J Clin Periodontol 2011; 38: 229–235 doi: 10.1111/j.1600-051X.2010.01689.x

Journal of Clinical Periodontology

Socio-economic position, smoking, and plaque: a pathway to severe chronic periodontitis

Avraham Zini[1], Harold D. Sgan-Cohen[1] and Wagner Marcenes[2]

[1]Department of Community Dentistry, Hadassah School of Dental Medicine, Hebrew University, Jerusalem, Israel; [2]Barts and the London School of Medicine and Dentistry, Queen Mary, University of London, London, UK

Zini A, Sgan-Cohen HD, Marcenes W. Socio-economic position, smoking, and plaque: a pathway to severe chronic periodontitis. J Clin Peridontol 2011; 38: 229–235. doi: 10.1111/j.1600-051X.2010.01689.x.

Abstract

Aim: To report periodontal status and elucidate the relationship among socio-economic position (SEP), plaque accumulation, tobacco smoking, and periodontitis in a representative sample of adult Jewish people, aged 35–44 years, living in Jerusalem.

Methods: This cross-sectional study was conducted using a stratified sample of two hundred and fifty-four 35–44-year-old adults in Jerusalem (limited to the Jewish population). A clinical examination (Community Periodontal Index and Plaque Index) and a self-administered questionnaire were applied.

Results: Two hundred and fifty-four adults, mean age 38.6 (SD = 3.3) years, participated. The response rate was 88%; intra-examiner κ values were above 0.87. The average number of healthy sextants was 1.18, while the average number of sextants with bleeding, calculus, shallow periodontal pockets, and deep periodontal pockets was 1.3, 2.6, 0.7, and 0.1, respectively. Lower level of education was associated with severe chronic periodontitis (SCP, $p = 0.012$) and also with smoking ($p = 0.030$) and higher level of plaque ($p < 0.001$). Smoking was associated with higher level of plaque ($p < 0.001$), which in turn was associated with SCP ($p = 0.020$).

Conclusion: This study presented a potential explanatory pathway for the relationship between SEP and SCP. Low level of education was proposed as a distal determinant, leading to tobacco smoking and higher levels of plaque, and finally to SCP.

Key words: periodontal health; periodontitis; plaque; smoking; socio-economic position

Accepted for publication 28 November 2010

Periodontal disease is recognized as one of the major and most prevalent oral pathologies throughout the world (Petersen et al. 2005). Severe chronic periodontitis (SCP) has been located among 5–20% of most adult populations (Petersen et al. 2005). Periodontal disease can affect the quality of life of adults (Brennan et al. 2007) and is associated with both dental and systemic ill-health (Slots 2003, Klinge & Norlund 2005).

Conflict of interest and source of funding statement

The authors declare they have no conflicts of interest.

This study was supported and funded by the authors' institution.

The estimation and understanding of periodontal disease occurrence in a population are regarded as essential for all individual and healthcare providers.

The wide range of periodontal pathologies is affected by a variety of factors, including genetics, socio-economic position (SEP), tobacco smoking, oral hygiene, and life style (Page & Kornman 2000, Hyman & Reid 2003). SCP has been found to be related to education as a strong SEP indicator (Borrell et al. 2006). Attainment of optimal oral hygiene has traditionally been regarded as strongly related to the prevention of gingivitis. Several studies have also indicated a relationship between oral hygiene and SCP (Hujoel et al. 2005, Bunyaratavej 2006), while others have questioned this association and suggested a genetic, or other, aetiology (Baker & Roopenian 2002, Kumar et al. 2009). Tobacco smokers have been shown to have higher levels of plaque (Ragghianti et al. 2004) and a considerable bulk of the literature has clarified that tobacco smoking is an independent determinant of periodontal disease (Johnson 2004, Vered et al. 2008). The wider and more comprehensive web of aetiology, including biological, behavioural, and SEP, as variables associated with periodontal disease, has not always, or adequately, been investigated and presented.

Similar to general health status, profound disparities have been reported, among populations, for periodontal health.

The indigenous poor, immigrants, racial and ethnic minority groups, and medically compromised patients are those who suffer the worst oral and periodontal health (Sheiham & Nicolau 2005, Godson & Williams 2008).

The objective of the present study was to report periodontal status and further elucidate the relationships among SEP, dental health behaviour, and SCP in a representative sample of adult Jewish couples aged 35–44 years living in Jerusalem.

Material and Methods

The cross-sectional data reported here were collected between December 2008 and July 2009 in Jerusalem, the largest Israeli city, both geographically and by population. The study protocol was approved by the Hadassah Hospital human ethics (''Helsinki'') IRB committee.

It was estimated that the minimal size of the sample to report outcomes of interest, with a 95% confidence interval and an acceptable error of 6%, was 267 adults. A 50% prevalence outcome of interest was used in this calculation.

The present study population was selected using a stratified random sampling technique and was limited to the Jewish community. There are 7,63,800 Jerusalem residents of whom 66% are Jews and 33% are Arabs (Central Bureau of Statistics, Israel 2010). Available statistical data and Israeli epidemiological research experience in social medicine have repeatedly demonstrated that among the local Jewish communities, religious groups can duly serve as proxies for social strata (Shuval 1992). The municipal education system includes 115 junior high schools and is categorized according to three school strata: 40 secular, 32 religious, and 43 ultra-orthodox schools. Five schools were randomly selected from each stratum, reaching a total of 15 schools. Within each of the three strata, 48 children, aged 12–13 years, were randomly selected ($N = 144$). A letter was sent to all of their 288 parents (144 mothers and 144 fathers), inviting them to participate. The inclusion criteria were both parents consenting to participate, aged 35–44 years, married or living together, without any chronic disease, of the randomly selected school children. The age range of 35–44 years old was selected according to the recommendation of the World Health Organization (WHO) for assessing oral health in the adult population (World Health Organization 1997).

Data were collected through a questionnaire and a clinical examination. Socio-demographic data included gender, age in years, level of education, employment status, and home density. Health behaviour data included toothbrushing, use of oral hygiene aids, and smoking during the last month.

Clinical examinations collected data describing plaque levels and periodontal health. Oral hygiene was assessed according to the Plaque Index (PlI) of Loe & Silness (1963). Periodontal status was assessed using the Community Periodontal Index (CPI), as recommended by, and according to the criteria of, the WHO (World Health Organization 1997). This index scale is nominal and ordinal: 0 = health; 1 = bleeding; 2 = calculus; 3 = ''shallow'' periodontal pocket of 4–5 mm; 4 = ''deep'' periodontal pocket above 6 mm; and 5 = excluded. The mouth is divided into six sextants (tooth numbers: 18–14, 13–23, 24–28, 38–34, 33–43, and 44–48) and CPI examines the following index teeth: 17, 16, 11, 26, 27, 36, 37, 31, 46, and 47 (six surfaces of each tooth). For each sextant, the worst score was recorded. A sextant is examined only if there are two or more teeth present and not indicated for extraction. SCP was operationally defined as having at least one site with a pocket depth of 6 mm or more (CPI score = 4).

All clinical examinations were carried out by one trained dentist (A. Z.) with the aid of a plane mouth mirror and a WHO CPI probe in natural light. Participants were examined in their homes seated on a standard chair. Radiography was not applied.

Analysis of data

Data were entered into Excel software and then SPSS 15.0 statistical package for analysis. The potential dependence among married couples clustering was controlled for using the STATA 9.0 package. κ statistical test was adopted to assess intra-examiner agreement. Repeated examinations were carried out among 22 participants, on a tooth basis, within a 2-week interval. The sampling strategy, which had been adopted, required data manipulation to adjust for over sampling of ultra-orthodox Jewish examinees and under sampling of religious non-orthodox and secular groups. The frequency in the raw data was 33.9% ultra-orthodox, 33.1% religious, and 33.1% for secular sectors. According to the National Bureau of Statistics, the Jerusalem Jewish population was classified as 23.1% ultra-orthodox, 38.9% religious, and 38.0% secular populations (Central Bureau of Statistics, Israel 2010). These proportions were applied in the weighting procedure and thereby the final data were optimally representative of the married Jewish adult population abiding in Jerusalem. Further descriptive analyses were carried out on the weighted data. Frequencies of oral health, associated with behaviour and dental status, were calculated.

Socio-demographic data were operationally manipulated for statistical analysis. Level of education was categorized into ''low education'' (no education/elementary school/high school/low orthodox seminar), ''Yeshiva education'' (orthodox seminar from and above age 18), and academic education (university or college). Employment status was dichotomized into employed and unemployed. Home density was calculated by dividing the number of people by the number of rooms and dichotomized into low (one or less persons per room) and high (more than one per room).

Health behaviour data were also operationally manipulated for data analysis purpose. Frequency of toothbrushing was categorized into once a day or less and twice a day or more. Only 25 participants reported brushing their teeth less than once a day. Daily use of oral hygiene aids was dichotomized into ''yes'' (use of inter-proximal brush, dental floss, or toothpick) and ''no'' (none of the above). The ultimate outcome of oral hygiene was assessed according to the PlI. The index for the patient was calculated by summing the average scores for each tooth and dividing by the number of teeth assessed (Almas et al. 2005). The score was then dichotomized into ''absence or little plaque'' ($\text{PlI} < 1$) and ''moderate to abundant plaque'' ($\text{PlI} \geq 1$). Reported tobacco smoking during the last month was dichotomized as ''yes'' or ''no''.

Descriptive data analyses included the average number of sextants with each CPI score and the percentage of people with worst CPI scores. Analytical data analysis, aimed at further comprehension of the SCP pathway, adopted a prevalence definition of at least one pocket depth of 6 mm or more. This is

Table 1. Mean number (SD) of sextants with different Community Periodontal Index (CPI) scores by gender, socio-economic, and oral health behaviour variables in a sample of two hundred and fifty-four 35–44-year-old Jewish living in Jerusalem

	N (%)	CPI 0 (healthy)	CPI 1 (bleeding)	CPI 2 (calculus)	CPI 3 (pocket, 4–5 mm)	CPI 4 (pocket, >6 mm)
Gender						
Male	127 (50)	0.6 (1.5)	0.9 (1.3)	3.2 (2.0)	0.8 (1.1)	0.4 (0.9)
Female	127 (50)	1.1 (1.8)	1.6 (1.9)	2.3 (2.0)	0.8 (1.2)	0.2 (0.7)
p value*		0.025	0.001	0.001	0.911	0.033
Education						
Low	106 (42)	0.6 (1.4)	1.2 (1.7)	2.8 (2.0)	0.8 (1.2)	0.4 (1.0)
Academic	109 (43)	0.8 (0.8)	1.4 (1.4)	2.8 (1.9)	0.8 (1.0)	0.1 (0.3)
Yeshiva	39 (15)	1.1 (1.9)	1.2 (1.7)	2.7 (2.1)	0.8 (1.1)	0.2 (0.6)
p value†		0.079	0.800	0.889	0.829	0.019
Employment status						
Unemployed	65 (26)	1.0 (1.8)	1.6 (1.8)	2.5 (2.1)	0.9 (1.4)	0.1 (0.2)
Employed	189 (74)	0.8 (1.6)	1.1 (1.6)	2.9 (2.0)	0.8 (1.0)	0.4 (0.9)
p value*		0.596	0.049	0.148	0.419	<0.001
Home density						
Low	128 (50)	0.9 (1.7)	1.0 (1.6)	2.9 (2.0)	0.8 (1.1)	0.4 (1.0)
High	126 (50)	0.9 (1.7)	1.4 (1.7)	2.7 (2.0)	0.8 (1.2)	0.2 (0.5)
p value*		0.994	0.041	0.548	0.806	0.010
Toothbrushing						
>once a day	122 (48)	1.1 (1.8)	1.4 (1.8)	2.4 (2.0)	0.7 (1.1)	0.3 (0.8)
Once a day	106 (42)	0.7 (1.6)	1.0 (1.5)	2.9 (2.0)	0.9 (1.2)	0.3 (0.8)
<once a day	25 (10)	0.2 (0.4)	1.2 (1.4)	3.7 (1.9)	0.8 (1.2)	0.1 (0.4)
p value†		0.018	0.229	0.010	0.527	0.496
Oral hygiene aids						
No	176 (69)	0.8 (1.7)	1.1 (1.1)	2.8 (2.0)	0.9 (1.1)	0.3 (0.8)
Yes	78 (31)	1.0 (1.7)	1.4 (1.9)	2.8 (2.1)	0.7 (1.1)	0.2 (0.7)
p value*		0.516	0.231	0.920	0.135	0.273
Smokers						
No	196 (77)	1.0 (1.8)	1.4 (1.7)	2.6 (2.0)	0.8 (1.1)	0.2 (0.6)
Yes	58 (23)	0.3 (1.1)	0.7 (1.3)	3.3 (2.0)	0.9 (1.2)	0.6 (1.2)
p value*		0.001	0.002	0.027	0.507	0.009
Plaque Index						
Absence or low	121 (48)	1.6 (2.1)	1.6 (1.8)	2.1 (2.0)	0.6 (1.0)	0.1 (0.5)
Moderate to abundant	133 (52)	0.2 (0.6)	0.9 (1.4)	3.4 (1.8)	1.0 (1.2)	0.4 (1.0)
p value*		<0.001	0.001	<0.001	0.006	0.002
Total weighted and adjusted‡	254	1.2	1.3	2.6	0.7	0.1

*Independent *t*-test.

†One-way ANOVA.

‡Weighted by school sector and adjusted by gender, age, education, employment status, and home density.

the equivalent of having a CPI score of 4.

A conceptual hierarchical data analysis model was adopted (Victora et al. 1997). This well-established approach uses sequential adjustments from distal to proximal determinants of a health condition, with the aim of elucidating these relationships. Conceptual analysis, contrary to statistical decisions on significant determinants of diseases, adopts a theoretical ordering. The justification for this ordering of variables, in the present study, was based on the literature review. Our hypothesis was that SEP is the distal determinant, in the pathway, influencing oral health behaviour and ultimately leading to SCP.

The first step was to carry out a multiple logistic regression forcing socio-economic indicators into the equation to identify the best indicator of SEP, adjusted by age and gender. A similar approach was used to identify the best indicator of oral hygiene. Following this step, the associations between explanatory variables and the outcome were assessed. All variables that had reached statistical significance at the 20% level were considered in the analysis.

Results

From a total of 288 parents, who were invited to participate, the response rate in this study was 88%. A total of 254 adults agreed to be examined and to answer the questionnaires. The intra-examiner agreement, for the clinical examinations, was good and all κ values were above a level of 0.87.

The sample comprised of 127 (50%) males and 127 (50%) females. The mean age was 38.6 years (SD = 3.26). Among the study population, the distribution of education level was 42.9% academic, 15.4% ''Yeshiva'', and 41.7% lower levels. Unemployed status was found among 25.6% of the people (Table 1). The average home density was 0.99 (SD = 0.54) and the median was 0.87.

The weighted and the adjusted average number of healthy sextants was 1.18, while the average number of sextants with bleeding, calculus, shallow periodontal pockets, and deep periodontal pockets was 1.3, 2.6, 0.7, and 0.1, respectively. Lower level of education was associated with a higher mean number of sextants with deep pockets. Unemployment and

Table 2. Distributions of the numbers (and percentages) of people with worst Community Periodontal Index (CPI) scores by socio-economic and oral health behaviour variables, among a sample of two hundred and fifty-four 35–44-year-old Jewish living in Jerusalem

WCPI	CPI 0 (healthy)	CPI 1 (bleeding)	CPI 2 (calculus)	CPI 3 (pocket 4–5 mm)	CPI 4 (pocket >6 mm)	p^*
Gender						
Male	4 (3.1)	6 (4.7)	51 (40.2)	41 (32.3)	25 (19.7)	
Female	8 (6.3)	20 (15.7)	45 (35.4)	43 (33.9)	11 (8.7)	0.005
Age						
35–39	5 (3.8)	15 (11.4)	53 (40.2)	44 (33.3)	15 (11.4)	
40–44	7 (5.7)	11 (9.0)	43 (35.2)	40 (32.8	21 (17.2)	0.593
Education						
Low	2 (1.9)	12 (11.3)	39 (36.8)	32 (30.2)	21 (19.8)	
Academic	2 (5.1)	3 (7.7)	14 (35.9)	17 (43.6)	3 (7.7)	
Yeshiva	8 (4.7)	11 (10.1)	43 (39.4)	35 (32.1)	12 (11.0)	0.278
Employment status						
Unemployed	4 (6.2)	9 (13.8)	24 (36.9)	24 (36.9)	4 (6.2)	
Employed	8 (4.2)	17 (9.0)	72 (38.1)	60 (31.7)	32 (16.9)	0.210
Home density						
Low	6 (4.7)	14 (10.9)	45 (35.2)	40 (31.3)	23 (18.0)	
High	6 (4.8)	12 (9.5)	51 (40.5)	44 (34.9)	13 (10.3)	0.481
Toothbrushing						
Twice per day	6(4.9)	20(16.4)	44(36.1)	35(28.7)	17(13.9)	
Once per day	6(5.7)	5(4.7)	39(36.8)	39(36.8)	17(16.0)	
Less	0(0)	1(4.0)	12(48.0)	10(40.0)	2(8.0)	0.104
Oral hygiene aids						
No	7(4.0)	16(9.1)	62(35.2)	63(35.8)	28(15.9)	
Yes	5(6.4)	40(12.8)	34(43.6)	21(26.9)	8(10.3)	0.296
Smoke						
No	11 (5.6)	23 (11.7)	75 (38.3)	66 (33.7)	21 (10.7)	
Yes	1 (1.7)	3 (5.2)	21 (36.2)	18 (31.0)	15 (25.9)	0.030
Plaque Index						
Absence or low	12 (9.9)	22 (18.2)	45 (37.2)	34 (28.1)	8 (6.6)	
Moderate to abundant	0 (0)	4 (3.0)	51 (38.3	50 (37.6)	28 (21.1)	<0.001
Total	12 (4.7)	26 (10.2)	96 (37.8)	84 (33.1)	36 (14.2)	
Total weighted and adjusted**	6.1%	12.9%	33.5%	34.7%	12.7%	

*Pearson's chi-square.

**Weighted by school sector and adjusted by gender, age, education, employment status, and home density.

higher home density both revealed a lower mean number of sextants with deep pockets and a higher mean number of sextants with symptoms of bleeding. Toothbrushing twice per day revealed a higher mean number of healthy sextants. Smokers revealed a lower mean number of sextants that were healthy or bleeding and a higher mean number of sextants with calculus or deep pockets. Higher PlI revealed a lower mean number of sextants that were healthy or bleeding and a higher mean number of sextants with calculus, shallow, or deep pockets (Table 1).

The weighted and the adjusted percentage of people with healthy periodontal status was 6.1%. The percentages of people, by worst CPI scores, were 12.9% with bleeding, 33.5% with calculus, 34.7% with shallow periodontal pockets, and 12.7% with deep periodontal pockets (Table 2). A significantly higher percentage of females demonstrated full-mouth periodontal health (CPI = 0 for all sextants) than males. A higher percentage of males demonstrated at least one sextant with deep pockets (CPI = 4), than females. Among smokers, a significantly higher percentage was found to have deep periodontal pockets. Higher PlI was significantly associated with the percentage of people with periodontal pockets (deep or shallow) and lower percentages with healthy or bleeding gums (Table 2).

A conceptual multiple logistic regression analysis forcing three SEP indicators, level of education, employment status, and home density, into the equation, adjusting for age and couple cluster, identified level of education ($p = 0.012$) as the best socio-economic indicator. The other SEP variables were not significantly associated with SCP. Similar statistical analysis, forcing oral hygiene indicators, frequency of toothbrushing, using oral hygiene aids, and level of plaque, into the equation identified plaque level ($p < 0.001$) as the strongest indicative variable. Tobacco smoking was significantly ($p = 0.030$) associated with SCP. Ultimately, the following explanatory variables were included in the final model: level of education, tobacco smoking, and level of plaque (Table 3).

The conceptual hierarchical modelling data analyses suggested that low level of education was the most distal determinant, leading to tobacco smoking and high levels of plaque, both significantly associated with SCP. An additional pathway of smoking associated with high plaque level was also identified. Lower level of education was significantly and independently associated with SCP ($p = 0.012$). In addition, lower level of education was significantly associated with tobacco smoking ($p = 0.023$) and higher level of plaque ($p = 0.007$). Tobacco smoking was also significantly associated with higher levels of plaque ($p = 0.001$). Higher level of plaque was significantly associated with SCP ($p = 0.004$). Tobacco smoking was significantly associated with SCP in the second mod-

Table 3. Conceptual multiple logistic regression of people without severe chronic periodontitis (SCP), adjusted by age and couple clusters, and then forcing level of education, smoking, and plaque level, into the models, in a sample of two hundred and fifty-four 35–44-year-old Jewish people living in Jerusalem

Explanatory variables	People without SCP	OR adjusted for age and couple clusters		OR adjusted for age and couple clusters, including tobacco smoking		OR adjusted for age and couple clusters, including tobacco smoking and plaque level	
	N (%)	OR (95% CI)	*p* value	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Education							
Low	85 (80.2)	1.0	–	1.0	–	1.0	–
Academic or Yeshiva	133 (89.9)	2.1 (1.2,4.0)	0.012	2.0 (1.1,3.7)	0.023	1.9 (1.0,3.7)	0.032
Smoking							
Yes	43 (74.1)	–	–	1.0	–	1.0	–
No	175 (89.3)	–	–	2.5 (1.1,5.7)	0.027	1.8 (0.8,4.3)	0.180
Plaque level							
Moderate to abundant	105 (78.9)	–	–	–	–	1.0	–
Absence or low	113 (93.4)	–	–	–	–	3.0 (1.2,7.6)	0.020

CI, confidence interval; OR, odds ratio.

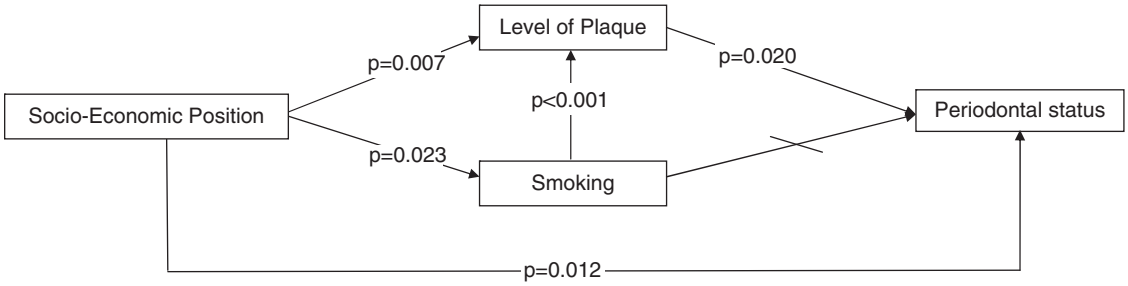

Fig. 1. A pathway model for socio-economic position as a distal determinant influencing oral health behaviours and affecting periodontal outcomes.

el ($p = 0.027$) but was not significant in the final model ($p = 0.180$), after inclusion of plaque level. Higher level of plaque, in the final model, was significantly associated with SCP ($p = 0.020$) adjusting for level of education and smoking (Table 3 and Fig. 1).

Discussion

This study adopted a practical and rational method to select a representative sample of Jerusalem Jewish adults by means of their school-going children. In Jerusalem, according to the National Bureau of Statistics, within the 35–44 years age stratum, the proportion of married people was 85% (Central Bureau of Statistics, Israel 2010). It should be noted that our descriptive findings such as proportion of tobacco smokers and levels of plaque can only be assumed for married Jewish couples, living in Jerusalem, with 12–13-year-old children attending school. However, it is unlikely that findings related to the biological effects of plaque and smoking on periodontal health and the ecological pathway should be different in this sample than among unmarried people, without children, from other geographical areas or even cultures.

The WHO CPI has several flaws and has often been criticized by periodontists, who prefer clinical attachment loss as a superior diagnostic measure. However, it should be noted that since the inception of CPI employment, in the 1970s, it remains the cornerstone of most global epidemiological research (World Health Organization 1997, 2010a, b). CPI enables estimation and comparison of epidemiological periodontal health status including treatment needs among and between populations. The findings of the present study suggested that periodontal status was better in this sample than previous information published in 2000 and currently reported in the WHO Oral Health Country Profile for Israel. Only 12.7% of the present population had pockets of 6 mm or more (CPI = 4), compared with 22% previously. Therefore, the burden of periodontal diseases in this population may have fallen. This possible improvement in Israeli national periodontal health should be interpreted with caution because the previous study was carried out exclusively among a military personnel population (*WHO Oral Health Country/Area Profile*, 2010) while the present data were derived exclusively from civilian residents of Jerusalem.

The findings of this study support the WHO claim that despite great improvements in oral health of populations, global problems still persist among underprivileged groups (Benigeri et al. 2000, Petersen et al. 2005). According to our data, the mean number of sextants with pockets of 6 mm or more (CPI = 4) was only 0.1 in the total population, but was 0.4 (close to fourfold) among those with lower education.

The hierarchical modelling data analyses suggested that low level of education was the most distal determinant of SCP. Behaviour variables such as tobacco smoking and plaque level may more fully explain the association between level of education and SCP (Fig. 1). The literature has shown that smoking

is a strong independent determinant of periodontal disease (Johnson 2004, Vered et al. 2008) and also associated with high plaque levels (Ragghianti et al. 2004). Tobacco smoking, in our final model, was not independently associated with SCP, adjusting for levels of education and plaque, but was associated with SCP via the pathway of plaque levels. The conceptual hierarchical model was developed and based on published literature (Newton & Bower 2005). There is strong evidence to claim that higher level of education influences people's health behaviours in a positive way (Payne & Locker 1996). People in lower SEP tend to have poor oral hygiene, and smoke more tobacco (Gundala & Chava 2010). There is also evidence that tobacco smokers tend to have poorer oral hygiene than non-tobacco smokers (Pejcic et al. 2007, Vered et al. 2008). These data, from the literature, provided the evidence-based theory for the conceptual model, which has been proposed in this study. Correspondingly, it is worthy of mention that the only complete way to explore these temporal relationships is to have data from prospective cohort studies.

Oral health individual care and community programmes have a tendency to concentrate on changing individual behaviour through health education programmes and paying little attention to socio-economical barriers. Low SEP is well acknowledged as a major risk to oral health (Marmot 2005, Petersen et al. 2005, Sheiham & Nicolau 2005, Godson & Williams 2008). The findings of this study emphasized those socio-economical factors, such as formal education, and not only health behaviour, that need to be addressed, in order to reduce health inequalities between and within populations (Macleod & Davey 2003).

Conclusion

This study demonstrated that periodontal status of Jewish married adults in Jerusalem was relatively good. The hierarchical conceptual modelling proposed that level of education was associated with periodontal status by way of oral health behaviour pathways. Accordingly, low level of education was a distal determinant, leading to tobacco smoking and higher levels of plaque, and finally to SCP. Behaviour variables such as tobacco smoking and plaque levels may explain the association between level of education and SCP.

References

Almas, K., Bulman, J. S. & Newman, H. N. (2005) Assessment of periodontal status with CPITN and conventional periodontal indices. *Journal of Clinical Periodontology* **18**, 654–659.

Baker, P. J. & Roopenian, B. C. (2002) Review: genetic susceptibility to chronic periodontal disease. *Microbes and Infection* **4**, 1157–1167.

Benigeri, M., Brodeur, J. M., Payette, M., Charbonneau, A. & Ismail, A. I. (2000) Community periodontal index of treatment needs and prevalence of periodontal conditions. *Journal of Clinical Periodontology* **27**, 308–312.

Borrell, L. N., Beck, J. D. & Heiss, G. (2006) Socioeconomic disadvantage and periodontal disease: the dental atherosclerosis risk in communities study. *American Journal of Public Health* **96**, 332–339.

Brennan, D. S., Spencer, A. J. & Roberts-Thomson, K. F. (2007) Quality of life and disability weights associated with periodontal disease. *Journal of Dental Research* **86**, 717–713.

Bunyaratavej, P. (2006) Oral hygiene status and smoking are strong risk indicators of periodontal disease in Thai adults. *Journal of Evidence Based Dental Practice* **6**, 199–200.

Central Bureau of Statistics, Israel. (2010) Social Survey in Israel. Available at http://www.cbs.gov.il (accessed on 21 April 2010).

Godson, J. H. & Williams, S. A. (2008) Inequalities in health and oral health in the UK. *Dental Update* **35**, 243–250.

Gundala, R. & Chava, V. K. (2010) Effect of lifestyle, education and socioeconomic status on periodontal health. *Contemporary Clinical Dentistry* **1**, 23–26.

Hujoel, P. P., Cunha-Cruz, J., Loesche, W. J. & Robertson, P. B. (2005) Personal oral hygiene and severe chronic periodontitis: a systematic review. *Periodontology 2000* **37**, 29–34.

Hyman, J. J. & Reid, B. C. (2003) Epidemiologic risk factors for periodontal attachment loss among adults in the United States. *Journal of Clinical Periodontology* **30**, 230–237.

Johnson, G. K. (2004) Cigarette smoking and the periodontal patient. *Journal of Periodontology* **75**, 196–209.

Klinge, B. & Norlund, A. (2005) A socio-economic perspective on periodontal diseases: a systematic review. *Journal of Clinical Periodontology* **32**, 314–325.

Kumar, T. S., Dagli, R. J., Mathur, A., Jain, M., Balasubramanyam, G., Prabu, D. & Kulkarni, S. (2009) Oral health status and practices of dentate Bhil adult tribes of southern Rajasthan, India. *International Dental Journal* **59**, 133–140.

Loe, H. & Silness, J. (1963) Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontologica Scandinavica* **21**, 533–551.

Macleod, J. & Davey, S. G. (2003) Psychosocial factors and public health: a suitable case for treatment? *Journal of Epidemiology and Community Health* **57**, 565–570.

Marmot, M. (2005) Social determinants of health inequalities. *Lancet* **365**, 1099–1104.

Newton, J. T. & Bower, E. J. (2005) The social determinants of oral health: new approaches to conceptualizing and researching complex causal networks. *Community Dentistry and Oral Epidemiology* **33**, 25–34.

Page, R. C. & Kornman, K. S. (2000) The pathogenesis of human periodontitis: an introduction. *Periodontology 2000* **14**, 9–11.

Payne, B. J. & Locker, D. (1996) Relationship between dental and general health behaviors in a Canadian population. *Journal of Public Health Dentistry* **56**, 198–204.

Pejcic, A., Obradovic, R., Kesic, K. & Kojovic, D. (2007) Smoking and periodontal disease, a review. *Medicine and Biology* **14**, 53–59.

Petersen, P. E., Bourgeois, D., Ogawa, H., Estupinan-Day, S. & Ndiyae, C. (2005) The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization* **83**, 661–669.

Ragghianti, M. S., Aguiar Greghi, S. L., Lauris, J. R. P., Passanezi Sant'Ana, A. C. & Passanezi, E. (2004) Influence of age, sex, plaque and smoking on periodontal conditions in a population from Bauru, Brazil. *Journal of Applied Oral Science* **12**, 457–462.

Sheiham, A. & Nicolau, B. (2005) Evaluation of social and psychological factors in periodontal disease. *Periodontology 2000* **39**, 118–131.

Shuval, J. T. (1992) *Social Dimensions of Health: The Israeli Experience*, 1st edition, pp. 29–32. London: Praeger.

Slots, J. (2003) Update on general health risk of periodontal disease. *International Dental Journal* **53**, 200–207.

Vered, Y., Livny, A., Zini, A. & Sgan-Cohen, H. D. (2008) Periodontal health status and smoking among young adults. *Journal of Clinical Periodontology* **35**, 768–772.

Victora, C. G., Huttly, S. R., Fuchs, S. C. & Olinto, M. T. (1997) The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *International Journal of Epidemiology* **26**, 224–227.

World Health Organization. (1997) *Oral Health Survey. Basic Methods*, 4th edition, pp. 36–38. Geneva: World Health Organization.

World Health Organization. (2010a) An overview of CPI (Community Periodontal Index) data in the WHO global oral health data bank, periodontal country profiles. Available at http://www.dent.niigata-u.ac.jp/prevent/perio/perio.xls (accessed on 21 April 2010).

World Health Organization. (2010b) *WHO Oral Health Country/Area Profile*. Geneva: World Health Organization. Available at http://www.dent.niigata-u.ac.jp/prevent/perio/perio.html (accessed on 21 April 2010).

Address:
Avi Zini
Department of Community Dentistry
Hadassah School of Dental Medicine
Hebrew University
PO Box 12272
Jerusalem 91120
Israel
E-mail: aviz@hadassah.org.il

Clinical Relevance

Scientific rationale for the study: The aetiology of SCP is complex. Existing literature, which predominantly focuses on behavioural and biological determinants, minimizes and even neglects the role of socio-economic risk factors. The current study attempts to fill this gap.

Principal findings: Data proposed a potential comprehensive explanatory pathway for the relationship between SEP and periodontitis. Low level of education was a distal determinant, leading to tobacco smoking and higher levels of plaque, and finally to SCP.

Practical implications: Periodontal healthcare and programmes may benefit from concentrating not only on personal health behaviour modification, but also on improved and wider understanding of possible socio-economic barriers, such as formal education.