

Changes in the Serum Level of High Density Lipoprotein-cholesterol after Smoking Cessation among Adult Men

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Background: Smoking and obesity are known risk factors for cardiovascular diseases, while low serum levels of high density lipoprotein-cholesterol is an independent risk factor for mortality from ischemic heart diseases. This study examines changes in the serum level of high density lipoprotein-cholesterol depending on changes in the state of smoking and body mass index.

Methods: A survey and blood check-up were conducted on medical examination, along with acts of smoking among male adults of 25 years or older who visited the health promotion center of Daegu Medical Center from 2007 to 2010, and the results were analyzed. The subjects were divided into two different groups, current smokers and abstainers, and body mass index, total cholesterol, high density lipoprotein-cholesterol, low density lipoprotein-cholesterol, and triglycerides for three years were compared in both groups. Changes between the first and second visits in body mass index and lipid profiles of the two groups were compared to analyze changes after abstaining.

Results: The subject group which showed a significant increase in high density lipoprotein-cholesterol level was only abstainers whose body mass index had decreased by more than 0.5 kg/m².

Conclusion: Smoking cessation increases serum levels of high density lipoprotein-cholesterol. If reduction of body mass index and smoking cessation are combined, the risk of cardiovascular disease will be lower in proportion to the increase in serum high density lipoprotein.

Keywords: Smoking Cessation; Body Mass Index; High Density Lipoprotein Cholesterol

INTRODUCTION

The smoking rates of Korean adult men are still high compared to those of advanced countries, and eating habits are

also becoming westernized. Accordingly, smoking and obesity are recognized as important social issues. Smoking is a risk factor that directly contributes to coronary heart disease. It is known, for example, that 25% to 30% of deaths from ischemic heart disease are attributed to smoking.¹⁾

Smoking causes intravascular adipolysis and dyslipidemia, which facilitate atherosclerosis, reduce serum levels of high density lipoprotein (HDL)-cholesterol, and increase total cholesterol, triglycerides, and lipid peroxide.²⁾ HDL-cholesterol plays a role in controlling diseases related to the cardiovascular system. It also functions as a medium in reverse cholesterol transportation from peripheral systems such as vascular tracts, hinders oxidation of low density lipoprotein (LDL)-cholesterol, thus providing anti-inflammatory effects, and also prevents

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atherosclerosis through antioxidant and antithrombotic effects.^{3,4)}

According to research on changes of HDL-cholesterol level, such factors as obesity, smoking, little physical movement, and little intake of alcohol, decrease HDL-cholesterol levels.⁵⁾ Low HDL cholesterolemia is an independent risk factor for cardiovascular diseases, and it is becoming increasingly common among Korean men.⁶⁾ In addition, although the extent of obesity in Korea is not serious compared to that in Western countries, the morbidity of cardiovascular diseases is high and the risk factors for cardiovascular systems are increasing.⁷⁾ The effect of smoking and obesity, therefore, is regarded as significant when it comes to low HDL cholesterolemia.

There have been various studies on the relation between smoking and obesity. One reported that smoking is related to a low body mass index (BMI) and that smoking cessation leads to weight gain⁸⁾ while another reported that the average weight of smokers is heavier than that of non-smokers,⁹⁾ which leaves the relation still uncertain. Thus, this study aims to examine changes in weight and serum level of HDL-cholesterol after smoking cessation.

METHODS

1. Subject and Definition

The subject group include 779 men of 25 years of age or older who had health screening examinations twice in 2007 (1st) and three years later in 2010 (2nd) at the health promotion center of Daegu Medical Center. Information on general characteristics and history of smoking was collected through the survey. Those who did not state health-related behaviors such as smoking, or did not make it clear (307 individuals), were excluded. Non-smokers, former abstainers (273 individuals), those with diseases (cancer, diabetes, diseases of the thyroid gland, active tuberculosis, chronic illness, etc.) that might affect weight or lipid profile and those who were taking medications (15 individuals) were excluded. The number of final subjects was 184.

The subjects were classified as current smokers and abstainers according to their current state of smoking. Specifically, current smokers were smoking at the time of the first and second examinations, and abstainers had smoked at the time of the first examination but tried to quit smoking and were no longer

smoking at the time of the second examination.

2. Study Methods

1) Height and weight

The body weight of subjects was measured on a 0.1 kg scale with the examination gown on. Height was measured on a 0.1 cm scale by using an automatic height measuring system.

2) Blood pressure

The subjects had a rest for 20 minutes and systolic blood pressure and diastolic blood pressure were measured at the right upper arm by an automatic pressure measuring device while they were sitting on a chair. In the case that the pressure was over 140/90 mm Hg, the pressures were measured again after a rest for 15 minutes.

3) Lipid profile

Total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides were measured from venous blood taken after fasting for 8 hours, by means of the Toshiba C8000 autoanalyzer (Toshiba, Tokyo, Japan).

3. Statistical Analysis

To analyze the difference in results of the first and second examinations among the two groups (current smokers and abstainers), a paired t-test was implemented. To analyze the difference in the examination results between the current smokers and abstainers, an independent t-test was implemented. The subjects were divided into three groups depending on the measure of changes in the BMI, and an independent t-test was implemented to analyze changes in the concentration of HDL-cholesterol among the current smokers and abstainers. For the statistical analysis, SPSS ver. 19.0 (SPSS Inc., Chicago, IL, USA) was used and statistical significance was defined as a P-value < 0.05.

RESULTS

1. General Characteristics of Subjects

The 184 individuals selected as the final research subjects were 44.9 years of age on average (Table 1), and among them, the

Table 1. Baseline characteristics of study subjects (n = 184).

Characteristics	Mean (SD)
Age (y)	44.9 (8.7)
Height (cm)	170.2 (6.7)
Weight (kg)	70.5 (10.7)
Body mass index (kg/m ²)	24.2 (3.0)
Systolic blood pressure (mm Hg)	125.7 (15.6)
Diastolic blood pressure (mm Hg)	76.2 (10.6)
Total cholesterol (mg/dL)	193.9 (36.8)
HDL-cholesterol (mg/dL)	51.0 (10.4)
LDL-cholesterol (mg/dL)	113.0 (36.0)
Triglyceride (mg/dL)	149.2 (87.4)

HDL: high density lipoprotein, LDL: low density lipoprotein.

Table 2. Subject characteristics at baseline and second visit by current smoker (n = 135).

	Baseline	After 3 years	P-value*
Age (y)	44.4 (8.9)	-	-
Height (cm)	170.5 (6.0)	170.7 (6.2)	0.129
Weight (kg)	70.8 (10.9)	70.4 (12.4)	0.482
Body mass index (kg/m ²)	24.3 (3.2)	24.1 (3.7)	0.260
Systolic blood pressure (mm Hg)	125.8 (15.8)	123.8 (14.8)	0.201
Diastolic blood pressure (mm Hg)	76.0 (10.17)	74.3 (9.1)	0.163
Total cholesterol (mg/dL)	192.3 (35.9)	191.6 (37.7)	0.763
HDL-cholesterol (mg/dL)	50.8 (10.3)	50.9 (10.6)	0.909
LDL-cholesterol (mg/dL)	111.3 (35.6)	109.9 (37.9)	0.529
Triglyceride (mg/dL)	150.7 (92.3)	153.9 (110.8)	0.644

Values are presented as mean (SD).

HDL: high density lipoprotein, LDL: low density lipoprotein.

*P-value by paired t-test.

number of current smokers was 135 (73%), and that of abstainers 49 (27%), respectively. No significant difference was found in changes in the BMI, blood pressure, or serum lipid between the results of the first and second examinations in the current smokers group (Table 2). In contrast, such factors as weight, BMI, and HDL-cholesterol level in the abstainers group significantly increased in the second examination (P < 0.05). No significant change was found in other variables stated above (Table 3).

Table 3. Subject characteristics at baseline and second visit by abstainer (n = 49).

	Baseline	After 3 years	P-value*
Age (y)	46.3 (8.0)	-	-
Height (cm)	169.6 (8.3)	169.6 (8.2)	0.940
Weight (kg)	69.8 (10.4)	71.0 (10.3)	0.020
Body mass index (kg/m ²)	24.1 (2.6)	24.6 (2.7)	0.024
Systolic blood pressure (mm Hg)	125.6 (15.2)	126.2 (10.7)	0.745
Diastolic blood pressure (mm Hg)	76.8 (12.0)	77.0 (8.9)	0.913
Total cholesterol (mg/dL)	198.2 (39.1)	198.7 (23.8)	0.913
HDL-cholesterol (mg/dL)	51.5 (11.0)	54.6 (12.1)	0.039
LDL-cholesterol (mg/dL)	117.6 (36.8)	118.1 (25.8)	0.931
Triglyceride (mg/dL)	145.2 (73.2)	130.1 (72.6)	0.145

Values are presented as mean (SD).

HDL: high density lipoprotein, LDL: low density lipoprotein.

*P-value by paired t-test.

2. Comparison of the Current Smokers' Group and Abstainers' Group

In the first examination, no significant difference was found between the current smokers and abstainers with regard to variables including the value of serum lipid. In the second examination, the HDL-cholesterol level of the abstainers was 54.6 mg/dL, which is significantly higher than the 50.9 mg/dL of the current smokers (P < 0.05) (Tables 4, 5).

3. Changes in Serum Level of HDL-cholesterol Depending on Changes in the Body Mass Index of the Current Smokers and Abstainers

As for changes in BMI (Δ , difference in the second and first examinations: kg/m²), the subjects were divided into three sub-groups: the group of decrease (Δ BMI < -0.5), group of no change ($-0.5 \leq \Delta$ BMI < 0.5), and group of increase ($0.5 \leq \Delta$ BMI). In each group, changes in the HDL-cholesterol level were observed in both the current smokers and abstainers. However, only the group of abstainers who showed BMI decrease showed significant increase (P < 0.05) in the HDL-cholesterol level, while the other groups showed no significant difference (Table 6).

Table 4. Comparisons between current smoker and abstainer at baseline.

	Current smoker (n = 135)	Abstainer (n = 49)	P-value*
Age (y)	44.4 (8.9)	46.3 (8.0)	0.193
Height (cm)	170.5 (6.0)	169.6 (8.3)	0.422
Weight (kg)	70.8 (10.9)	69.8 (10.4)	0.609
Body mass index (kg/m ²)	24.3 (3.2)	24.1 (2.6)	0.826
Systolic blood pressure (mm Hg)	125.8 (15.8)	125.6 (15.2)	0.947
Diastolic blood pressure (mm Hg)	76.0 (10.17)	76.8 (12.0)	0.647
Total cholesterol (mg/dL)	192.3 (35.9)	198.2 (39.1)	0.344
HDL-cholesterol (mg/dL)	50.8 (10.3)	51.5 (11.0)	0.724
LDL-cholesterol (mg/dL)	111.3 (35.6)	117.6 (36.8)	0.295
Triglyceride (mg/dL)	150.7 (92.3)	145.2 (73.2)	0.708

Values are presented as mean (SD).

HDL: high density lipoprotein, LDL: low density lipoprotein.

*P-value by independent t-test.

Table 5. Comparisons between current smoker and abstainer after 3 years.

	Current smoker (n = 135)	Abstainer (n = 49)	P-value*
Height (cm)	170.7 (6.2)	169.6 (8.2)	0.314
Weight (kg)	70.4 (12.4)	71.0 (10.3)	0.791
Body mass index (kg/m ²)	24.1 (3.7)	24.6 (2.7)	0.417
Systolic blood pressure (mm Hg)	123.8 (14.8)	126.2 (10.7)	0.227
Diastolic blood pressure (mm Hg)	74.3 (9.1)	77.0 (8.9)	0.084
Total cholesterol (mg/dL)	191.6 (37.7)	198.7 (23.8)	0.221
HDL-cholesterol (mg/dL)	50.9 (10.6)	54.6 (12.1)	0.049
LDL-cholesterol (mg/dL)	109.9 (37.9)	118.1 (25.8)	0.103
Triglyceride (mg/dL)	153.9 (110.8)	130.1 (72.6)	0.165

Values are presented as mean (SD).

HDL: high density lipoprotein, LDL: low density lipoprotein.

*P-value by independent t-test.

Table 6. Changes in HDL-C according to changes in BMI and smoking habits.

Changes in BMI (kg/m ²)	No. of subject	ΔHDL-cholesterol (mg/dL)		
		Current smoker (n = 135)	Abstainer (n = 49)	P-value*
ΔBMI < -0.5	54	1.3 (8.6)	7.0 (8.9)	0.049
-0.5 ≤ ΔBMI < 0.5	71	-0.2 (8.8)	0.9 (7.6)	0.646
0.5 ≤ ΔBMI	59	-1.0 (6.2)	1.7 (9.7)	0.188

Values are presented as mean (SD).

HDL: high density lipoprotein, BMI: body mass index, Δ: changes from the baseline.

*P-value by independent t-test.

DISCUSSION

The aim of this study is to examine changes in such factors as weight, blood pressure, and serum lipid level after smoking cessation among men 25 years of age or older. Among the subjects, the abstainers showed significant increase in weight after three years, which is in line with the finding that the BMI significantly increases among non-smokers than smokers.¹⁰⁾

According to the research of FINRISK from 1982 to 1997, however, the BMI of smokers was lower than that of non-smokers

in the early stage, but at the end of the 15-year-long investigation, no difference was found between smokers and non-smokers.¹¹⁾ Thus, the weight gain in the abstainers of this study could be controversial as to whether it is temporary or consistent.

Several cross-sectional studies reported that smoking is related to low HDL cholesterolemia,¹²⁾ and that smoking cessation contributes to the increase of HDL-cholesterol.¹³⁾ In this study as well, it turned out that the serum levels of HDL-cholesterol increased in the abstainers after three years. Although the relation between smoking and low HDL cholesterolemia has yet to be verified, some research stated that smoking facilitates the

secretion of catecholamine and drastically increases free fatty acid, which leads to the increase of very low density lipoprotein and LDL-cholesterol and to the decrease of HDL-cholesterol at the same time.¹⁴⁾

According to one study, as the serum level of HDL-cholesterol increases as much as 1 mg/dL, the risk of coronary heart disease decreases as much as 2% to 3%.^{15,16)} In this study, among abstainers, the serum level of HDL-cholesterol increased as much as 3 mg/dL, which is comparable to the case of those who kept smoking. Among abstainers whose BMI decreased as much as 0.5 kg/m², the level of increase was 7 mg/dL on average.

While the weight and BMI increased in the abstainers, the serum level of HDL-cholesterol increased as well. Although there was a report that 1 kg of weight gain might reduce the serum level of HDL-cholesterol by as much as 0.5% to 1%,^{17,18)} the effect of weight gain on HDL-cholesterol is considered to be counterbalanced by smoking cessation. Despite weight gain, the risk of cardiovascular system disease decreased in general when subjects stopped smoking. This could provide the basis on which to emphasize the importance of smoking among smokers who hesitate to quit smoking due to possible weight gain. This study shows that if the initiation of smoking cessation goes along with efforts to lose weight, the serum level of HDL-cholesterol could drastically increase.

The limitations of this study are as follows. First, since this is a retrospective study and a self-reported questionnaire was used, there is a possibility of error of recall. Furthermore, because the period of smoking cessation was not specifically presented, it is difficult to predict changes in the results as the term of smoking cessation extends. Second, such factors as level of alcohol intake, physical movement, or dietary pattern, which may affect the serum level of HDL-cholesterol and weight, were not considered in this study. Third, since domestic smoking rates among women were low, the subjects were limited to men. Since the subject group was small in number, the application to the general population may be limited. It is thought, however, that such disadvantages will be complemented by a prospective study in the future, conducted among the general population.

In conclusion, the combination of smoking cessation and weight control can increase the serum level of HDL-cholesterol more effectively, and thus prevent cardiovascular system diseases.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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