

The Evolution of Dietary Behaviour and its Effect on Modern Obesity

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Obesity is one of the most complex of human disorders and is a reflection of biological and sociocultural evolution. The last important stage of this evolutionary process in respect of diet was the late Paleolithic age from 35,000 to 20,000 BC. This was the last period where human physiology and biochemistry interacted with extrinsic influences typical of those for which they were originally selected.

Changing Dietary Behaviour

The human diet at that time was characterised by the use of uncultivated vegetables, wild game and fish and the prevailing energy intake was in the order of 3000 calories/day (Eaton & Konner 1985), considerably more than that required for our present day sedentary lifestyles.

A great deal is known about the relationship between energy intake and life expectancy in humans. Major prospective studies (Kromhout et al. 1982; Kushi et al. 1985;

Lapidus et al. 1986; Morris et al. 1977) have all shown that higher levels of energy intake are associated either with increased total mortality or certainly with increased coronary mortality which is the major cause of premature death in affluent societies. All are consistent in demonstrating that an increment of about 300 calories over the current levels of energy intake confer increased mortality rates.

The quality of the food is also quite crucial (table I). Analysis of the late Paleolithic diet by comparison with the current American (or equally Australian) diet shows that protein made an appreciable and quite exceptional contribution (34%) to energy intake. In most occidental diets protein comprises 12 to 15% of total dietary energy. The proportion of carbohydrate remains about the same while fat intake has doubled since the late Paleolithic diet. Evidence suggests that the preferred levels of fat intake in the human diet should be between 20 and 30%. Societies which are presently changing from a lower to a higher fat intake (like the Japanese) are still managing to achieve longer life expectancies as they move up to 25% of energy intake from fat.

The polyunsaturated to saturated fatty acid ratio (P : S) was higher and, interestingly, the cholesterol intake similar, however, it is important to appreciate that this cholesterol intake was for a rather different P : S ratio and background macronutrient intake.

There has also been a marked change in energy density of the human diet, moving from low energy food (expressed as calories or kilojoules/mass, volume, gram or millilitre of food) with high nutrient density (expressed as the amount of nutrient/kilojoule or calorie) to food with high energy but a low nutrient density. The energy density of food can be artificially raised by cooking methods such as frying. For example, a boiled potato is low in energy consisting mostly of carbohydrate and a small amount of protein and fibre. If this potato is then sliced and cooked in fat there is a marked increase in the energy density and fat and carbohydrate content.

Table I.
Nutritional comparison of late Paleolithic and modern diets

	Late Paleolithic diet	Current American diet
Total dietary energy (%)		
protein	34	12
carbohydrate	45	46
fat	21	42
P : S ratio (polyunsaturated to saturated)	1.41	0.44
Cholesterol (mg)	591	600
Fibre (g)	45.7	19.7
Sodium (mg)	690	2300-6900
Calcium (mg)	1580	740
Ascorbic acid (mg)	392	87.7

What is Obesity?

Obesity is regarded by many as a disorder of weight in relation to height but this is an inadequate view. Quetelet devised a more sophisticated way of looking at height/weight relationship.

$$\text{Body mass index (BMI)} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

This equation mathematically minimises those factors associated with height, e.g. muscle mass and bone, leaving fat to have more of an influence on the expression. Using this calculation several categories of body mass can be described and are reflected in the well known J-shaped relationship between BMI and mortality rates (fig. 1).

Unfortunately this equation is not adequate when considering the definition of obesity from a medical point of view. Several studies, but most notably those of Björntorp and colleagues (Lapidus et al. 1984; Larsson et al. 1984) have clearly shown that the distribution of fat around the abdomen is crucial as a determinant of health outcome. Their prospective studies have indicated that total mortality is adversely affected when the waist : hip ratio is increased and that the mortality attributed to coronary disease, stroke and diabetes are all increased as this ratio increases. A healthy ratio would appear to be less than 0.90.

Factors Affecting Obesity

There are 2 factors that are most important in the genesis of obesity in present society, fat intake and the level of physical activity. A classical study by Roe and colleagues (Lissner et al. 1984; Lapidus et al. 1984) showed a significant change in weight in accordance with the proportion of fat intake. People also inadvertently chose to eat more food when the dietary fat was more. However, it may not only be the amount of fat but also the polyunsaturated : saturated fatty acid ratio that may matter. Polyunsaturated fat may not be as adversely consequential as saturated fat (Jones & Schoeller 1988).

A study by Wood et al. (1988) showed that both diet and exercise after 12 months led to significant reductions in fat body mass but that exercise did not reduce lean mass while diet did. This stresses the importance of long term exercise in the maintenance of lean body mass and itself allowing the reduction in fat body mass.

Genetic factors may also play a role in obesity but they may not express themselves unless there are cultural and psychosocial factors which allow their expression. The decrease in level of physical activity and increase in level

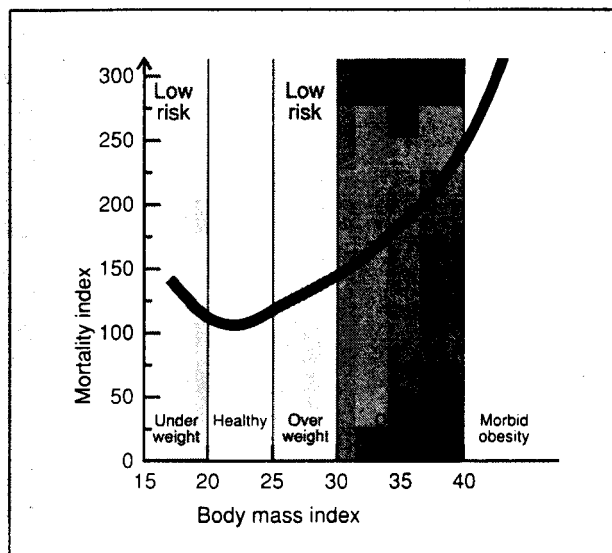


Fig. 1. Relationship between body mass index and mortality rates.

of animal fat in the human diet have been crucial in allowing the evolution of human obesity.

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