PART II

Aetiological factors in coronary heart disease

Obesity and coronary heart disease

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Summary
Firstly, the incidence of obesity in the United Kingdom is not accurately known at the present time. Secondly, regional studies indicate that approximately half the population is overweight. The relationship of major degrees of obesity with sudden death and angina is established. The reversibility of the rise in coronary heart disease in obese subjects after weight reduction suggests that this is an important prophylactic measure particularly in middle-aged men. Thirdly, the prospective role of exercise in preventing coronary heart disease particularly in obese subjects deserves further investigation.

MYOCARDIAL infarction is the commonest single cause for admission to the medical wards of this hospital, and coronary heart disease incidence has risen to epidemic proportions. In this country, ischaemic heart disease accounts for one quarter of the male deaths between 35 and 44 years and more than one third of the deaths between 45 and 54 years. (Oliver, 1965). The Registrar General’s statistics in 1967 show an apparent rise of 60% in ischaemic heart disease since 1950. It is important to remember that when we are treating patients in coronary care units we are treating the survivors, because a high proportion of the mortality occurs in the first hour after myocardial infarction, and many of these patients die before admission to hospital. If we are going to examine the factors which influence this fatal disease we must examine the epidemiology of ischaemic heart disease and look at the population as a whole, rather than those ‘selected’ patients sent into hospital. It is generally agreed that the aetiology of ischaemic heart disease is multifactorial and several factors have been implicated such as obesity, diet, physical inactivity and cigarette smoking; however, it is the purpose of the present paper to critically examine the relationship of obesity to coronary heart disease.

The measurement of obesity
The measurement of body fat is a difficult estimation, and it is sometimes convenient for research physicians to measure subcutaneous fat folds by Harpenden calipers, or by means of isotopic dilution methods using tritiated water. However such methods are either too complex, or are liable to error, and are unsuitable for clinical practice. The routine clinical measurement of obesity largely ignores the possibility that excess body weight is sometimes due to hypertrophied muscles, as in the manual worker, and until a reliable and simple clinical method of measuring body fat is available, body weight is used as the clinical index of obesity.

It is also very difficult to define overweight. There has been no national United Kingdom study of body weights since Kemsley (1952) and the United States Metropolitan Life Insurance figures (1959), which are based on Insurance lives, are more than 10 years out of date. The latter refer to ‘desirable weights’ calculated retrospectively on the body weights which give the lowest mortality. The Metropolitan Life Insurance statistics are socially biased because these are based on information from the higher socio-economic groups, whereas obesity is much commoner in the ‘lower’ social classes IV and V.

There have been many indices used for the definition of overweight. Weight alone is not enough because it is dependent on height. Khosala & Lowe (1967) used the index \( W/H^2 \times 100 \), where \( W \) is the weight and \( H \) is the height and this index is very useful because the mean and standard deviation are
readily calculated and conversion from pounds and inches to kg and cm is easy. The index $W/H^2 \times 100$ is independent of height, and can be readily used for an epidemiological index, such as a correlation with coronary heart disease.

A similar index called the Ponderal Index (Seltzer, 1966) which is the height in inches divided by the cube root of weight in pounds. Seltzer showed an abrupt increase in risk of death as the Ponderal Index fell below 12. Before this there was little change in mortality, suggesting that frank obesity was necessary to show an excess mortality.

Although no national weight statistics are available in the United Kingdom, the indications are that about half the population are over their desirable weight. Montegriffo (1968) carried out a survey in London with employees of an industrial company and found that 60% of males between 40 and 49 years were over desired weight. Females between 50 and 59 years showed a 64% incidence of persons over desirable weight. Comparisons made with previous studies in the United Kingdom show an increase in weight for males but little change in females. It appears probable from the Framingham data that the rise in incidence of obesity in males in the United Kingdom is an important factor in the rise in coronary heart disease. Further prospective surveys of overweight and normal men are necessary to determine this relationship. Regional differences in obesity may explain the striking regional variation in the incidence of coronary heart disease within the United Kingdom; for example, the mortality from this disorder is much higher in Scotland than England (Oliver & Stuart Harris, 1965).

Relationship of obesity to ischaemic heart disease

The basis of much of our information on body weight and ischaemic heart disease comes from the Framingham population study in the United States where 5127 men and women were followed up for a period of over 12 years for signs of initial development of ischaemic heart disease. Men had a three-fold increased risk of sudden death if they were 20% or more overweight (Fig. 1). Angina pectoris was two-and-a-half times more likely to occur in men who were 30% overweight (Fig. 2). These high incidences of sudden deaths and angina in men were similar in females. A person with a symptomless electrocardiographic abnormality had an equal risk of developing coronary heart disease as a person who was 30% overweight.

Measurements of subcutaneous fat have been made and there is a positive correlation between body fat and coronary heart disease (Comstock, Kendrick & Livesey, 1966). In patients admitted to hospital with a proven myocardial infarction there was a significant increase in body fat compared with controls matched for age and sex (Sanders, 1959). The metabolic responses in obese subjects are different from normals, and rises in the serum cholesterol, serum lipids and plasma insulin levels have been observed. These abnormalities also occur in premature coronary disease (Tzagournis, Seidensticker & Hamwi, 1968). It is likely that the metabolic alterations in obesity predispose to atherosclerosis, and these metabolic changes are reversible on weight reduction.

The question we must ask from this work is what happens to the overweight individual who is successful in reducing weight? It is extremely difficult to find accurate long-term data on this question. The only figures that are available are the Metropolitan Life Insurance figures for a 20-year period on persons who have successfully reduced and had survived for a period of time (Fig. 3). Individuals who had successfully reduced weight were compared with the general life experience of overweight persons. The ratio of actual deaths to expected deaths was 1.42;
when patients were re-rated after weight reduction this figure of 1.42 reduced to 0.9, i.e. slightly lower than the expected mortality over a period of more than 20 years. Successful reduction of weight reduces the incidence and mortality due to ischaemic heart disease to normal. Christakis et al (1966), in an anti-coronary club in New York, put a series of normal subjects on a low fat diet over a period of years and he compared this with a comparable number of controlled subjects. The group with the low fat diet lost weight and the new incidence of new coronary episodes was significantly reduced compared with persons of the same age, sex and social class, who had not been on a low fat diet. The serum cholesterol also fell on a low fat diet. If one is overweight and is successful in reducing weight, then the incidence of all forms of ischaemic heart disease is dramatically reduced.

There is much more information still to be obtained on the relationship of body weight and coronary heart disease. In some way if a person is overweight and takes regular exercise, the evidence is that the latter protects the individual from the earlier onset of angina or myocardial infarction (Borhani, Hechter & Breslow, 1963). There is a great need for a controlled prospective study of the effect of exercise on the prevention of coronary heart disease in normal and overweight subjects, particularly among middle-aged executives, where ischaemic heart disease is common.

References
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