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AGE, DIABETES AND SMOKING IN LOWER LIMB AMPUTATION FOR ARTERIAL OCCLUSIVE DISEASE

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The increased number of amputations for arterial occlusive disease noted in western countries is only partly explained by increasing numbers of the elderly. A prospective analysis of the influence of diabetes and smoking habits was therefore carried out. In 1978–81, 188 lower limb amputees in Lund were examined and classified as non-smokers, ex-smokers, light smokers and heavy smokers. These figures were compared with corresponding figures among age-correlated controls and to a group of hip fracture patients. The material was divided into men and women and into non-diabetics and diabetics. Smokers had much lower mean age at amputation. Out of 188 amputees only 23 were not either a diabetic, a smoker or 80 years or more. The population study indicates a correlation between smoking and amputation for ichaemia. The coincident increase in cigarette consumption in Sweden is illustrated and it is suggested that smoking should be noted as routinely as diabetes at amputations.

Key words: amputation; arterial occlusive diseases; diabetes mellitus; epidemiology; smoking

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The growing number of elderly people in the population and the prolonged survival of patients with diabetes do not explain the increase in the number of amputations (Liedberg & Persson 1983). That smoking could be a contributing factor is often mentioned, but no studies dealing with the role of smoking habits among these patients appear to have been published. The old concept of Buerger's disease among smokers (Mc Kusick et al. 1962) being an inflammatory vascular process without arteriosclerosis, seems to account only for a very small proportion of amputations. This study was undertaken to analyse the smoking factor among patients amputated for ischaemia of a non-traumatic and nontumorous nature.

PATIENTS AND METHODS

The factors of age, diabetes and smoking habits were prospectively and consecutively studied in all 197 patients living in Malmöhus County treated for ischaemia by amputation below the knee or more proximally in Lund from January 1978 through March 1981. Full information was not obtained in nine patients. Of the 188 amputees 100 were men (53 percent). Age and sex is shown in Figure 1.

Only patients receiving insulin injections or antidiabetic drugs before amputation were recorded as diabetics.

Smoking habits were classified with respect to type, amount and length of time since cessation. If the patient's mental condition was too poor to extract this information, the relatives were asked about it. Patients were recorded to be either nonsmokers, previous smokers if they had stopped more than 1 year before amputation, light smokers if they smoked less than 10 cigarettes a day or heavy smokers (10 cigarettes or more a day or 10 g tobacco a day).

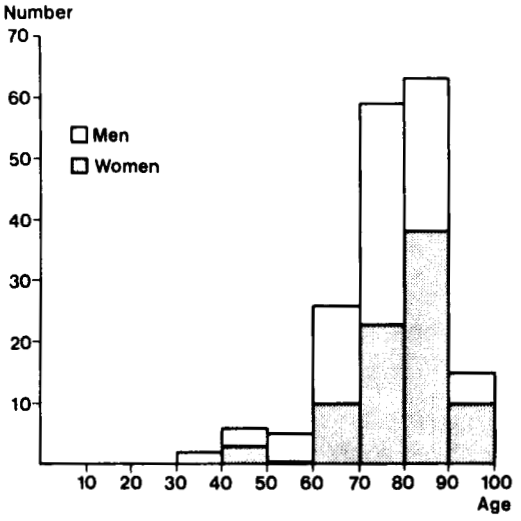

Figure 1. Age and sex at amputation for ischaemia in Lund 1978–80.

A control material was assembled, matched according to age and sex from the population register. Of 105 questionnaires 94 answers were obtained. An additional reference study was done concerning smoking habits among a consecutive series of patients with hip fractures.

Information about the general consumption of cigarettes, snuff and total tobacco during 1910–80 was obtained from the Swedish authorities. To illustrate some other general concomitant environmental factors information about number of cars (transportation and pollution factors) and consumption of alcohol were also added (Figures 5–8).

Statistical analysis was made with corrected χ^2 when compared to control material and with classical analysis of variance in age comparisons.

RESULTS

Among the 188 studied amputees 100 were men (53 percent). Eighty-five either were or had been daily smokers, 61 had concomitant diabetes. The mean age at amputation was 75.6 years among males and 78.9 among females. Division of the material into very old amputees (80 years or more), smokers and diabetics is shown in a Venn diagram (Figure 2). Due to different smoking habits between the sexes the material was divided into males and females. Among the 100 male amputees 75 were or had been daily smokers, 29

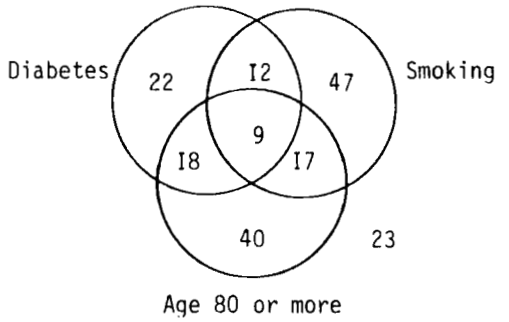

Figure 2. Age, diabetes, and smoking as comcomitant factors among 188 amputees, both sexes.

had diabetes and 38 were 80 years or older. Only five amputations had been performed in males who were not smokers, diabetics, or at least 80 years (Figure 3). Among the 88 female amputees 10 were or had been daily smokers, 32 had dia-

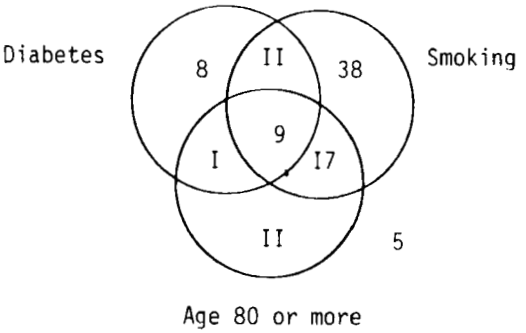

Figure 3. Age, diabetes, and smoking as concomitant factors among 100 male amputees.

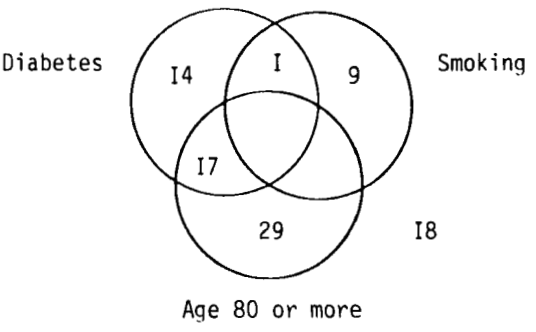

Figure 4. Age, diabetes, and smoking as concomitant factors among 88 female amputees.

Table 1. Smoking habits and diabetes among male amputees compared to matched controls and to hip fracture patients

Smoking history	Amputees		Controls		Hip fractures	
	Non-diabetics	Diabetics	Non-diabetics	Diabetics	Non-diabetics	Diabetics
Never smoked	16	9	14	–	16	2
Ex-smokers	18	12	27	3	5	–
Light smokers	20	4	7	–	3	1
Heavy smokers	17	4	5	–	5	–
Total	71	29	53	3	29	3

Table 2. Smoking habits and diabetes among female amputees compared to matched controls and to hip fracture patients

Smoking history	Amputees		Controls		Hip fractures	
	Non-diabetics	Diabetics	Non-diabetics	Diabetics	Non-diabetics	Diabetics
Never smoked	47	31	35	1	78	8
Ex-smokers	2	–	1	–	4	–
Light smokers	3	–	1	–	5	–
Heavy smokers	4	1	–	–	1	–
Total	56	32	37	1	88	8

betes and 46 were at least 80. Only 18 amputations had been performed in females who were not smokers, diabetics, or at least 80 (Figure 4). Among the 23 amputees falling outside the subsets of smokers, diabetics or at least 80, the median age was 76 years (range 54–79). The youngest out of four men was 54 years old and had a rheumatoid arthritis with vasculitis. In 12 cases amputation was due to embolism.

As diabetes and smoking might contribute to vascular disease, each was isolated. Current smokers were overrepresented among nondiabetic amputees. A χ^2-test showed that smokers were overrepresented with $P = 0.002$ for all and in males but not in females compared with the age and sex matched control material.

Smoking also affects the age at amputation. Among the non-diabetic amputees there was a lower mean age at amputation among smokers. The consumption of pipe tobacco was transformed into the corresponding number of cigarettes. Snuff-takers were treated as non-smokers. Table 3 shows the mean age of men at amputation according to smoking habits, the median age being 83 in non-smokers and 75 in all who had been smokers. The same calculation was

Table 3. Age at amputation and smoking habits among non-diabetic males

Smoking habits	No. of amputees	Mean age	Range
Non-smokers	16	80.9	54–91
Ex-smokers	18	76.9	64–84
Light smokers	20	77.2	62–94
Heavy smokers	17	67.6	46–89

Table 4. Age at amputation and smoking habits among non-diabetic women

Smoking habits	No. of amputees	Mean age	Range
Non-smokers	47	82.9	69–98
Ex-smokers + Light smokers	5	69.4	66–79
Heavy smokers	4	57.0	48–71

done for female amputees (Table 4), the median age being 82 in non-smokers and 66 in all who had been smokers. Increased smoking lowered the age at amputation in men ($P < 0.001$) and in women ($P < 0.001$).

The role of diabetes in amputation is clear ($P < 0.001$) from Tables 1 and 2. The mean time from diagnosis to amputation was 13 years.

The effect on age at amputation of a concomitant diabetes mellitus can be studied in the same way by excluding all smokers. The mean age at amputation among non-smoking, non-diabetic men was 81 (median 83) and among the non-smoking diabetics 72 (median 69) years. The mean age at amputation in non-smoking, non-diabetic women was 83 (median 82) years and for the non-smoking diabetics 78 (median 82).

The mean age in non-smoking diabetic males was 72.0 (median 69) years and in all that had been smokers 76.4 (median 79). The mean age in diabetic men treated with insulin injections was 70.4 years and in those treated with oral drugs 79.5.

DISCUSSION

With increasing age vascular degenerative changes develop (Auerbach 1968) and intermittent claudication becomes more frequent (Kannel & Shurtleff 1973) as does the first admission due to peripheral arterial insufficiency (Tibell 1971). The Framingham study suggests that the incidence of intermittent claudication was comparable between the sexes when women were 10 years older than men (Kannel & Shurtleff 1973) and in this study the difference was 3.3 years. In this study 84 out of 188 patients were at least 80 years old and mean age in non-smoking, non-diabetics was 80.9 in males and 82.9 in females.

Among the 188 amputees 32 percent had diabetes. The prevalence of diabetes mellitus (Schersten 1980) in the area ranged from 0.9 percent in the 40–49 year group to 9 percent in the group 80 years or older. Diabetes was far more common among amputees than in the population. The prevalence of diabetes mellitus seems to rise in Sweden. In a nearby county 0.5 per cent were diabetics (Silwer 1958) compared to the 1.6 percent found in the latest study performed in a part of the hospital area (Schersten 1980). In the control material four of 94 patients were diabetics. This means that one third of the amputations occur in this small part of the population. Patients with juvenile diabetes mellitus with peripheral vascular disease below the age of 60 are uncommon (Oakley 1955), as also found in series of amputees (Goldner 1960). In this series three of the 61 diabetics were below 60 and all three were smokers.

Diabetics are younger at amputation in most studies (Hansson 1964, Hierton 1973, Christensen 1976). Otteman (1965), however, found that the diabetic patients were an average of 4 years older among 323 leg and foot amputees. In this study diabetic men were 9 years younger and women 5 years younger than the non-diabetics excluding all smokers.

The proportion of smokers among male and female amputees was different. The explanation for this is that women seldom started a smoking habit in this age group. This also affects the mean age at amputation in smokers and non-smokers. Daily smoking of more than 10 cigarettes reduced the mean age at amputation 13 years in men and 26 years in women, which is affected by the higher occurrence of smoking in younger women. There are now more young smoking women than men (Baroll & Ramström 1980), which might lead to a future increase in female amputations. In a study of the relation between aortic arteriosclerosis and the use of cigarettes and alcohol, the smoking habits of females above the age of 70 are noted. Six percent smoked less than 10 cigarettes per day and 5 percent more than 10 cigarettes per day. No significant relation between arteriosclerosis and alcohol was found (Sacket et al. 1961). In that autopsy study "a graded and statistically significant increase in the severity of aortic arteriosclerosis was found with increasing use of cigarettes measured by both intensity and duration". Alcohol consumption affects mortality and has a U-shaped curve, giving lowest mortality in the moderate drinkers. Additionally in all groups of alcohol consumption a higher death risk was found in smokers than in non-smokers (Marmoth 1981). This excess mor-

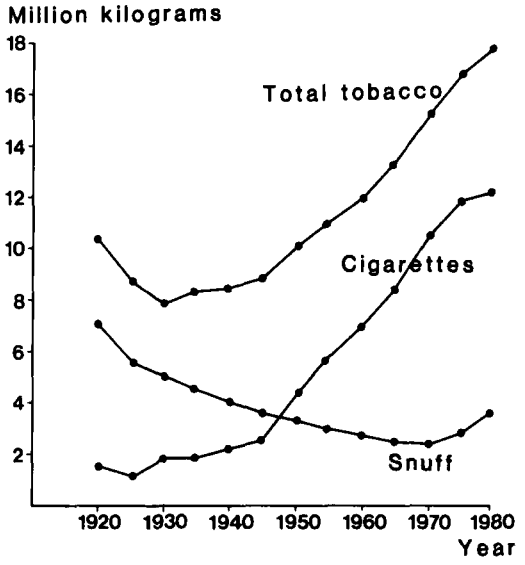

Figure 5. Smoking and snuff-taking in Sweden 1920–80.

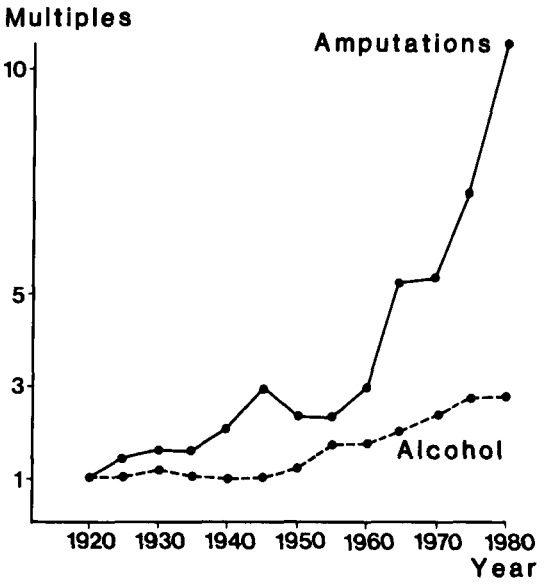

Figure 7. Amputations and alcohol in Sweden 1920–80.

tality may partly explain the few amputated smokers 80 years or older (Figures 2, 3 and 4).

It is known that cigarette smoking affects the course of peripheral arterial disease (Juergens et al. 1960, Holmes et al. 1979). Smoking of cigarettes positively correlated with a higher incidence of intermittent claudication. Heavy smokers are at three times the risk of non-smokers developing intermittent claudication. The arteriosclerotic process as occurring in the heart, head and peripheral arteries in the legs appear to

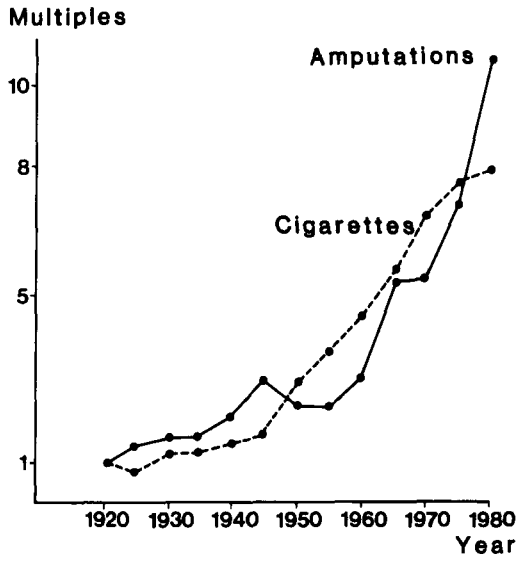

Figure 6. Amputations and cigarettes in Sweden 1920–80.

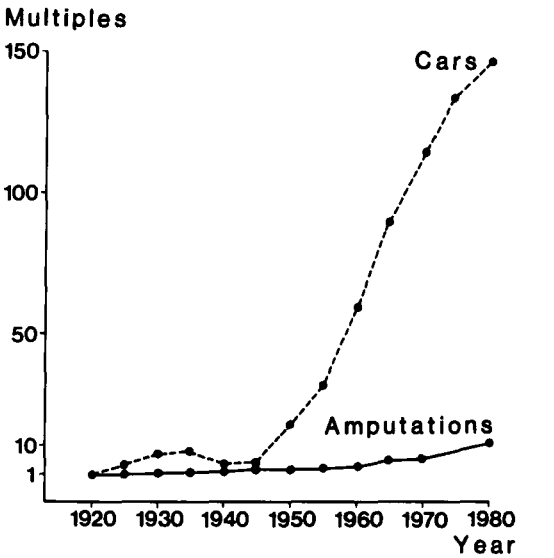

Figure 8. Amputations and cars in Sweden 1920–80.

be pathologically identical (Kannel & Shurtleff 1973). There was a significant overrepresentation of current smokers among the amputees compared to their controls matched according to age and sex in men. Previous smokers, however, did not show any higher risk in this study and stopping smoking seems to halt vascular changes (Janzon 1974).

Arteriosclerosis is a multifactorial disease (Böttiger & Carlsson 1980). The demonstration of changes in some environmental factors like cars and alcohol consumption illustrates some large changes that have occurred contemporarily but does not implicate any causative mechanism. Earlier, the young cigarette smoking male with occlusive vasculitis without arteriosclerosis has been identified under the name of Buerger's disease (Mc Kusick et al. 1962). Here a larger group with arteriosclerosis leading to amputation is correlated to smoking and it is suggested that smoking as well as diabetes should be noted as specific subsets of arterial occlusive disease among amputation patients. This might possibly lead to increased cessation of smoking even at amputation and thereby increased chances of avoiding further amputations. Until the causes have been further clarified it is suggested that besides diabetes, smoking and ages of 80 or above should be noted.

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