 Jönköping, Sweden. Tel: +46 36 32 46 23. E-mail: Fredrik.Frisk@lj.se

(Received 25 August 2005; accepted 10 November 2005)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.1080/00016350500469680

logistic regression analysis reflected no evidence of a relationship between socio-economic status and periapical status. However, several carious lesions, quality of dental treatment, regularity of dental visits, and smoking were associated with periapical status. A shortcoming of this study, well accounted for in the article, was the low attendance rate (51%), which may have had implications on the result in terms of selection bias.

Aleksejuniene et al. [14] studied a random sample of 147 individuals aged 35–44 years in Lithuania and found that dental-related variables – caries, dry mouth – were associated with periapical status. Surprisingly, they also found that regular dental visits and high education were associated with periapical disease, too. Since this study used a rather small sample with a narrow age-span, the conclusions cannot be made for the whole population.

To our knowledge, the above-mentioned studies are the only contemporary ones focusing on determinants for periapical disease, other than technical or biological factors. The objective of the present study was to analyse possible socio-economic risk indicators for apical periodontitis with a representative sample.

Material and methods

The Prospective Population Study of Women in Göteborg, Sweden, was initiated in 1968. A random sample of 1622 women aged 38, 46, 50, 54, and 60 years were invited for a combined medical, psychiatric, and dental examination [15]. The attendance rate was 90.1%, i.e. 1462 women took part in the study and were re-examined in 1980–81 and 1992–93. Of those studied in the previous examinations, 836 women took part in the medical study and 702 in the dental study in 1992–93. With randomly selected samples of women born in 1942 and 1954 added, and extension of the cohorts of women born in 1922 and 1930, the medical part of the study, in 1992–93, consisted of 1087 participants, 981 of whom took part in the dental study [16]. In the present investigation, data from the 1992–93 examination are used. The oldest age group, women born in 1908, and edentulous individuals were omitted, leaving 844 subjects for the analysis (Table I). For non-participation analysis, see Bengtsson et al. [17].

Table I. Age distribution. Age cohorts and frequency

Age	Frequency
38	64
50	97
62	252
70	230
74	150
78	51

The dental study consisted of periodontal screening, dental radiographic examination (orthopanthomogram), and a questionnaire. Data from questionnaires regarding health-related lifestyle and socio-economic factors were used from the medical study.

The dependent variable was apical periodontitis, and was dichotomized in no teeth with apical periodontitis (AP = 0) or one or more teeth with apical periodontitis (AP > 0). Characteristics for cases versus non-cases are presented in Table II.

The independent variables were age, number of teeth (1–32), number of restored teeth, number of root-filled teeth, and number of teeth with carious lesions. Satisfactory masticatory function and satisfactory dental esthetics were measured on a scale of 1–5, and were dichotomized to poor (1–3) or acceptable (4–5) as crude measures of perceived oral health. Time elapsed since previous dental visit (<1 year vs ≥ 1 year), regular dental visiting habits (≥ 1 time/year vs <1 time/year), dental anxiety according to the Dental Anxiety Scale (DAS), with sum of scores 4–20, dichotomized to DAS >13 vs ≤ 13, smoking (smoker, non-smoker), alcohol habits (never, weekly, daily), marital status (married, unmarried). Subjective evaluations of economy, health, and life situation were accounted for as socio-economic variables and were measured on a scale of 1–7 and dichotomized to poor (1–4) or acceptable (5–7).

Statistical analysis

Multivariate logistic regression analysis was used to reveal possible associations between the independent variables and apical periodontitis. An algorithm proposed by Nagelkerke was used for model evaluation (SPSS version 12.01). For comparison of group characteristics, an independent *t*-test was used for continuous variables and chi-squared test for categorical variables.

Results

Sample mean age was 64.4 years (SD 10.5) and mean number of teeth 20.0 (SD 7.2), and these did not differ between cases and non-cases. The medians for DAS and subjective evaluation of economy, health and life situation were 6 for all variables and for satisfactory masticatory function and dental esthetics the medians were 4 for both variables.

Regarding different characteristics between cases and non-cases: cases had more restored teeth, more root-filled teeth, more teeth with carious lesions, more often reported their masticatory function as poor and more often reported their health as acceptable (Table II).

The multivariate logistic regression analysis revealed root-filled teeth, teeth with carious lesions,

Table II. Characteristics for individuals with and individuals without apical periodontitis, respectively. Mean values, standard deviations, and frequencies

	AP >0 (n =255)		AP =0 (n =589)	
	Mean	SD	Mean	SD
Age	65.3	9.0	64.1	11.0
No. of teeth	20.0	6.4	20.0	7.5
No. of restored teeth	16.1	6.4	15.0	7.1*
No. of root-filled teeth	4.9	3.1	3.4	3.0*
No. of teeth with carious lesions	0.5	1.1	0.2	0.7*
No. of teeth with AP	1.5	1.0	0.0	0.0*
Latest dental visit				
<1 year	87.8%		88.3%	
≥1 year	12.2%		11.7%	
Frequency of dental visits/year				
<1 visit	7.1%		7.0%	
≥1 visit	92.9%		93.0%	
Marital status				
Married	58.8%		55.7%	
Unmarried	41.2%		44.3%	
Smoking				
Smoker	19.0%		24.2%	
Non-smoker	81.0%		75.8%	
Alcohol habits				
Never	21.2%		20.7%	
≥1/week	78.8%		79.3%	
Masticatory function*				
Acceptable	76.1%		82.2%	
Poor	23.9%		17.8%	
Dental esthetics				
Acceptable	51.0%		57.3%	
Poor	49.0%		42.7%	
Life situation				
Acceptable	86.9%		84.9%	
Poor	13.1%		15.1%	
Economy				
Acceptable	81.0%		81.2%	
Poor	19.0%		18.8%	
Health*				
Acceptable	76.4%		69.5%	
Poor	23.6%		30.5%	
Dental anxiety score				
≤13	94.5%		94.8%	
>13	5.5%		5.2%	

*p <0.05. Independent t-test for continuous variables and chi-squared test for categorical variables.

and acceptable health to be predictive of apical periodontitis (Table III). The association between perceived health and apical periodontitis was an unexpected finding. However, in an age-specific subanalysis, the positive association between acceptable health and apical periodontits could not be found in the youngest age groups, women born in 1942 and 1954.

Discussion

The aim of this study was to explore the association between socio-economic variables and apical periodontitis. Dental-related variables, root-filled teeth, and teeth with carious lesions were found to be significantly associated with apical periodontitis, but the socio-economic variables available in the present study were not found to be related to periapical status.

Socio-economic factors are suggested to have an impact on general and oral health. The pathways for this association are not clear, but it is reasonable to assume that socio-economic variables act through health-related factors such as diet and dental habits, and this could explain the social gradient found in the prevalence of caries [1,2].

In the present study, the only variable of socio-economic relevance that turned out to be predictive of apical periodontitis was perceived acceptable health. This association was not valid for all age groups and an element of chance cannot be ruled out. Moreover, an evaluation of the multivariate logistic regression revealed a low Nagelkerke statistic, indicating that the model explained only a

Table III. Multivariate logistic regression analysis of associations between the independent variables and AP

	OR	CI (95%)
Age	1.00	(0.98–1.02)
No. of teeth	0.98	(0.94–1.01)
No. of restored teeth	1.02	(0.98–1.06)
No. of root-filled teeth	1.17	(1.10–1.23)*
No. of teeth with carious lesions	1.48	(1.19–1.85)*
Latest dental visit		
<1 year	1.0	(Reference)
≥1 year	0.99	(0.53–1.86)
Frequency of dental visits/year		
≥1 visit	1.0	(Reference)
<1 visit	1.04	(0.45–2.40)
Marital status		
Married	1.0	(Reference)
Unmarried	0.85	(0.61–1.19)
Smoking		
Non-smoker	1.0	(Reference)
Smoker	1.35	(0.91–2.02)
Alcohol habits		
Never	1.0	(Reference)
≥1/week	1.09	(0.73–1.63)
Masticatory function		
Acceptable	1.0	(Reference)
poor	1.49	(0.97–2.27)
Dental esthetics		
Acceptable	1.0	(Reference)
Poor	1.11	(0.79–1.57)
Life situation		
Acceptable	1.0	(Reference)
Poor	1.08	(0.61–1.92)
Economy		
Acceptable	1.0	(Reference)
Poor	1.08	(0.69–1.68)
Health		
Acceptable	1.0	(Reference)
Poor	0.59	(0.38–0.93)*
Dental anxiety score		
≤13	1.0	(Reference)
>13	1.14	(0.52–2.51)

*$p < 0.05$.
OR = odds ratio. CI = confidence interval 95%. AP = individuals with ≥1 periapical radiolucency.
Nagelkerke R-square = 0.12.

small fraction of the variability. However, women reporting acceptable health may have been more health concerned and therefore more prone to choose conservative dental treatment rather than extraction. In a subanalysis dividing the sample into two subsamples with regard to perceived health, women reporting acceptable health were found to visit the dentist more often and had more retained and restored teeth than women reporting poor health (Table IV). Why would this put women reporting acceptable health at higher risk of having apical periodontitis?

From a prognostic point of view, extraction seems to be the best treatment available for elimination of apical periodontitis. Epidemiologic studies show that the healing rate after endodontic treatment is 65–75% in general practice [18,19]. Thus, adopting a conservative approach to treatment of apical peridontitis, i.e. endodontic treatment, can be expected to result in a higher frequency of periapical radiolucencies than in the case of extraction. This might explain why individuals with low socio-economic status do not have a higher prevalence of apical peridontitis despite the fact that they have more teeth with carious lesions. There are studies reporting social indifference regarding DMF scores, but when separated, individuals with low social-economic status have lower F scores and higher D and M scores [20], which is a finding parallel with results from a study on high dental anxiety individuals [21]. Controlling for extent and severity of disease, Gilbert et al. [22] reported a higher risk of tooth loss for individuals of low socio-economic status once entering the dental care system. Aleksejuniene et al. [14] have demonstrated that high education is significantly associated with apical periodontitis.

The socio-economic variables in the present study were marital status, perceived health, economy, and life situation. We had no objective data regarding income, social class, education, or occupation, which is a limitation of the study since we cannot claim to have all information regarding the socio-economic status of the studied women. However, different studies in this field use a plethora of variables accounted for as describing socio-economic disparities in populations. To our knowledge, there is little consensus regarding the variables that are most valid for describing socio-economic status.

Self-rated health has been found to be predictive of mortality, irrespective of social class and long-standing disease [23]. Self-rated health also seems to be strongly predictive of cause-specific death, such as diabetes, infectious and respiratory diseases [24]. Thus, self-rated health is a valid measure of present illness, since it is predictive of mortality. Gender differences have been found in several studies, where the association between self-rated health and mortality is stronger among women than among men, but the results are inconclusive because other studies have reported a stronger association among men [25].

Dental visiting habits did not have any significant association with apical periodontitis in the present study. One can probably apply the same reasoning already discussed above for individuals with low socio-economic status, i.e. subjects who have irregular dental visiting habits and/or seldom visit the dental office often have fewer teeth and can be presumed to choose extraction of teeth rather than endodontic therapy when diagnosed with apical periodontitis. Aleksejuniene et al. [14] found that regular visiting habits were associated with apical periodontitis, while Kirkevang & Wenzel [13] found that no usage of services of dental care was predictive of apical periodontitis.

Table IV. Characteristics for individuals reporting acceptable health and those reporting poor health, respectively. Mean values, standard deviations, and frequencies

	Acceptable ($n=584$)		Poor ($n=233$)	
	Mean	SD	Mean	SD
Age	63.9	10.9	65.2	9.5
No. of teeth	20.6	7.0	18.7	7.2*
No. of restored teeth	15.9	6.7	14.0	7.2*
No. of root-filled teeth	3.9	3.2	3.8	3.0
No. of teeth with carious lesions	0.3	0.9	0.3	0.8
No of teeth with AP	0.5	0.9	0.4	0.8
Latest dental visit				
<1 year	88.4%		88.4%	
≥ 1 year	11.6%		11.6%	
Frequency of dental visits/year*				
<1 visit	5.7%		10%	
≥ 1 visit	94.3%		90%	
Marital status*				
Married	59.1%		51.1%	
Unmarried	40.2%		48.9%	
Smoking				
Smoker	23.2%		22.7%	
Non-smoker	76.8%		77.3%	
Alcohol habits*				
Never	17.8%		28.3%	
≥ 1/week	82.2%		71.7%	
Masticatory function*				
Acceptable	84.9%		69%	
Poor	15.1%		31%	
Dental aesthetics*				
Acceptable	60.3%		43.2%	
Poor	39.7%		56.8%	
Life situation*				
Acceptable	97.6%		54.7%	
Poor	2.4%		45.3%	
Economy*				
Acceptable	86.8%		65.9%	
Poor	13.2%		34.1%	
Dental anxiety score*				
≤ 13	96.2%		91.7%	
>13	3.8%		8.3%	

*$p<0.05$. Independent t-test for continuous variables and chi-squared test for categorical variables.

Several authors have pointed to smoking as a risk indicator for apical periodontitis. When studying 247 individuals with regard to presence of apical periodontitis and smoking, Bergström et al. [26] found that smoking was significantly associated with periapical disease. The same association was shown by Kirkevang & Wenzel [13] and by Aleksejuniene et al. [14]. This could not be found in the present study and may be explained by the rather small fraction of our sample reporting smoking, 22%, compared to Kirkevang & Wenzel's 43.5% [13] and Bergström et al.'s 32.8% [26].

Dental caries and its related treatment has been demonstrated to be significantly associated with apical periodontitis in previous studies [13,14]. The results in the present study are concordant with these findings, as number of teeth with carious lesions and root-filled teeth proved to be predictive of apical periodontitis, while number of restored teeth did not. However, the associations were weak. The radiographic recordings were made from panoramic radiographs, which may have underestimated the prevalence of caries and the extension of the restorations. Moreover, the clinical screening did not provide information on defective fillings or secondary caries, which may be difficult to identify by means of radiographic examination. A more sensitive diagnostic methodology could have supported a stronger relationship between teeth with carious lesions, restored teeth, and apical periodontitis.

This study used a cross-sectional study design. However, the sample studied was not selected at the same time. The body of the sample was selected in 1968 and to ensure representativity new randomly selected cohorts of 38-year-old women were added in 1980–81 and 1992–93. Moreover, the cohorts of women born in 1930 and 1922 were added with new samples of randomly selected women in 1980–81 and 1992–92, respectively. This may have implications for the representativity of the sample. However, epidemiologic surveys frequently have to cope with

non-participation and loss to follow up, challenging representativity and generalization of the results. Also, we do not know whether results from a population in 1992–93 are valid today and we refrain from speculation about what changes may have taken place in the population during these years. However, the survey has been ongoing since 1968 and new examinations are scheduled. Thus, from future results we will be able to learn about changes in the population and what implications these may have on the results.

In conclusion, from the results in our material, apical periodontitis is associated with teeth with carious lesions and root-filled teeth. Socio-economic variables or dental visiting habits do not appear to have obvious implications for periapical status.

Acknowledgments

This study was supported by the Swedish Research Council, grant 13449, the Swedish Foundation for Health Care and Allergy Research, grant V2000 099, the Public Dental Service, Göteborg, the Göteborg Dental Society (SPAN Foundation), and the Public Dental Service, Östergötland, Sweden. We thank ACTA, Athena Nordic, Dentosal, and Zendium for providing the study participants with toothbrushes and toothpaste.

References

[1] Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KMS. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent Oral Epidemiol 2004;32:345–53.

[2] Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. Ann NY Acad Sci 1999; 896:3–15.

[3] McEwan BS, Seeman T. Protective and damaging effects of mediators of stress. Elaborating and testing the concepts of allostasis and allostatic load. Ann NY Acad Sci 1999;896: 30–47.

[4] Marthaler TM. Changes in dental caries 1953–2003. Caries Res 2004;38:173–81.

[5] Bjertness E, Eriksen HM. Design of a socio-ecologic caries model and testing on 50-year-old citizens of Oslo, Norway. Acta Odontol Scand 1992;50:151–62.

[6] Treasure E, Kelly M, Nuttall N, Nunn J, Bradnock G, White D. Factors associated with oral health: a multivariate analysis of results from the 1998 Adult Dental Health survey. Br Dent J 2001;190:60–8.

[7] Stashenko P. Etiology and pathogenesis of pulpitis and apical periodontitis. In: Örstavik D, Ford P, editors. Essential endodontology. Oxford: Blackwell Science; 1998. p. 42–67.

[8] Eriksen HM, Berset GP, Hansen BF, Bjertness E. Changes in endodontic status 1973–1993 among 35-year-olds in Oslo, Norway. Int Endod J 1995;28:129–32.

[9] Sidaravicius B, Aleksejuniene J, Eriksen HM. Endodontic treatment and prevalence of apical periodontitis in an adult population of Vilnius, Lithuania. Endod Dent Traumatol 1999;15:210–5.

[10] Frisk F, Hakeberg M. A 24-year follow-up of root filled teeth and periapical health amongst middle aged and elderly women in Göteborg, Sweden. Int Endod J 2005;38:246–54.

[11] Kirkevang LL, Hörsted-Bindslev P, Ørstavik D, Wenzel A. Frequency and distribution of endodontically treated teeth and apical periodontitis in an urban Danish population. Int Endod J 2001;34:198–205.

[12] Ödesjö B, Helldén L, Salonen L, Langeland K. Prevalence of previous endodontic treatment, technical standard and occurrence of periapical lesions in a randomly selected adult, general population. Endod Dent Traumatol 1990;6:265–72.

[13] Kirkevang LL, Wenzel A. Risk indicators for apical periodontitis. Community Dent Oral Epidemiol 2003;31:59–67.

[14] Aleksejuniene J, Eriksen HM, Sidaravicius B, Haapasalo M. Apical periodontitis and related factors in an adult Lithuanian population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;90:95–101.

[15] Bengtsson C, Blohme G, Hallberg L, Hällström T, Isaksson B, Korsan-Bengtsen K, et al. The study of women in Gothenburg 1968–1969: a population study. General design, purpose and sampling results. Acta Med Scand 1973;193:311–8.

[16] Ahlqwist M, Bengtsson C, Hakeberg M, Hägglin C. Dental status of women in a 24-year longitudinal and cross-sectional study. Results from a population study of women in Göteborg. Acta Odontol Scand 1999;57:162–7.

[17] Bengtsson C, Ahlqwist M, Andersson K, Björkelund C, Lissner L, Söderström M. A 24-year follow-up study with special reference to participation, representativeness, and mortality. Scand J Prim Health Care 1997;15:214–9.

[18] Ödesjö B, Helldén L, Salonen L, Langeland K. Prevalence of previous endodontic treatment, technical standard and occurrence of periapical lesions in a randomly selected adult, general population. Endod Dent Traumatol 1990;6:265–72.

[19] Eriksen HM. Endodontology – epidemiologic considerations. Endod Dent Traumatol 1991;7:189–95.

[20] Beck JD, Kohout F, Hunt RJ. Identification of high caries risk adults: attitudes, social factors and disease. Int Dent J 1988;38:231–8.

[21] Hakeberg M, Berggren U, Gröndahl HG. A radiographic study of dental health in adult patients with dental anxiety. Community Dent Oral Epidemiol 1993;21:27–30.

[22] Gilbert GH, Duncan P, Shelton BJ. Social determinants of tooth loss. Health Serv Res 2003;38:1843–62.

[23] Burström B, Fredlund P. Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? J Epidemiol Community Health 2001;55:836–40.

[24] Benjamins MR, Hummer RA, Eberstein IW, Nam CB. Self-reported health and adult mortality risk: an analysis of cause-specific mortality. Soc Sci Med 2004;59:1297–306.

[25] Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. J Health Soc Behav 1997;38:21–37.

[26] Bergström J, Babcan J, Eliasson S. Tobacco smoking and dental periapical condition. Eur J Oral Sci 2004;112: 115–20.