A personal interview was conducted to obtain the information regarding gender, smoking habit. Anthropometric evaluation included measurements of weight and height for the calculation of body mass index (BMI). In addition, biochemical values such as total protein, calcium, total cholesterol, c-reactive protein, high-density lipoprotein (HDL)-cholesterol, triglyceride and immunoglobulin G (IgG) were also evaluated while the serum level of albumin was measured by bromcresol green albumin (BCG) method. Four dentists carried out intra-oral examination under sufficient illumination using artificial light. The periodontal condition, measured as loss of attachment (LA), was recorded using mouth mirrors and specially designed pressure-sensitive Vivacare, TPS Probe® (Vivacare, Schaan, Liechtenstein). Probing was performed at six sites per tooth for all teeth present and the measurements were recorded approximately to the nearest whole millimetre. The examiners were calibrated both prior to and during the survey and kappa values between each pair of examiners were in the range of 0.62-1.00 for assessing attachment level.

Statistical analyses were performed as follows. Initially, serum albumin concentration was considered as a dependent continuous variable and the unit of analysis was the subject. Gender (male, female), smoking habit (yes, no), BMI (<20, ≥20), the percentage of sites with LA6+mm (<10%, ≥10%), the number of teeth present (<20, ≥20) were selected as independent variables. Student's t-test was employed to compare the difference between two means. In addition, the relationship between serum albumin concentration and percentage of sites of LA 6+ mm and serum values for nutritional and biochemical parameters were evaluated by Student's t-test. Finally, a multiple linear regression analysis was used to estimate the independent effect of periodontal disease status on serum albumin level while controlling confounding factors. Serum albumin

concentration was used as the dependent variable, while the variables that showed significant relationships with serum albumin concentration at P≤ 0.05 in initial analyses, were selected as independent variables. All calculations and statistical analyses were performed using the STATA® software package.

Results

Out of the sample, 48.1% of subjects have or had smoking experience, while 12.8% of them were current smokers. The mean number of remaining teeth was 18.1 per subject. More than 70% of subjects had at least one site with LA 6+ mm, while 91 (24.7%) exhibited 10% or more of sites with LA 6+ mm, as severe periodontal disease. The serum albumin level of the sample was 3.2 to 4.8 g/dl with a mean of 4.1±0.2 (results not shown in the table).

Table 1 shows the relationship between individual characteristics, dental status and serum albumin concentration. Male subjects or smokers* showed a significantly lower level of serum albumin, respectively (P<0.001, P=0.008*). Subjects with 10% or more sites of LA 6+ mm also showed lower serum albumin concentration compared with subjects who have less than 10% of sites with LA 6+ mm (P=0.003). There were not significant differences between number of teeth present, BMI and serum albumin concentration. Relations between serum albumin and serum parameters for nutritional and biochemical values are listed in Table 2. Subjects with lower level of total protein (<6.5g/dl), calcium (<4.5mEg/l), c-reactive protein (>0.45mg/dl) and total cholesterol (<150mg/dl) had significantly lower serum albumin concentrations (P<0.001). In addition, the subjects with a lower level of total cholesterol and a higher level of c-reactive protein* had a significantly greater percentage of sites with LA 6+ mm,

respectively (P<0.001, P<0.05*). Table 3 shows the final multiple regression model for serum albumin alongside the independent variables that demonstrated significant effects on serum albumin. It was found that % of sites of LA 6+ mm had a significant effect on serum albumin (correlation coefficient = -0.14; p<0.05), which was independent of the other covariates.

Discussion

In this cross-sectional investigation, a significant association was found between periodontal disease as measured by percentage of sites with LA 6+ mm and the serum albumin concentration. In fact, we observed an inverse independent relationship between periodontal disease and serum albumin concentration. Some epidemiological studies have demonstrated a relationship between dental status and level of serum albumin. According to Mojon et al. (1999), institutionalized older adults (mean age=85 years) who had teeth with vertical mobility combined with periodontal pockets greater than 6+ mm had a significantly lower serum albumin concentration (3.3g/dl). More recently, Yoshihara et al. (2003) reported that the number of untreated teeth was a significant factor associated with lower serum albumin concentration in an elderly population. Accordingly, our results have supported previous reports indicating an association between oral health status, in particular periodontal disease, and level of serum albumin.

Hypoalbuminemia may be linked to various adverse effects. Several researchers have proposed an association between serum albumin level and mortality rate. Corti et al. (1994) investigated the relationship between serum albumin level and all-cause mortality in an elderly population aged 71+ years, and reported graded increase in

mortality rate with decreasing albumin level while hypoalbuminemia was associated with a significantly increased mortality rate. Phillips et al. (1989) also reported that there was a marked increase in mortality rate with decreasing serum albumin concentrations that persisted even after adjusting for age, social class, town of residence, cigarette smoking, serum total cholesterol, serum total calcium and systolic blood pressure. Moreover, according to Shibata et al. (1991), subjects aged 69-71 years who were divided into four groups by the quartile of serum albumin levels (-4.1, 4.2-4.3, 4.4-4.5, 4.6+, g/dl) had significantly different 10 year survival rates. It was evident even a difference in survival rates between the first and second quartiles. Therefore, the present findings indicated, periodontal disease status denoted by the percentage of sites with LA 6+ mm might have a substantial influence not only on the subjects' serum albumin levels but also on general health aspects.

Although the precise mechanism underlying the serum albumin–periodontal relationship is not well understood, we hypothesis that this relationship might be explained by the following two conceivable possibilities, namely, the influence of nutritional aspect or chronic disease aspect (Yoshihara et al. 2003). According to our results, serum albumin concentration was significantly associated with lower levels of total protein, calcium, c-reactive protein and total cholesterol. In addition, our subjects with less than 150mg/dl of total cholesterol and more than 0.45mg/dl of c-reactive protein* showed significantly lower serum albumin levels and higher percentage of sites with LA 6+ mm, respectively ($P<0.001$, $P<0.05$*). Therefore, our results suggested that not only nutritional aspect but also inflammatory reactants might be intervened by both serum albumin concentration and periodontal disease condition. Indeed, several reports have indicated a relation between nutritional condition and serum albumin (Magagnotti

et al. 2000, Giordano et al. 2001) though a few studies have observed an association between nutritional aspects (mainly vitamin C) and periodontal disease (Ismail et al. 1983, Nishida et al. 2000, Amarasena et al. 2005).

A significant association between serum albumin concentration and IgG has also been reported (Goubran Botros et al., 1996). C-reactive protein is not a nutritional parameter but may be used to identify the presence of inflammation in individuals with lower serum albumin concentration (Gabay & Kushner, 1999). The level of serum albumin may fall due to a variety of infections with an increase of c-reactive protein and IgG concentration. Elevated c-reactive protein and IgG levels in periodontal patients have been reported (Sahingur & Cohen 2000, Noack et al., 2001). The present study, however, failed to show a statistically significant correlation between serum albumin and IgG though c-reactive protein had such an association. The serum albumin concentration showed a tendency to decrease with increasing levels of IgG. A statistically significant association was not found between IgG and periodontal disease conditions.

Considering these results, it could be suggested that the significant relationship between periodontal disease and serum albumin concentration in our subjects might be influenced by nutritional aspect rather than chronic infectious disease. On the other hand, Mojon et al. (1999) reported that a compromised oral functional status has little influence on the nutritional status of semi-dependent elders, while those in poorer health might be more susceptible to poor oral function. In addition, the rate of albumin synthesis in elderly subjects might not be sensitive to changes in protein intake (Walrand et al. 2000). It has also been reported that synthesis speed of albumin in the liver in elderly is not influenced by the ingestion of protein.

Since there is no-uniformity in case definitions or the method used among studies the

effect of periodontal disease on the level of serum albumin that has been shown by these studies are strictly not comparable. Moreover, this study population may be considered a bias one since it consisted of generally dynamic, independent and non-institutionalized elderly people who volunteered to participate in the survey (Amarasena et al., 2005). It has been observed that such non-institutionalized elderly who are active and independent may be less prone to severe periodontal disease than institutionalized elderly who are less active and dependent (Ogawa et al. 2002, Hirotomi et al. 2002).

In view of these facts, and because of the cross-sectional design of the present study, we cannot confirm a clear cause-effect relationship between serum albumin and periodontal disease at this stage. In order to explore the actual relationship between periodontal disease status and serum albumin level, further prospective studies and clinical trials will be necessary.

In conclusion, the findings of the present study might point to a statistically significant association between periodontal disease status and serum albumin concentration in this elderly population.

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Table1. Relationship between serum albumin, subject characteristics and dental status

	serum albumin (g/dl)	
	Mean (SD)	P value
Gender		
Male	4.07 (.23)	<0.001
Female	4.18 (.22)	
Smoking habit		
Yes	4.08 (.24)	0.008
No	4.15 (.22)	
BMI		
<20	4.10 (.27)	NS
≥20	4.12 (.23)	
% of sites with LA6+ mm		
<10%	4.14 (.23)	0.003
≥10%	4.06 (.22)	
No. of present teeth		
<20	4.11 (.22)	NS
≥20	4.13 (.24)	

NS: Not significant

Table2. Relationship between serum albumin, periodontal disease and serum bloods parameters for nutritional and biochemical values

Parameters	Category	N. of subjects	serum albumin (g/dl)			sites with LA 6+ mm	
			Mean	SD	P value	%	P value
Total Protein	<6.5	17	3.78	0.24	<0.001	7.7%	NS
(g/dl)	6.5-8.2	344	4.14	0.22		8.3%	
	>8.2	5	4.04	0.19		13.5%	
Calcium	<4.5	88	3.95	0.23	<0.001	7.9%	NS
(mEg/l)	≥4.5	278	4.17	0.21		8.5%	
Total Cholesterol	<150	17	3.96	0.26	<0.001	21.4%	<0.001
(mg/dl)	150-219	250	4.09	0.23		8.6%	
	≥220	99	4.22	0.22		5.4%	
C-reactive Protein	≤0.45	354	4.13	0.23	<0.001	8.0%	<0.05
(mg/dl)	>0.45	12	3.87	0.24		16.4%	
HDL-Cholesterol	<40	28	4.05	0.22	NS	9.5%	NS
(mg/dl)	≥40	338	4.13	0.24		8.2%	
Triglyceride	<50	16	4.04	0.28	NS	12.4%	NS
(mg/dl)	50-149	231	4.11	0.24		8.6%	
	≥150	118	4.15	0.22		7.4%	
IgG	<1000	39	4.16	0.25	NS	4.8%	NS
(g/dl)	1000-1900	316	4.12	0.23		8.6%	
	>1900	11	3.98	0.19		13.8%	

NS: Not significant

Table3. Multiple linear regression and associated P values

	Dependent variable serum albumin (g/dl)				
Independent variables	Coef.	Std. Err.	P value	95%CI	
% of sites with LA 6+ mm	-0.137	0.067	<0.05	-0.268	-0.048
Total Protein(g/dl)	0.146	0.023	<0.001	0.100	0.192
Calcium (mEg/l)	0.490	0.057	<0.001	0.377	0.602
Total Cholesterol (mg/dl)	0.001	0.000	0.001	0.001	0.002
C-reactive Protein(mg/dl)	-0.117	0.029	<0.001	-0.174	-0.060
Gender	0.041	0.030	0.173	-0.018	0.101
Smoking habit	-0.050	0.029	0.087	-0.108	0.007
Constant	0.638	0.237	<0.05	0.172	1.103

P<0.001, R-squared = 0.4503

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「地域住民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：

「高齢者における Body Mass Index と歯周病進行の関連に関する疫学研究」

D．研究協力者：廣冨敏伸

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E．研究目的：

高齢者では、無意識の体重減少がしばしば起こる。最近の疫学研究により、歯周病と肥満の関連が明らかにされているが、歯周病と痩せていることとの関連についてはほとんど注目されていない。さらに、歯周病と肥満の関連についての研究はその多くが横断調査であるため、それらの因果関係については不明な点が多い。

本研究の目的は、新潟市在住の高齢者を対象とした4年間の経年調査データを用いて、BMIと歯周病進行の関連を明らかにすることにある。

F．研究方法：

厚生科学研究(高齢者の口腔健康状態と全身健康状態の関係についての総合研究)において、平成10年度に行われたベースライン調査で対象とした70歳高齢者600人のうち、4年後のフォローアップ調査に参加した有歯顎者368人(男性189人、女性179人)を本研究の対象とした。ベースライン時に計測した身長と体重より Body Mass Index(BMI)を算出し、WPRO (the steering committee of the Western Pacific Region of the WHO)分類に基づき対象者を5群に分けた。歯周組織の診査項目は歯周ポケット深さ(PD)およびアタッチメントレベル(AL)で、全ての機能歯を対象に1歯あたり6点について診査を行った。診査部位各点(1人当たり最大192点)において、4年間で3mm以上の AL

増加が認められた場合を歯周病進行と定義した。そして歯周病進行の認められた部位の割合を、BMI、性別、現在歯数、および喫煙の有無別に算出し、比較した。さらに、歯周病進行を上位10パーセンタイルの割合で有する者を従属変数に、BMI、性別、現在歯数、およびベースライン時の歯周組織状態を独立変数に用いて、多重ロジスティック回帰分析を行った。独立変数のうち、BMI、性別および現在歯数についてはダミー変数として、ベースライン時の歯周組織状態については連続量として取り扱った。

G．研究結果および考察：

対象者368人のうち、歯周病進行は男性で82.0%、女性で76.5%に認められた。歯周病進行の認められた部位の割合が有意に高かったのは、BMIの最も低い群(12.7%)、BMIの最も高い群(17.2%)、男性(8.6%)、および現在歯数の少ない群(歯数1-9本群で10.6%、10-19本群で9.5%)であった(Table 1)。歯科保健行動に関する変数(歯ブラシを用いる頻度、歯間部清掃の頻度、定期的な歯科受診の有無、および過去1年間の歯科受診の有無)と歯周病進行の間には有意な関連は認められなかった。多重ロジスティック回帰分析の結果(Table 2)、BMIと歯周病進行にはU字型の関連が認められた。すなわち、標準的なBMI(18.5-22.9)を有する者に比べて、BMIの最も低い群(<18.5)では3.7倍、BMIの最も高い群(≧30)では9.5倍、歯周病進行の危険度が高かった。

H．結論：

本研究の結果から、高齢者においては肥満のみならず痩せていることも歯周病進行リスクであることが示唆された。

I．研究発表論文：

なし

Table 1. Percent of sites with periodontal disease progression over 4 years by characteristics of subjects at baseline (n=368)

Variables at baseline	n	mean % (SD)	p †
Body mass index (kg/m^2)			
<18.5	30	12.67 (12.05)	<0.05
18.5-22.9	180	6.53 (9.39)	
23-24.9	88	7.66 (11.00)	
25-29.9	65	6.42 (11.12)	
≥30	5	17.19 (24.60)	
Gender			
Male	189	8.56 (11.73)	<0.05
Female	179	6.23 (9.49)	
Number of teeth present			
1-9	46	10.64 (15.80)	<0.001
10-19	113	9.54 (10.78)	
20-32	209	5.58 (8.89)	
Smoking status‡			
Current smoker	60	8.92 (8.93)	NS
Non smoker	301	6.99 (10.59)	
Tooth brushing frequency‡			
One time per day	105	7.98 (10.86)	NS
≥2 times per day	258	7.26 (10.79)	
Interdental cleaning‡			
Daily/frequently	138	6.74 (10.78)	NS
Rarely/never	215	7.79 (10.77)	
Dental attendance			
Regularly	80	5.71 (8.37)	NS
Not regularly	288	7.91 (11.29)	
Last dental visit‡			
Within 1 year	250	7.45 (11.03)	NS
More than 1 year	117	7.35 (10.19)	

† NS: not significant. P values in variables with two alternatives were obtaind from student t-test and in variables with three or more alternatives from one-way analysis of variances.

‡ Total number of subjects varies due to missing values.

Table 2. Multivariate logistic regression analysis for the association between body mass index (BMI) and periodontal disease progression over 4 years

Independent variables	Odds ratio	*p*	95% CI
BMI (kg/m^2)			
<18.5	3.66	0.021	1.22-11.03
18.5-22.9 (ref.)	1.00		
23-24.9	1.63	0.301	0.65-4.12
25-29.9	1.57	0.414	0.53-4.61
≥30	9.47	0.028	1.28-70.24
Gender (0: female, 1: male)	1.24	0.595	0.56-2.72
Number of teeth present			
1-9	4.26	0.007	1.49-12.14
10-19	2.78	0.020	1.17-6.59
20-32 (ref.)	1.00		
Periodontal condition			
% sites with PD ≥6 mm	7.24†	0.009	1.63-32.10
% sites with AL ≥6 mm	1.12†	0.501	0.80-1.58

Dependent variable was periodontal disease progression in the highest 10th percentile over four years

† Odds ratio is calculated based on a 10% increment in percent of affected sites.

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C. 研究協力課題：

「高齢者の口腔健康と精神健康状態との関連についての研究」

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E. 研究目的

高齢者に多く認められる疾患に、うつ病、不安障害、神経症などの精神疾患がある。高齢者には配偶者の死亡、仕事の喪失あるいは身体機能の変化などが若年者より多く発生し、これらにうまく対処できなかった結果、このような精神疾患を発症するといわれている。精神疾患は初期に発見されて、適切な治療を受けると治癒、または悪化の防止が可能である。しかしながら、精神疾患は自覚されにくいため、重症になってから周囲が気づくことが多い。高齢者の自殺率は高く、精神健康状態のマネジメントは急務である。一般的に精神科や心療内科への受療行動は起こしにくいが、口腔内の不調があれば歯科への受診は容易に行える。したがって、歯科において、精神疾患の早期発見が可能であると仮説をたてた。

本研究の目的は、口腔健康状態および口腔保健行動と精神健康状態の関連を明らかにすることである。

F. 対象および方法

調査対象者は新潟市在住の77歳の高齢者である。調査対象者のうち、歯科健診を受けた373名(男197名、女176名)を分析対象者とした。

精神健康状態の評価には，WHO世界保健機関版に準拠したGHQ精神健康調査票を用いた質問紙を用いた。精神健康状態の調査は、他の生活習慣などのアンケートと一緒にGHQ

質問調査票を事前に対象者に郵送し、当日、健診会場で回収した。GHQ スコアは通法にしたがって算出し、6/7 を区分点として、6 点以下を健常群、7 点以上を神経症群と定義した。

口腔の指標として、う蝕(DT、DFT)、根面う蝕(根面 DT、根面 DFT)、歯周ポケット、LA、安静時唾液(ロールワッテ法)、パラフィン刺激唾液を用いた。

G.研究結果および考察

分析対象者のうち無歯顎者は 31 名(8.3%)、有歯顎者は 342 名(91.7%)だった。分析対象者の一人平均現在歯数は 16.61(SD=9.37)で、性差は認められなかった。

GHQ スコアの最頻値は 0 点(19.0%)、最大値は 27 点、平均値は 4.8(SD=5.1)だった。

神経症群／健常群(以下、GHQ 群)の割合は 47.1%／52.9%と健常群の割合のほうが高かった。男女別にみた GHQ 群別の割合および GHQ 点数の平均値を表 1 に示す。神経症者の割合は女性において 36.9%、男性では 19.2%と女性のほうが有意($p<0.001$)に高かった。GHQ スコアの平均値は女性が 5.6(SD=5.6)、男性が 4.0(SD=4.5)で有意差($p<0.05$)が認められた。

男女別に示した現在歯数、安静時唾液量、刺激唾液量、DT、DFT、根面 DT、根面 DFT、最大 Pd、最大 LA、Pd 平均、LA 平均の GHQ 群別の平均値および所有者率を表 2 および表 3 に示す。男性で平均値に有意差が認められたのは、平均 LA(健常者群＞神経症者群)のみだったが、女性では安静時唾液(健常者群＞神経症者群)、刺激唾液(健常者群＞神経症者群)、根面 DT(健常者群＜神経症者群)、最大 Pd(健常者群＜神経症者群)だった。所有者率では、男性では有意差のあった指標はなかったが、女性では DT あり、根面 DT あり、最大ポケット 6mm 以上、最大 LA 6mm 以上、安静時唾液 0.1g 未満、刺激唾液 0.7ml 未満の者の割合が神経症群のほうが有意に高かった。

次に、口腔に関するアンケートと GHQ 群別のクロス集計を表 4 に示す。男性では口腔乾燥に関する 6 項目すべてに有意差が認められた。女性では口腔乾燥に関する 3 項目で有意差があった。口腔の自覚症状と歯科受診に関しては、男女とも「歯ぐきが痛んだりはれたりする」「言葉がうまく発音できない」と答えた者が神経症群のほうが有意($p<0.05$)に割合が高く、さらに女性において「モノが咬みにくい」と答えた者が神経症群のほうが有意($p<0.05$)に割合が高かった。