Table 1 Person-level logistic regression analysis to seek characteristics of subjects with severe periodontal disease

Characteristics of subjects		N.	AL of 7+ mm	odds ratio	S.E.	*p* value	95% C.I.*	
age	0: 70 yrs	554	47.3%	1.12	0.26	0.619	0.71	1.77
	1: 80 yrs	104	51.0%					
sex	1: male	335	62.1%	3.35	0.55	0.000	2.43	4.63
	0: female	323	33.1%					
No. of remaining teeth (dummy)	1-9 (standard)	139	43.9%	1.00				
	10-19	198	56.6%	1.71	0.40	0.022	1.08	2.72
	20-32	321	44.2%	1.01	0.22	0.960	0.66	1.56

N=658 ; p =0.0000, Pseudo R^2=0.0718

* confidence interval

Table 2 Tooth-level logistic regression analysis to seek characteristics of teeth with severe periodontal disease

Characteristics of teeth		N.	AL of 7+ mm	odds ratio	S.E.	*p* value	95% C.I.*	
age	0: 70 yrs	10,302	7.2%	1.28	0.13	0.014	1.05	1.56
	1: 80 yrs	1,301	12.3%					
sex	1: male	5,962	10.9%	2.74	0.22	0.000	2.34	3.21
	0: female	5,641	4.4%					
No. of remaining teeth (dummy)	1-9 (standard)	725	19.4%	1.00				
	10-19	2,853	12.6%	0.53	0.06	0.000	0.42	0.67
	20-32	8,025	4.9%	0.19	0.02	0.000	0.14	0.24
Location of teeth (dummy)	upper incisor	2,543	7.0%	1.19	0.14	0.121	0.95	1.49
	upper premoler	1,598	7.1%	1.23	0.16	0.109	0.95	1.60
	upper molar	1,387	15.8%	3.45	0.40	0.000	2.75	4.33
	lower incisor (standard)	3,035	6.5%	1.00				
	lower premoler	1,743	4.6%	0.69	0.10	0.009	0.52	0.91
	lower molar	1,297	8.5%	1.55	0.21	0.001	1.19	2.02
teeth status (dummy)	sound (standard)	3,946	5.6%	1.00				
	decayed	396	21.5%	2.40	0.37	0.000	1.77	3.24
	filled	2,629	8.4%	1.44	0.15	0.000	1.17	1.76
	abutment for bridge	1,348	9.2%	1.45	0.18	0.003	1.13	1.85
	crown	3,284	7.4%	0.92	0.10	0.443	0.75	1.14
abutment for removable denture	1: yes	1,285	14.6%	1.17	0.12	0.138	0.95	1.44
	0: no	10,318	6.9%					

N=11,603 ; p =0.0000, Pseudo R^2=0.1143

* confidence interval

Table 3 Person-level logistic regression analysis to seek characteristics of subjects experienced attachment loss

Characteristics of subjects at baseline		N.	Loss of 3+ mm	odds ratio	S.E.	*p* value	95% C.I.*	
sex	1: male	208	79.8%	1.33	0.33	0.258	0.81	2.18
	0: female	186	69.9%					
No. of remaining teeth (dummy)	1-9 (standard)	60	55.0%	1.00				
	10-19	105	85.7%	4.50	1.75	0.000	2.10	9.64
	20-32	229	75.5%	2.48	0.77	0.003	1.35	4.54
Highest PD	0: 6 mm or less	325	73.5%	0.85	0.35	0.685	0.38	1.89
	1: 7 mm or more	69	82.6%					
Highest AL	0: 6 mm or less	208	67.3%	2.37	0.72	0.005	1.30	4.31
	1: 7 mm or more	186	83.9%					

N=394 ; p =0.0000, Pseudo R^2=0.0735

* confidence interval

Table 4 Tooth-level logistic regression analysis to seek characteristics of teeth experienced attachment loss

Characteristics of teeth at baseline		N.	Loss of 3+ mm	odds ratio	S.E.	*p* value	95% C.I.*	
sex	1: male	3,950	21.7%	1.43	0.09	0.000	1.26	1.61
	0: female	3,420	15.9%					
No. of remaining teeth (dummy)	1-9 (standard)	294	23.1%	1.00				
	10-19	1,417	25.6%	1.17	0.18	0.323	0.86	1.58
	20-32	5,659	17.2%	0.73	0.11	0.042	0.54	0.99
Highest PD	0: 6 mm or less	7,290	18.8%	1.80	0.47	0.022	1.09	2.99
	1: 7 mm or more	80	40.0%					
Highest AL	0: 6 mm or less	6,912	18.3%	1.32	0.16	0.025	1.03	1.67
	1: 7 mm or more	458	29.3%					
Location of teeth (dummy)	upper incisor	1,611	17.9%	1.04	0.10	0.694	0.86	1.24
	upper premoler	997	18.7%	1.08	0.12	0.453	0.88	1.33
	upper molar	873	22.8%	1.38	0.15	0.003	1.12	1.71
	lower incisor (standard)	1,934	17.4%	1.00				
	lower premoler	1,097	17.0%	0.93	0.10	0.506	0.76	1.15
	lower molar	858	24.1%	1.53	0.16	0.000	1.24	1.89
teeth status (dummy)	sound (standard)	2,681	16.9%	1.00				
	decayed	198	21.7%	0.96	0.18	0.846	0.67	1.39
	filled	1,845	20.0%	1.18	0.10	0.039	1.01	1.39
	abutment for bridge	834	21.8%	1.22	0.13	0.055	1.00	1.50
	crown	1,812	19.6%	1.04	0.09	0.682	0.87	1.23
abutment for removable denture	1: yes	589	27.0%	1.29	0.14	0.024	1.03	1.60
	0: no	6,781	18.3%					

N=7,370 ; p =0.0000, Pseudo R^2=0.0223

* confidence interval

Table 5 Tooth-level logistic regression analysis to seek characteristics of teeth lost

Characteristics of teeth at baseline		N.	teeth lost	odds ratio	S.E.	*p* value	95% C.I.*	
sex	1: male	4,107	3.8%	1.20	0.17	0.195	0.91	1.58
	0: female	3,522	2.9%					
No. of remaining teeth (dummy)	1-9 (standard)	346	15.0%					
	10-19	1,511	6.2%	0.45	0.09	0.000	0.30	0.67
	20-32	5,772	2.0%	0.25	0.05	0.000	0.16	0.38
Highest PD	0: 6 mm or less	7,523	3.1%	1.54	0.46	0.146	0.86	2.75
	1: 7 mm or more	106	24.5%					
Highest AL	0: 6 mm or less	7,081	2.4%	4.94	0.86	0.000	3.51	6.95
	1: 7 mm or more	548	16.4%					
Location of teeth (dummy)	upper incisor	1,678	4.0%	1.85	0.43	0.008	1.17	2.92
	upper premoler	1,033	3.5%	1.50	0.40	0.124	0.89	2.53
	upper molar	925	5.6%	1.91	0.48	0.010	1.17	3.13
	lower incisor (standard)	1,968	1.7%					
	lower premoler	1,124	2.4%	0.99	0.28	0.962	0.57	1.70
	lower molar	901	4.8%	2.10	0.54	0.004	1.27	3.49
teeth status (dummy)	sound (standard)	2,703	0.8%					
	decayed	226	12.4%	5.65	1.84	0.000	2.99	10.69
	filled	1,874	1.5%	1.48	0.43	0.181	0.83	2.62
	abutment for bridge	871	4.2%	3.86	1.10	0.000	2.21	6.75
	crown	1,955	7.3%	6.07	1.49	0.000	3.75	9.84
abutment for removable denture	1: yes	671	12.2%	1.88	0.33	0.000	1.32	2.66
	0: no	6,958	2.5%					

N=7,629 ; p =0.0000, Pseudo R^2=0.2007

* confidence interval

高齢者における歯周組織破壊の Risk Indicator について

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「高齢者の口腔保健と全身的な健康状態の関係についての総合研究」

C．研究協力課題名：「高齢者における歯周組織破壊のRisk Indicatorについて」

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E．研究目的：

歯周疾患は歯の喪失原因であるだけでなく、全身疾患との関連が報告され、歯周疾患に対するリスクファクターの解明が進められている。しかし、これまでの調査対象はその多くが60歳代までであり、喪失歯が増加する70歳以上の高齢者については歯周疾患進行の実態が把握できていないのが実情である。さらに全身健康要因を調査項目に含めた大規模なコホート調査は数限られており、70歳以上の健常高齢者における歯周疾患進行のリスクファクターについては未解である。高齢者における健康維持のためには、歯周疾患進行に対する真のリスクファクターの解明が急務であり、生理的変化の加齢現象を考慮にいれた経年的な疫学調査が必要である。本研究においては、70歳以上の健常高齢者における歯周疾患進行に影響を及ぼすリスクファクターについて調査した。

F．研究方法：

新潟市在住の70歳(昭和2年生まれ)の599名のうち、口腔内に1歯以上をもつ有歯顎者554名を調査対象にした。ベースライン時に、生活環境調査、全身健康および歯周組織診査を行った。生活環境調査では、老研式活動指標、喫煙ならびに飲酒習慣、口腔衛生習慣、歯科受療行動等に関わるアンケートを行った。また、全身健康診査では、血圧測定のほか血液生化学検査を実施し、肝機能(GOT・GOT・Gamma-GTP)、腎機能(Creatinine)、免疫機能(IgG・IgA・IgM)、脂質(Total-Cholesterol・Triglyceride)、栄養(Total-Protein・Calcium・Blood-Sugar・Albumin)を測定した。歯周組織診査については、セメントーエナメル境から歯周ポケット底部までのアタッチメントロスを歯周組織の代表指標に用いた。診断基準の統一を図るために十分な訓練を受けた4名の歯科医師が、VIVACARE TPS PROBE*を用いて測定した。対象歯は、智歯を含むすべての現在歯とし、1歯につき6点(頬，唇側と口蓋，舌側それぞれの近心，中央，遠心)測定を行った。調査対象者のうち、2年後の追跡調査を受診し、かつ有歯顎であった394名(男性208名、女性186名)を分析対象とした。追跡調査においてアタッチメントロスが、新たに3ｍｍ以上進行した場合を歯周疾患進行と定義し、これを1点以上有するか否かで対象者を2群に分類して、歯周疾患進行に影響を及ぼすリスクファクターについて分析した。

G．研究結果・考察：

対象者のうち、75.1％(296名)に歯周疾患進行が1点以上認められ、そのうち168名は4点以上有し

ていた。次に、ベースライン時の生活環境調査結果および歯周組織状態が、その後の歯周疾患進行に及ぼす影響を Chi-square test により分析した。性別では女性に比べ男性*に、生活習慣では禁煙者より喫煙者***に、また口腔内状態ではアタッチメントレベル 6 mm以上を持つ者***に歯周疾患進行が多く認められた(P<0.05*、P<0.001***)。一方、ベースライン時の血液生化学検査と歯周疾患進行との関係を Student t-test により評価したが、有意な結果は得られなかった。さらに、歯周疾患進行のリスクファクターを見出すために、歯周疾患進行の有無を目的変数にし、Chi-square test で有意であった性別、喫煙、アタッチメントレベル 6 mm以上に現在歯数 20 本未満を加えて説明変数とし、ロジスティック回帰分析を行った。その結果、喫煙、アタッチメントレベル 6 mm以上に、それぞれオッズ比 3.74 および 2.29 で有意な関係が得られた。喫煙者は禁煙者より 3.74 倍ならびに口腔内のアタッチメントレベルが 6 mm以上を持つ者は 6 mm未満を持つ者より 2.29 倍の危険度で、歯周疾患が進行しやすいことが見出された。

H．結論:

70 歳以上の健常高齢者における歯周疾患進行のリスクファクターには、喫煙とアタッチメントレベル 6 mm以上が有意に関連していることが示された。

I．研究発表論文:

投稿原稿

Title of the article

Risk factors for periodontal disease progression among elderly people

Short title

Periodontal disease progression among elderly

Authors' names

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Abstract

The aim of this study was to identify the risk factors for periodontal disease progression by individual characteristics at the baseline among elderly people. Subjects were selected from 4,542 people aged 70 years residing in Niigata city, who were in good general health and who did not require special care for their daily activities. Gender, smoking and alcohol drinking habits were obtained using a questionnaire, while serum levels of disease markers were investigated and attachment levels were clinically recorded. For the assessment of periodontal disease progression, additional attachment loss was used if one or more sites had a 3 mm or more increase in probing attachment level. Three hundred ninety four subjects (208 males and 186 females) were surveyed. Approximately 75 per cent of subjects exhibited additional attachment loss over a two- year period. Significant associations were found between additional attachment loss and smoking, and attachment level of 6 mm or more at the baseline, with odds ratios of 3.75 and 2.29, respectively. Smoking habit and baseline attachment level of 6 mm or more may be considered as risk factors for further attachment loss among healthy elderly people.

Key words

epidemiology; periodontal disease; longitudinal; risk factors; elderly

Introduction

For elderly people, protecting and promoting masticatory function is essential in order to maintain physical and social qualities of life. As is widely known, however, elderly populations in many countries often show high rates of edentulousness and the dentate often has only a few functional teeth. Therefore, it is important to collect and analyze data on the progression of periodontal disease in elderly people, in order to identify those who are likely to loose their teeth (Miyazaki et al.1995).

Periodontal destruction is a frequent experience among elderly people (Slade et al.1995, Brown et al. 1996). It is a primary factor contributing to the loss of approximately one in five teeth among adults in Western populations (Ainamo et al. 1984, Kay et al. 1986, Bailit et al. 1987, Niessen et al. 1989, Chauncey 1989, Reich et al. 1993, Beck et al. 1997). It also contributes to as many as 40 per cent of extractions (Johnson 1993). According to the National Pathfinder Survey in 1999, over 70 per cent of elderly people in Japan have experienced periodontal disease progression (Report on the Survey of Dental Diseases.1999).

Risk factors are characteristics that have a causal relationship with the development of a disease (Beck 1994). Longitudinal studies are essential to identify risk factors as well as periodontal disease progression (Norderyd et al. 1999). However, a relatively limited number of longitudinal studies have employed a multivariate approach for identifying true risk factors while simultaneously controlling for the effect of possible confounders (Papapanou 1996). The reported risk factors for periodontal disease progression are age, smoking and periodontal pathogens, which have also been identified as risk indicators in numerous cross-sectional studies, both among older adults (Jette et al & Locker et al 1993) and younger age groups (Beck et al.1996). More recently, the possible role of periodontal infections as risk factors for systemic diseases such as diabetes and coronary heart disease has attracted special attention (Genco 1996, Papapanou 1996, The Research, Science and Therapy Committee of the American Academy of Periodontology 1998). Although many epidemiological studies have been carried out, the link between other behavioural factors and biological pathways with periodontal destruction is still uncertain (Dolan et al. 1997). Moreover, the majority of adults in these studies were only in their 60s (Beck et al.1990, Fox et al. 1994) and risk factors for periodontal disease progression, especially in healthy elderly people aged 70 years and over, has not yet been assessed. Consequently, further longitudinal studies on such groups are needed to confirm whether these variables are true risk factors and also to identify others that have not been included in studies conducted to date. Such studies will contribute both to the planning of appropriate care and to monitoring of the overall effects of oral care services in a given population (Locker et al. 1998).

The aim of this study was to identify the risk factors for periodontal disease progression among healthy elderly people aged 70 years and over.

Materials and Methods

Niigata city is the capital of Niigata prefecture. It is the largest Japanese city along the coast of the Sea of Japan and has a population of about 520,000. First, 4,542 (2,099 males and 2,443 females) aged 70 years registered as citizens in Niigata city were sent a written request to participate in an oral

and general health survey for the elderly in 1998. After two requests, 1,692 responded positively, but appointments for examinations could be arranged only for 600 persons. The final study population consisted of 599 subjects (306 males and 293 females). The sample size comprised 13.2 per cent of the total number of citizens aged 70 years in Niigata. A cross-sectional study design was used to collect oral epidemiological and personal information from only 554 dentate (281 males and 273 females) subjects at the baseline to longitudinally investigate periodontal disease progression.

In 2000, the subjects examined in 1998 were recalled for re-examination. A total of 436 subjects (234 males and 202 females) were examined. Seven subjects had become completely edentulous. Accordingly, 394 dentate (208 males and 186 females) subjects were included to analyze periodontal disease progression. All subjects were examined at local community centers in Niigata. None of the subjects was hospitalized or institutionalized. They were in good general health, did not require special care for their daily activities, and had high scores of reliability and validity in a multidimensional 13-item index of competence (TMIG Index of Competence) (Koyano et al.1991).

Four dentists carried out oral examinations under sufficient illumination using artificial light. The periodontal condition, measured as loss of periodontal attachment in millimeters, was recorded using dental mirrors and specially designed periodontal probes (VIVACARE TPS PROBE®). Probing was performed at six sites per tooth for all teeth including third molars. Measurements were excluded when the cemento-enamel junction could not be visualized or when pockets could not be probed (for example, when large amounts of calculus were present). Fractional millimeter measurements were rounded up to the nearest whole millimeter at the time of data recording. The four examiners were calibrated on volunteer patients in the Faculty Hospital before and during the survey. Inter-examiner reliability was assessed through replicate examinations of 18 patients. Kappa values between each pair of examiners were in the range of 0.56 to 0.92 for assessing loss of periodontal attachment.

An personal interview was performed to obtain the bulk of information regarding several predictor variables including gender, smoking and alcohol drinking habits, utilization of dental services including pattern of visits, treatment needs and recent visit in a year and dental self-care behaviors (use of floss, inter dental brush and tooth brush). In order to monitor the general health condition, blood pressure levels were recorded and serum levels of disease markers were also investigated. These disease markers were liver agents (GOT, GPT and Gamma-GTP), kidney agent (Creatinine), immunoglobulins (IgG, IgA and IgM), lipo factors (Total-Cholesterol and Triglyceride) and nutritional factors (Total-Protein, Calcium, Blood-Sugar and Albumin).

A variety of modelling procedures were used to identify factors measured at the baseline that were associated with periodontal disease progression for subjects. Initially, a cross-sectional approach was used with potential variables of individual characteristics, and subsequently the Chi-squared test was employed to determine whether or not the predictor variables could be used to identify subjects who were likely to exhibit additional attachment loss. The student's t-test was performed to determine whether there was any significant difference between mean serum levels of disease markers at the baseline and the additional attachment loss.

Moreover, the degree of association between periodontal disease progression and the explanatory variables was investigated using logistic regression analysis. The variable selection process was terminated when the efficient score Chi-square statistics for the joint significance of all variables not in the model had a p-value >0.05. The final model was used to estimate the probability of additional attachment loss of 3 mm or more. The dependent variable, periodontal disease progression, was defined as subjects exhibiting one or more sites with an additional loss of 3 mm or more between the two examinations. The criterion for entry or removal of independent variables was p=0.05. The independent variables used were gender, smoking, attachment level of 6 mm and the number of remaining teeth. The number of remaining teeth was included in the model as a covariate because of its association with other explanatory variables. The odds ratios with the 95 per cent confidence intervals (CI) are presented. All calculations and statistical analyses were performed using the STATA® software package.

Results

Table 1 shows the relationship between the baseline variables and additional attachment loss. Our sample was 52.8 per cent male and 47.2 per cent female. The mean number of remaining teeth was 18.8 per subject (data not shown). Seventeen per cent of the subjects were smokers, while 27.2 per cent of them had a habit of daily alcohol consumption. Almost all subjects (96.4 per cent) had at least one site with an attachment level of 4 mm or more, while 64.1 per cent of them had at least one site with an attachment level of 6 mm or more.

Among all the subjects, 296 (75.1 per cent) exhibited additional attachment loss of 3 mm or more at one or more sites after 2 years. One hundred and twenty-eight subjects exhibited a change at less than 4 sites, while 168 subjects exhibited a change at 4 or more sites. Male subjects (79.8 per cent) appeared to have a greater risk of additional attachment loss than females ($P<0.05$). Subjects who smoked had a higher percentage (92.5 per cent) of additional attachment loss compared to those who did not smoke ($P<0.001$). Subjects whose attachment level was 6 mm or more at the baseline were more likely to show additional attachment loss (81.7 per cent) when compared with subjects with a baseline attachment level of 6 mm or less (63.4 per cent) ($P<0.001$). There were no significant correlations between the individuals exhibiting additional attachment loss and alcohol consumption, the utilization of dental services or dental self-care behaviours.

The mean serum levels of disease markers in the study subjects are presented in Table 2. There were no significant correlations between mean serum levels of disease markers and additional attachment loss.

The results of multivariate logistic regression analysis are shown in Table 3. The variables in order of selection were smoking, gender, attachment level of 6 mm or more and 20 remaining teeth. Smoking was found to be highly correlated with periodontal disease progression with an odds ratio of 3.74 (CI: 1.40-9.96). The clinical variable, attachment level of 6 mm or more at the baseline, was also strongly related to additional attachment loss with an odds ratio of 2.29 (CI: 1.40-3.75).

Discussion

In this investigation, smoking and baseline attachment level of 6 mm or more were found to be strongly associated with periodontal disease progression, with odds ratios of 3.74 and 2.29, respectively. Thus, subjects with smoking habits and those who had baseline attachment levels of 6 mm or more would respectively have 3.74 and 2.29 times higher odds of showing additional attachment loss than non-smoking subjects and those who had baseline attachment level of 6 mm or less.

Many epidemiological studies have demonstrated that of all the risk factors identified, smoking may be the environmental risk factor most strongly associated with adult periodontitis, especially severe periodontitis (Grossi et al. 1994, Mangusson et al. 1996, Hildebolt et al 1997, Page et al. 1997, Norderyd & Hugoson 1998). In our study, smokers had a higher odds ratio even after adjusting for other factors such as gender, age and the number of remaining teeth. Accordingly, our results supported previous reports indicating a strong association between smoking and periodontal disease progression. As shown at the baseline, smoking was found to be the most important explanatory variable for periodontal disease progression. The strong association between smoking and subsequent attachment loss could be explained by a number of biologic phenomena. Nicotine, the chief noxious substance found in cigarettes, and its byproducts have a vasoconstrictive effect, not only on peripheral circulation, but also on coronary, placental, and gingival blood vessels (González et al. 1996).

In addition, according to The Research, Science and Therapy Committee of the American Academy of Periodontology 1996, nicotine may reduce the functional activity of leukocytes and macrophages both in saliva as well as crevicular fluid, and it decreases chemotaxis and phagocytosis of blood and tissue polymorphonuclear leukocytes.

Clinical experience reveals that patients with more periodontal destruction are at greater risk for additional disease than subjects with little or no evidence of destruction (Haffajee et al. 1991, Brown et al. 1994). Accordingly, the present investigation demonstrated the strength of the relationship between a baseline attachment level of 6 mm and more and additional attachment loss of 3 mm or more. Moreover, our results suggested that the other explanatory variables except smoking are less useful as predictors for additional attachment loss in elderly subjects. It is important to assess why subjects who had a previous experience of periodontal disease are more at risk for additional attachment loss. The most obvious reason is that the host is more susceptible. Secondly, the subjects with previous periodontal disease experience may harbor large numbers of pathogens in multiple periodontal sites, thus facilitating the spread of infection (Haffajee et al. 1991). However, more recently, Beck et al. (2000) reported that people or sites with high clinical attachment levels at the baseline might be less likely to demonstrate subsequent attachment loss over time. Since there is no uniformity in case definitions or the length of follow up among different studies the incidence rates reported by these studies are not strictly comparable. Consequently, further studies based on uniform criteria will be necessary to confirm the evidence of destruction.

The most appropriate epidemiological indicator for periodontal destruction is based on the measurement of loss of periodontal attachment. Moreover, previously experienced loss of periodontal

attachment is a prognostic indicator for future periodontal disease progression (Papapanou et al. 1989). As such, this study assessed periodontal conditions among elderly people by measuring the loss of periodontal attachment. Subjects were divided into those who did and did not exhibit progression of destructive periodontal disease over two years based on the changes in probing attachment level at 6 sites per tooth for all teeth. Any number of criteria could have been used to make this assignment. Stringent criteria such as the requirement of large millimeter changes at a site or changes at more than one site would minimize false positives but increase the likelihood of false negatives. On the other hand, more permissive criteria such as a change of 1 or 2 mm at a single site would have the opposite effect (data not shown). The criterion of at least one site exhibiting 3 mm or more was chosen in an attempt to minimize false positives resulting from the use of single measurements at each visit (Lindhe et al. 1989a, Elter et al.1999). The periodontal disease progression in our population over the 2-year period is in accordance with that of other studies (Lindhe et al. 1989b, Beck et al. 1995, Levy et al. 1990). For example, the finding that 62 per cent of 60-79 year olds had 3 mm or more additional attachment loss over a 2-year period by Lindhe et al. is consistent with our findings.

The correlations between mean serum levels of disease markers and additional attachment loss were not significant. As our study was aimed at determining the role of periodontal disease progression among healthy elderly subjects, the subjects selected were in good general health and did not require special care for their daily activities. None of the subjects was hospitalized or institutionalized. Thus, the relatively small variability of serum levels of disease markers in the population studied may have limited our determination of a relationship between additional attachment loss and systemic diseases. Moreover, it is likely that our population, which included volunteers with a high interest in general and oral health care, would be healthier compared to those who did not participate in the survey. This may have biased the findings.

One of the goals of epidemiological research on periodontitis is to identify suitable methods to distinguish subjects who are at greater risk for future periodontal destruction from those who are not (Haffajee et al. 1991). At this stage of our study, there appear to be few diagnostic variables which can distinguish subjects at risk for periodontitis from subjects not at risk. Our findings, however, are consistent with the results of other studies, which have failed to detect many risk factors for periodontal disease progression among healthy elderly aged 70 years and over (Norderyd et al. 1999, Locker et al. 1998).

In conclusion, the baseline measures of explanatory variables in our longitudinal study indicated that smoking and attachment level of 6 mm or more may be considered as risk factors for further periodontal disease progression among healthy elderly people aged 70 years and over.

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Table1 . Relationships between the baseline parameters and additional attachment loss of 3mm or more at 1 or more sites

Parameters	Category	Number of subjects in groups	Subjects exhibiting additional attachment loss	%	P value
All subjects		394	296	75.1%	
Gender	Male	208	166	79.8%	*
	Female	186	130	69.9%	
Smoking habit	Yes	67	62	92.5%	***
	No	322	231	71.7%	
Attachment level	4<mm	14	9	64.3%	***
	4mm≦, <6mm	128	81	63.3%	
	6mm≦	252	206	81.7%	
Alcohol drinking habit	Daily	107	78	72.9%	NS
	Not daily	281	215	76.5%	
Visit dentist regularly	Yes	81	63	77.8%	NS
	No	312	232	74.4%	
Feel need for treatment	Yes	204	152	74.5%	NS
	No	171	129	75.4%	
Recent visit dentist in a year	Yes	263	196	74.5%	NS
	No	130	99	76.2%	
Use of Floss	Yes	30	20	66.7%	NS
	No	349	265	75.9%	
Use of Inter dental brush	Yes	136	107	78.7%	NS
	No	243	178	73.3%	
Brushing frequency	1/day	273	203	74.4%	NS
	2/day more	112	87	77.7%	

*** : P<0.001 * : P<0.05 NS : Not significant (Chi-squared *test*)

Table2. Relationships between the baseline mean blood pressure levels, serum levels of disease markers and additional attachment loss of 3mm or more at 1 or more sites

Paramcters	Category	Subjects not exhibiting additional attachment loss		Subjects exhibiting additional attachment loss		P value
		Mean	SD	Mean	SD	
High blood pressure	120-140 (mmHg)	133.49	16.62	132.16	15.55	NS
Low blood pressure	70-90 (mmHg)	71.35	8.74	72.23	8.59	NS
GOT	10-40 (U/L)	22.62	7.87	22.29	8.27	NS
GPT	5-45 (U/L)	19.91	7.43	20.35	9.69	NS
Gamma-GTP	<60 (U/L)	19.71	24.66	19.24	16.34	NS
Creatinine	M:0.8-1.3 F:0.6-1.0 (mg/dl)	0.90	0.18	0.94	0.21	NS
IgG	1000-1900 (mg/dl)	1481.45	236.68	1508.54	334.69	NS
IgA	96-430 (mg/dl)	292.15	101.67	321.85	137.27	NS
IgM	48-350 (mg/dl)	132.13	88.19	146.22	78.35	NS
Total-Cholesterol	150-219 (mg/dl)	207.20	33.42	201.04	32.87	NS
Triglyceride	50-149 (mg/dl)	123.32	64.45	131.97	70.68	NS
Total-Protein	6.5-8.2 (g/dl)	7.20	0.36	7.23	0.43	NS
Calcium	4.1-5.0 (mEq/L)	4.50	0.17	4.50	0.17	NS
Blood-Sugar	70-110 (mg/dl)	106.85	46.91	104.21	33.00	NS
Albumin	3.7-5.5 (g/dl)	4.32	0.24	4.30	0.26	NS

NS : Not significant (Student's *t-test*)