Original

Health effects caused by cessation of cigarette smoking

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Abstract

To evaluate the medical effects induced by the cessation of cigarette smoking, the subjects who had been followed up in a financing company were analyzed epidemiologically. The duration of the observation period was 2 years. Two health surveys were performed for each subject. The number of nonsmokers, ex-smokers and smokers were 117, 38 and 379, respectively. The results based on the analysis of covariance using the age and value of each medical indicator measured at the first health surveys as the covariates showed that the obesity index, diastolic blood pressure and the serum level of uric acid were significantly higher in the ex-smokers than in the nonsmokers and the smokers ($p < 0.05$). Fasting blood sugar, triglyceride and total cholesterol in the ex-smokers who had smoked 20 or more cigarettes per day ($N = 20$) were higher than in the ex-smokers who had smoked less than 20 cigarettes per day ($N = 18$) ($p < 0.05$). There were no significant differences in the medical indicators among the subjects with different durations of cessation of cigarette smoking. The factor analyses concerning the dietary habits were calculated. The ex-smokers had significant negative trends in the second factor score and significant positive trends in the third factor score between the first and second health surveys when compared with the nonsmokers and the smokers. These trends showed that the ex-smokers seemed to make their dietary habits unhealthy and to increase their calorie intake. In view of these relationships between the medical indicators and the modification in dietary habits, health education concerning dietary habits should be carried out when cessation of smoking cigarette is recommended.

Key words: smoking, obesity, food habits, blood chemical analysis, health education

Introduction

Cessation of cigarette smoking plays a major role in the prevention of cerebrovascular disease, coronary heart disease and some malignant neoplasms.^{1,2} Improvement of respiratory functions³⁻⁵ and decreased incidence of chronic diseases^{6,7} are well-known effects induced by the cessation of cigarette smoking. Comstock *et al.*⁸ reported that significant weight gains were seen in the ex-smokers. But there were few reports concerning the modification of the medical indicators and life-style induced by the cessation of cigarette smoking.

It would be worthwhile for the accomplishment of effective health education to understand the influences upon the medical indicators and the life-styles induced by the cessation of cigarette smoking, because it would seem that some risk factors of chronic diseases would be influenced by abstinence from smoking.

It is the purpose of this study to evaluate the health effects induced by the cessation of cigarette smoking based on the epidemiological follow-up study.

Subjects and methods

The subjects were 640 male workers in a financing company, located in the Tokyo metropolitan area. They were eligible for this study, because they underwent a series of health checkups. The first health surveys were performed from September '80 to August '81. The second ones were performed from September '82 to August '83. All subjects underwent two health surveys.

The smoking status between the first and second health checkups are shown in Table 1. The nonsmokers were defined as the subjects who had never smoked cigarettes

Table 1
Smoking status between the first and second health surveys

First health survey	Second health survey				Total
	No	Ex-smoker	<20 cigarettes/day	≥20 cigarettes/day	
No	115	0	4	2	121
Ex-smoker	0	106	10	5	121
<20 cigarettes/day	0	18	95	19	132
≥20 cigarettes/day	0	20	25	221	266
Total	115	144	134	247	640

until the second health surveys. They were 117 subjects and their mean age was 45.3 ± 4.1 y.o. (Mean $\pm$ S.D.). The ex-smokers were defined as the subjects who stopped smoking cigarettes during this observation period. They were 38 subjects and their mean

age was 46.3 ± 4.7 y.o. (Mean $\pm$ S.D.). The smokers were defined as the subjects who had smoked cigarettes up until the second health surveys. They were 378 subjects and their mean age was 46.3 ± 4.3 y.o. (Mean $\pm$ S.D.).

The medical indicators used in this study were the obesity index, systolic and diastolic blood pressure, triglyceride, total cholesterol, high density lipoprotein cholesterol, uric acid, fasting blood sugar, glutamic oxalacetic transaminase, glutamic pyruvic transaminase, gamma glutamyl transpeptidase. The obesity index was calculated as below;

$$\begin{aligned} \text{standard weight} &= (\text{height(cm)} - 100) * 0.9 \\ \text{obesity index} &= \frac{(\text{actual weight(kg)} - \text{standard weight})}{\text{standard weight}} \end{aligned}$$

Blood pressure were measured in the sitting position using a sphyngomanometer. Blood was drawn for biochemical measurements in the fasting state. All biochemical items during this study period were measured using the same equipment in the same laboratory. These were measured by ordinary methods.⁹⁻¹⁵ The data concerning smoking status and dietary habits were obtained through questionnaires. The questions concerning dietary habits were frequency of having breakfast, volume of staple food, frequency of meat, seafood, egg, vegetable, fruit, greasy food and confectionery intake, and sense of salt taste.

Analyses of covariances were computed in order to adjust the different age and medical indicator values measured at the first health surveys between the different smoking groups.

The three major factor loading scores were calculated on the basis of responses regarding dietary habits at the first healthy surveys. The factor scores of each subject at the first and second health surveys were computed based on the above mentioned factor loading scores.

Statistical analyses were performed using SAS program packages¹⁶ on Facom 360 M at the Keio University Computer Center. Least-square means were calculated based on the method of Searle *et al.*¹⁷

Results

The comparison of medical indicators between the nonsmokers, the ex-smokers and the smokers are shown in Table 2. The obesity index, diastolic blood pressure and the serum levels of uric acid in the ex-smokers were significantly higher than those in the smokers ($p < 0.001$). Also, the obesity index, systolic and diastolic blood pressure and the serum levels of uric acid in the ex-smokers were significantly higher than those in the nonsmokers ($p < 0.01$). The smokers had significantly higher serum triglyceride levels as compared with nonsmokers ($p < 0.05$).

The comparison of medical indicators between the ex-smokers whose smoking

Table 2
Comparison of biomedical indicators by smoking status

	Nonsmoker N=117	Ex-smoker N=38	Smoker N=379	Nonsmoker vs. Ex-smoker	Ex-smoker vs. Smoker	Non- smoker vs. Smoker
	Mean±S.E.	Mean±S.E.	Mean±S.E.			
Obesity	3.10±0.39	5.47± 0.68	2.65±0.22	p=0.003	p<0.001	p=0.306
SBP	116.9 ±1.0	122.7 ± 1.8	119.0 ±0.6	p=0.005	p=0.051	p=0.073
DBP	78.6 ±0.7	83.2 ± 1.3	78.1 ±0.4	p=0.002	p<0.001	p=0.587
TG	107.3 ±6.0	110.8 ±10.6	121.7 ±3.4	p=0.772	p=0.329	p=0.038
TC	211.2 ±2.2	214.6 ± 3.8	211.0 ±1.2	p=0.438	p=0.363	p=0.924
HDLC	54.5 ±0.7	56.3 ± 1.3	54.4 ±0.4	p=0.209	p=0.152	p=0.933
UA	6.06±0.07	6.67± 0.13	5.99±0.04	p<0.001	p<0.001	p=0.399
FBS	101.5 ±0.8	102.6 ± 1.5	102.0 ±0.5	p=0.542	p=0.711	p=0.634
GOT	22.6 ±1.1	22.9 ± 1.9	23.0 ±0.6	p=0.894	p=0.977	p=0.778
GPT	20.0 ±1.2	20.0 ± 2.0	21.1 ±0.6	p=0.994	p=0.610	p=0.421
GGT	28.4 ±1.4	33.3 ± 2.9	30.8 ±0.9	p=0.142	p=0.396	p=0.221

Abbreviations and units; Obesity: Obesity index, SBP: Systolic blood pressure (mmHg), DBP: Diastolic blood pressure (mmHg), TG: Triglyceride (mg/dl), TC: Total cholesterol (mg/dl), HDLC: High density lipoprotein cholesterol (mg/dl), UA: Uric acid (mg/dl), FBS: Fasting blood sugar (mg/dl), GOT: Glutamic oxalacetic transaminase (K.U.), GPT: Glutamic pyruvic transaminase (K.U.), GGT: Gamma glutamyl transpeptidase (K.U.)

Table 3
Comparison of biomedical indicators between different amount of cigarette smoking before abstinence

	<20 cigarettes/day N=18	>=20 cigarettes/day N=20	
	Mean±S.E.	Mean±S.E.	
Obesity	3.41± 1.84	6.22± 1.74	p=0.276
SBP	121.6 ± 2.6	122.8 ± 2.4	p=0.745
DBP	74.3 ± 1.8	76.1 ± 1.7	p=0.485
TG	95.9 ±13.3	135.7 ±12.6	p=0.048
TC	207.9 ± 5.7	228.2 ± 5.4	p=0.015
HDLC	54.1 ± 2.7	56.9 ± 2.6	p=0.475
UA	6.75± 0.24	6.74± 0.23	p=0.627
FBS	100.7 ± 2.0	106.3 ± 1.9	p=0.047
GOT	23.2 ± 2.5	22.6 ± 2.3	p=0.868
GPT	20.0 ± 2.6	19.6 ± 2.5	p=0.906
GGT	26.2 ± 6.9	40.8 ± 6.6	p=0.134

Abbreviations and units are referred to the footnote of Table 2.

amounts before they stopped smoking were different are shown in Table 3. Twenty of the ex-smokers had smoked 20 or more cigarettes per day before the cessation. Eighteen of the ex-smokers had smoked less than 20 cigarettes per day before the cessation. The ex-smokers who had smoked 20 or more cigarettes per day had significantly higher serum levels of triglyceride, total cholesterol and fasting blood sugar compared with the ex-smokers who had smoked less than 20 cigarettes per day.

The comparison of medical indicators between subjects with different duration of abstinence from cigarette smoking is shown in Table 4. Nineteen of these had stopped smoking for less than 1 year and nineteen of these had stopped for more than 1 year. There were no significant differences in the medical indicators among the subjects whose periods of abstinence from smoking were different.

The major three factor loading scores are shown in Table 5. In the first factor, the questions concerning frequency of meat, seafood, egg and greasy food intake had relatively large positive factor loading scores. In the second factor, the questions concerning frequency of vegetable and fruit intake had large positive factor loading scores. On the other hand, the questions concerning frequency of greasy food and confectionery intake and salt taste had large negative factor loading scores. In the third factor, the questions of frequency of having breakfast and the amounts of staple food had large positive factor loading scores. The differences in the factor scores between the first and second health surveys are shown in Table 6. The ex-smokers had significant negative trends in the

Table 4
*Comparison of biomedical indicators between different duration of
abstinence from cigarette smoking*

	Less than 1 year N=19	1 year or over N=19	
	Mean $\pm$ S.E.	Mean $\pm$ S.E.	
Obesity	4.21 $\pm$ 1.84	5.57 $\pm$ 1.84	p=0.612
SBP	120.0 $\pm$ 2.5	124.5 $\pm$ 2.5	p=0.221
DBP	81.1 $\pm$ 1.8	83.3 $\pm$ 1.8	p=0.400
TG	110.9 $\pm$ 13.1	112.8 $\pm$ 13.1	p=0.921
TC	214.8 $\pm$ 6.3	214.4 $\pm$ 6.3	p=0.961
HDLC	56.0 $\pm$ 2.6	57.2 $\pm$ 2.6	p=0.767
UA	6.77 $\pm$ 0.24	6.35 $\pm$ 0.24	p=0.231
FBS	103.6 $\pm$ 2.1	101.6 $\pm$ 2.1	p=0.500
GOT	23.2 $\pm$ 2.4	22.5 $\pm$ 2.4	p=0.222
GPT	20.1 $\pm$ 2.6	19.5 $\pm$ 2.6	p=0.871
GGT	40.8 $\pm$ 6.9	26.9 $\pm$ 6.9	p=0.168

Abbreviations and units are referred to the footnote of Table 2.

Table 5
Factor loading scores concerning dietary habits

Item	Factor 1	Factor 2	Factor 3	Communality
Frequency of having breakfast	0.147	0.171	0.691	0.528
Volume of staple food	0.151	-0.248	0.540	0.375
Frequency of meat intake	0.706	-0.124	-0.173	0.544
Frequency of seafood intake	0.502	0.188	-0.227	0.339
Frequency of intake	0.548	-0.144	-0.007	0.321
Frequency of vegetable intake	0.216	0.770	-0.114	0.652
Frequency of fruit intake	0.407	0.600	0.113	0.538
Frequency of greasy food intake	0.640	-0.299	-0.131	0.517
Frequency of confectionery intake	0.375	-0.285	0.411	0.391
Sense of salt taste	0.084	-0.333	-0.403	0.280

Table 6
Differences in factor scores by smoking status between
the first and second health surveys

	Nonsmoker N=117	Ex-smoker N=38	Smoker N=379	Non- smoker vs. Ex-smoker	Non- smoker vs. Smoker	Ex- smoker vs. Smoker
	Mean $\pm$ S.D.	Mean $\pm$ S.D.	Mean $\pm$ S.D.			
1st score	-0.174 $\pm$ 0.895	-0.124 $\pm$ 1.120	-0.010 $\pm$ 1.016	p=0.401	p=0.047	p=0.273
2nd score	-0.134 $\pm$ 1.123	-0.436 $\pm$ 1.046	-0.055 $\pm$ 1.019	p=0.064	p=0.248	p=0.016
3rd score	-0.120 $\pm$ 0.898	0.192 $\pm$ 0.745	-0.041 $\pm$ 0.834	p=0.017	p=0.119	p=0.035

Differences are the value of subtracting the first from the second health survey.

second factor score and significant positive trends in the third factor score compared with the nonsmokers and the smokers. The smokers had significant positive trends in the first factor score compared with the nonsmokers.

Discussion

The cessation of cigarette smoking has been of prime importance in the prevention of chronic diseases.^{1,2} The improvement of respiratory functions³⁻⁵ and decreases in death rates in chronic diseases^{6,7} are well-known sequences to the cessation of cigarette smoking. There were few epidemiological studies to evaluate the influence on the medical indicators and life-styles induced by the cessation of cigarette smoking. It would be worthwhile to evaluate the health effects caused by the abstinence from smoking using epidemiological analysis, because these findings would be helpful in conducting effective

health education concerning the cessation of smoking.

In this study population, the rate of the cessation of smoking was $38/379 = 10.0\%$ and Comstock *et al.*⁸ have reported a similar rate during a 5 year observation. From the viewpoint of the subject's concern about his health, this study group was regarded as a similar population to the one reported by Comstock *et al.*⁸

The ex-smokers had significantly higher obesity indices, diastolic blood pressure and serum levels of uric acid compared with the nonsmokers and the smokers. In addition, there were no significant differences in medical indicators between the nonsmokers and the smokers except for the serum triglyceride levels. Accordingly, the increases in the obesity index, diastolic blood pressure and the serum levels of uric acid were interpreted as influences caused by the cessation of cigarette smoking, not as the recovery of these findings to the levels of the nonsmokers.

The ex-smokers who had smoked 20 or more cigarettes per day had significantly high levels of triglyceride, total cholesterol and fasting blood sugar compared with the exsmokers who had smoked less than 20 cigarettes per day. Brunzell *et al.*¹⁸ reported that the fasting levels of lipoprotein lipase activity were significantly higher than those in the nonsmokers matched for age and sex. Lipoprotein lipase is the enzyme which degraded triglyceride to fatty acid and glycerol.¹⁹ But the serum levels of triglyceride in the smokers were significantly higher those in the nonsmokers. The serum levels of triglyceride should be considered from aspects of both the anabolism and the catabolism of triglyceride. In that case, the anabolism of triglyceride might be increased in the smokers compared with the nonsmokers. The balance of anabolism and catabolism of triglyceride in the ex-smokers might also have been influenced by the amount of smoking before the cessation.

There were no differences in the medical indicators among the ex-smokers whose durations of cessation of smoking were different. These influences caused by abstinence from smoking therefore seem to continue at least 2 years after the cessation.

The influences on the obesity index, diastolic blood pressure and the serum levels of uric acid suggest that the ex-smokers have changed their dietary habits. Factor analysis concerning the dietary habits showed that the first factor score is associated with the amount of food intake excluding staple food. The second one is associated with the consciousness of the health regarding the dietary intake. The third one is associated with the amount of staple food intake.

Concerning the differences in the factor scores between the first and second health surveys, the ex-smokers had significant negative trends in the second factor score and significant positive trends in the third factor score compared with the nonsmokers and the smokers. But there were no significant differences in the second and third factor score compared with the nonsmokers and the smokers. But there were no significant differences in the second and third factor scores between the nonsmokers and the

smokers. The ex-smokers therefore showed a decline in their dietary habits increased their calorie intake.

There have been some studies^{20,21} which attempted to explain the etiology of the weight gain caused by the cessation of cigarette smoking. Glauser *et al.*²⁰ reported that the basal oxygen consumption was diminished in the ex-smokers. Robert *et al.*²² reported that the activity of lipoprotein lipase predicted the weight gain after the cessation of smoking. But in these studies the sample sizes were small and the observation periods were less than a few weeks. Therefore, it might be difficult to explain the whole mechanism of weight gain after abstinence from smoking. Burse *et al.*²¹ reported that appetite was increased while metabolism was unchanged after cessation of smoking. The findings of Burse *et al.*²¹ were considered to be consistent with our results, because increased caloric intake were observed in the ex-smokers. In light of the increase in the serum levels of uric acid, cessation of smoking might also cause behavior modifications concerning dietary habits.

Further study is required to evaluate how long these influences induced by the cessation of smoking will continue. In addition, it was not obvious how these findings would affect the occurrences of chronic diseases. Decreased death rates in the ex-smokers have been reported in some epidemiological studies.^{6,7} On the other hand, the fact was that the risk factors of chronic diseases¹ such as the obesity index, diastolic blood pressure and the serum levels of uric acid were influenced by cessation of smoking. Accordingly, it is suggested that health education concerning dietary habits is necessary when cessation of cigarette smoking is recommended.

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