CIGARETTE SMOKING AND SERUM LIPIDS IN YOUNG MEN

BY

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In mortality statistics cigarette-smoking habits have been observed to be correlated with coronary heart disease (Hammond and Horn, 1954; Doll and Hill, 1956; Hammond and Horn, 1958); and the serum lipid level and especially the serum cholesterol and β-lipoproteins are known to be raised in population groups with coronary heart disease. With these facts in mind, many investigators have studied the relationship between cigarette smoking and the serum lipid level (Gofman *et al.*, 1955; Karvonen *et al.*, 1959; Thomas, 1958, 1960; Dawber *et al.*, 1959; Blackburn *et al.*, 1960; Bronte-Stewart, 1961). All these studies support the view that the serum cholesterol level is higher in smokers than in non-smokers. The present communication shows that there was no correlation between smoking habits and serum lipid pattern in a group of young men in Finland.

Material and Methods

The material presented consists of a series of 314 healthy young men who started military service in Finland in 1957–60. The subjects were selected at random. Their mean age was 19.7 years (range 18–25). Blood samples were taken from the cubital vein in the morning after overnight fasting during the first three days of military service. From the specimens the serum total cholesterol (Anderson and Keys, 1956) and the serum total phospholipids (Fiske and Subbarow, 1925) were determined. Serum lipo-protein fractions were separated with the aid of paper electrophoresis, and from the fractions so separated the cholesterol content of the α- and β-lipoproteins was determined. The details and evidence of their accuracy have been presented in a previous study (Konttinen, 1959). Blood-pressure was also measured and relative body weight was calculated according to the Metropolitan Life Insurance Company's (1943) tables. To be sure that the men were healthy, determinations were also made of the blood sedimentation rate and blood haemoglobin level, and the urine was analysed for glucose and protein. Mass *x*-ray examinations of the chest were also made.

The smoking habits were reported in response to a questionary filled in by each man. There were 145 men who had never smoked. The smokers, divided into subgroups according to daily consumption of tobacco (see Table), had smoked for at least one year before entering military service. The few pipe smokers were not included in the series. Nearly all the smokers smoked American-type cigarettes with or without a filter.

Results

In the different groups the similarity in level of all the lipids studied (see Table) is obvious. Statistically there is no difference between the groups in total cholesterol, β-cholesterol, or phospholipids. Analysis reveals a probable difference ($P<0.05$) in α-cholesterol variance, but this seems not to depend on the smoking, since this difference is between light smokers and non-smokers. On the other hand, between non-smokers and heavy or moderate smokers there appears to be no significant difference in α-cholesterol.

Discussion

In the present study the similarity in serum lipids found in smokers to those found in non-smokers is at variance with the results of previous studies, in all of which the cholesterol level has been stated to be higher in smokers. The material presented here is very similar in all respects except smoking habits. Body build, expressed as relative body weight, was very much the same. The men came from the same parts of Finland and the occupational structure of the different groups was also similar. The blood samples had been taken similarly in the different groups in respect of time and season. The age range of the whole series is quite narrow (18–25 years) and there is very little difference between the groups. As the men were young they had not been smoking very long, although one criterion in selecting them was at least one year's smoking. Karvonen *et al.* (1959), however, observed a higher serum cholesterol level in smokers of all age-groups, except 50–59 years, in West Finland; the youngest age-group in their study was 20–29 years. Gofman *et al.* (1955) found that the difference in serum lipids between smokers and non-smokers was greater in their youngest (20–29) age-group than in the older ones. In the present study the subjects were slightly younger than the youngest age-groups mentioned above. If the explanation for the difference between the observations in the mentioned studies and the present one lies in this point, the effect on serum lipids of exposure to cigarette smoking seems to occur after some years of smoking, but not, however, during so short a smoking period as in the present work.

When considering atherosclerosis many investigators have stressed the importance of the β:α ratio in the lipoprotein fractions. It has been noticed that an increase in this ratio is encountered in patients with atherosclerosis (Nikkilä, 1953; Oliver and Boyd, 1955; Jencks *et al.*, 1956). In the studies concerning the correlation between smoking and serum lipids in which lipoprotein fractions are included the β:α ratio has been found to be raised in smokers (Gofman *et al.*, 1955; Bronte-Stewart, 1961). In the present study, by contrast, no trend parallel with the smoking habits could be discerned in serum lipid levels.

The serum phospholipids have been shown to have the important function of stabilizing other lipids in solution

Serum Lipids in 314 Young Men Grouped According to Smoking Habits

Group	No. of Cigarettes/ Day	No. of Men	Serum Cholesterol (mg./100 ml.)	Serum α-Cholesterol (mg./100 ml.)	Serum β-Cholesterol (mg./100 ml.)	Serum Phospholipids (mg./100 ml.)	Relative Body Weight (kg.)	Age (Years)
			Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean	Mean
Non-smokers		145	203·8±32·5	52·8±11·4	151·0±34·1	218·0±34·8	68·4	19·3
Light smokers	1–10	53	206·8±37·0	58·2±9·55	148·6±34·9	222·3±32·5	69·9	19·9
Moderate smokers	11–19	54	213·1±34·5	55·2±13·7	157·9±35·5	224·7±31·0	67·2	20·1
Heavy smokers	20+	62	202·3±32·8	55·7±10·8	146·6±31·1	210·5±24·6	68·2	19·8

(Ahrens and Kunkel, 1949), and it has therefore been inferred that an increase in the ratio of phospholipids to cholesterol helps to prevent atherosclerosis. This view has been supported by the observation that the phospholipid : cholesterol ratio is smaller in atherosclerosis than in age-matched controls (Gertler *et al.*, 1950 ; Oliver and Boyd, 1953). The published studies on the relation between serum lipids and smoking do not include reports concerning serum phospholipids. In the present study phospholipids show no trend paralleling the smoking habits.

Attempts have been made to relate the rise in serum lipids observed in the previous studies in smokers to differences in the diet possibly due to smoking. Krut *et al.* (1961) have noted a difference in the perception of bitter taste between smokers and non-smokers. According to those authors this could lead to smokers having a preference for some special foods. The same group of investigators (Perrin *et al.*, 1961) have observed that smokers consumed more fat than non-smokers, but the difference was too small to explain the difference in serum lipids, and in Finland S. Punsar (unpublished data) could not detect any difference between the diet of smokers and that of non-smokers. Even the greater amount of fat consumed by smokers does not necessarily signify that all this fat is absorbed, for a recent study (Konttinen and Rajasalmi, to be published) has shown that the rise in serum triglycerides after a fatty meal is less in heavy smokers than in non-smokers.

The effect of giving up smoking should throw further light on the correlation between cigarette smoking and serum lipids, but in the only relevant report I found in the literature no change in serum cholesterol was detected in the six subjects studied (Thomas and Eisenberg, 1959).

The possibility has also been discussed that smoking could be another manifestation of the disturbance responsible for the rise in the serum cholesterol level, and in this connexion mental tension was incriminated as the cholesterol-elevating factor (Thomas and Murphy, 1958 ; Wertlake *et al.*, 1958 ; Grundy and Griffin, 1959 ; Dreyfuss and Czaczkes, 1959 ; Peterson *et al.*, 1960). It should be remembered, however, that mental tension cannot be measured but only estimated.

It is evident that further investigations of the relationship of smoking to the serum lipids are required.

Summary

Serum total cholesterol and the cholesterol content of the α- and β-lipoprotein fraction and serum phospholipids have been determined in a series of 314 healthy young men (range 18–25 years) starting military service, grouped according to smoking habits. There were no differences relating to smoking habits in any of the lipids studied.

Addendum.—Since the present study was made Acheson and Jessop (1961) have published their work on serum lipids in old men grouped according to smoking habits. They could find no association between cigarette or pipe smoking and serum cholesterol or β : α-lipoprotein ratio.

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ALLERGIC REACTIONS TO TETANUS TOXOID

A REPORT OF FOUR CASES

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Tetanus is caused by the absorption of the toxins of *Clostridium tetani*. Established tetanus carries a poor prognosis, and among the 200 or so cases that occurred in England and Wales in 1959 there were 25 deaths (Registrar-General, 1961). Two substances are available for prophylactic treatment—tetanus antitoxin and tetanus toxoid. The former is a short-term prophylactic given at the time of wounding to effect passive immunization. Tetanus toxoid, a long-term prophylactic, is available as either alum-precipitated toxoid used in the United States, or formol toxoid (Tet/Vac/FT), used in this country for active immunization. A primary course consists of three subcutaneous or intramuscular injections of 1 ml. The interval between the first and second injections is 6 to 12 weeks and that between the second and third injections 6 to 12 months. A reinforcing dose of 1 ml. every five years maintains an effective antitoxin titre.

Tetanus antitoxin may cause allergic reactions (Clarke, 1960) ; in comparison, tetanus toxoid is regarded as a safe and effective method of immunization. However, it is not generally realized that tetanus toxoid can also produce allergic reactions. Four such reactions are reported below.