2D: OBESITY AND DIABETES

Dennis Wilson

Definition of obesity and overweight

The World Health Organisation (WHO) defines obesity in terms of body mass index (BMI). This is a measure derived from dividing body weight in kilograms by the square of height in metres. Individuals with a body mass index between 18.5 and 25 are regarded as being of normal weight. Those between 25 and 30 are regarded as overweight and obesity is defined as a body mass index equal to, or greater than 30.

BMI is well correlated with body fat but is relatively unaffected by height. Obesity is associated with a number of other illnesses particularly heart disease, diabetes, high blood pressure and some forms of cancer. This is particularly true for people with a predominance of abdominal obesity as opposed to those where the fat distribution is primarily in the buttocks. To take this into account other ways of assessing obesity have been developed. These include measuring the ratio of circumference at the waist to the circumference at the hip or simply measuring the abdominal circumference, with obesity being defined in males as a waist circumference of greater than or equal to 102cm and females of greater than or equal to 88cm.

Prevalence of obesity

Recent studies have shown that the prevalence of obesity in Australia has doubled for men in the past 20 years and tripled for women. If BMI is used to define obesity 20% of Australians over 25 are obese and if abdominal obesity is taken into account, using abdominal circumference as the measure, then 30% are obese. Other studies have also shown that 19-25% of Australian children and adolescents are overweight or obese.

Similar dramatic increases have been seen in many Western countries, with studies suggesting that reduced exercise is a more important cause than increased calorie intake. A recent study in Australia finds that half of Australian residents aged 25 and over are not sufficiently active for good health. Public Health Strategies such as ACTIVE AUSTRALIA are aimed at increasing participation in physical activity to help address this. Studies in the United States have shown that reduced physical activity in children has been associated with increased time spent watching television. One school based trial showed that body mass index could be reduced by restricting television viewing times.

Causes of overweight and obesity

A large number of factors influence the development of overweight and obesity, but in the final analysis these conditions represent the accumulation of body fat due to excess of energy intake over energy expenditure. In obesity increased energy intake, which is often not recognised, overcompensates for energy expenditure. Energy intake is determined by factors such as availability of food and is influenced by issues such as portion sizes and a preference for more palatable food. This is often associated with an increased intake of fats and refined carbohydrates such as sugars with a low satiety value. Alcohol can also contribute to an excess of energy intake.

Social factors and eating habits are also important. In this context, biological hunger should be distinguished from appetite or emotional hunger. Biological hunger is a

physiological process, which increases over time and will not go away while waiting to eat. It is not reduced by other distractions. Appetite on the other hand is psychological rather than physiological and does not increase with time. It often goes away with waiting and can be reduced by other distractions.

On the expenditure side of the equation, a significant amount of energy is used for essential basal metabolic processes such as maintaining body temperature and ion gradients across cell membranes. Other essential functions, such as cardiac and respiratory muscle activity and gastrointestinal motility and secretion require energy. Exercise obviously also utilises energy. As already indicated, lifestyle changes have contributed to a decrease in physical activity throughout industrialised societies.

Genetic influences are also important in the development of obesity. However, the genes contributing to the more common forms of obesity in humans have not been identified. Five single gene mutations resulting in gross obesity have been identified in rodents and corresponding defects have been identified in several of these genes in humans. One of the best known is the gene which codes for the hormone leptin produced by fat tissue. The obese mouse (ob/ob) has a defect in this gene and is unable to produce leptin. Giving leptin results in weight loss. Less than ten people in the world have been shown to have obesity due to this cause. Most obese people have high leptin levels and may have difficulty responding to it. A similar situation exists in another strain of obese mouse (db/db). Unfortunately giving excessive doses of leptin causes only minor weight reduction.

Disorders of other hormones are only rare causes of obesity. These can occur in persons with underactive thyroid function or overactive adrenal function, but these are easily diagnosed and treated. Some medications can be associated with weight gain such as steroids and anti psychotics. Weight gain may occur in diabetics associated with the use of insulin or sulphonylureas. It is also common with the withdrawal of nicotine at the time of cessation of smoking. The association between birth weight, and subsequent obesity and the development of other illnesses such as coronary heart disease has attracted attention in recent years. Birth weight itself is a poor predictor of future obesity but infants who are small or short have a higher risk of subsequent abdominal obesity and associated illnesses.

Prevention and treatment of overweight and obesity

The prevention and treatment of obesity are important because they will reduce the risks and costs of associated illnesses like heart disease and diabetes. Prevention involves education, which should start in schools, with education about the importance of healthy eating and encouragement of physical activity. In individuals who are already obese, behaviour modification is required. Programs conducted by psychologists and other trained personnel such as physical educators may be helpful. Maintenance of weight reduction is a major challenge, since a large percentage of people who lose weight are as heavy or heavier twelve months later than they were at the outset. Increasing energy expenditure through physical exercise is particularly helpful in long term maintenance of lower weight.

Medication for weight reduction

The use of medication to assist with weight reduction is a further option. Many medications used for this purpose in the past were found to be addictive or to have other

significant side effects. The most recently introduced agent in Australia is orlistat, which inhibits the breakdown of fat in the gut and therefore inhibits its absorption. The non absorbed fat is excreted and therefore energy intake is reduced. Weight reduction will ensue if total calorie intake has been reduced by this partial reduction in fat absorption. However, if a major proportion of the calories in the diet come from carbohydrate sources little weight reduction will occur. Other agents are under investigation including P57, the appetite suppressing ingredient in the Hoodia cactus, which has been used for hundreds of years to stave off hunger by the !Kung bushmen around the Kalahari desert.

Obesity related to diabetes

The association between obesity and type 2 diabetes has been known for a long time. Diabetes is a metabolic disorder characterised by chronically elevated blood glucose levels and associated disturbances in carbohydrate, fat and protein metabolism. There are two common types of diabetes in Australia. Type 1 is an autoimmune disease leading to destruction of the pancreatic insulin producing cells. This accounts for about 10% of the total number of people with diabetes in Australia.

Type 2 diabetes is much more common and is due to insulin resistance and a relative impairment of insulin secretion. Recent studies have shown that the prevalence of type 2 diabetes in Australians over the age of 25 is 8% for males and 7% for females, giving an absolute prevalence of nearly one million. This is double the incidence detected in surveys in Western Australia 20 years ago, and the increase is parallel to the increase in obesity in the community. The other striking observation is that type 2 diabetes is occurring increasingly in younger people especially associated with obesity. As noted earlier, the pattern of fat distribution is important, with central obesity being more associated with diabetes. Other factors which are important are high free fatty acid levels and possibly tumour necrosis factor alpha secreted by fat cells. A new hormone secreted by fat cells (resistin) was described earlier in 2001 and it may help to explain why obesity can lead to type 2 diabetes by producing insulin resistance. The circulating levels of this hormone are reduced by the administration of one of the most recently released anti diabetic drugs (Rosiglitazone) which acts by decreasing insulin resistance. Initial studies have been reported in mice and studies in humans are required.

Genetic influences and diabetes

Genetic influences are also important in the development of type 2 diabetes. This is shown by observations such as the fact that type 2 diabetes is more prevalent in certain ethnic groups living in the same environment, eg urbanised Aborigine populations (20%) and Europeans (7%) in Australia. A large number of patients with type 2 diabetes have at least one parent with the condition and amongst twins if one is affected nearly 100% of the others will develop the condition. Much effort has been spent looking for the genes involved. Only about 5% of cases with the condition have a mutation in a single gene affecting insulin release. Rare examples of mutations causing insulin resistance have been described but none of these play an important part in the common form of type 2 diabetes.

Complications of diabetes

The long-term effects of diabetes are damage to a variety of tissues leading to complications such as heart disease, impaired vision, lower limb amputation and kidney failure. The combination of obesity, diabetes, elevated blood pressure and elevated lipids

is often described as the metabolic syndrome. The mechanism of the connection between these conditions is poorly understood. Obesity causes insulin resistance and may also decrease the sensitivity of insulin secreting cells to glucose.

Regardless of these considerations, the end result is a chronic medical condition which needs lifelong treatment to prevent or delay the development of devastating complications. A major cause of morbidity and mortality in diabetes is vascular disease, and up to 75% of deaths are due to cardiovascular disease. 30% of patients in coronary care units in Australia have diabetes, more than 30% in renal dialysis programs are diabetic, as are up to 50% in some rehabilitation services following strokes or lower limb amputation. Diabetes remains the most common cause of blindness in those under 60 years of age in Australia.

Management of diabetes

Treatment begins with the recognition of the condition. Unfortunately recent studies show that only 50% of those with type 2 diabetes have the condition diagnosed. The same is true for some important associated conditions such as hypertension, which contributes significantly to the development of the vascular complications. Once recognised, people with diabetes should be provided with support and information about the condition. They should be assessed for complications which are often present at the time of diagnosis. Advice should be provided on changes in diet and lifestyle which may help especially if weight reduction is required. Smoking should be discouraged, because of its contribution to vascular complications. Monitoring of the condition and its complications should be commenced.

Initially many individuals will be able to control their diabetes by changing their diet, increasing exercise and reducing weight. Eventually medication may be required for most. A range of medications are available, including agents which will improve insulin sensitivity (Metformin and Glitazones), agents which improve insulin secretion (Sulfonylureas and Meglitinides) and an agent which slows down carbohydrate absorption (Acarbose). 25% of people with type 2 diabetes will eventually require insulin. Other issues which need to be addressed include the treatment of associated elevation of blood pressure and blood lipids. Aspirin may also help to reduce vascular risks.

Prevention or treatment?

Many studies (eg the UK prospective diabetes study) have shown that controlling blood sugars, blood pressure and blood lipids will significantly delay the onset and progression of the complications of diabetes. Unfortunately “health care systems” or in this context more appropriately named “disease care systems” continue to pour vast quantities of resources into the management of the end stages of diabetes in renal dialysis and vascular surgical units, while missing many opportunities to intervene early for the benefit of the individual and the health care budget. With the current epidemic of both obesity and diabetes, this situation is only going to become worse unless there is a significant change in health care policy.

Discussion notes

- If obesity and type 2 diabetes are determined by lifestyle choices, it raises the ethical issue of preventable behaviours having outcomes which syphon off scarce resources for medical care. In terms of community responsibility it could be argued that the food

industry might one day be sued for marketing potentially harmful products (some of them “low fat” foods), akin to damages awarded against the tobacco industry. An alternative viewpoint is that freedom to do whatever one wishes – either as an individual or a corporation-- is highly prized, regardless of the consequences, and that medical care should be equally available both to people who eat and exercise sensibly and to those who do not.

- One of the key education strategies in our schools – and in raising children generally – is to teach them that behaviours have consequences. Maintaining that position is one of the toughest calls a classroom teacher (and a loving parent) can make. In terms of health education of the community we need to confront the reality that the cost of one person abrogating a freedom to themselves may well be a greater (but hidden) denial of freedom to another. While we have been programmed by the evolutionary process for a “fight or fight” response to urgent crises, there appears to be much less commitment to achieving long term survival goals, either by the community or by policy makers.
- While overweight, obesity and type 2 diabetes are common in societies which have access to plentiful food and where there is little need to exercise, there are exceptions to predictions of body weight from the conventional energy balance hypothesis. Thus, there are individuals who have high intakes of food and do little exercise but do not gain weight. Recent observations suggest that such persons may expend a lot of energy by ‘fidgeting’, without moving around. Conversely, many people are resistant to weight loss despite dieting and exercising, and it is important to be supportive rather than judgmental about them.
- Body weight is the resultant of interplay between genetic, environmental and behavioural influences. Endomorphy (a tendency towards a rotund body build) and genetic factors are neglected contributors to obesity. Thus, some people, including the Papago Indians of Southern Arizona, several Polynesian groups and many Middle and South American Indians apparently possess a high frequency of genes for obesity, while others, such as the Nilotes, Masai and Watusi of Africa clearly possess a low frequency of genes for obesity and a high frequency of genes for leanness. Within Western cultures, several studies have found that up to eighty percent of obese children had at least one fat parent, while twenty five percent had both parents obese. Moreover, the correlation of weight between identical twins living in different environments was extremely high, while the correlation between fraternal twins was quite low.
- The tendency for some ethnic groups, including Australian Aborigines and Polynesians to become obese and develop type 2 diabetes when exposed to energy -rich Western diets has been attributed to their possession of a so-called ‘thrifty gene’. This gene supposedly enables hunter-gatherers to survive under conditions of food shortage, but operates in the direction of fat synthesis and storage under conditions of plenty.
- While the causation of obesity remains complex and poorly understood, and its treatment generally unsuccessful, the evolutionary principle outlined by Stephen Boyden in paper 1B remains a useful guideline for prevention and management. That is that, as in our hunter-gatherer ancestors, optimum health can be attained from the consumption of a variety of unrefined plant foods with supplements of lean meat and fish, together with regular exercise.

Further Reading

1 WHO Consultation on Obesity. Obesity: Preventing and Managing the Global Epidemic. Geneva, 3-5 June 1997. WHO Geneva 1998, 1.

2 Diabesity and Associated Disorders in Australia 2000. International Diabetes Institute, Melbourne 2001.
3 Current Therapeutics Diabetes Supplement, 13 May 2001.
4 Positional Cloning of the Mouse Obese Gene and its Human Homolog. Zhang Y et al. Nature 1994, 372; 425.
5 The Hormone Resistin Links Obesity to Diabetes. Steffan C et al. Nature 2001, 409: 307-312.