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Cardiovascular Disease Risk Factors in Women Working in a Tobacco Plant

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Abstract: To estimate the effect of exposure to tobacco dust on lipid parameters that increase the incidence of cardiovascular disease (CVD), 70 female workers were selected from the tobacco processing section of a tobacco plant, and 55 women were selected from the administration selection as the controls. The subjects were homogeneous in terms of primary and secondary risk factors such as age, alcohol intake, menstrual status, physical activity, diet, familial hyperlipidemia and heart disease. They were divided into two subgroups, smokers and non-smokers.

Venous blood and morning urine samples were simultaneously taken from workers after a 12-14 h period without food or cigarettes. Triglyceride (TG), total cholesterol (TC) and high-density lipoprotein closterol (HDL-C) in the serum of the workers were measured spectrophotometrically, while apolipoprotein-AI (Apo-AI), apolipoprotein-B100 (Apo-B) and lipoprotein a (Lp(a)) were determined nephelometrically. The levels of urinary continine, a metabolite of nicotine, was measured using the radioimmunoassay method. The urine cotinine/creatinine ratio and low-density lipoprotein cholesterol (LDL-C) were calculated. The data obtained were defined as the mean±SD. In the comparison of the groups, Student's test was used.

The urinary continine/creatinine ratio, and serum levels of TC, TG and LDL-C in the tobacco workers were significantly higher than in the controls ($p<0.001$, $p<0.05$, $p<0.001$ and $p<0.05$ for non-smokers; $p<0.001$, $p<0.05$, $p<0.01$ and $p<0.01$ for smokers, respectively). However, the serum levels of HDL-C in the tobacco workers were significantly lower ($p<0.001$ for non-smokers and $p<0.05$ for smokers). Smokers had significantly high urine continine/creatinine ($p<0.001$), high serum levels of TC (0.001), TG ($p<0.01$) and LDL-C ($p<0.05$), but significantly low HDL-C ($p<0.001$) when compared with non-smokers. Similarly, when smokers were compared with non-smokers in the controls, smokers had significantly high urine cotinine/creatinine ($p<0.001$), high serum levels of TC ($p<0.05$), TG ($p<0.01$) and LDL-C ($p<0.01$), but significantly low HDL-C ($p<0.05$). There were no significant correlations between the urine continine/creatinine ratio and the other parameters we used in the smokers and non-smokers of both groups. These results suggest that chronic exposure to tobacco dust results in harmful changes in the serum lipid profile, which could increase the incidence of CVD.

Key Words: Tobacco dust, tobacco worker, lipids, occupational diseases.

Introduction

Cigarette smoking has acute and long-term effects on various functions, which may adversely affect the cardiovascular system. Epidemiological data indicate that smoking is one of the major risk factors in the development of cardiovascular disease (CVD) (1-3). Active and passive smoking is also connected with lipid abnormalities, which are accepted as being risk factors for CVD (4-10).

Tobacco smoke contains approximately 4000 consitutient. Nicotine is one of the most pharmacologically active tobacco components with a wide range of cardiovascular effects (5). Short-term experiments with humans (11) have shown that oral administration of nicotine raises plasma total cholesterol (TC) and low density lipoprotein-cholesterol (LDL-C), and lowers high-density lipoprotein cholesterol (HDL-C). Some investigators showed that the changes produced in

the metabolism of lipids on nicotine administration were similar to those observed on exposure of rats to cigarette smoke, and concluded that nicotine is one of the risk factors in the development of atherosclerosis (4). These obsevations are clinically important because of the widespread use of smokeless tabocco products (12) and increased prescription of nicotine chewing gum or transdermal nicotine to help individiulas stop smoking (13).

People working in tobacco plants are ontinuously exposed to tobacco dust that includes nicotine and other harmful tobacco contituents. Although some article have been published on the occupational health problems of people working in the tobacco industry (14-16), there is insufficient information about whether or not chronic exposure to tobacco dust changes serum levels of lipids, lipoproteins and apolipoproteins. In this study, the effects of long term exposure to tobacco dust on the serum lipid profile were investigated in tobacco plant workers.

Materials and Methods

Female workers (n=300) were approached from a tobacco factory producing cheroots, i.e a special form of small cigars. Of these, 150 agreed to participate in this study. Of these, 125 were accepted according to our inclusion criteria. A previously prepared questionnaireas given to all subjects. The questionnaire contained questions about chronic illness and primary and secondary risk factors for CVD such as age, sex, cigarette smoking, alcohol intake, menstrual status, physical activity, eating habits, and family history of heart disease. All subjects were clinically health and had normal menses, a sedentary life style and the same low socio-economic status. None of them used alcohol. Dietary intake was of minor importance because of the relatively homogeneous nutritional environment. Seventy subjects were working in the raw tobacco area, and were included in "The Tobacco Workers Group". Others (n=55) working in the administrative section was included in "The Control Group". Each group was divided into two subgroups: smokers who smoked cigarettes every day and non-smokers. Many of the non-smokers were considered to be passive smokers because their husbands were smokers.

Venous blood and first morning urine samples were imulatenously taken from workers after a 12-14 h period without food or cigaretes. Urine creatinine and total cholesterol (TC), triglyceride (TG), and HDL-C in venous blood were measured spectrophotometrically measured with Boehringer-Mannheim kits (Mannheim, Germany) in a Hitachi 747 autoanalyser, and Apo-Al, Apo-B and Lipoprotein a (Lp (a)) levels were determined nephelometrically with Behring kits (Marburg, Germany) in a Behring BNA Nephelometer. LDL-C was also calculated using Friedwall's formula.

Cotinine, a metabolite of nicotine, was measured by the radioimmunoassay method with "nicotine metabolite" kits (DPC, Los Angles, USA). All urine and blood samples were ssayed in duplicate. The intra-assay coefficients of variation for the middle sensitivity (835±56 ng/ml) were 5%. The cotinine/creatinine (ng/mg) ratio was used in the evaluation of the nicotine status of the subjects.

The total amount of dust in the raw tobacco area and the administrative section was measured on five different days using conventional dust-measuring equipment using the gravimetric method. A personal sampling pump and 37-mm membrane filter were used in the measurements.

The data were defined as mean±SD. When comparing the data on tobacco workers exposed to tobacco dust with data for the controls, Student's t test was used. The correlations between cotinine/creatine and the other parameters were performed with Spearman's test. A probability less than or equal to 0.05 was considered significant.

Results

The total dust levels of both environments are shown in Figure 1. The mean total dust level in the tobacco processing area was significantly higher than that in the administrative section ($p<0.001$).

Table 1 shows the characteristic features of the subjects. All the subjects in the groups had similar working hours, age and systolic and diastolic blood pressures. They number of cigarettes smoked per day was not significantly different between smokers in both groups, but the tobacco workers had a significantly high body mass index (BMI) when compared with the others ($p<0.05$).

Table 2 shows the changes of the urinary cotinine/creatinine ratio and serum levels of lipid and apolipoproteins in both groups. The urinary cotinine/creatinine ratio and serum levels of TC, TG and LDL-C in the tobacco workers were significantly higher than in the controls ($p<0.001$, $p<0.05$, $p<0.001$ and $p<0.05$ for non-smokers; $p<0.001$, $p<0.05$ $p<0.01$ and $p<0.01$ for smokers respectively). Serum levels of HDL-C were significantly lower in the tobacco workers than in the controls ($p<0.001$ for non-smokers and $p<0.05$ for smokers).

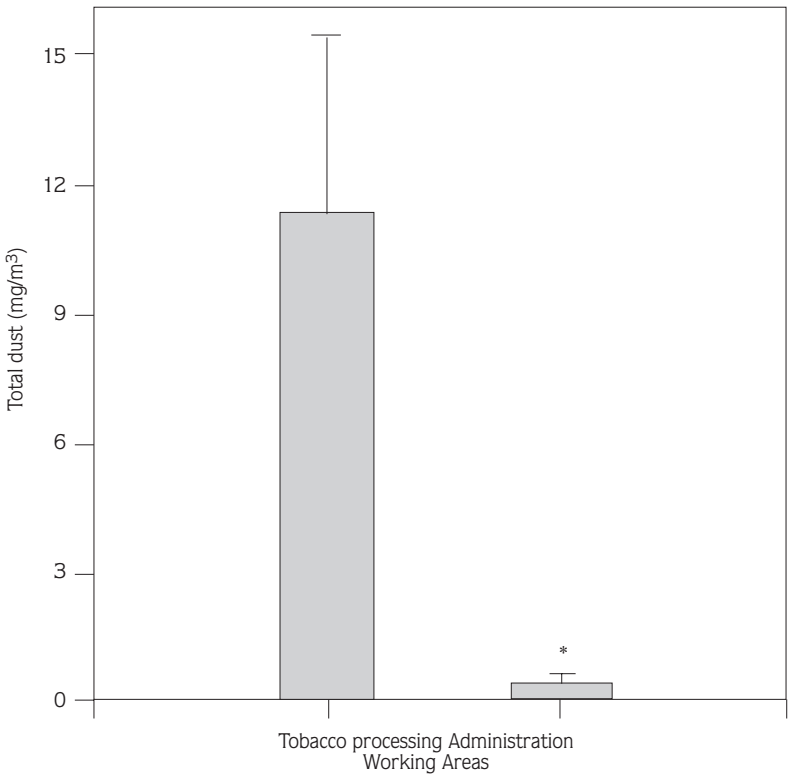

Figure 1. The mean total dust in both enviroments (*, p<0.001).

Table 1. The characteristic features of subjects (*).

	Tobacco Workers		Controls	
	Non-smokers	Smokers	Non-smokers	Smokers
Number of subjects	50	20	35	20
Working time(year)	17.9±2.2	15.8±4.8	16.8±2.5	16.5±3.5
Cigarette/day	-	16.56±6.6	-	14.8±6.7
Age	41.7±4.0	38.9±5.6	42.0±6.5	39.9±4.3
Body mass index(kg/m2)	29.9±3.7a	30.0±4.7a	27.4±4.7	26.5±5.7
Blood pressure (mmHg)				
Systolic	116.5±12.1	114.3±13.1	117.8±16.7	115.2±12.4
Diastolic	76.8±8.3	73.4±12.1	78.4±7.8	78.1±7.9

*, Lower case letters in the table indicate significance when tobacco workers were compared with the controls.

(a, p<0.05)

Of the tobacco workers, smokers had significantly higher urine cotinine/creatinine ratios (p<0.001), serum TC (p<0.001), TG (p<0.01) and LDL-C (p<0.05), but significantly lower HDL-C than non smokers (p<0.001). Similarly, when smokers were compared with non-smokers in the control groups, smokers had significantly high urine continine/creatinine ratios (p<0.001), TC (p<0.05), TG (p<0.01) and LDL-C (p<0.01), but significantly lower HDL-C (p<0.05).

There was no significant correlation between the urine cotinine/creatinine ratio and the other parameters in the smokers and non-smokers of both groups.

Discussion

Occupational health problems among tobacco plant workers and tobacco harvesters have been investigated and some respiratory disorder, like dyspnea, emphysema,

Table 2. The changes in urinary continine and serum levels of lipids and apolipoproteins (*,**).

	Tobacco Workers		Controls	
	Non-smokers	Smokers	Non-smokers	Smokers
Number of subjects	50	20	35	20
Urine cotinine/ Creatinine (ng/mg)	210.3±64.5 a, t	1664±5876 a	53.1±30.5 t	1428±430
TC (mg/dl)	192.0±27.3 c,t	219.6±30.4 c	181.4±25.5 f	199.7±24.1
TG (mg/dl)	143.4±60.4 a,tt	178.0±38.6 b	115.2±33.8 tt	154.0±28.6
HDL-C (mg/dl)	38.8±5.0 a,t	34.2±3.8 c	43.9±5.5 t	37.8±5.2
LDL-C (mg/dl)	125.2±26.2 c,f	149.1±28.9 b	115.8±22.1 tt	131.1±25.6
Apo A-I (mg/dl)	145.2±21.2	139.2±22.1	151.3±23.5	144.6±22.7
Apo B (mg/dl)	115.5±27.2	117.6±33.2	110.6±21.4	114.0±26.9
Lp (a) (mg/dl)	22.3±10.0	19.6±9.9	23.5±17.3	19.0±16.6

*, Lower case letters in the table indicate significance when tobacco workers were compared with the controls.

(a, $p<0.001$; b, $p<0.01$; c, $p<0.05$)

**, Playbill symbols indicate significance when non-smokers wereompared with smokers in both groups (t, $p<0.001$; tt, $p<0.01$; f, $p<0.05$)

chronic bronchitis and skin, nose and eye irritations have been reported (15, 16). In addition, green tobacco sickness, characterised by nausea, vomiting, dizziness, weakness etc. has been described in tobacco workers (14). No research is available on lipid, lipoprotein and apolipoprotein values for chronic exposure to tobacco dust. For this reason, the aim of the present study was to evaluate the effect of chornic exposure to tobacco dust on serum lipid profile in tobacco workers.

Environmental tobacco smoke has been recognised as an important component of indoor air pollution. Smoking indoors has been prohibited in many countries. Many investigations of active and passive smoking have shown some harmful changes in serum lipid levels, and proved the association between passive smoking and heart diseases (1,3,8-11, 18, 19). It has also, been determined that oral nicotine intake or chewing gum containing nicotine cause harmful changes in the levels of lipids and lipoproteins (4, 5, 11-13). Zhu BQ et al. (2) showed that rabbits exposed to a high dose of tobacco smoke had increased levels of plasma TG, TC and LDL-C and decreased levels of HDL-C. Cluette-Brown (5) observed similar effects of tobacco smoke on TC and LDL-C in animals fed with oral nicotine. Moskowitz et al. (19) showed that adolescent children whose parents smoked had elevated levels of cholesterol and decreased levels of HDL-C. Pomerehn et al. (20) observed similar effects of tobacco smoke on HDL in children whose parents smoked and in children who smoked or chewed tobacco themselves. Latha et al. (4) reported increased plasma TC, TG and LDL-C and decreased plasma HDL-C on administration of nicotine to rats. These effects were dose dependent; the greater the exposure to tobacco smoke, the greater were the changes in these variables.

In our study, non-smoking tobacco workers had significantly higher urinary cotinine/creatinine ratios than the non-smoking controls. This indicats that tobacco workers absorbed a significant amount of nicotine. Smoking and non-smoking tobacco workers had significantly higher TC, TG and LDL-C, and lower HDL-C than the controls. Two factors could explain these marked differences in the serum lipid levels of these two study groups of similar socio-economic status, dietary habits, menstrual status, age and daily cigarette consumption. Firstly, women in the tobacco-processing section have to sit approximately 7 hours in front of conveyor belts using only their hands while dealing with tobacco leaves. This limited physical activity of tobacco workers may account for the significant changes in serum lipids, and could also be responsible for significantly high BMI ($p<0.05$). Secondly, chorinc exposure to tobacco dust may create harmful effects on the serum lipid profile of tobacco workers, as with active and passive smoking or oral nicotine intake with nicotine chewing gums. These

changes in serum lipid and lipoprotein levels could be induced by nicotine. The increase in the serum TG in women workers exposed to tobacco dust could possibly also be the result of decreased activity of lipoprotein lipase (4). The oral nicotine intake decreases plasma lecithin: cholesterol acyltransferase (LCAT) activity (7). LCAT, located on the HDL surface, is involved in the esterifaction of cholesterol in the plasma and partly responsible for modulation of serum HDL levels (21). There are three mechanisms which may explain the LDL incerase: (a) increased hepatic production of LDL precursor (22); (b) impaired clearence of LDL from the plasma compartment (5); and (c) chronic oral nicotine intake increasing hepatic microsomal enzymes and possibly enhancing LDL precursor synthesis (23). Consequently, oral nicotine, independent of other tobacco components, may cause increases in atherogenic LDL by multiple molecular mechanisms.

According to to our results, smokers had higher urinary cotininie/creatinine ratios than non-smokers in both groups ($p<0.001$). In addition, smokers had significantly higler TC, TG and LDL-C and lower HDL-C serum levels than non-smokers. These findings show that active smoking causes too great an intake of nicotine and is a more important determiner of serum lipid profile than tobacco dust exposure. Besides, smoking tobacco workers had the worst serum lipid profile because the effect of exposure to tobacco dust was added to the effect of smoking.

In conclusion, we propose that occupational chronic exposure to tobacco dust is associated with adverse changes in lipid values, such as high levels of TG and LDL-C and low levels of HDL-C, increasing the risk of cardiovascular diseases.

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