Log-a-risk—An aid to advising the coronary candidate

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The assessment of risk factors and intervention for heart disease are being increasingly advocated for the primary prevention of coronary heart disease (Inter-Society Commission, 1970; Carruthers, 1973; Turner and Ball, 1973). As most of the adult population of the western world have some degree of atheromatosis, the physician is like a stockbroker advising a client on his portfolio, dealing in probabilities rather than certainties. Even so, the exercise is likely to be profitable, and can be undertaken with the aid of a mental check list, tables such as those in the American Heart Association's *Coronary Risk Handbook*, calculators, or even computers (Keys *et al.*, 1972).

Whichever method is used, it should preferably take into account the following factors:

(1) As complete and precise an assessment of the major accepted risk factors, which include age, sex, blood-pressure, smoking, and cholesterol level, as is possible within the constraints of time, simplicity and expense.

(2) Risk factors appear to interact to multiply rather than add to the risk.

(3) The data used as a basis for risk calculation should be from a prospective study on a large population of similar ethnic constitution, geographical distribution and subject to the same environmental influences as the group to which it is applied.

(4) It should be of use in guiding and encouraging factor intervention and monitoring an individual's response to particular preventive measures.

' Log-a-risk ' calculator

The ' Log-a-risk ' calculator is an attempt to fulfil as many as possible of these often conflicting

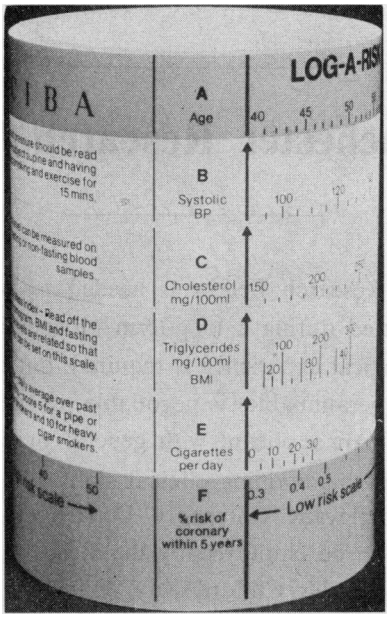

Figure 1 The ' Log-a-risk ' calculator

criteria. In about one minute it solves a multiple logistic equation giving the probability of a middle-aged man developing coronary heart disease within five years. It uses the data provided by the ' seven countries study', according to the method of multi-variate analysis described by Keys *et al.*, 1972.

It consists of a hollow plastic cylinder ten centimetres long and seven centimetres in diameter, with six scales on the outside, four of which are sliding (figure 1). Allowance is made for the risk factors by successive setting of the appropriate point on each scale against the zero mark on the one beneath.

Scale A at the top is graduated in years from 40 to 60. Scale B is for systolic blood pressure in mm Hg. This is recorded with the subject supine and having avoided smoking and exercise for at least a quarter-of-an-hour. Systolic rather than diastolic readings are thought to have greater predictive value as not only are they more easily measured, relying on observation of the appearance of a sound rather than a change in its character, but represent the result of the ' stress test ' involved in attending the physician.

Scale C is for the patient's cholesterol level in mg/100 ml estimated on either a random or fasting blood sample.

Scale D represents a correction made, in addition to blood pressure and cholesterol, for the patient's degree of adiposity. The original data were expressed in terms of body mass index (BMI) which should strictly be used if the other correlation coefficients used in the multiple logistic equation are to be preserved. It can be calculated from the formula.

$$\text{BMI.} = \frac{\text{Weight in kg}}{\text{Height in metres}^2} \quad \text{or} \quad \frac{\text{Weight in lbs}}{\text{Height in ins}^2} \times 703$$

These calculations are presented on scale D in the form of a nomogram (figure 2), with metric conversion units on the adjacent scales, the body mass index being read off the line at the point where it intersects a straight line joining the subject's level of weight and height.

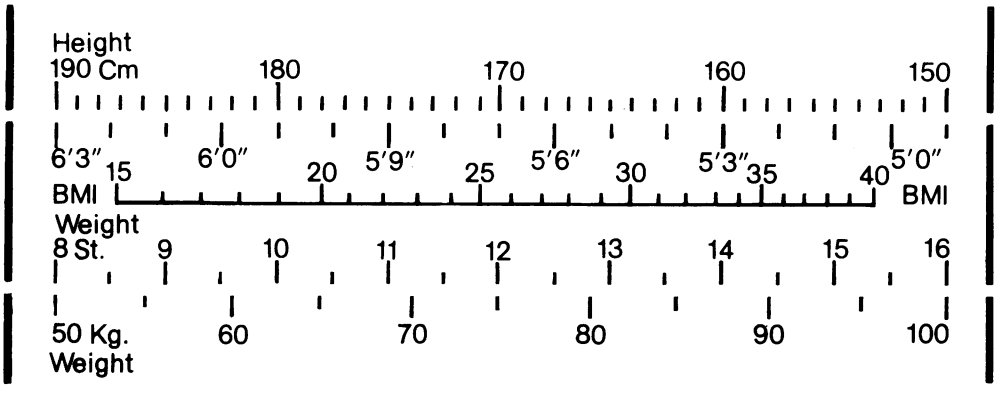

Figure 2. Nomogram for finding the body mass index

Cholesterol and triglyceride levels are the minimal requirements to make projections from lipid profiles (Carruthers, 1973; Lewis *et al.*, 1974), and are usually measured together, as the fasting plasma triglyceride concentration is correlated with relative body weight according to Rifkind and Berg (1966). Using a correlation derived from their paper, scale D can also be used by direct setting against triglyceride level in mg per 100 ml.

Scale E is directly calibrated in terms of the average number of cigarettes smoked per day, although expressed in the equation in less convenient arbitrary units.

The risk of a patient suffering a first heart attack during the next five years can be read off as a percentage on Scale F at the point adjacent to the cigarette consumption. This has been calibrated by calculation of a wide range range of probabilities on a Nova 1220 computer according to the following equation: where P is the probability of developing coronary heart disease within five years:

$$(P) = \frac{1}{(1+e-[a+\beta_1 x_1+\beta_2 x_2 \ldots . +\beta_k x_k])}$$

where a is a constant, $x_1, x_2 \ldots . x_k$ are measurements of predisease characteristics, and $\beta_1, \beta_2 \ldots .$ β_k are coefficients for the corresponding variables.

For ' European men ' (Inter-Society Commission, 1970):

$$P = \frac{1}{(1+2{\cdot}7183-[11{\cdot}888+(0{\cdot}066 \times \text{age}) + (0{\cdot}019 \times \text{BP}) + 0{\cdot}008 \times \text{Chol.}) + (0{\cdot}026 \times \text{BMI}) + (0{\cdot}065 \times \text{Cig.})])}$$

The calculator derives its name from this equation, which multiplies the effects of the risk by first adding them together and then making them the power of an expression of probability put on a log scale.

Other risk factors

Other risk factors such as emotional stress and physical inactivity can if wished be incorporated outside the confines of the equation, and, it is suggested, may be the important missing variables postulated in the analysis of the data on which these calculations are based (Inter-Society Commission, 1970).

The large scale prospective western collaborative group study (Rosenman *et al.*, 1970) has indicated that whatever the level of other risk factors, subjects exhibiting the aggressive, competitive, time and dead-line conscious, type A pattern of behaviour have about twice the incidence of ischaemic heart disease of those showing the more placid, easy-going type B behaviour pattern. Also Morris *et al.* (1973) have shown that vigorous off-the-job physical activity in a group of civil servants was associated with halving of the chances of suffering a heart attack. As a rough guide in advising the coronary candidate, if a person showing the type A behaviour pattern has, or adopts, exercise as an ally, there should be no compensatory factor applied to the risk indicated on the bottom of the calculator: otherwise it should be doubled. If a person showing the type B behaviour pattern is also physically active, the risk indicated should be halved.

Discussion

Aligning the subject's age on scale A, with the zero marks on scales B to E, allows the theoretical lowest risk level to be read on scale F. It ranges from 0·3 to 1·2 per cent at ages 40 and 60 respectively. Relative risk can then be calculated by comparison with the subject's absolute risk. It enables positions on a quintile or decile distribution curve to be assessed in population studies.

The lowest theoretical risk level is likely to be an unrealistic goal for most people. For example, non-smoking 60-year-old men with a blood pressure of 90 mm Hg, a cholesterol of 150 mg per 100 ml, who are six feet tall and weigh only eight stone are not the norm in our society. What is probably more useful in everyday practice is encouraging particularly younger subjects to move from the high risk to the low risk scales using measures such as stopping smoking, treating hypertension and reducing lipid levels by a judicious combination of the appropriate diet and exercise.

Although there is no guarantee that the patient will automatically derive the full benefit indicated on this calculator, several studies suggest that physician-assisted risk factor assessment and, where necessary, intervention is an effective method of preventing ischaemic heart disease (Gordon *et al.*, 1971) and a large scale World Health Organisation trial has started in several European countries, including Great Britain.

One of the points to emerge from this method of integrating risk factors is the relative discriminating power of each. Systolic blood pressure has the largest effect, twice as much as that of the 20-year old span covered, which is slightly less than that of cholesterol. Body mass index and cigarette consumption both have only a small discriminating power when blood-pressure and cholesterol level have been taken into account, suggesting that they mainly operate through these two latter variables. Benefits from reducing weight and stopping smoking are therefore not limited to the small range indicated on scales D and E, but are likely to influence scales B and C

to an even greater extent. However, the seven countries data from which the coefficients are derived, is at variance with those of other studies such as Framingham (Gordon *et al.*, 1971) which suggest smoking has a larger direct effect.

Although this calculator is designed to indicate the five-year risk of European men suffering their first heart attack, the coefficients are available for estimation of the risk in American men (Keys *et al.*, 1972) and women (Gordon *et al.*, 1971) by means of the same device.

In patients who have already had their first attack, the risk of having another within the succeeding five years is on average about five times greater (Inter-Society Commission for Heart Disease Resources, 1970) although other factors, such as the site and severity of myocardial damage are likely to invalidate probabilities derived from this limited computation.

It is hoped the calculator may be of use in logging the progress of the coronary candidate, and help to reduce his chances of suffering from an eminently preventable illness.

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I should like to thank Professor Geoffrey Rose and Mr John Glenn for their advice and help in designing this calculator.

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THE DIAGNOSTIC PROCESS IN GENERAL PRACTICE

The Royal College of General Practitioners (1972) states that the general practitioner's diagnoses "will be composed in physical, psychological and social terms." This expresses well the three parts of the diagnosis, but does not emphasise enough that the process by which the diagnosis is reached in general practice also uses facts from the physical, psychological and social state: i.e. the practitioner thinks in three 'dimensions' simultaneously. Here a rare medical diagnosis was suspected in general practice during a general-practitioner consultation of average length (ten minutes), predominantly from psychosocial data.

It is characteristic of primary care that working hypotheses are formed fast on limited data. It is possible that if the facts available to the general practitioner can be analysed, and those which he uses in diagnosis identified, patterns can be found. Pattern recognition is important in primary care partly because the presentation of many diseases is different in the very early stages before the textbook picture emerges.

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