Current practice in dietary management of diabetic children

A transatlantic comparison

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Birkbeck, J. A., Truswell, A. S., and Thomas, B. J. (1976). *Archives of Disease in Childhood*, 51, 467. **Current practice in dietary management of diabetic children: a transatlantic comparison.** Dietary therapy practice in 18 British clinics for diabetic children is reviewed, and contrasted with Canadian and American practice. Values for dietary composition expressed as energy are presented for small groups of British and Canadian children. Fat is often the principal energy source in British diabetic children; protein intake is much higher in the Canadian. It is suggested that British practice might be improved by the adoption of a simple uniform exchange system. Reported differences in growth characteristics may reflect differences in protein intake.

'Quot homines, tot sententiae.'

Although there is a great lack of unanimity regarding all aspects of the management of the diabetic child, this is especially true of dietary management. Since the beginning of the insulin era, regimens varying from a highly calculated, weighed, diet to a totally uncontrolled, 'free' diet have been advocated. This paper presents the results of a survey of current practice in British clinics for diabetic children, compares these with North American practice, and discusses briefly the problems arising from the present system.

Material

Information on general trends in dietary management was obtained from the Survey of Diabetic Diet Management (Thomas, Truswell, and Brown, 1974a, b; Truswell and Thomas, 1975). From the 199 clinics responding to the questionnaire, the 18 dealing exclusively with children were selected. These do not necessarily reflect all shades of British paediatric opinion, but include large clinics with as many as 214 patients down to small ones with as few as 20, and probably represent a cross-section of current practice. The questionnaire yields general information about the types of diet used. From a small clinic not included in the main survey, but whose practice conforms to the general

pattern, detailed results of representative 24-hour recall studies were obtained in 24 children of various ages. These were analysed using the computerized Food Composition tables of the DHSS.

Comparative North American data were obtained from the Diet Manuals of the Canadian Diabetic Association (CDA) and the American Diabetes Association (ADA), and detailed analyses from a longitudinal study of 47 children in a Canadian clinic where specific dietary rules were applied. This last study by one of us (J.A.B.) again is calculated from 24-hour diet records, obtained at each clinic visit, usually quarterly, over a period of at least one and usually several years.

Results

British clinic survey.

Carbohydrate intake. 14 of the 18 clinics routinely used a system of carbohydrate exchanges. Only 2 clinics did not prescribe the carbohydrate intake, and of these only one used an essentially 'free' diet, restricting only excessive sucrose intake. Of the 16 centres using carbohydrate exchanges at least some of the time, 15 used a 10 g unit and one a 5 g unit. 11 centres felt they used a diet of 'average' carbohydrate content (defined as about 50% of total energy intake from this source). 6 used a lower (about 40%) level and one did not specify. 2 clinics reported an almost complete embargo on sucrose, 9 used 'moderate' restriction, and 6 confined the restriction to 'excess', that is added sugar.

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There is much confusion in the clinics which provided details of their exchange system about method of exchange calculation. This is sometimes done in terms of portion size: the $\frac{1}{2}$ ounce of cornflakes is variously described as 3 rounded, or 3 heaped, tablespoons. Foods appearing as exchanges in one system (e.g. an 'average helping' of fresh unsweetened strawberries) appear as a 'free food' in others ('take one helping fresh or sweetened with saccharine').

Vegetables (other than starchy types such as potatoes or beans) generally appear on 'free' food lists, some being arbitrarily marked as 'one helping only'—without specifying what a 'helping' is. Among clinics using a 10 g exchange, one restricts the intake of turnips (carbohydrate content, cooked, only 2.3 g/100 g) while another does not restrict carrots (carbohydrate content 4.3 g/100 g). Other clinics place all vegetables except potatoes on an unrestricted list.

Overall it appears that many aspects of the carbohydrate exchange system are very arbitrary, and the manifest lack of standardization must make transfer of a patient to another clinic quite confusing. These systems have been discussed in detail (Thomas *et al.*, 1974b).

Fat intake. The majority of clinics (13) did not place any restriction on fat intake. 4 occasionally placed restrictions in selected cases, but only one regularly recommended limitation of fat intake. Again, 13 clinics did not make any recommendations concerning the use of polyunsaturated fat products. 4 clinics 'occasionally' recommended them, curiously not always the same ones restricting fat intake.

Protein intake. Only one clinic controlled protein intake.

Total energy intake. Except in cases of excessive weight gain or obesity (all clinics regularly weighed their patients), 9 clinics did not recommend any limitation of total energy intake. 4 routinely prescribed total energy, and 5 sometimes did so. Of these 9 clinics prescribing, all used kilocalories and none the dreaded megajoule. In 17 clinics the dietitian normally calculated the patient's carbohydrate intake, in one the protein, in 5 the energy intake (plus 3 more in selected cases), but in only one the fat intake 'sometimes'. One clinic did not regularly record intake at all.

Weighing of food. 13 clinics recommended weighing carbohydrate intake for a limited period,

presumably to familiarize the family with portion sizes. 3 clinics recommended regular weighing, and only 2 never recommended weighing.

Individual study. The dietary intake, by the 24-hour recall method, of 24 juvenile diabetics in a clinic not included in the large survey showed the expected wide range of energy intake, from a 4-year-old eating 1475 kcal/day to a 'very large' teenager eating 4550 kcal/day.

Mean carbohydrate intake, expressed as a proportion of total energy intake, was 41.8% (range 30–52); mean fat intake was 44.1% (range 33–55); and protein 14.1% (range 11–16). Sucrose intake ranged from 0–96 g/day, with a mean of 25 g.

In any situation where carbohydrate intake is limited but other items are not, a high fat intake is clearly a risk. Of the 24 children, 16 were apparently deriving more energy from fat than from carbohydrate, and saturated fat predominated. Only 4 children seemed to be using polyunsaturated vegetable margarine in any quantity, and even then not exclusively. However, many consumed ice cream, cream, and even lard, not infrequently. All made use of 'dietetic' products, especially confectionery (23), soft drinks (22), jams (13), and sweeteners (8).

Canadian study. The standard diet for both child and adult diabetics, recommended by the CDA and the ADA, provides 40% of energy as carbohydrate, 40% as fat, and 20% as protein. This restriction of carbohydrate is largely made possible by a high protein intake. We have previously found that the typical diet of a Western Canadian child is composed of roughly 50% of energy from carbohydrate, 35% from fat, and 15% from protein. It has not been traditional to modify the fat composition of diabetic diets. The basis of the CDA exchange system is shown in the Table.

A large clinic for juvenile diabetics was organized by one of us (J.A.B.) in Vancouver, Canada, in which both fat and cholesterol restriction, and increased polyunsaturated fat intake, were encouraged, but energy restriction was rarely used. Energy intake was maintained by increasing starch intake.

A longitudinal study on 47 children aged 5 to 21, carried out over several years, showed that the mean energy yield from carbohydrates was 48% (range 38–55), from fat 32.2% (range 25–40), and from protein 19.9% (range 16–26). It should be emphasized that such a level of protein intake is quite expensive. Compared to our British series, it appeared that diabetic 'control' in terms of glucose

TABLE
Exchange system, Canadian Diabetic Association

Food group	Composition of unit (g)			Energy (kcal)
	Carbohydrate	Fat	Protein	
(1) Milk	6	4	4	85
(2a) Vegetables (high carbohydrate)	7	0	2	35
(2b) Vegetables (low carbohydrate)	—	—	—	—
(3) Fruit	10	0	0	40
(4) Bread & cereals	15	0	2	70
(5) Meat & protein foods	0	5	7	75
(6) Fat	0	5	0	45

The ADA system differs in that their milk exchange is twice as large, and the 2a and 2b nomenclature is reversed.

excretion and periods of ketosis was superior: growth may also be superior (Birkbeck, 1972).

Discussion

On the basis of the evidence presented, it seems likely that at least a majority of groups in Britain managing diabetes in children adopt a fairly unstructured approach to diet, except perhaps in an attempt to control carbohydrate intake. Since the metabolic errors in diabetes involve all aspects of metabolism and not simply that of carbohydrate, this is not very logical. It is unfortunate that, because of the historical accident that the method for measuring carbohydrates antedated others, there has always been a preoccupation with carbohydrate metabolism to the virtual exclusion of lipid and protein in diabetic care.

In the universal exchange system, as used by the CDA and ADA, foods are divided into groups of roughly similar composition so that an exchange of any food within a group will yield roughly the same amount of carbohydrate, protein, and fat as an exchange of any other food in the same group. Details of the system are given in the Table. Though some have found such systems too complex (e.g. Holland, 1968), in our experience parents and children given adequate instruction find them acceptable.

The carbohydrate exchange system, in practice, can clearly lead to a situation where fat and to a large extent saturated fat provides the main source of energy. It must be borne in mind that the usual way of expressing food intake in terms of caloric yield is quite misleading. Particularly in a growing child, a major proportion of both exogenous and endogenous amino acids are not used for energy generation but for structural purposes, which themselves require energy. If this apparent contribution is deducted, then over 50% of energy requirements are derived from fat in many of the children in our local series.

Juvenile diabetics are particularly prone to both small—and large—vessel degenerative angiopathy, and high lipid diets are held by many to be contraindicated in those susceptible to such disease (Schettler and Wahl, 1969; Christakis and Rinzier, 1969; ICHDR, 1970). It is not known in the national survey what proportion of the energy intake was derived from fat. If one assumes that there is a real difference between those clinics specifying a 'low' compared to an 'average' carbohydrate intake, then assuming 12–15% of energy to be calculated as protein, anywhere from 35% in the 'low' group to 45% in the 'average' group of energy is derived from fat. The higher figures clearly imply that fat is the greater source of energy.

Our previous studies (Birkbeck, 1969, 1970) have shown firstly that an isocaloric change to a higher carbohydrate diet (50–55% of energy) does not affect insulin requirements; and secondly that the lower fat intake can be further modified by the introduction of simple restrictions (such as limiting egg intake) and the use of commercially available products such as polyunsaturated vegetable margarine. Significant reductions in plasma cholesterol and triglyceride levels can be achieved (Stone and Connor, 1963). We have not found the slightly more complex exchange system (which does not require constant weighing) difficult for the child or family to learn or to use.

Notwithstanding the work of Yudkin and colleagues (Yudkin, 1972), a specific role for sucrose in the genesis of angiopathy is not substantiated as yet. Sucrose ingestion, however, results in extremely rapid fluctuations in the blood glucose level which the child who is dependent on exogenous insulin cannot possibly handle, resulting in increased hyperglycaemia and glucosuria. These have unpleasant short-term as well as possible long-term consequences.

A high-protein diet is a necessary consequence of the type of diet fashionable in North America.

Such diets are expensive. In our own series, except in the rare case of obesity, total energy intake was unrestricted: rather its sources were controlled. In Britain a considerably lower protein intake was found. It may be that this difference is relevant to the growth pattern differences seen in studies from the two areas. Our own studies in Canada suggest unimpaired growth in the adequately treated diabetic (Birkbeck, 1972), while recent British studies (Jivani and Rayner, 1973; Tattersall and Pyke, 1973) suggest some growth impairment is to be expected. Insulin appears to facilitate amino acid transfer into the cell, and there is no reason to suppose that the diabetic child, given all the imperfections of current insulin therapy, should be more efficient in the utilization of protein than he is of carbohydrate or fat.

Conclusions

Current dietary practice in the management of the diabetic British child appears to be somewhat illogical and suffers from a considerable lack of uniformity. Emphasis only on control of carbohydrate intake ignores other important aspects of the diet and tends to result in excessive fat intake. It is possible that these dietary practices could be improved by the use of a single exchange system along the lines of the North American systems, modified to local usage, though too rigid application of such systems should be avoided.

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