Obesity and exercise

How can exercise help to control obesity? Weight reducing diets may be unhealthy

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Obesity is a situation where energy imbalance is reflected in overfatness. The contributing factors may fall into one of the following categories:

- Overconsumption of energy
- Underexpenditure of energy
- Altered efficiency of energy utilisation
- Any combination of these

To any one of these categories various genetic and environmental factors may contribute. Amongst the environmental factors are those that are of a personal, social or cultural nature. Of course, there is now little doubt that genetic factors are important in the development of obesity (Stunkard & 1986); this does not mean that the operation of such factors is through altered efficiency of energy utilisation, not that our mental faculties cannot determine the expression of obesity or that management is not practical.

Contributors to energy expenditure

In 1985 a joint FAO/WHO/UNU Committee reviewed the components of energy consumption (James 1989). The basal metabolic rate (BMR) is the major contributor to energy expenditure, with baseline requirement 1.27 x BMR; this includes the obligatory post-prandial energy expenditure and the variable (regulatory) dietary thermogenesis in the main. When the individual smokes or regularly uses caffeine-containing food and beverage items, these will contribute to the baseline requirement. When minor physical movement is taken into account, the maintenance energy requirement is about 1.4 x BMR. Energy expenditure during physical activity is over and above this maintenance requirement, but generally about a third to a half as much again as the BMR.

From this it might be thought that physical activity might contribute in a much less important way to total energy expenditure than BMR. However, lean body mass is a major determinant of the BMR and its maintenance through physical activity is therefore another important modus operandi for physical activity in energy expenditure.

Lean body mass and physical activity

In 1972, Shock showed how total energy intake progressively declined with advancing years, from age 28 to 80 (Figure 1)

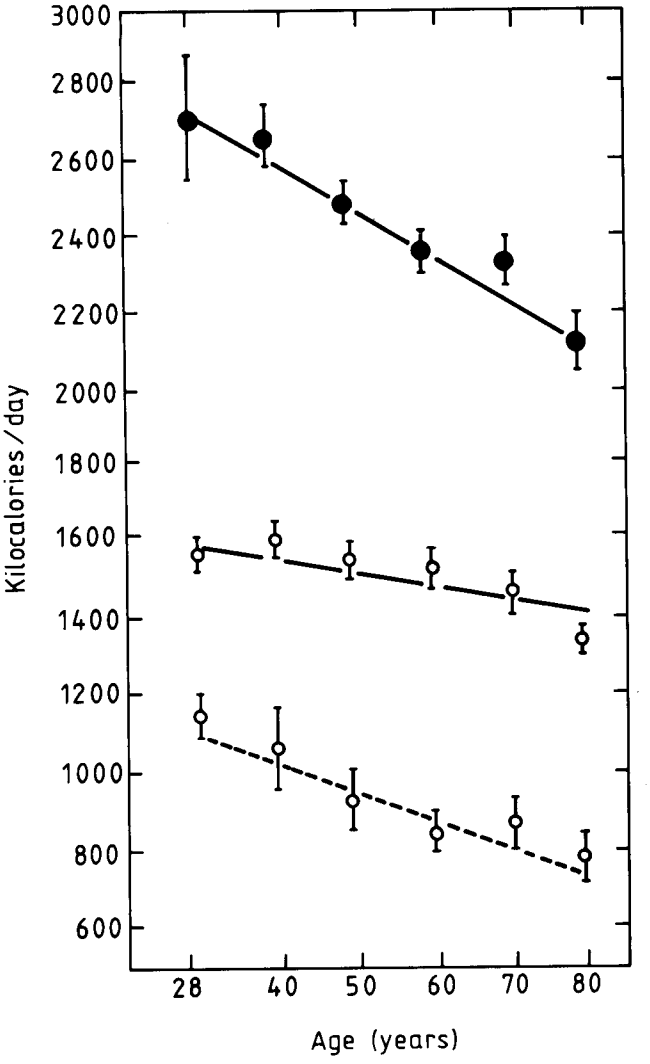

Figure 1. Daily intake and expenditure of energy in normal males

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The associated decreases in energy expenditure were both in basal expenditure and expenditure for activity, with a relatively greater rate of reduction in expenditure for activity. Again, however, the decline in physical activity will have contributed to the decline in basal expenditure through reduced lean body mass. This is not to say that factors other than physical activity might not be contributory to the decline in lean body mass, and more research is required, by way of prospective studies, to determine how much of these age-related changes are preventable by the maintenance of physical activity.

Indeed, recent work on mitochondrial DNA mutation and declining mitochondrial function, with advancing age, in skeletal muscle suggest that this phenomenon itself may be contributory to declining energy expenditure by lean body mass (Marzuki & Linnane 1989, Trounce & 1989). The same workers at the Monash Centre of Molecular Biology and Medicine have suggested that some of these age-related changes may be preventable by nutrition support (Linnane & 1989).

Plane of energy balance and mortality

Several prospective studies now indicate that with higher levels of energy intake, life expectancy is increased (Table 1).

Table 1. Energy intake and mortality rates

Study	Kind of mortality rate influenced	Reference
London men	Coronary	Morris & (1987)
Zutphen men	Coronary & total	Kromhout & (1984)
Boston-Ireland study	Coronary	Kushi & (1985)
Western Swedish women	Coronary	Lapidus & (1986)

The order of magnitude of increased energy intake conferring significant improvement in mortality rate is of the order of 300 calories (1,200 kiloJoules) per day. Studies where physical activity has been looked at in relation to life expectancy are in agreement that this order of energy expectancy from physical activity also increases life expectancy (Paffenbarger & 1986, Pekkanen & 1987). What this means is that one can afford to eat more, and that it may be desirable to do so, if one is more physically active. The energy intake studies also provide information about the quality of food of which it is desirable to eat more and, in general, this is plant foods and fish.

Thus, although in the short-term, it may be desirable to restrict energy intake to deal with the problem of obesity, maintenance of preferred body composition will be achieved, in the best interest of life expectancy, at higher planes of physical activity and food intake. The role of restriction and a very low energy diet (VLED) in the management of obesity must be seen in this context.

Overfatness versus overweight

Using the body mass index (BMI), the definition of obesity is that it is a BMI in excess of 30kgm^{-2}. By this definition, and from the National Heart Foundation risk factor prevalence surveys of 1980 and 1983, the Australian prevalence of obesity in adults is about 7%. The state of prevalence of obesity depends, of course, on the definition. Overweight, short of obesity, is regarded as the BMI range from 25–30kgm^{-2}. The term overweight is cautiously used because not all those with a BMI in this range are overfat. There are athletes who have BMI's in the overweight range who are not overfat when more direct measurements are made of fat tissue by underwater weighing or skinfold thicknesses. At the same time, there are those with apparently healthy BMI's between 20 and 25kgm^{-2} who are too fat and have too little lean body mass; they are generally the particularly sedentary. Grades of obesity, according to Garrow (1981), are shown in Table 2.

Table 2. Grades of obesity

Body mass index	Grade	Description
20–25	0	
25–30	I	Overweight
30–40	II	Obesity
>40	III	More obesity

However, it will ultimately be more satisfactory to define obesity in terms of the amount of percentage of body fat.

Secular trends in energy balance

If we knew more certainly what the trends in prevalence of obesity and trends in energy intake have been in the Australian community over the last several decades, we could draw more certain conclusions about the relative importance of food intake on the one hand and physical activity on the other in the development of obesity amongst Australians.

Evidence from the apparent consumption of foods in Australia per capita per day, from 1938/39 to 1983/84, suggests that, if anything, there have been rather small increases in energy intake during this period from 13,050 to 14,370 kJ per day (Calvert & 1987). It is generally presumed that the prevalence of obesity in Australia has increased significantly during this period and historical records seem to support this view. If that is the case, then it seems likely that a progressive decline in physical activity has been more important than an increase in food intake in an increased prevalence of obesity.

Distribution of body fat

If our concern is the health consequence of obesity, we may need to be more concerned about the distribution of fat than total body fatness. Increasing evidence points to the importance of abdominal fatness as a risk factor for cardiovascular disease, diabetes mellitus and total mortality (Lapidus & 1984, Larsson & 1984, Ohlsson & 1985, Shimokata & 1989).

The determinants of abdominal adiposity are still being defined but would appear to include the following: maleness, total fatness, physical fitness, (sports index and endurance), alcohol and cigarette smoking.

Seidell & (1988) have produced cross-sectional evidence that a sports index and indices of physical endurance are inversely related to abdominal fatness. Thus, there may be a particular role of physical activity in the reduction of that component of body fat most important in respect of adverse health outcomes. There may yet, however, be important interactions between other lifestyle behaviours and inactivity. For example, evidence from the same group of workers suggest that when liver dysfunction of the kind seen with alcohol excess is in evidence, there is more abdominal fatness, and also that smoking may contribute to abdominal fatness as well. Confirmation of an adverse effect of cigarette smoking on abdominal fat also comes from

recent work of Shimokata & (1989) in men aged 19-102 years. That these several factors may be involved in the genesis of abdominal adiposity, underscores the importance of food intake in the overall assessment of this problem.

Exercise and diet in management

Perhaps the most important study now available to allow an assessment of the relative value of exercise and restrictive dieting in the management of overfatness came from Stanford University (Wood & 1988). The study was a one-year randomised controlled trial where overweight sedentary men were allocated to an exercise group, a diet group and a control group, and followed for one year. Exercisers and dieters lost body weight similarly and significantly more than controls. However, the exercisers did not experience a significant loss in non-fat body mass, whereas dieters did. The same study sheds light on the mechanism for an increase in the cardio-protective form of cholesterol transport, high density lipoprotein (HDL), which increased in both exercisers and dieters similarly, and which therefore would appear to be principally dependent on reduction in fat body mass.

Apart from the ability to eat more nutritious food with exercise and to avoid a reduction in lean body mass and the conferrence of increased life expectancy, exercise would appear to have the following advantages: appetite control, so decreasing the focus on food, self-esteem, and well-being, together with a more healthful approach to eating.

The handicapped

Due regard needs to be paid to those who have difficulty in increasing their level of physical activity and yet who are prone to obesity. These include the physically handicapped.

Innovative clinical thinking can, nevertheless, often find ways in which the handicapped can increase their level of activity. Those with osteoarthritis can often undertake hydrotherapy or exercise in the water. Movement of unaffected parts of the body, limbs or trunk, can often be effected or aided for those who are bed-bound or dependent on wheelchairs. More attention is now being directed towards the ergonomics and design of wheelchairs to allow for effective wheelchair exercise (Dreisinger & Londeree 1982). Indeed, there are now situations in which wheelchair athletes assume levels of fitness superior to their sedentary counterparts who are capable of walking!

Critical factors in prevention and management

Taking the prospective studies of food intake and exercise into account, it must be argued that increased levels of physical activity over those currently found in sedentary western society will be of more advantage in decreasing morbidity and increasing life expectancy than a progressive reduction in food intake. Evidence suggests that it is excessive fat intake that is particularly conducive to over-consumption and the development of obesity (Roe 1987).

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