

Nutrition and diabetes

The nutritional prevention of most diabetes may start as early as fetal life with maternal nutrition. Reduced food variety, excessive refining of food and saturated fat, with sedentary lifestyles unmask predispositions to non insulin dependent diabetes and increase the likelihood of complications. Food pattern is important, with preference for small, more frequent than large infrequent meals being an advantage. For short term (acute meal response) and longer term glycaemic control, as well as an aid to satiety, low fat low glycaemic index foods are encouraged. Some sucrose and alcohol are compatible with good glycaemic control. Nutritional behaviours are more likely to change if the socio-cultural context is respected and negotiation rather than prescription is used. Informed self monitoring reinforces adherence

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Mark L Wahlqvist

The problem

The prevalence of both insulin dependent diabetes mellitus (IDDM) and non insulin dependent diabetes mellitus (NIDDM) continues to increase in Australia, with NIDDM doubling during the 1980s.¹ Certain ethnic groups within Australia, (indigenous Australians, Asians and South East Asians) are more prone to this condition than Caucasian Australians.^{2,3} Although the prevalence is still greater in the older generation, even NIDDM may start during adolescence.^{4,5} This phenomenon presents a major challenge for the prevention and management of diabetes. Consideration must also be given to **impaired glucose tolerance (IGT)** which precedes NIDDM, but if managed correctly is reversible.

The big question is at which point nutritional factors begin to play a role in the pathogenesis of IGT and NIDDM. The work of Barker⁶⁻¹⁰ and Lucas^{11,12} indicates that a direct link may exist between **maternal nutrition, fetal development and childhood nutrition** and the development of NIDDM later in life. If so, the intergenerational effects of nutrition (previously thought to be genetic) may be particularly important.

The Swedish diabetes register has provided some evidence that food processing may be important in the development of diabetes.¹³ More specifically an energy dense (especially high fat, high alcohol, low dietary fibre) diet predisposes towards obesity¹⁴ and, therefore, to NIDDM.¹⁵ More work is required to understand the complex relationships between urbanisation, obesity and NIDDM, but factors that

predispose towards less lean mass and more body fat, especially more visceral fat, appear critical.^{16,17} These understandings increasingly provide a basis for nutritional intervention

Swedish studies have also looked at the role of exercise in the prevention¹⁸ and management of NIDDM,¹⁹ suggesting a direct link.

In planning a nutritional approach to diabetes management an overall philosophy is needed (Table 1, Figure 1).

Food patterns

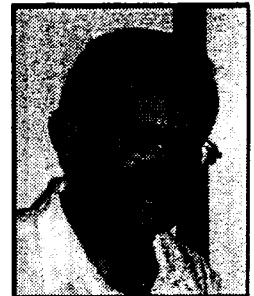
Distributing food through the day

In healthy individuals, there is relatively greater resistance to insulin in the latter part of the day compared with the earlier part.²⁰ However, this may not apply once NIDDM is established.²¹

Nevertheless, at any time of the day, once insulin response or action is in any way compromised, the glycaemic response to increasing food portion size needs to be considered. Thus, spreading food out across the day remains an important strategy in nutrition management of NIDDM.

Jenkins has shown that small frequent non fatty meals also decrease overall cardiovascular risk factor profiles.²² From a practical point of view, this means that substituting snacks like sweet and even savoury biscuits (which are often high in fat) with fruit.

There is increasing evidence that a variety of foods may be associated with reduced overall glycaemic response and status (Table 2).²³⁻²⁵



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Table 1. Rationale for nutrition in diabetes care

- Preventing the development of diabetes in susceptible individuals or for secondary reasons, such as those with pancreatic disease or using glucocorticosteroids.¹⁸
- To reduce the damaging effects of elevated blood glucose on tissues such as the eye, kidneys, nervous system and arteries.⁴³
- To keep the blood fats (cholesterol, triglycerides, HDL or high density lipoprotein cholesterol) as normal as possible.^{44,45}
- To reduce damaging effects on tissues by any other mechanism, such as oxidation.^{42,46}
- To improve the action of available insulin by:
 - minimising abdominal fatness
 - improving the action of the insulin receptor in cell membranes⁴⁷
 - improving the action of insulin in the cell
 - reducing the amount of circulating free fatty acids (FFA)
 - increasing the utilisation of FFA in ways that do not interfere with glucose metabolism.^{19,48,49}

Table 2. Dietary food variety list.

- A. Plant-derived food**
 - 1 Cereals — wheat based, rye based, oats, rice, barley
 - 2 Vegetables — green leafy, flower type (broccoli, cauliflower), root, runner-yellow (pumpkin, squash), tomatoes
 - 3 Fruits — citrus, stone, bananas, tropical, berries
 - 4 Legumes
 - 5 Nuts — almonds, peanuts, cashew
 - 6 Infusions, beverages — tea, coffee
- B. Fungi and yeasts**
 - 1 Mushrooms
 - 2 Yeast — brewers, bakers
- C. Animal derived**
 - 1 Finned fish fresh or tinned
 - 2 Crustaceans
 - 3 Shellfish
 - 4 Ruminant animals — sheep, cattle, deer
 - 5 Monogastric animals — pig
 - 6 Avian — poultry, pigeon
- D. Confectionery** — sugar based, chocolate
- E. Alcoholic beverages**

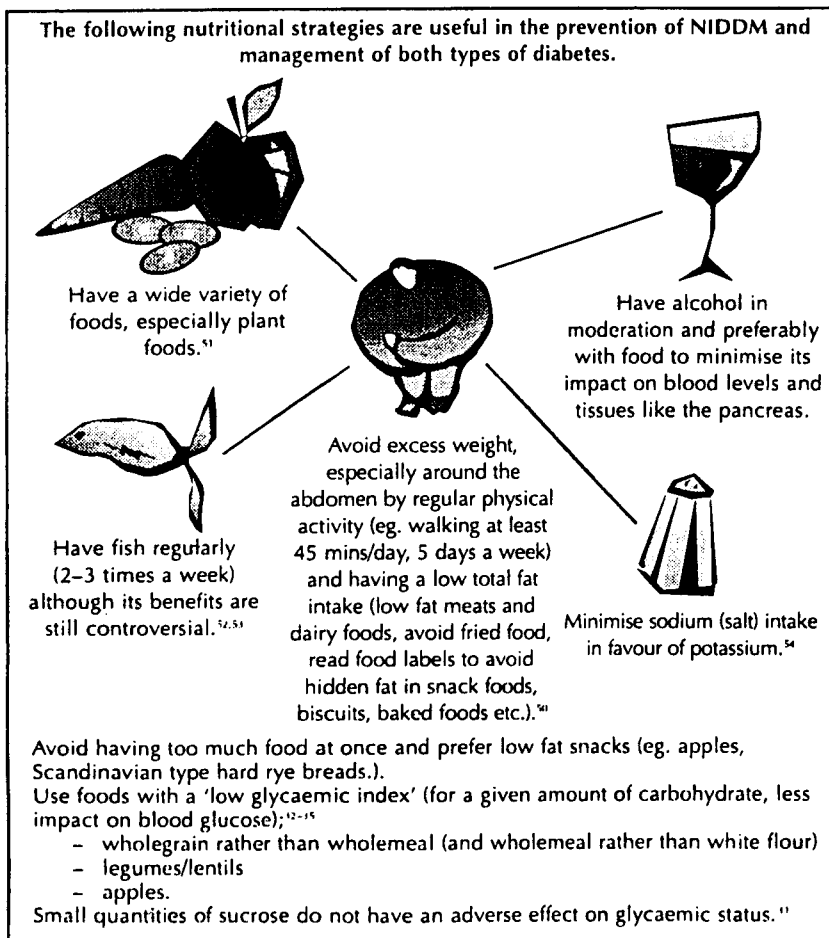


Figure 1. Nutrition strategies for prevention, glycaemic management and reduction of complications.

These findings about food variety may depend on a number of food properties which includes both nutrients and non nutrients (phytochemicals). **Phytochemicals** are increasingly of interest as cardioprotective agents.

IDDM versus NIDDM

The difference between IDDM and NIDDM in relation to food pattern is that, where pharmacological agents are not used, the glycaemic response is principally determined, (for a given level of physical activity and state of psychosocial stress)⁵⁶ by the food intake and pattern. A recent study has shown that cereal fibre has a particularly strong inverse relationship to NIDDM.⁵⁷

Where insulin is used, especially by a 'Basal-Bolus' regimen, some flexibility in food intake is possible (Figure 2). If fixed insulin regimens, such as single or twice daily, including medium and short acting components are used, meal and snacking times must follow the insulin dose.

Food choices

The major development of relevance to food choice in diabetes relates to the fact that a given amount of carbohydrate may be followed by a very different glycaemic response depending on

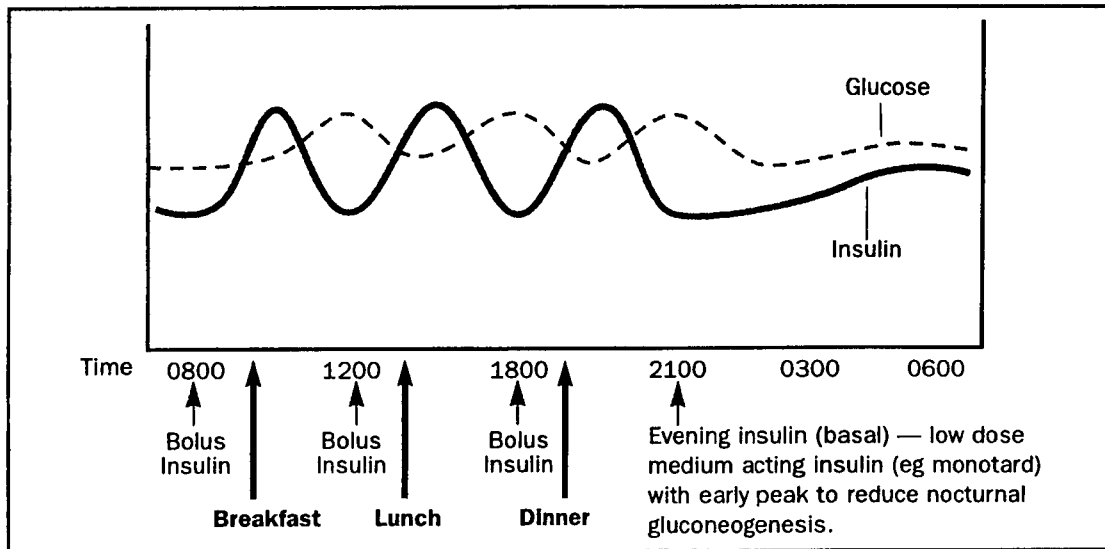


Figure 2. Basal-bolus insulin regimen.

the phytochemical and other chemical modifying factors in the food or meal.²⁸⁻³⁰

Glycaemic index

As a consequence, the glycaemic index has been developed. This relates the area under the blood glucose response curve from a food with equivalent carbohydrate, to that with a reference food, such as glucose or white bread (Figure 3). In general, a simple sugar which contains both glucose and fructose (eg. sucrose) or which contains glucose and galactose (eg. lactose)³¹ will have a lower glycaemic response than one that has only glucose. Foods that are more viscous or where particle size is greater (eg. multigrain bread) will have lower glycaemic indices. Legumes have, as a food category, the (Table 3) lowest glycaemic indices.³²⁻³⁵ Fatty foods tend to delay gastric emptying and are generally excluded from food plans for diabetics as they are not nutrient dense (nutritious) and they contribute to the development of long term macrovascular complications. Another problem with a high fat intake is that it predisposes to insulin resistance, unless it is rich in omega-3 fatty acids.^{36,37} Mono unsaturated fats also have a place.³⁸

Alcohol

Alcohol can reduce blood glucose because it reduces gluconeogenesis. This effect can be reduced if it is taken with food. If the particular alcoholic drink contains carbohydrate, the patient can evaluate this with blood glucose monitoring. While there is no specific reason to exclude diabetics

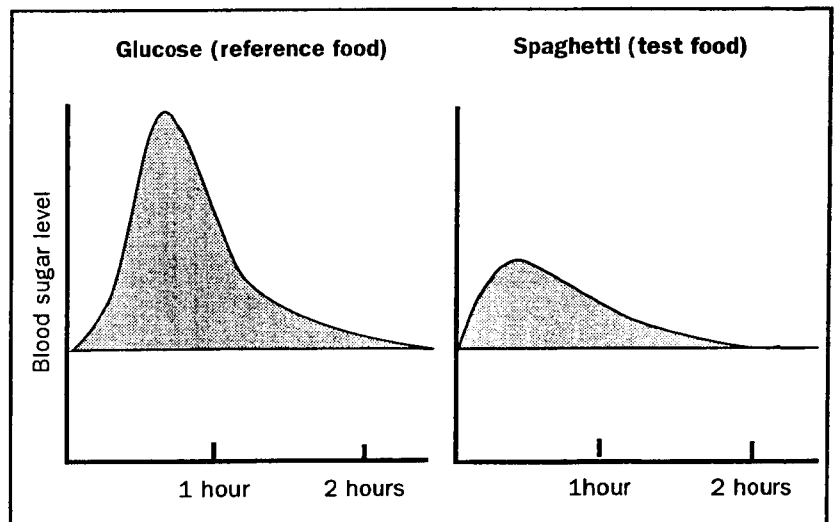


Figure 3. Measuring the GI factor of a food. The effect of a food on blood sugar levels is calculated using the area under the curve.

from drinking alcohol, consideration should be given to the likelihood of further pancreatic beta cell damage or cirrhosis (which itself impairs glucose tolerance) and the more general socio-medical concerns with alcohol.

Changing nutritional behaviours

Initially, it is important to elicit and record what a patient eats, then negotiate change and review what is achieved, with further counselling. The process of recording food intake by way of a diary can be part of the process of behavioural change.³⁹

Working with a person's food culture, family and work place needs is essential for adherence to agreed change. 'Diets' should not be 'prescribed.'

Table 3. The glycaemic index of some foods

Breakfast cereals		
	Kellogg's All-Bran	30
	Kellogg's Corn Flakes	77
	porridge	42
Grains/Pastas		
Rice	Calrose	83
	Basmati	58
	brown	76
Noodles	instant	47
Pasta	egg fettuccine	32
	spaghetti	41
Bread		
	bagel	72
	mixed grain bread	45
	wholemeal bread	77
Crackers		
	Ryvita	69
	Jatz	55
Biscuits		
	Arrowroot	69
	oatmeal	55
Vegetables		
	carrots	49
Potato	baked	85
	French fries	75
Legumes	lentils	29
	soya beans	18
	broad beans	79
Fruit	apple	36
	banana	53
	apricot	31
	grapefruit	25
	plum	24
Dairy Foods		
Milk	whole	27
	skim	32

Indeed, there is evidence that slavish compliance may actually be associated with increased morbidity and mortality.^{26,41}

Delayed gastric emptying with gastroparesis

Where autonomic neuropathy supervenes, as a diabetic complication, gastroparesis can present considerable difficulty for nutritional management because of the unpredictability of gastric emptying, with hyper and hypoglycaemia. Sometimes prokinetic agents like cisapride (Prepulsid) can be helpful.

Maintaining outcomes

The most valuable aid to long term success in nutritional management is the informed independence of the patient. This can be aided by interest in prevention from

first degree relatives (who are themselves at risk of developing NIDDM). Behaviours that seek and help to achieve a preferred body composition need to be encouraged as this will also aid euglycaemia, and low macrovascular risk factor profiles.

Blood glucose monitoring which accounts for the short and long term effects of dietary change is important — the benefits of a higher unrefined carbohydrate (or high monounsaturated, such as olive oil)⁴² eating pattern may unfold over a couple of weeks for glycaemic status⁴² and months for body composition. In other words, checking blood glucose after a meal tells only part of the potential benefit of nutritional change — fasting blood glucose falls more slowly and decreased body fatness even more slowly.

Where the patient and family take more day to day control, the doctor and dietitian can take more strategic and surveillance roles.

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SUMMARY OF IMPORTANT POINTS

- Food intake along with physical activity and emotional stress are all determinants of glycaemic status.
- The glycaemic index (GI) of foods indicates that a number of food factors other than glucose content are important for good glycaemic response to foods and meals.
 - Low glycaemic index foods could also be ones low in fat.
 - Foods that have the lowest GIs included lentils, pasta, noodles, multigrain breads and some fruits (eg. grapefruit, plums).
 - Fruits are to be preferred to their juices.
- Counsel change in a socio-cultural context and in a step-wise fashion by negotiation rather than prescription.

REPRINT REQUESTS

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